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# MIG 2015



## MIELIE-INLIGTINGSGIDS MAIZE INFORMATION GUIDE

Saamgestel deur die LNR-Instituut vir Graangewasse  
Compiled by the ARC-Grain Crops Institute



Hierdie publikasie word defonds deur die Mielietrust  
This publication is funded by the Maize Trust.

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# M I G | 2015

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## **Mielie-Inligtingsgids • Maize Information Guide**

Saamgestel deur die LNR-Instituut vir Graangewasse

'n Instituut van die Landbounavorsingsraad

Compiled by ARC-Grain Crops Institute

An Institute of the Agricultural Research Council



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## VOORWOORD

Internasionaal gesproke, produseer ons genoeg mielies om die stygende populasie te voed. Daar is tans in die wêreld genoeg oordragvoorraad vir twee en 'n half maande, wat meer is as in die afgelope paar jaar. In Suid-Afrika geld die positiewe situasie ook, maar soos elders ervaar en volg ons ook die daling in internasionale mieliepryse. Die belang van produktiwiteit, nie van net mielies as gewas nie, maar al die verwante produksiesisteme, word beklemtoon deur die voortdurend veranderende bemarkings- en produksie-omgewings. Afgesien van rekord mielie-oeste en die ideale omgewingstoestande, is dit onafwendbaar dat die winsgewendheid van mielieproduksie onder druk gaan kom in sekere produksiestreke.

Een van die min opsies tot ons beskikking, om die voortdurende aanslag op mielieproduksie af te weer, is nie net die hoë genetiese opbrengs nie, maar ook om die winsgewendheid van basters te ontgin. Dieselfde geld ook vir ons produksiepraktyke, insetkoste en cultivarkeuses in die onderskeie produksiegebiede van die somerreëvalstreek. Weldeurdagte besluitneming sal mededingendheid met ander gewasse en ook winsgewendheid verseker.

Daarom glo ons hier by LNR-Graangewasse, dat die 2015 Mielie-Inligtingsgids (MIG) weer eens vir u 'n belangrike bate in die besluitnemingsproses sal wees. Die MIG verteenwoordig die mees volledige, objektiewe wetenskaplike evaluasie van die aanbevole mielie-cultivars se prestasie in elk van die relevante produksiestreke in Suid-Afrika.

Ons erken met waardering, die waardevolle bydraes van verskeie navorsers, samewerkers en ook die finansiële bystand van die LNR en Mielietrust.



**Dr J le Roux**

**ALGEMENE BESTUURDER: LNR-VELDGEWAS DIVISIE**

## PREFACE

Internationally speaking we are producing enough maize to feed the increasing world population with carry-over stocks higher than the recent past, which equates to a two and a half months' supply. Although a similar positive supply situation prevails in South Africa, we are also experiencing and following the significant downward trend in international maize prices. This ever changing marketing and production environment again emphasises the importance of the productivity, not only of maize as a crop, but also of its related production systems. Notwithstanding the record maize yields of the recent past and the most conducive growth conditions experienced, the profitability of maize production are certainly to come under pressure in specific production areas.

One of the few options available to us to negate this continuous onslaught on the profitability of maize production, is not only to exploit the high genetic yield potential of the new hybrids available to us, but to do so profitably. The same applies for our production practices, input costs and cultivar selections in the various production regions of the summer rainfall areas. Sound decision-making will ensure competitiveness with other crops and profitability per se.

For that reason we at the ARC-Grain Crops Institute believe the 2015 Maize Information Guideline (MIG) will again be a valuable asset in your decision-making armour. The MIG represents the most comprehensive objective scientific evaluation on the performances of recommended maize cultivars as for each relevant production area in South Africa.

We acknowledge the valuable inputs made by the various scientists, collaborators and the funding of the ARC and the Maize Trust.



**DR J Le Roux**

**GENERAL MANAGER: ARC-FIELD CROPS DIVISION**

## KULTIVAREVALUERING

Inligting rondom die kultivars wat deur die produsent aangeplant word, is van kardinale belang. Dit beïnvloed 'n groot deel van die produsent se beplanning vir die seisoen. Betroubare en indien moontlik, onafhanklike inligting rakende kultivars moet aan elke produsent beskikbaar wees. Die LNR - Instituut vir Graangewasse (LNR-IGG), in samewerking met landboubesighede en die saadbedryf, poog om in hierdie belangrike behoefte van die produsent te voldoen. Die onus rus op die produsent om nuwe of onbekende kultivars eers op sy plaas te toets, voordat daar op groot skaal van beproefde kultivars afgesien word.

## KULTIVARINLIGTING

Die boer moet aan die einde van elke seisoen 'n baie belangrike besluit neem naamlik: Watter kultivars gaan die volgende jaar geplant word? 'n Korrek beplande kultivarkeuse kan beslis 'n belangrike bydrae lewer om risiko te verminder en moet 'n belangrike onderdeel uitmaak van 'n produsent se produksiebeplanning.

Kultivars verskil van mekaar in een of meer van 'n verskeidenheid eienskappe en elkeen het dus 'n eiesoortige aanpasbaarheid en opbrengspotensiaal. Hierdie kultivar-verskeidenheid stel alternatiewes beskikbaar wat goed benut kan word en die volgende is be-

langrike riglyne vir kultivarbeplanning wat oorweeg moet word:

- Moet nooit 'n staatmaker-kultivar binne een seisoen met 'n nuwe of onbekende kultivar vervang nie.
- Kultivarverskeidenheid versprei risiko. Plant 'n reeks kultivars wat verskil in groeiseisoenlengte en eienskappe.
- Kultivars moet aanpas by 'n spesifieke opbrengspotensiaal, maar moet in staat wees om hoër potensiaaltoestande te benut en 'n aanvaarbare opbrengs by laer potensiaaltoestande te lewer. Kultivars met 'n wye aanpassingsvermoë kan hier 'n rol speel.
- Hersien Kultivarkeuse jaarliks.

## KULTIVARBEPLANNING

'n Waardevolle hulpmiddel by kultivarbeplanning is die oessekerheidswaardes, wat 'n afleiding is van inligting wat deur die regressiegrafiek van 'n kultivar uitgebeeld word. Hierdie oessekerheidswaardes word verkry van die onderste betroubaarheidsband van die regressiegrafiek by 'n 90% waarskynlikheidspeil. Dit beteken dat die oessekerheidswaarde van 'n kultivar by 'n sekere potensiaal die minimum opbrengs is wat daardie kultivar in nege uit tien gevalle kan behaal. By die berekening van oessekerheidswaardes (opbrengste) word die opbrengsge-

neigheid, gemiddelde opbrengs en stabiliteit in ag geneem.

In die oessekerheidstabelle word die volgende inligting verskaf: Eerstens word die oessekerheidswaardes by verskillende potensiaal toestande aangetoon. Tweedens volg die gemiddelde opbrengs van die kultivar vir die stel proewe wat gebruik is. Dan volg die helling van die regressielyn waarvan die opbrengsgeneigheid afgelei kan word. Indien die helling groter as 1.0 is, dui dit op 'n hoër potensiaal kultivar; kleiner as 1.0 dui dit op 'n laer potensiaal kultivar, terwyl 'n waarde naby of gelyk aan 1.0 dui op 'n wyd aangepasde kultivar met 'n regressielyn ewewydig aan die gemiddelde lyn. Laastens volg die opbrengstabiliteit wat deur die  $D^2$ -waarde aangedui word. Hoe meer die  $D^2$ -waarde neig na nul, hoe meer stabiel en voorspelbaar is die kultivar in terme van opbrengs, en hoe groter die  $D^2$ -waarde is hoe meer sal opbrengs tussen seisoene wissel.

Die prosedure wat gevolg word vir die maak van kultivaraanbevelings is kortliks as volg: Eerstens moet vasgestel word vir watter opbrengspotensiaal aanbevelings gemaak word. Die produsent moet homself vergewis van die potensiaal wat ter sprake is. Die tweede stap is om die oessekerheidstabel te raadpleeg by die vasgestelde potensiaal. Selekteer by die gekose potensiaal daardie kultivars met die hoogste oessekerheidswaardes. Die kultivars met die hoogste waardes behoort vir u die beste kans op 'n stabiele, suksesvolle opbrengs te verseker. Indien

verdere verfyning in die keuse nodig is, kan die opbrengsgeneigheid en -stabiliteit gebruik word. Dieselfde prosedure kan met potensiaalgebiede aan weerskante van die gekose potensiaal gevolg word vir 'n meer betroubare aanbeveling.

## KULTIVARS VOLGENS MIELIE-PRODUKSIE-STREKE

Vir die doel van hierdie publikasie is die kultivarproewe ingedeel in streke volgens hitte eenhede, reënval en produksie en verder verwerk tot oessekerheidswaardes. Waar voldoende inligting

### VRYWARING

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oor 'n betrokke kultivar beskikbaar is, is die inligting van drie seisoene saamgevoeg. Andersins is die inligting van die nuwer kultivars bekom uit die eenjarige en tweejarige data van die onderskeie groter oostelike en westelike streke. Om voldoende betroubare inligting te verskaf, is van die produksiegebiede saamgevoeg. Proewe wat in die westelike produksiegebied gedoen is, is saamgevoeg (streek 1). Proewe in die oostelike streke is opge-

deel in drie produksiestreke: matige ooste (streek 2), koue ooste (streek 3) en KwaZulu-Natal streek (streek 4). Inligting oor kultivars onder besproeiing is in twee streke verdeel: Koel tot matige streek en 'n warm streek wat in afsonderlike tabelle aangebied word. Hierdie inligtingstuk poog nie om die enigste bron van inligting te wees nie. Kultivarinligting is ook by koöperasies en die saadmaatskappye beskikbaar.

## CULTIVAR EVALUATION

Information on cultivars planted by producers is of utmost importance. It affects seasonal planning by producers to a large extent. Reliable and if possible independent information regarding cultivars should be available to every producer. The ARC- Grain Crops Institute (ARC-GCI) in co-operation with agricultural businesses and the seed industry attempt to satisfy the producers' requirements. The responsibility is with the producer to test new or unknown cultivars first before dispensing with the known cultivars on a large scale.

## CULTIVAR INFORMATION

At the end of each season the farmer has to decide which cultivars are to be planted during the following season. A correctly planned cultivar choice can contribute greatly to reduce risk and constitutes an

important part of the producer's production planning. Cultivars differ in one or more of a number of characteristics. Each cultivar has a particular adaptability and yield potential. Variability of cultivars provides alternatives, which can be utilized effectively. The following are important guidelines in cultivar planning which can be considered:

- Never replace a reliable cultivar with a new or unknown cultivar in a single season.
- Cultivar variability divides the risk factor. Use a series of cultivars, which differ in length of growing season and other characteristics.
- Cultivars must be adapted to a specific yield potential but should be able to utilize increased potential conditions and still deliver an acceptable yield at reduced yield potential. Cultivars with a wide adaptability can play a role under these conditions.
- Cultivar choice should be revised annually.

## CULTIVAR PLANNING

A valuable aid in cultivar planning is the yield reliability values, which are the deviations from the regression graph of a cultivar. The yield reliability values are obtained from the lower reliability band of the regression graph at a 90% probability level. This means that the yield reliability value of a particular cultivar at a given potential is the minimum yield, which can be obtained in nine out of ten seasons. In the calculation of yield reliability values (yield) the yield tendency, average yield and stability are taken into consideration.

In the yield reliability tables the following information is presented: Firstly, the yield reliability values at different yield potential levels are shown. Secondly, the average yield of the cultivar for the set of trials used is presented. Thereafter the slope of the regression line indicates the yield tendency. If the slope is greater than 1.0, it indicates a higher potential cultivar; smaller than 1.0 a lower potential cultivar, while a value near or equal to 1.0 indicates a widely adapted cultivar. Lastly, the yield stability is indicated by the  $D^2$ -values. With  $D^2$ -values approaching zero, the cultivar can be expected to be more stable and predictable in terms of yield achievement, and the greater the  $D^2$ -values are, the more the yield would vary between seasons.

The procedure to be followed in the making of cultivar recommendations is briefly as follows: Determine for which yield potential recommendations

must be made. This must be done by the producer (farmer). The next step is to consult the yield reliability table at the determined yield potential. Select at the chosen yield potential those cultivars with the highest yield reliability values. The cultivars with the highest values should provide one with the best chance for a stable, successful yield. The same procedures can be followed with yield potentials on both sides of the chosen yield potential for a more reliable recommendation.

## CULTIVAR GROUPING ACCORDING TO MAIZE PRODUCTION REGIONS

For the purpose of this publication the cultivar trials were divided into regions according to heat unit, precipitation and production for which yield reliability values were calculated. Information pertaining to three seasons was combined where sufficient information on a particular cultivar was available. Information on the newer cultivars was obtained from data of the annual and bi-annual reports of the greater eastern and western regions. Data for certain production regions have been combined in order to obtain more reliable information. Trials conducted in the western areas (region 1) were combined. Trials conducted in the eastern areas were divided into three production regions: temperate eastern (region 2), cold eastern (region 3)

and KwaZulu-Natal region (region 4). Information of cultivars under irrigation was divided into two regions: Cold to temperate region and hot region and is represented in separate tables. Note that this brochure is not the only source of information. Cultivar information is also available at co-operatives and seed companies.

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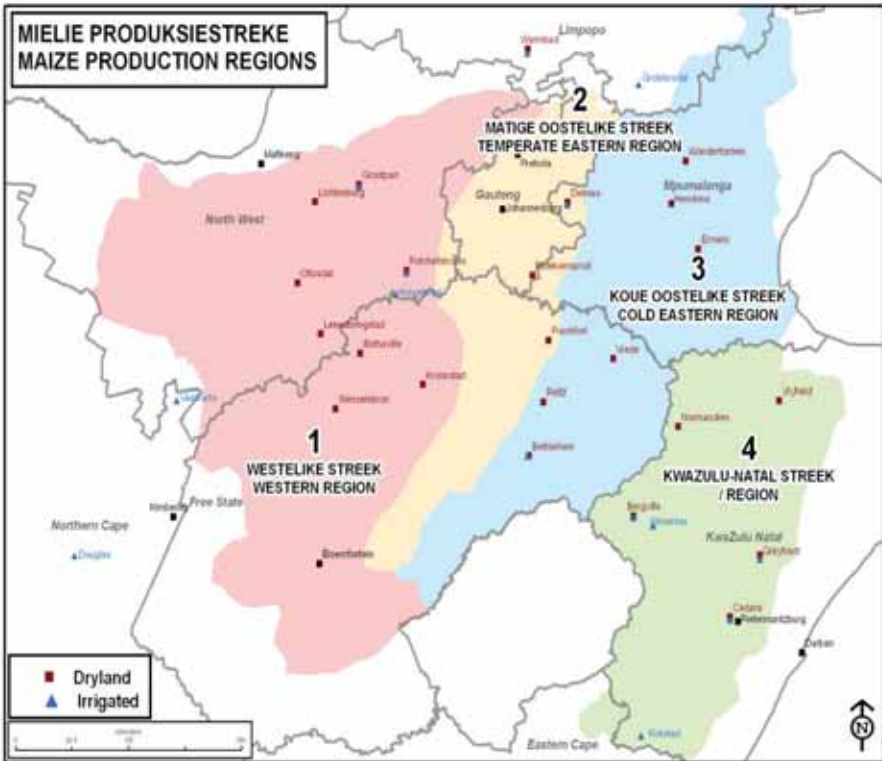
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# Kultivarinligting vir u gebied

## Cultivar Information for your area

KULTIVARINDELING VOLGENS MIELIE PRODUKSIESTREKE  
CULTIVAR GROUPING ACCORDING TO MAIZE PRODUCTION REGIONS

1. Westelike streek / Western region
2. Matige oostelike streek / Temperate eastern region
3. Koue oostelike streek / Cold eastern region
4. KwaZulu-Natal streek / region
5. Besproeiing / Irrigation  
Koue tot matige streek / Cold to temperate region  
Warm streek / region



**GEELMIELIEKULTIVARS VIR DIE WESTELIKE STREEK (Streek 1)  
YELLOW MAIZE CULTIVARS FOR THE WESTERN REGION (Region 1)**

Kultivars waarvan inligting vir drie seisoene beskikbaar is (oessekerheidswaardes)  
55 proewe ((Aantal lokaliteite oor drie seisoene)  
Cultivars of which information is available for three seasons (yield reliability values)  
55 trials (Sum of the Localities during three seasons)

CULTIVAR	Opbrengspotensiaal / Yield potential						
	3 TON	4 TON	5 TON	6 TON	Gem/ Mean#	Hell/ Slop	D2
DKC80-40BR GEN*	3.12	4.22	5.31	6.41	5.45	1.10	0.371
DKC80-12BGEN	3.05	4.13	5.20	6.28	5.34	1.08	0.322
PAN 6P-110	3.05	4.09	5.12	6.15	5.25	1.03	0.335
DKC73-74BRGEN	3.26	4.15	5.04	5.93	5.15	0.89	0.344
LS 8518	2.96	3.99	5.01	6.04	5.14	1.03	0.306
LS 8524R	2.96	3.90	4.84	5.78	4.96	0.94	0.283
IMP 51-22B	2.62	3.69	4.76	5.83	4.90	1.07	0.538
SC 608	2.98	3.85	4.72	5.58	4.82	0.87	0.816

Kultivars waarvan inligting vir twee seisoene beskikbaar is (oessekerheidswaardes) 35 proewe  
(Aantal lokaliteite oor twee seisoene)  
Cultivars of which information is available for two seasons (yield reliability values) 35 trials  
(Sum of the Localities during two seasons)

CULTIVAR	Opbrengspotensiaal / Yield potential						
	3 TON	4 TON	5 TON	6 TON	Gem/ Mean#	Hell/ Slop	D2
PAN 6Q-408CB	3.33	4.41	5.50	6.58	5.59	1.09	0.168
DKC80-40BR GEN*	3.26	4.35	5.44	6.54	5.54	1.09	0.433
DKC80-12BGEN	3.17	4.27	5.36	6.46	5.46	1.10	0.487
PAN 6P-110	3.20	4.24	5.29	6.33	5.38	1.04	0.407
LS 8518	3.08	4.09	5.10	6.11	5.19	1.01	0.459
DKC73-74BR GEN	3.33	4.22	5.11	6.00	5.19	0.89	0.383
P 2432R	3.02	4.00	4.98	5.96	5.07	0.98	0.287
DKC73-70B GEN	3.19	4.08	4.97	5.86	5.05	0.89	0.417
KKS 8410BR	2.97	3.95	4.93	5.91	5.02	0.98	0.302
SC 608	3.23	4.04	4.86	5.68	4.94	0.82	0.889
LS 8524R	2.96	3.90	4.84	5.78	4.92	0.94	0.305
IMP 51-22B	2.43	3.56	4.70	5.84	4.80	1.14	0.512
Phb 33H54BR	2.50	3.57	4.65	5.73	4.74	1.08	0.390
SC 506	2.66	3.65	4.64	5.62	4.72	0.99	0.380
LS 8536B	2.66	3.65	4.63	5.61	4.72	0.98	0.294

Kultivars waarvan inligting vir een seisoen beskikbaar is (gemiddeldes) 18 proewe  
(Aantal lokaliteite vir een seisoen)  
Cultivars of which information is available for one season (mean values) 18 trials  
(Sum of the Localities during one season)

CULTIVAR	Gem/Mean#
PAN 6R-680R	6.58
DKC80-40BR GEN*	6.55
BG 6308B	6.00
PAN 6R-880CBGT	5.88
LS 8526	5.54
LS 8528R	5.32
KKS 8326B	4.96

\*Verwysingskultivar / Reference cultivar

# Mean yield of the specific cultivar over all trials

# Gemiddelde opbrengs vir die spesifieke kultivar vir al die proewe

### WITMIELIEKULTIVARS VIR DIE WESTELIKE STREEK (Streek 1) WHITE MAIZE CULTIVARS FOR THE WESTERN REGION (Region 1)

Kultivars waarvan inligting vir drie seisoene beskikbaar is (oessekerheidswaardes) 55 proewe  
(Aantal lokaliteite oor drie seisoene)  
Cultivars of which information is available for three seasons (yield reliability values) 55 trials  
(Sum of the localities during three seasons)

CULTIVAR	Opbrengspotensiaal / Yield potential						
	3 TON	4 TON	5 TON	6 TON	Gem/ Mean#	Hell/ Slop	D2
PAN 6Q-245*	3.19	4.26	5.33	6.41	5.74	1.07	0.251
DKC77-85B GEN	2.92	4.02	5.11	6.21	5.53	1.10	0.279
P 2653WB	3.12	4.11	5.09	6.08	5.47	0.99	0.331
DKC78-45BR GEN	2.99	4.02	5.05	6.08	5.44	1.03	0.319
LS 8533R	3.04	3.93	4.81	5.69	5.15	0.88	0.400
IMP 52-11B	2.73	3.67	4.61	5.54	4.96	0.94	0.271

Kultivars waarvan inligting vir twee seisoene beskikbaar is (oessekerheidswaardes) 35 proewe  
(Aantal lokaliteite oor twee seisoene)

Cultivars of which information is available for two seasons (yield reliability values) 35 trials  
(Sum of the Localities during two seasons)

**Opbrengspotensiaal / Yield potential**

CULTIVAR	3TON	4TON	5 TON	6 TON	Gem/ Mean#	Hell/ Slop	D2
PAN 6Q-245*	3.22	4.29	5.36	6.44	5.86	1.07	0.153
PAN 6Q-345CB	3.17	4.25	5.34	6.42	5.83	1.08	0.348
DKC77-77BR	3.19	4.26	5.33	6.40	5.82	1.07	0.212
BG 5285	3.23	4.25	5.27	6.30	5.75	1.02	0.494
DKC78-79BR	3.26	4.23	5.21	6.18	5.65	0.98	0.356
PAN 6R-845CBGT	3.24	4.20	5.15	6.10	5.59	0.95	0.298
DKC77-85B GEN	2.78	3.91	5.04	6.17	5.56	1.13	0.357
DKC78-45BR GEN	2.91	3.98	5.06	6.14	5.56	1.08	0.316
DKC78-17B	3.13	4.11	5.10	6.08	5.55	0.98	0.232
P 2653WVB	3.05	4.06	5.07	6.09	5.54	1.01	0.469
BG 5685R	2.99	4.01	5.04	6.06	5.51	1.02	0.364
BG 5485B	3.28	4.18	5.07	5.97	5.49	0.90	0.436
P 2961W	3.12	4.04	4.96	5.89	5.39	0.92	0.593
LS 8539B	2.88	3.85	4.83	5.80	5.28	0.97	0.307
P 2653WBR	2.55	3.63	4.70	5.78	5.20	1.08	0.405
LS 8533R	2.83	3.72	4.61	5.51	5.02	0.89	0.524
KKS 4581BR	2.59	3.51	4.43	5.36	4.86	0.92	0.366
IMP 52-11B	2.60	3.52	4.43	5.34	4.85	0.91	0.329

Kultivars waarvan inligting vir een seisoen beskikbaar is (gemiddeldes) 18 proewe  
(Aantal lokaliteite vir een seisoen)

Cultivars of which information is available for one season (mean values) 18 trials  
(Sum of the Localities during one season)

CULTIVAR	Gem/Mean#
3X23B144WVY	6.89
PAN 6Q-245*	6.78
DKC78-87B	6.76
BG 5785BR	6.68
IMP 53-49B	6.56
P 2961WVB	6.32
PAN 6R-665R	6.25
3X28B174VVYB	6.25
P 2823WBR	6.17



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IMP 52-11R	6.06
PAN 5R-851CBGT	6.03
SC 411	5.20

\*Verwysingskultivar / Reference cultivar

# Mean yield of the specific cultivar over all trials

# Gemiddelde opbrengs vir die spesifieke kultivar vir al die proewe

**AGRONOMIESE EIENSKAPPE VAN MIELIEKULTIVARS VIR  
DIE WESTELIKE STREKE  
AGRONOMIC CHARACTERISTICS OF MAIZE CULTIVARS FOR THE  
WESTERN AREAS**

Kultivars waarvan inligting vir drie seisoene beskikbaar is  
Cultivars of which information is available for three seasons

Cultivar	Groei seisoen Growing season	% Omval Lodging	% Spruite Tillers	Koppe Ears plant-1	% Graan Vog Grain moisture
DKC73-74BR GEN	M	1.43	17.78	1.32	13.12
DKC77-85B GEN	M	2.56	33.15	1.93	12.73
DKC78-45BR GEN	M	2.57	28.98	1.95	13.45
DKC80-12B GEN	M	0.43	24.20	1.81	12.22
DKC80-40BR GEN*	M	0.00	23.74	1.94	11.93
IMP 51-22B	M/K/S	0.42	39.51	1.75	11.47
IMP 52-11B	M	0.00	48.31	1.61	12.47
LS 8518	M	1.03	34.22	1.56	14.17
LS 8524R	M	0.21	30.14	1.59	12.01
LS 8533R	M	2.60	39.85	1.88	12.32
P 2653WB	M	1.45	42.21	1.56	13.94
PAN 6P-110	M	0.69	28.92	1.90	13.54
PAN 6Q-245*	M	2.28	32.98	1.99	13.32
SC 608	L	5.31	23.02	1.52	19.08

Kultivars waarvan inligting vir twee seisoene beskikbaar is  
Cultivars of which information is available for two seasons

Cultivar	Groei seisoen Growing season	% Omval Lodging	% Spruite Tillers	Koppe Ears plant-1	% Graan Vog Grain moisture
BG 5285	M	2.87	22.00	1.89	13.01
BG 5485B	M	0.61	23.22	1.84	13.04
BG 5685R	M	0.97	20.85	1.88	12.39
DKC73-70BGEN	M	0.75	18.18	1.42	13.26
DKC73-74BRGEN	M	0.70	16.26	1.35	13.35
DKC77-77BR	M	2.62	34.54	1.97	13.23
DKC77-85BGEN	M	2.93	28.39	1.91	12.95
DKC78-17B	M	4.42	31.08	1.92	14.32
DKC78-45BRGEN	M	2.98	27.13	1.99	13.83
DKC78-79BR	M	1.34	27.99	1.97	13.74
DKC80-12BGEN	M	1.48	22.32	1.86	12.57
DKC80-40BRGEN*	M	2.52	24.31	1.97	12.18
IMP 51-22B	M-K/S	1.22	37.52	1.75	11.69
IMP 52-11B	M	0.72	41.27	1.54	12.58
KKS 4581BR	M	1.20	22.40	1.62	13.58
KKS 8410BR	M	0.77	18.34	1.51	13.14
LS 8518	M	1.97	29.08	1.55	14.55
LS 8524R	M	0.13	27.16	1.61	12.15
LS 8533R	M	0.76	36.83	1.89	12.60
LS 8536B	M	2.39	22.24	1.65	11.97
LS 8539B	M	3.03	20.78	1.69	13.64
P 2432R	M	0.73	21.96	1.54	12.95
P 2653WVB	M	1.06	36.13	1.58	14.27
P 2653WBR	M	1.17	39.03	1.63	14.41
P 2961W	M	1.43	34.21	1.71	13.89
PAN 6P-110	M	0.68	26.60	1.94	14.05
PAN 6Q-245*	M	3.56	28.49	1.97	13.64
PAN 6Q-345CB	M	3.43	34.44	2.06	13.02
PAN 6Q-408CB	M	1.19	21.55	1.85	13.93
PAN 6R-845CBGT	M	1.73	37.60	1.94	12.86
Phb 33H54BR	M-K/S	1.71	25.09	1.64	11.68
SC 506	M / L	2.70	18.47	1.48	14.10
SC 608	L	2.36	22.42	1.52	19.72

Kultivars waarvan inligting vir een seisoen beskikbaar is  
Cultivars of which information is available for one season

Cultivar	Groei seisoen	% Omval	% Spruite	Koppe	% Graan Vog
	Growing season	Lodging	Tillers	Ears plant-1	Grain moisture
3X23B144WY	M	0.76	43.65	2.20	12.21
3X28B174WYB	M	0.79	43.75	2.05	12.84
BG 5785BR	M	0.00	22.21	2.11	12.09
BG 6308B	M	0.00	16.73	2.00	12.62
DKC78-87B	M	0.56	23.97	2.21	13.52
DKC80-40BR GEN*	M	0.00	19.21	2.13	12.09
IMP 52-11R	M-K/S	0.00	37.23	1.74	12.08
IMP 53-49B	M	0.00	48.11	2.04	13.15
KKS 8326B	M	0.00	16.95	1.51	12.21
LS 8526	M-K/S	6.04	15.36	1.91	11.80
LS 8528R	M-K/S	2.46	20.35	1.79	11.99
P 2823WBR	M	1.95	28.76	1.92	12.71
P 2961WB	M	0.00	28.85	1.83	13.22
PAN 5R-851CBGT	M	0.69	11.29	1.88	12.21
PAN 6Q-245*	M	0.00	30.01	1.89	14.54
PAN 6R-665R	M	0.00	28.68	2.10	12.05
PAN 6R-680R	M	0.00	22.22	2.11	13.82
PAN 6R-880CBGT	M	0.72	20.26	2.02	12.49
SC 411	M	0.76	23.35	1.50	12.42

**DAE TOT BLOM / DAYS TO FLOWERING**

	Kort(K)/ Short(S)	Meduim(M)/ Medium (M)	Lank(L)/Long(L)
Koel Streke/Cool areas	70-75	75-80	80-85
Warm Streke/Warm areas	60-65	65-70	70-75

## DROUGHTTEGO™ HYBRIDS FOR FOOD SECURITY



### WHY MAIZE?

With over 70% of the population in South Africa depending on maize as their staple food it only makes sense that the research focusing on food security and sustainability is aimed at maize.

South Africa is generally not suitable for crop production. Only about 13% of the country is arable due to low rainfall and poor soils. Maize yields obtained by large-scale commercial farmers and smallholder farmers for rain-fed crops are only about 5.0 t/ha and 1.0 t/ha, respectively. This is mainly because, on the one hand, large-scale commercial farmers grow their rain-fed maize crops at very low plant populations to avoid moisture stress. On the other hand, smallholder farmers get very low yields because they apply very little fertiliser and their crops are often subjected to moisture stress during periodic droughts. Only about 20% of the maize crop in South Africa is grown under irrigation because of limited water resources. Climate change is predicted to worsen the situation with more variable rainfall and above average temperatures. Identifying ways to mitigate and adapt to climate change are fundamental to realising food security and improved livelihoods in South Africa and the rest of the continent.

## THE SOLUTION

To address these challenges the Agricultural Research Council (ARC) is participating in a public-private partnership formed in 2008, called the Water Efficient Maize for Africa (WEMA). WEMA products will be low-cost drought tolerant three-way conventional and transgenic hybrids that give at least 25% yield advantage under moderate drought conditions. The hybrids are currently being developed using a range of approaches including conventional plant breeding, an advanced breeding technique called marker assisted breeding, and transgenic approaches which are sometimes referred to as genetic modification (GM technology).

ARC has now registered two DroughtTEGO™ hybrids, WE3127 and WE3128, with the Department of Agriculture, Forestry and Fisheries.

- **WE3127** yields 5-7t/ha under moderate drought conditions. It has early to medium maturity and takes 65-67, 70-75 days to flower in hot and cool areas, respectively.
- **WE3128** yields 6-8t/ha under moderate drought conditions. It has medium maturity and takes 67-70, 75-80 days flower in hot and cool areas, respectively.

Certified seed of these two hybrids will be available from Jermart Seeds and Capstone Seeds from 2015.

The WEMA partnership is coordinated by the African Agricultural Technology Foundation (AATAF) and brings together the national agricultural research systems in Kenya, Mozambique, South Africa, Tanzania and Uganda.

## WEMA PARTNER INSTITUTIONS

- African Agricultural Technology Foundation (AATF)
- National Agricultural research systems in:
  - Kenya Agricultural and Livestock Research Organisation (KALRO)
  - Mozambique-National Agricultural Institution of Mozambique (IIAM)
  - South Africa-Agricultural Research Council (ARC)
  - Tanzania-Commission for Science and Technology (COSTECH)
  - Uganda-National Agricultural Research Organisation (NARO)
- International Maize and Wheat Improvement Center (CIMMYT)
- Monsanto

## Funding Partners

- Bill and Melinda Gates Foundation
- Howard G. Buffett Foundation
- United States Agency for International Development (USAID)

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Mary James at Email: JamesM@arc.agric.za

**GEELMIELIEKULTIVARS VIR DIE GEMATIGDE OOSTELIKE STREKE (Streek 2)  
YELLOW MAIZE CULTIVARS FOR THE TEMPERATE EASTERN REGION (Region 2)**

Kultivars waarvan inligting vir drie seisoene beskikbaar is (oessekerheidswaardes) 24 proewe  
(Aantal lokaliteite oor drie seisoene)

Cultivars of which information is available for three seasons (yield reliability values) 24 trials  
(Sum of the Localities during three seasons)

**Opbrengspotensiaal / Yield potential**

CULTIVAR	3 TON	4 TON	5 TON	6 TON	Gem/ Mean#	Hell/ Slop	D2
DKC80-40BR GEN*	2.44	3.64	4.84	6.04	9.74	1.20	0.653
LS 8518	3.04	4.09	5.14	6.19	9.43	1.04	0.410
DKC80-12B GEN	2.75	3.84	4.93	6.03	9.41	1.09	0.900
LS 8524R	2.78	3.86	4.94	6.03	9.37	1.08	1.615
Phb 32W72B	2.45	3.58	4.71	5.84	9.34	1.13	0.521
PAN 6P-110	2.95	3.97	5.00	6.03	9.20	0.72	1.026
DKC73-74BR GEN	3.54	4.44	5.34	6.24	9.02	0.90	0.548
Phb 33H52B	3.52	4.41	5.30	6.19	8.95	0.89	0.471
SC 608	2.72	3.70	4.68	5.66	8.68	0.98	1.436
IMP 52-12	3.13	4.01	4.89	5.77	8.48	0.88	1.043
IMP 51-92R	3.69	4.46	5.23	6.00	8.39	0.77	1.001

Kultivars waarvan inligting vir twee seisoene beskikbaar is (oessekerheidswaardes) 14 proewe  
(Aantal lokaliteite oor twee seisoene)

Cultivars of which information is available for two seasons (yield reliability values) 14 trials  
(Sum of the Localities during two seasons)

**Opbrengspotensiaal / Yield potential**

CULTIVAR	3 TON	4 TON	5 TON	6 TON	Gem/ Mean#	Hell/Slop	D2
PAN 6Q-408CB	2.78	3.97	5.17	6.36	10.67	1.20	0.847
DKC80-40BR GEN*	2.80	3.94	5.09	6.23	10.34	1.14	0.280
DKC80-12B GEN	3.94	4.87	5.81	6.74	10.09	0.93	1.114
LS 8536B	1.87	3.10	4.33	5.56	9.97	1.23	1.112
LS 8518	1.75	2.99	4.23	5.47	9.93	1.24	0.353
Phb 32W72B	1.46	2.74	4.02	1.28	9.90	1.28	0.670
PAN 6P-110	4.12	4.96	5.80	6.64	9.65	0.84	0.859
LS 8524R	1.88	3.05	4.23	5.40	9.62	1.17	2.133
DKC73-74BR GEN	4.56	5.33	6.09	6.86	9.61	0.77	0.635
Phb 33H52B	3.20	4.14	5.08	6.02	9.39	0.94	0.375
DKC73-70B GEN	4.02	4.83	5.65	6.46	9.38	0.81	0.816
IMP 51-92R	4.15	4.90	5.65	6.40	9.10	0.75	1.021
SC 608	1.33	2.51	3.68	4.85	9.08	1.17	2.069
IMP 52-12	3.16	4.06	4.95	5.84	9.06	0.89	1.279
KKS 8410BR	4.22	4.96	5.69	6.42	9.06	0.73	0.456
SC 506	2.76	3.66	4.56	5.45	8.69	0.90	0.800

Kultivars waarvan inligting vir een seisoen beskikbaar is (gemiddeldes) 7 proewe  
(Aantal lokaliteite vir een seisoen)  
Cultivars of which information is available for one season (mean values) 7 trials  
(Sum of the Localities during one season)

CULTIVAR	Gem/Mean#
PAN 6R-680R	11.41
P 2432R	10.53
DKC80-40BR GEN*	10.29
PAN 6R-880CBGT	10.21
KKS 4412B	9.56
BG 6308B	9.39
PAN 4P-228	9.34
PAN 4B-312CB	9.16
LS 8526	9.11
LS 8528R	8.61
KKS 8330B	8.58

\*Verwysingskultivar / Reference cultivar

# Mean yield of the specific cultivar over all trials

# Gemiddelde opbrengs vir die spesifieke kultivar vir al die proewe

### WITMIELIEKULTIVARS VIR DIE GEMATIGDE OOSTELIKE STREEK (Streek 2) WHITE MAIZE CULTIVARS FOR THE TEMPERATE EASTERN REGION (Region 2)

Kultivars waarvan inligting vir drie seisoene beskikbaar is (oeseekerheidswaardes) 24 proewe  
(Aantal lokaliteite oor drie seisoene)  
Cultivars of which information is available for three seasons (yield reliability values) 24 trials  
(Sum of the Localities during three seasons)

CULTIVAR	Opbrengspotensiaal / Yield potential						
	3 TON	4 TON	5 TON	6 TON	Gem/ Mean#	Hell/ Slop	D2
PAN 6Q-245*	3.15	4.25	5.35	6.46	9.75	1.10	0.997
Phb 31M09	4.10	4.97	5.83	6.70	9.30	0.87	0.787
LS 8533R	3.65	4.58	5.51	6.44	9.22	0.93	1.110
DKC78-45BR GEN	2.42	3.54	4.65	5.77	9.11	1.12	0.340
Phb 30D09BR	2.84	3.84	4.83	5.83	8.81	1.00	0.679
IMP 52-11B	2.71	3.70	4.69	5.68	8.64	0.99	0.493
KKS 8301	2.13	3.13	4.12	5.12	8.09	1.00	1.627

Kultivars waarvan inligting vir twee seisoene beskikbaar is (oesekeerheidswaardes) 14 proewe  
 (Aantal lokaliteite oor twee seisoene)  
 Cultivars of which information is available for two seasons (yield reliability values) 14 trials  
 (Sum of the localities during two season)

**Opbrengspotensiaal / Yield potential**

CULTIVAR	3 TON	4 TON	5 TON	6 TON	Gem/ Mean#	Hell/ Slop	D2
DKC78-79BR	3.55	4.59	5.64	6.68	10.64	1.04	0.474
BG 5285	2.26	3.46	4.66	5.86	10.42	1.20	0.499
PAN 6Q-345CB	2.45	3.62	4.78	5.95	10.38	1.17	1.037
PAN 6Q-245*	3.69	4.65	5.61	6.57	10.22	0.96	1.156
PAN 6R-845CBGT	2.48	3.59	4.71	5.82	10.05	1.11	1.081
DKC78-17B	3.00	4.02	5.05	6.08	9.97	1.03	0.627
BG 5485B	1.18	2.47	3.76	5.06	9.95	1.29	0.200
P 1973B	3.36	4.32	5.29	6.25	9.92	0.97	0.685
DKC78-45BR GEN	3.54	4.47	5.39	6.32	9.83	0.93	0.290
LS 8539B	3.68	4.58	5.47	6.37	9.76	0.90	0.494
Phb 31M09	4.19	4.98	5.77	6.56	9.55	0.79	0.972
BG 5685R	3.06	4.01	4.96	5.91	9.51	0.95	0.314
Phb 30D09BR	2.94	3.90	4.86	5.83	9.48	0.96	0.411
LS 8533R	3.80	4.62	5.44	6.26	9.37	0.82	1.281
IMP 52-11B	2.46	3.40	4.35	5.29	8.87	0.94	0.450
KKS 8301	2.36	3.31	4.26	5.21	8.81	0.95	1.703

Kultivars waarvan inligting vir een seisoen beskikbaar is (gemiddeldes) 7 proewe  
 (Aantal lokaliteite vir een seisoen)  
 Cultivars of which information is available for one season (mean values) 7 trials  
 (Sum of the localities during one season)

CULTIVAR	Gem/Mean#
PAN 4B-311B	10.73
PAN 6Q-245*	10.68
DKC78-87B	10.59
3X23B144WYB	10.29
BG 5785BR	10.18
PAN 6R-665R	10.03
P 2653WB	9.78
IMP 52-11R	8.92
SC 411	8.56

\*Verwysingskultivar / Reference cultivar

# Mean yield of the specific cultivar over all trials

# Gemiddelde opbrengs vir die spesifieke kultivar vir al die proewe

**GEELMIELIEKULTIVARS VIR DIE KOUE OOSTELIKE STREEK (Streek 3)  
YELLOW MAIZE CULTIVARS FOR THE COLD EASTERN REGION (Region 3)**

Kultivars waarvan inligting vir drie seisoene beskikbaar is (oessekerheidswaardes) 25 proewe  
(Aantal lokaliteite oor drie seisoene)

Cultivars of which information is available for three seasons (yield reliability values) 25 trials  
(Sum of the Localities during three seasons)

<b>Opbrengspotensiaal / Yield potential</b>							
CULTIVAR	3 TON	4 TON	5 TON	6 TON	Gem/ Mean#	Hell/ Slop	D2
DKC73-74BR GEN	3.50	4.53	5.56	6.60	8.66	1.03	0.966
DKC80-12B GEN	3.29	4.31	5.34	6.37	8.42	1.03	0.969
DKC80-40BR GEN*	3.09	4.15	5.20	6.26	8.37	1.06	0.486
PAN 6P-110	2.41	3.60	4.79	5.98	8.36	1.19	1.043
LS 8518	3.10	4.08	5.05	6.03	7.98	0.98	0.507
Phb 32W72B	3.42	4.32	5.22	6.12	7.93	0.90	0.491
IMP 52-12	3.13	4.06	4.99	5.92	7.77	0.93	0.890
Phb 33H52B	2.49	3.54	4.59	5.63	7.73	1.05	0.664
LS 8524R	3.15	4.06	4.97	5.87	7.68	0.91	0.938
SC 608	2.39	3.45	4.50	5.56	7.68	1.06	0.458
IMP 51-92R	3.03	3.91	4.79	5.67	7.43	0.88	1.239

Kultivars waarvan inligting vir twee seisoene beskikbaar is (gemiddeldes) 18 proewe  
(Aantal lokaliteite oor twee seisoene)

Cultivars of which information is available for two seasons (mean values) 18 trials  
(Sum of the Localities during two seasons)

<b>Opbrengspotensiaal / Yield potential</b>							
CULTIVAR	3 TON	4 TON	5 TON	6 TON	Gem/Mean#	Hell/ Slop	D2
DKC73-74BR GEN	4.00	4.96	5.91	6.87	8.87	0.96	1.388
PAN 6Q-408CB	2.52	3.72	4.92	6.13	8.65	1.20	3.041
DKC73-70B GEN	3.39	4.40	5.42	6.44	8.56	1.02	0.908
DKC80-40BR GEN*	3.12	4.16	5.20	6.25	8.43	1.04	0.602
PAN 6P-110	1.58	2.93	4.27	5.61	8.43	1.34	0.977
DKC80-12B GEN	3.32	4.32	5.31	6.31	8.41	1.00	1.197
LS 8536B	3.34	4.29	5.24	6.19	8.18	0.95	1.218
Phb 32W72B	4.07	4.86	5.65	6.44	8.09	0.79	0.717
LS 8518	3.44	4.35	5.26	6.18	8.09	0.91	0.472
KKS 8410BR	3.77	4.59	5.42	6.24	7.96	0.82	0.990
SC 608	2.40	3.49	4.57	5.66	7.93	1.08	0.480
Phb 33H52B	2.59	3.61	4.62	5.63	7.75	1.01	0.817
IMP 52-12	2.56	3.58	4.59	5.61	7.74	1.02	0.849
IMP 51-92R	2.80	3.75	4.69	5.63	7.59	0.94	1.613
LS 8524R	3.26	4.09	4.92	5.75	7.49	0.83	0.846
SC 506	1.84	2.91	3.99	5.07	7.32	1.08	1.033

Kultivars waarvan inligting vir een seisoen beskikbaar is (gemiddeldes) 10 proewe  
(Aantal lokaliteite vir een seisoen)

Cultivars of which information is available for one season (mean values) 10 trials  
(Sum of the Localities during one season)

CULTIVAR	Gem/Mean#
PAN 6R-680R	10.05
DKC80-40BRGEN*	9.05
P 2432R	8.99
PAN 4B-312CB	8.93
LS 8526	8.67
PAN 6R-880CBGT	8.25
LS 8528R	8.07
BG 6308B	8.04
PAN 4P-228	7.79
KKS 4412B	7.70
KKS 8330B	7.66

\*Verwysingskultivar / Reference cultivar

# Mean yield of the specific cultivar over all trials

# Gemiddelde opbrengs vir die spesifieke kultivar vir al die proewe

## Noordelike Streek

### BESTUURDER:

Erus Hefer

083 461 6675

### VERKOOPSBESTUURDERS:

Vrystaat en Noordwes  
Noordwes en Botswana  
Limpopo en Gauteng  
Mpumalanga  
Mpumalanga  
Noord-Kaap, Vrystaat & Namibië

Henk Crafford  
Franco Marais  
Willem Labuschagne  
Daneel Fourie  
Anina Snyman  
Michael O'Neill

078 459 4833  
081 018 3296  
083 501 0109  
083 461 6671  
082 772 5769  
083 631 7716

### GEWASBESTUURDERS:

Sonneblom  
Mielies  
Sojabone

Joubert Swanepoel  
Daneel Fourie  
Roelf van Niekerk

081 011 0009  
083 461 6671  
083 625 4906

### LANDBOUKUNDIGES:

Stefan Jacobs  
Wèan Benadie

081 018 7229  
063 253 2000

## Kusstreek

### BESTUURDER:

Marcell van der Westhuizen

083 626 3235

### VERKOOPSBESTUURDERS:

Wes-Kaap & Suid-Kaap  
George  
Oos-Kaap

Jan Botes  
Andrè Pretorius  
Marcell van der Westhuizen

083 277 5893  
082 807 8240  
083 626 3235

HOOFKANTOOR: POSBUS 300 BRACKENFELL

TEL: (021) 981 1126 E-POS: [info@agricol.co.za](mailto:info@agricol.co.za) [www.agricol.co.za](http://www.agricol.co.za)

AGRICOL TAKKE: George Tel: 044 878 2408 Port Elizabeth Tel: 041 373 9894

Kimberley Tel: 053 841 0675 Nigel Tel: 011 814 4466 Pretoria Tel: 012 803 6033

Potchefstroom Tel: 018 294 7470 Howick Tel: 033 330 2765



**WITMIELIEKULTIVARS VIR DIE KOUE OOSTELIKE STREEK (Streek 3)  
WHITE MAIZE CULTIVARS FOR THE COLD EASTERN REGION (Region 3)**

Kultivars waarvan inligting vir drie seisoene beskikbaar is (oessekerheidswaardes)

25 proewe (Aantal lokaliteite oor drie seisoene)

Cultivars of which information is available for three seasons (yield reliability values) 25 trials

(Sum of the Localities during three seasons)

**Opbrengspotensiaal / Yield potential**

CULTIVAR	3TON	4TON	5 TON	6 TON	Gem/ Mean#	Hell/ Slop	D2
DKC78-45BRGEN	2.75	3.85	4.94	6.03	8.17	1.09	0.988
PAN 6Q-245*	2.96	4.01	5.06	6.11	8.16	1.05	1.174
LS 8533R	3.31	4.27	5.24	6.20	8.10	0.97	0.633
Phb 31M09	3.88	4.72	5.56	6.40	8.05	0.84	0.603
Phb 30D09BR	3.13	4.12	5.11	6.10	8.05	0.99	0.915
KKS 8301	2.63	3.63	4.64	5.65	7.62	1.01	0.885
IMP 52-11B	2.35	3.40	4.46	5.51	7.58	1.06	0.727

Kultivars waarvan inligting vir twee seisoene beskikbaar is (oessekerheidswaardes) 18 proewe

(Aantal lokaliteite oor twee seisoene)

Cultivars of which information is available for two seasons (yield reliability values) 18 trials

(Sum of the Localities during two seasons)

**Opbrengspotensiaal / Yield potential**

CULTIVAR	3 TON	4 TON	5 TON	6 TON	Gem/ Mean#	Hell/ Slop	D2
DKC78-17B	2.63	3.81	4.98	6.16	8.82	1.17	1.134
BG 5285	2.02	3.28	4.55	5.81	8.67	1.26	1.063
PAN6Q-345CB	2.22	3.44	4.65	5.86	8.62	1.21	0.798
BG 5485B	2.53	3.67	4.81	5.95	8.54	1.14	0.617
DKC78-79BR	2.04	3.26	4.47	5.69	8.44	1.22	0.460
PAN 6R-845CBGT	2.23	3.40	4.57	5.73	8.38	1.17	0.808
PAN 6Q-245*	3.14	4.13	5.13	6.12	8.37	0.99	1.382
DKC78-45BR GEN	3.49	4.40	5.32	6.23	8.30	0.93	0.411
BG 5685R	2.98	3.97	4.96	5.95	8.20	0.99	0.775
LS 8533R	3.40	4.30	5.21	6.11	8.16	0.90	0.454
Phb 30D09BR	3.18	4.12	5.06	6.00	8.14	0.94	1.640
P 1973B	3.97	4.76	5.55	6.34	8.12	0.79	1.442
Phb 31M09	4.42	5.12	5.82	6.51	8.10	0.70	0.933
LS 8539B	3.44	4.31	5.18	6.05	8.03	0.87	0.620
KKS 8301	3.28	4.15	5.03	5.90	7.88	0.53	1.222
IMP 52-11B	3.03	3.88	4.74	5.59	7.52	0.85	1.222

Kultivars waarvan inligting vir een seisoen beskikbaar is (gemiddeldes) 10 proewe  
(Aantal lokaliteite vir een seisoen)  
Cultivars of which information is available for one season (mean values) 10 trials  
(Sum of the Localities during one season)

CULTIVAR	Gem/Mean#
PAN 4B-311B	9.36
3X23B144WYB	9.19
PAN 6Q-245*	9.18
IMP 52-11R	9.15
DKC78-87B	9.14
P 2653WB	9.13
BG 5785BR	8.88
PAN 6R-665R	8.82
SC 411	7.56

\*Verwysingskultivar / Reference cultivar

# Mean yield of the specific cultivar over all trials

# Gemiddelde opbrengs vir die spesifieke kultivar vir al die proewe

### GEELMIELIEKULTIVARS VIR KWAZULU NATAL STREEK (Streek 4) YELLOW MAIZE CULTIVARS FOR KWAZULU NATAL REGION ( Region 4)

Kultivars waarvan inligting vir drie seisoene beskikbaar is (oesekeerheidswaardes) 20 proewe  
(Aantal lokaliteite oor drie seisoene)  
Cultivars of which information is available for three seasons (yield reliability values) 20 trials  
(Sum of the Localities during three seasons)

CULTIVAR	Opbrengspotensiaal / Yield potential						
	3 TON	4 TON	5 TON	6 TON	Gem/ Mean#	Hell/ Slop	D2
DKC80-40BR GEN*	2.77	3.93	5.10	6.26	10.58	1.16	0.981
PAN 6P-110	3.16	4.22	5.29	6.35	10.28	1.06	0.843
DKC80-12B GEN	2.78	3.84	4.90	5.97	9.90	1.06	1.531
SC 608	2.51	3.61	4.71	5.81	9.90	1.10	0.710
DKC73-74BR GEN	3.42	4.38	5.33	6.28	9.82	0.95	0.604
LS 8518	2.34	3.45	4.56	5.67	9.78	1.11	0.859
Phb 32W72B	3.33	4.27	5.22	6.17	9.68	0.95	0.613
Phb 33H52B	2.98	3.96	4.95	5.93	9.59	0.98	0.662
LS 8524R	3.17	4.08	5.00	5.91	9.31	0.92	1.068
IMP 51-92R	2.93	3.83	4.74	5.65	9.01	0.91	2.001
IMP 52-12	3.62	4.42	5.21	6.01	8.97	0.80	0.445



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### Witmielies

#### Nuwe kultivars

DKC78-27  
DKC78-87B  
DKC78-83R  
DKC78-79BR  
DKC77-77BR  
DKC79-25B

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Kontak gerus ons kliëntediens by:  
011 790-8200 of [customercare.sa@monsanto.com](mailto:customercare.sa@monsanto.com)

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#### Bestaande kultivars

CRN3505  
DKC78-35R  
DKC77-61B  
DKC77-85B GEN  
DKC78-17B  
DKC78-45BR GEN

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Kultivars waarvan inligting vir twee seisoene beskikbaar is (oesekekerheidswaardes)  
 15 proewe (Aantal lokaliteite oor twee seisoene)  
 Cultivars of which information is available for two seasons (yield reliability values) 15 trials  
 (Sum of the Localities during two seasons)

**Opbrengspotensiaal / Yield potential**

CULTIVAR	3 TON	4 TON	5 TON	6 TON	Gem/ Mean#	Hell/ Slop	D2
DKC80-40BR GEN*	2.70	3.91	5.11	6.32	11.20	1.20	0.961
PAN 6P-110	3.18	4.25	5.32	6.39	10.73	1.07	0.933
PAN 6Q-408CB	3.01	4.08	5.14	6.21	10.53	1.07	0.615
SC 608	2.46	3.59	4.72	5.84	10.41	1.13	0.519
LS 8518	2.82	3.87	4.92	5.97	10.22	1.05	0.689
DKC80-12B GEN	2.41	3.51	4.61	5.70	10.16	1.10	1.902
DKC73-74BR GEN	3.48	4.42	5.37	6.31	10.15	0.95	0.550
Phb 32W72B	2.55	3.61	4.67	5.73	10.02	1.06	0.550
DKC73-70B GEN	3.11	4.09	5.07	6.04	10.00	0.98	0.538
KKS 8410BR	4.31	5.11	5.90	6.70	9.92	0.80	0.720
SC 506	3.69	4.57	5.45	6.32	9.87	0.88	0.969
Phb 33H52B	2.48	3.52	4.55	5.59	9.79	1.04	0.741
LS 8524R	3.61	4.46	5.32	6.17	9.64	0.86	1.260
LS 8536B	2.43	3.43	4.43	5.43	9.48	1.00	1.080
IMP 51-92R	2.26	3.28	4.29	5.31	9.42	1.02	1.870
IMP 52-12	3.56	4.37	5.19	6.01	9.31	0.82	0.632

Kultivars waarvan inligting vir een seisoen beskikbaar is (gemiddeldes)  
 6 proewe (Aantal lokaliteite vir een seisoen)  
 Cultivars of which information is available for one season (mean values) 6 trials  
 (Sum of the Localities during one season)

CULTIVAR	Gem/ Mean#
PAN 6R-680R	9.89
DKC80-40BR GEN*	9.88
BG 6308B	9.31
P 2432R	9.19
LS 8526	9.02
PAN 6R-880CBGT	8.93
PAN 4B-312CB	8.88
PAN 4P-228	8.85
LS 8528R	8.85
KKS 4412B	8.74
KKS 8330B	8.69

\*Verwysingskultivar / Reference cultivar  
 # Mean yield of the specific cultivar over all trials  
 # Gemiddelde opbrengs vir die spesifieke kultivar vir al die proewe

**WITMIELIEKULTIVARS VIR KWAZULU NATAL STREEK (Streek 4)**  
**WHITE MAIZE CULTIVARS FOR KWAZULU NATAL REGION (Region 4)**

Kultivars waarvan inligting vir drie seisoene beskikbaar is (oessekerheidswaardes) 20 proewe  
 (Aantal lokaliteite oor drie seisoene)

Cultivars of which information is available for three seasons (yield reliability values) 20 trials  
 (Sum of the localities during three seasons)

**Opbrengspotensiaal / Yield potential**

CULTIVAR	3 TON	4 TON	5 TON	6 TON	Gem/ Mean#	Hell/ Slop	D2
PAN 6Q-245*	2.07	3.27	4.48	5.68	9.94	1.20	0.319
Phb 30D09BR	3.56	4.52	5.49	6.45	9.85	0.96	0.559
DKC78-45BR GEN	3.29	4.28	5.27	6.26	9.74	0.99	0.836
IMP 52-11B	3.09	4.11	5.13	6.14	9.74	1.02	0.479
Phb 31M09	2.55	3.61	4.68	5.74	9.51	1.07	0.454
KKS 8301	3.46	4.34	5.22	6.10	9.20	0.88	1.035
LS 8533R	2.99	3.87	4.75	5.63	8.75	0.88	0.793

Kultivars waarvan inligting vir twee seisoene beskikbaar is (oessekerheidswaardes)  
 15 proewe (Aantal lokaliteite oor twee seisoene)

Cultivars of which information is available for two seasons (mean values) 15 trials  
 (Sum of the localities during two seasons)

**Opbrengspotensiaal / Yield potential**

PAN 6Q-245*	2.22	3.40	4.58	5.76	10.50	1.18	0.363
DKC78-17B	3.22	4.25	5.28	6.31	10.44	1.03	0.533
PAN 6R-845CBGT	3.72	4.67	5.62	6.57	10.37	0.95	0.585
Phb 30D09BR	3.60	4.56	5.53	6.49	10.35	0.96	0.862
BG 5485B	3.51	4.47	5.43	6.39	10.24	0.96	0.935
DKC78-45BR GEN	3.12	4.13	5.13	6.14	10.17	1.01	0.950
BG 5285	3.11	4.12	5.12	6.12	10.14	1.00	0.585
IMP 52-11B	2.63	3.69	4.75	5.82	10.09	1.06	0.446
PAN 6Q-345CB	2.87	3.90	4.93	5.96	10.09	1.03	0.693
LS 8539B	2.46	3.54	4.63	5.72	10.08	1.09	0.539
DKC78-79BR	2.70	3.75	4.80	5.85	10.07	1.05	0.804
Phb 31M09	2.92	3.93	4.95	5.97	10.06	1.02	0.743
KKS 8301	3.01	3.94	4.87	5.81	9.54	0.93	1.192
BG 5685R	2.16	3.21	4.26	5.31	9.53	1.05	0.555
P 1973B	3.55	4.40	5.25	6.10	9.51	0.85	0.760
LS 8533R	3.19	4.02	4.85	5.67	8.99	0.83	0.655



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## Geelmielies

### Nuwe kultivar

DKC61-94BR

### Bestaande kultivars

DKC80-40BR GEN

DKC80-12B GEN

DKC80-30R

DKC62-80BR GEN

DKC64-78BR GEN

DKC73-76R

DKC62-84R

DKC73-74BR GEN

DKC73-70B GEN

DKC73-72

DKC66-32B

DKC66-36R

DKC80-10

DKC61-90

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Kultivars waarvan inligting vir een seisoen beskikbaar is (gemiddeldes) ó proewe  
(Aantal lokaliteite vir een seisoen)  
Cultivars of which information is available for one season (mean values) ó trials  
(Sum of the Localities in one season)

CULTIVAR	Gem/Mean#
PAN 4B-311B	10.15
3X23B144VYB	9.76
IMP 52-11R	9.71
P 2653VVB	9.57
PAN 6Q-245*	9.55
BG 5785BR	9.33
PAN 6R-665R	9.28
DKC78-87B	9.12
SC 411	8.53

\*Verwysingskultivar / Reference cultivar

# Mean yield of the specific cultivar over all trials

# Gemiddelde opbrengs vir die spesifieke kultivar vir al die proewe

### AGRONOMIESE EIENSKAPPE VAN MIELIEKULTIVARS VIR DIE OOSTELIKE STREKE AGRONOMIC CHARACTERISTICS OF MAIZE CULTIVARS FOR THE EASTERN AREAS

Kultivars waarvan inligting vir drie seisoene beskikbaar is  
Cultivars of which information is available for three seasons

Cultivar	Groei seisoen Growing season	% Omval Lodging	% Spruite Tillers	Koppe Ears plant-1	% Graan Vog Grain moisture
DKC73-74BR GEN	M	3.75	7.58	1.11	15.08
DKC78-45BR GEN	M	3.64	8.73	1.59	15.01
DKC80-12B GEN	M	9.07	13.49	1.62	14.49
DKC80-40BR GEN*	M	7.96	8.48	1.68	14.53
IMP 51-92R	M-S/K	4.69	9.11	1.22	14.01
IMP 52-11B	M	5.39	21.24	1.22	14.34
IMP 52-12	M-S/K	2.54	19.38	1.21	13.39
KKS 8301	M-S/K	7.94	5.86	1.39	14.34
LS 8518	M	4.13	20.92	1.22	15.63
LS 8524R	M-S/K	4.16	18.64	1.37	13.33
LS 8533R	M	9.47	10.03	1.46	13.82
PAN 6P-110	M	7.67	13.12	1.64	16.07
PAN 6Q-245*	M	12.49	11.00	1.63	15.72
Phb 30D09BR	M	5.68	9.01	1.11	15.12
Phb 31M09	M-S/K	6.70	15.32	1.24	13.30
Phb 32W72B	M-S/K	4.36	10.69	1.47	13.04
Phb 33H52B	M-S/K	2.33	13.09	1.31	12.68
SC 608	M-L	11.24	7.52	1.30	19.72

Kultivars waarvan inligting vir twee seisoene beskikbaar is  
 Cultivars of which information is available for two seasons

Cultivar	Groei seisoen Growing season	% Omval Lodging	% Spruite Tillers	Koppe Ears plant-1	% Graan Vog Grain moisture
BG 5485B	M	5.86	8.45	1.39	15.82
BG 5685R	M	5.76	8.04	1.41	14.89
DKC73-70B GEN	m	2.68	5.99	1.19	15.05
DKC73-74BR GEN	M	3.73	6.68	1.11	15.70
DKC78-17B	M	3.35	9.41	1.65	15.84
DKC78-45BR GEN	M	2.83	7.99	1.62	15.70
DKC78-79BR	M	5.37	7.19	1.62	15.56
DKC80-12B GEN	M	8.59	6.68	1.63	15.20
DKC80-40BR GEN*	M	8.02	8.83	1.72	15.29
IMP 51-92R	M-S/K	4.42	7.52	1.22	14.74
IMP 52-11B	M	2.87	15.33	1.23	14.88
IMP 52-12	M-S/K	3.36	13.02	1.19	14.34
KKS 8301	M-S/K	2.60	6.28	1.26	14.06
KKS 8410BR	M	3.38	5.81	1.25	15.04
LS 8518	M	2.93	11.27	1.22	16.06
LS 8524R	M-S/K	3.34	10.73	1.38	14.02
LS 8533R	M	3.71	9.21	1.47	14.29
LS 8536B	M	7.51	4.91	1.42	13.91
LS 8539B	M	6.85	7.98	1.26	15.82
P 1973B	M	3.10	9.27	1.35	13.95
PAN 6P-110	M	5.24	7.48	1.64	16.85
PAN 6Q-245*	M	7.51	9.36	1.66	16.47
PAN 6Q-345CB	M	6.71	10.98	1.67	15.71
PAN 6Q-408CB	M	5.71	7.89	1.56	16.44
PAN 6R-845CBGT	M	4.53	11.37	1.63	15.06
Phb 30D09BR	M	4.17	5.52	1.10	15.52
Phb 31M09	M-S/K	5.18	12.24	1.23	13.98
Phb 32W72B	M-S/K	3.54	7.16	1.51	13.58
Phb 33H52B	M-S/K	2.71	9.31	1.34	13.33
SC 506	M-L	4.45	6.75	1.26	16.67
SC 608	M-L	10.34	6.25	1.30	20.06

Kultivars waarvan inligting vir een seisoen beskikbaar is  
 Cultivars of which information is available for one season

Cultivar	Groei seisoen Growing seisoen	% Omval Lodging	% Spruite Tillers	Koppe Ears plant-1	% Graan Vog Grain moisture
3X23B144WYB	M	10.86	6.91	1.37	15.47
BG 5785BR	M	5.20	3.50	1.47	14.54
BG 6308B	M	6.85	3.32	1.58	15.35
DKC78-87B	M	8.54	4.97	1.62	15.08
DKC80-40BR GEN*	M	10.87	5.76	1.66	14.87
IMP 52-11R	M-S/K	4.81	7.40	1.18	14.27
KKS 4412B	M-S/K	6.44	4.52	1.30	13.72
KKS 8330B	M-S/K	3.40	5.82	1.15	13.90
LS 8526	M-S/K	13.36	2.99	1.58	12.42
LS 8528R	M-S/K	4.62	5.27	1.32	13.51
P 2432R	M	3.87	6.16	1.41	14.64
P 2653WB	M	5.78	7.62	1.18	15.96
PAN 4B-311B	M-S/K	5.97	7.03	1.16	15.02
PAN 4B-312CB	M-S/K	9.82	5.06	1.36	13.58
PAN 4P-228	M-S/K	4.86	5.04	1.34	12.79
PAN 6Q-245*	M	9.94	4.18	1.60	15.92
PAN 6R-665R	M	8.83	4.13	1.59	15.51
PAN 6R-680R	M-L	7.88	6.12	1.67	17.36
PAN 6R-880CBGT	M-L	5.07	5.50	1.52	15.47
SC 411	M	9.30	4.89	1.20	14.82

### DAE TOT BLOM / DAYS TO FLOWERING

	Kort(K)/ Short(S)	Meduim(M)/ Medium (M)	Lank(L)/Long(L)
Koel Streke/Cool areas	70-75	75-80	80-85
Warm Streke/Warm areas	60-65	65-70	70-75

### KORTGROEISEISOEN GEELMIELIEKULTIVARS / (Koel tot matige streek) SHORT GROWING SEASON FOR YELLOW MAIZE CULTIVARS (Cool to temperate region)

Kultivars waarvan inligting vir drie seisoene beskikbaar is (oessekerheidswaardes) 24 proewe  
(Aantal lokaliteite oor drie seisoene)  
Cultivars of which information is available for three seasons (yield reliability values) 24 trials  
(Sum of the Localities during three seasons)

**Opbrengspotensiaal / Yield potential**

CULTIVAR	7 TON	8 TON	9 TON	10 TON	11 TON	Gem/ Mean#	Hell/ Slop
BG 3492B	5.71	7.09	8.46	9.83	11.20	13.33	1.37
PAN 3Q-740BR*	7.29	8.36	9.42	10.49	11.55	13.21	1.07
PAN 3Q-240	7.92	8.81	9.70	10.59	11.48	12.87	0.89
PAN 3D-736BR	6.86	7.92	8.98	10.04	11.11	12.73	1.06
PAN 3P-502R	7.86	8.73	9.60	10.46	11.33	12.72	0.87
Phb 32D96B	6.36	7.47	8.58	9.70	10.81	12.54	1.11
IMP 50-90BR	5.94	7.12	8.29	9.46	10.64	12.47	1.17
IMP 50-10R	7.10	8.06	9.02	9.99	10.95	12.46	0.96
DKC64-78BRGEN	7.63	8.50	9.36	10.23	11.09	12.44	0.87
DKC62-84R	6.99	7.96	8.93	9.90	10.87	12.38	0.97
DKC61-90	7.91	8.70	9.49	10.28	11.07	12.31	0.79
PAN 6126	7.43	8.29	9.14	9.99	10.84	12.17	0.85
DKC62-80BRGEN	6.39	7.42	8.45	9.48	10.52	12.12	1.03
KKS 8216BR	6.54	7.54	8.53	9.53	10.53	12.08	1.00

Kultivars waarvan inligting vir twee seisoene beskikbaar is(oessekerheidswaardes) 16 proewe  
(Aantal lokaliteite oor twee seisoene)

Cultivars of which information is available for two seasons (yield reliability values) 16 trials  
(Sum of the Localities during two seasons)

**Opbrengspotensiaal / Yield potential**

CULTIVAR	7 TON	8 TON	9 TON	10 TON	11 TON	Gem/ Mean#	Hell/ Slop
BG 3492B	5.13	6.65	8.16	9.68	11.20	13.27	1.52
BG 3292	5.46	6.87	8.28	9.69	11.09	13.01	1.41
PAN 3Q-740BR*	7.68	8.65	9.63	10.61	11.59	12.92	0.98
PAN 3P-502R	8.34	9.16	9.98	10.80	11.62	12.74	0.82
PAN 3Q-240	8.61	9.38	10.15	10.92	11.69	12.74	0.77
IMP 50-90BR	6.55	7.66	8.78	9.89	11.01	12.53	1.12
BG 3592R	6.01	7.23	8.44	9.65	10.86	12.51	1.21
PAN 3D-736BR	7.64	8.54	9.43	10.33	11.22	12.44	0.89
DKC62-80BR GEN	7.82	8.66	9.50	10.34	11.18	12.33	0.84
DKC62-84R	7.04	8.02	9.00	9.99	10.97	12.31	0.98
DKC64-78BR GEN	7.95	8.76	9.57	10.38	11.19	12.29	0.81
DKC61-90	7.94	8.75	9.55	10.36	11.17	12.26	0.81
Phb 32D96B	6.61	7.65	8.69	9.74	10.78	12.20	1.04
IMP 50-10R	6.27	7.35	8.42	9.50	10.57	12.04	1.08
KKS 8216BR	6.76	7.74	8.72	9.70	10.68	12.02	0.98
PAN 6126	8.21	8.89	9.58	10.26	10.94	11.87	0.68
DKC61-94BR	7.42	8.23	9.05	9.86	10.67	11.78	0.81
IMP 50-10B	4.55	5.80	7.05	8.29	9.54	11.24	1.25

Kultivars waarvan inligting vir een seisoen beskikbaar is (gemiddeldes) 11 proewe  
 (Aantal lokaliteite vir een seisoen)  
 Cultivars of which information is available for one season (mean values) 11 trials  
 (Sum of the Localities during one season)

CULTIVAR	Gem/Mean#
PAN 3Q-740BR*	13.46
BG 3792BR	13.41
PAN 4B-312CB	12.72
KKS 8326B	12.39
KKS 8330B	12.12
IMP 50-10BR	11.75
KKS 8328B	11.03

# Mean yield of the specific cultivar over all trials

# Gemiddelde opbrengs vir die spesifieke kultivar vir al die proewe

\*Verwysingskultivar / Reference cultivar

### KORTGROEISEISOEN GEELMIELIEKULTIVARS (Warm Streek) SHORT GROWING SEASON FOR YELLOW MAIZE CULTIVARS (Hot region)

Kultivars waarvan inligting vir drie seisoene beskikbaar is (oesekeerheidswaardes) 15 proewe  
 (Aantal lokaliteite oor drie seisoene)  
 Cultivars of which information is available for three seasons (yield reliability values) 15 trials  
 (Sum of the Localities during three seasons)

#### Opbrengspotensiaal / Yield potential

CULTIVAR	7 TON	8 TON	9 TON	10 TON	11 TON	Gem/ Mean#	Hell/ Slop
BG 3492B	6.79	7.91	9.04	10.16	11.29	14.86	1.13
DKC62-84R	7.54	8.54	9.54	10.54	11.54	14.71	1.00
PAN 3D-736BR	6.30	7.47	8.64	9.81	10.98	14.70	1.17
DKC62-80BRGEN	6.92	8.00	9.08	10.17	11.25	14.69	1.08
PAN 6126	7.79	8.73	9.66	10.60	11.53	14.50	0.93
KKS 8216BR	7.29	8.28	9.27	10.26	11.25	14.39	0.99
PAN 3Q-740BR*	6.07	7.21	8.34	9.48	10.61	14.22	1.14
PAN 3Q-240	4.88	6.18	7.47	8.77	10.07	14.18	1.30
PAN 3P-502R	5.25	6.47	7.70	8.92	10.14	14.01	1.22
DKC64-78BRGEN	9.59	10.19	10.79	11.39	11.99	13.90	0.60
DKC61-90	7.59	8.46	9.32	10.18	11.05	13.79	0.86
IMP 50-90BR	7.00	7.31	8.33	9.36	10.39	13.65	1.03
Phb 32D96B	6.88	7.82	8.77	9.71	10.65	13.63	0.94
IMP 50-10R	8.82	9.43	10.04	10.65	11.26	13.19	0.61

Kultivars waarvan inligting vir twee seisoene beskikbaar is (oesekeerheidswaardes) 10 proewe  
(Aantal lokaliteite oor twee seisoene)

Cultivars of which information is available for two seasons (yield reliability values) 10 trials  
(Sum of the Localities during two seasons)

**Opbrengspotensiaal / Yield potential**

CULTIVAR	7 TON	8 TON	9 TON	10 TON	11 TON	Gem/ Mean#	Hell/ Slop
DKC62-80BR GEN	9.20	10.04	10.88	11.72	12.55	15.59	0.84
DKC61-94BR	4.91	6.30	7.68	9.06	10.44	15.44	1.38
BG 3492B	7.46	8.49	9.51	10.54	11.56	15.28	1.03
DKC62-84R	5.97	7.18	8.39	9.60	10.81	15.20	1.21
PAN 6126	8.44	9.29	10.14	10.99	11.85	14.93	0.85
PAN 3P-502R	7.00	8.44	9.41	10.39	11.36	14.90	0.98
PAN 3Q-240	7.00	7.08	8.26	9.44	10.62	14.90	1.18
KKS 8216BR	8.66	9.47	10.29	11.11	11.93	14.89	0.82
PAN 3D-736BR	4.34	5.72	7.09	8.46	9.84	14.81	1.37
PAN 3Q-740BR*	7.55	8.49	9.43	10.37	11.31	14.71	0.94
IMP 50-10B	5.58	6.73	7.89	9.04	10.20	14.38	1.16
DKC64-78BR GEN	11.33	11.72	12.12	12.51	12.90	14.33	0.39
IMP 50-90BR	3.89	5.24	6.59	7.93	9.28	14.15	1.35
BG 3292	3.95	5.29	6.62	7.96	9.29	14.14	1.34
BG 3592R	6.58	7.56	8.54	9.52	10.50	14.04	0.98
DKC61-90	6.04	7.09	8.13	9.18	10.23	14.02	1.05
Phb 32D96B	8.06	8.83	9.59	10.36	11.12	13.89	0.77
IMP 50-10R	10.68	11.06	11.45	11.84	12.23	13.63	0.39

Kultivars waarvan inligting vir een seisoen beskikbaar is (gemiddeldes) 5 proewe  
(Aantal lokaliteite vir een seisoen)

Cultivars of which information is available for one season (mean values) 5 trials  
(Sum of the Localities during one season)

CULTIVAR	Gem/Mean#
PAN 4B-312CB	14.96
PAN 3Q-740BR*	15.43
KKS 8330B	14.03
KKS 8328B	14.27
KKS 8326B	14.78
IMP 50-10BR	14.14
BG 3792BR	14.93

\*Verwysingskultivar / Reference cultivar

# Mean yield of the specific cultivar over all trials

# Gemiddelde opbrengs vir die spesifieke kultivar vir al die proewe

**AGRONOMIESE EIENSKAPPE VAN MIELIEKULTIVARS VIR KORTGROEISEISOEN  
AGRONOMIC CHARACTERISTICS OF MAIZE CULTIVARS FOR SHORT GROWING  
SEASON**

Kultivars waarvan inligting vir drie seisoene beskikbaar is  
Cultivars of which information is available for three seasons

Cultivar	Groei seisoen	% Omval	% Spruite	Koppe	% Graan Vog
	Growing season	Lodging	Tillers	Ears plant-1	Grain moisture
BG 3492B	K/S	2.55	14.30	1.09	14.11
DKC61-90	K/S	1.43	11.00	1.08	13.23
DKC62-80BRGEN	K/S	1.24	14.01	1.13	13.72
DKC62-84R	K/S	0.42	13.34	1.09	13.90
DKC64-78BRGEN	K/S	1.00	13.68	1.08	13.23
IMP 50-10R	K/S	2.19	12.04	1.10	13.05
IMP 50-90BR	K/S	1.95	11.88	1.09	13.51
KKS 8216BR	K/S	6.04	9.88	1.05	13.92
PAN 3D-736BR	K/S	2.93	12.79	1.12	14.44
PAN 3P-502R	K/S	6.07	15.19	1.11	13.44
PAN 3Q-240	K/S	6.34	12.91	1.08	13.47
PAN 3Q-740BR*	K/S	6.38	14.15	1.12	13.70
PAN 6126	K/S	2.47	14.12	1.10	13.71
Phb 32D96B	M-K/S	3.60	11.52	1.09	13.33

Kultivars waarvan inligting vir twee seisoene beskikbaar is  
Cultivars of which information is available for two seasons

Cultivar	Groei seisoen	% Omval	% Spruite	Koppe	% Graan Vog
	Growing season	Lodging	Tillers	Ears plant-1	Grain moisture
BG 3292	K/S	1.33	9.18	1.06	14.95
BG 3492B	K/S	3.81	10.73	1.06	14.89
BG 3592R	M-K/S	2.23	14.08	1.06	15.27
DKC61-90	K/S	2.26	12.73	1.06	14.10
DKC61-94BR	K/S	0.95	14.20	1.08	14.35
DKC62-80BR GEN	K/S	1.47	14.88	1.10	14.64
DKC62-84R	K/S	0.37	10.13	1.09	13.82
DKC64-78BR GEN	K/S	2.79	11.90	1.08	14.13
IMP 50-10B	K/S	5.55	12.49	1.12	14.73
IMP 50-10R	K/S	7.65	9.88	1.07	14.05
IMP 50-90BR	K/S	2.42	10.77	1.08	14.06
KKS 8216BR	M-K/S	8.04	9.38	1.03	15.90
PAN 3D-736BR	K/S	2.69	11.23	1.10	14.37
PAN 3P-502R	K/S	4.48	19.58	1.09	14.32

PAN 3Q-240	K/S	9.50	10.36	1.08	14.17
PAN 3Q-740BR*	K/S	9.38	11.46	1.09	14.60
PAN 6126	K/S	2.55	10.91	1.07	14.10
Phb 32D96B	M-K/S	5.05	8.40	1.07	15.09

Kultivars waarvan inligting vir een seisoen beskikbaar is  
 Cultivars of which information is available for one season

Cultivar	Groei seisoen Growing season	% Omval Lodging	% Spruite Tillers	Koppe Ears plant-1	% Graan Vog Grain moisture
BG 3792BR	K/S	1.78	17.96	1.07	15.38
IMP 50-10BR	K/S	5.73	16.08	1.06	15.69
KKS 8326B	M-K/S	8.65	21.14	1.08	17.88
KKS 8328B	M-K/S	0.17	15.15	1.08	17.05
KKS 8330B	M-K/S	2.62	17.52	1.05	16.77
PAN 3Q-740BR*	K/S	2.72	19.42	1.09	15.22
PAN 4B-312CB	M-K/S	6.26	14.30	1.11	15.42

\*Verwysingskultivar / Reference cultivar

# Mean yield of the specific cultivar over all trials

# Gemiddelde opbrengs vir die spesifieke kultivar vir al die proewe

## BEMESTING

Bemesting is een van die grootste koste-items vir graanprodusente. Dit is egter ook die moeilikste inset om te hanteer omdat 'n besluit oor die hoeveelheid en tipe kunsmis wat gebruik moet word, deur baie faktore beïnvloed word. Dit is algemene gebruik om die hoeveelheid kunsmis wat toegedien word te koppel aan die verwagte opbrengs of opbrengsmikpunt. Daar is egter baie ander faktore wat die reaksie van 'n gewas op bemesting beïnvloed. Dit sluit faktore soos die volgende in: kleipersentasie, tipe klei, organiese materiaal, vlakke van plantvoedingstowwe in die grond voor bemesting, reënval en -verspreiding, gronddiepte en suurversadiging.

### GRONDMONSTERNEMINGS-METODES

Die hoofdoelstelling met 'n bemestings-/bekalkingsprogram is om enige vorm van grondchemiese beperking op die mees ekonomies doeltreffende wyse op te hef, dit wil sê om wins bo insetkoste in die verband te maksimaliseer. Dit is slegs moontlik indien die omvang van alle grondchemiese beperkinge effektief deur grondmonsternemings en laboratoriumtleidings vasgestel kan word.

Grondontledings vorm die basis van bemestingsaanbevelings. Plantvoedingstowwe is gewoonlik nie eweredig in die grond versprei nie omdat kunsmis

gebandplaas word en normale bewerkings dié kunsmis nie goed met die grond meng nie. Dit is dus noodsaaklik om te verseker dat grondmonsters korrek geneem word. Die Bemestingshandleiding van die Misstofvereniging van Suid-Afrika (MVSA, 2007) bevat uitstekende riglyne vir die neem van grondmonsters en behoort deur elke produsent geraadpleeg te word. Hier word slegs enkele van die belangrikste punte beklemtoon:

1. Waar meer as een grondtipe op 'n land voorkom, moet 'n monster vir elke grondtipe ontleed word.
2. Een verteenwoordigende monster vir elke 50 ha behoort voldoende te wees.
3. Elke monster moet uit minstens 20 submonsters bestaan wat eweredig oor die grondeenheid geneem is.
4. Submonsters moet goed gemeng word voordat 'n verteenwoordigende monster daaruit geneem word.
5. Bogrondmonsters moet geneem word van 0 - 150 mm diep en ondergrondmonsters van 150 - 600 mm diep.
6. Dit is nie nodig om meer as vyf submonsters per grondeenheid te neem in die geval van ondergrondmonsters nie.
7. Waar presisieboerdery toegepas word, word monsters geneem volgens 'n voorafverkose ruitpatroon, byvoorbeeld een monster per 5 ha, maar gewoonlik word een

monster per een of twee hektaar geneem.

Monsterneming van bestuursones word ook toegepas en behels 'n proses waarvolgens vooraf, oor 'n periode van tot drie jaar, punte geïdentifiseer word waar monsters geneem word. Daar word gewoonlik gebruik gemaak van satelietbeelde, opbrengskaarte en fisiese inspeksie om punte te identifiseer.

8. Die betroubaarheid van grondontledings hang grootliks af van hoe verteenwoordigend die grondmonsters van die betrokke lande is.

## METODE 1

Hierdie metode word aanbeveel onder omstandighede waar residuele voedingstowwe en grondsuurheid relatief homogeen versprei is, soos byvoorbeeld by onbewerkte gronde of waar residuele bande deur bewerkings opgehef is. Bogrondmonsters (0 - 150 mm) word eweredig teen 20 - 40 submonsters per eenheid (<50 ha), verkieslik met 'n grondboor met deursnee van 75 mm of meer, geneem. Vir ondergrondmonsters is vyf submonsters van 150 - 600 mm diep voldoende. Indien stikstofontledings gedoen word, moet aparte maar enkele monsters van 0 tot 600 mm diep ontleed word.

## METODE 2

Hierdie metode word aanbeveel onder omstandighede waar residuele

voedingstowwe en grondsuurheid nie homogeen versprei is nie, soos byvoorbeeld na oes en voor die eerste bewerking van die komende seisoen.

Aangesien alle bemestingstowwe vir mielieproduksie in die RSA met planttyd gebandplaas word en gewoonlik deur 'n N-kantbemesting opgevolg word en ook omdat bestellings vir bemestingstowwe en kalk lank voor die eerste bewerking geplaas moet word, is hierdie metode in die meeste mielieproduserende gebiede van toepassing.

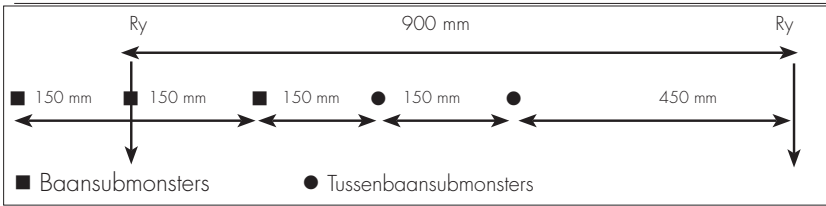
Verteenwoordigende monsters van 'n 300 mm wye baan oor die mielierye word afsonderlik van tussenbaangrondmonsters geneem en ontleed, soos hieronder skematies voorgestel vir 'n rywydte van 900 mm.

### Baansubmonsters (■)

Drie monsters word oor die baan geneem op so 'n wyse dat die kunsmisband gemonster word. Die drie monsters verteenwoordig 'n baan van ±300 mm.

### Tussenbaansubmonsters (●)

Een monster word presies in die middel van twee rye geneem (450 mm vanaf die ry vir 'n rywydte van 900 mm). 'n Tweede monster word presies tussen die baanmonster (■) en die tussenbaansubmonster (●) geneem (300 mm van die plantry af vir 'n 900 mm rywydte).



Alle grondmonsters word met 'n Thompson, Edelman of grondbore met soortgelyke afmetings geneem. Die diepte-inkremte is 0 - 150 mm en 150 - 600 mm. Die prosedure in die figuur word vyf keer per 50 ha eenheid herhaal. Die vyf monsters van die 0 - 150 mm diepte word goed gemeng en een monster daaruit geneem wat ontleed word. Dieselfde prosedure geld vir die 150 - 300 mm en 300 - 600 mm dieptes.

Monsters moet lugdroog gemaak word of gevries word wanneer N-ontledings verlang word indien dit nie binne 24 uur by die laboratorium besorg kan word nie. Monsters moet in alle gevalle nie in die son gelaat word nie. Die grondmonsters vir ontleding behoort elk 'n massa van 500 tot 1000 g te hê.

### DIE OPHEFFING VAN GRONDSUURHEID

Mielieproduksie word slegs deur grondsuurheid beperk, indien toksiese vlakke van sekere elemente, soos aluminium (Al) en mangaan (Mn) in die grond teenwoordig is. Hoë waterstof (H)-konsentrasies, dit wil sê lae pH is nie opsigself noodwendig beperkend nie. Al-toksisiteit gaan met grondsuurheid gepaard terwyl Mn-toksisiteit selde daarmee geassosieer word. Beide vorms van toksisiteit kan gelyktydig voorkom.

Die gevaar van Al-toksisiteit by mielies bestaan slegs indien die pH (KCl) <4.5 of die pH (H<sub>2</sub>O) <5.5 is, maar dan is dit nog nie te sê dat dit wel sal voorkom nie. Al-toksisiteit word gekenmerk deur kort, dik wortels sonder enige wortelhare. Die toksisiteit van Al word bepaal deur die verhouding van Al plus H tot die som van kalium (K), kalsium (Ca), magnesium (Mg), en Al plus H. Hierdie verhouding, uitgedruk as 'n persentasie, staan bekend as suurversadiging. Die omvang van oesverliese word toenemend groter soos wat suurversadiging hoër as 20% styg omdat die opname van voedingstowwe en water dan en slegs dan beperk word. By 80% suurversadiging word geen opbrengs verwag nie. Onder omstandighede waar beide Al- en Mn-toksisiteite voorgekom en die suurversadiging tot onder 20% verlaag word, word die Mn-toksisiteit ook voldoende geneutraliseer.

Wanneer bekalk word, word kalkbehoefte bepaal ten einde 'n suurversadiging van 0 - 15% te bereik, sodat daar 'n mate van 'n buffer teen herversuring en Al-toksisiteit ingebou is. 'n Groot buffer teen herversuring (bv. 'n suurversadiging van 0%) kan geregverdig word indien: a) die tempo van herversuring hoog is; b) grondsuurheidsvariasie op 'n land hoog is; c) meer gevoelige gewasse soos koring en droëbone in 'n wisselboustelsel ingesluit is, en d) daar eers weer na drie of meer jare bekalk gaan word. Die koste daaraan verbonde om suurversadigingswaardes laer as 15% te bereik

moet egter deeglik in ag geneem word. Kalktoedienings, wat meer is as wat nodig is, soos om die suurversadiging na 0% te verlaag kan gewoonlik nie geregverdig word nie.

pH-gebaseerde kalkbehoefte bepalingmetodes, soos die pH (KCl)-tekstuur- en SMP-buffermetode, kan slegs potensieële risikos verbonde aan grondsuurheid uitskakel. Volgens dié metodes bereken, kan die hoeveelheid kalk benodig om die pH van 'n suur grond tot byvoorbeeld pH (KCl)-waarde van 5 te lig, nie ekonomies geregverdig word nie. Gevolglik word die bepaling van kalkbehoefte op pH-gebaseerde metodes nie aanbeveel nie.

Dit is egter belangrik om vas te stel tot op watter diepte in die grondprofiel versuring voorkom en tot waar dit opgehef moet word alvorens kalk- en gipspeile bereken word.

## KALKKWALITEIT

Kalkkwaliteitsparameters sluit die vol-



**Versuring en die gepaardgaande aluminiumtoksisiteit begin dikwels in kolle. Plantegroei swakker en het 'n ligte groen kleur.**

gende in: (a) kalsiumkarbonaat ekwivalent (KKE) in soutsuur (HCl); (b) die KKE in hars (Rh-metode) waar swakker suur gebruik word; (c) deeltjiegrooiteverspreiding (graad van fynheid), en d) pH (KCl). Hierdie onderskeie waardes kan egter nie direk en eensydig in verband gebring word met die neutralisering van grondsuurheid onder veldtoestande nie, maar wel met behulp van wiskundige modelle. Kalke met die hoogste KKE (HCl), KKE (Rh), met die grootste persentasie fyn deeltjies en hoogste pH behoort egter grondsuurheid die beste onder veldtoestande te neutraliseer.

Wet No. 36 van 1947 bepaal dat 100% van die partikels van standaard kalk <1700  $\mu\text{m}$  moet wees en 50% <250  $\mu\text{m}$ . In die geval van mikro-fyn kalk, moet 95% van die partikels <250  $\mu\text{m}$  wees en 80% <106  $\mu\text{m}$ . Vir beide tipes kalk moet die kalsiumkarbonaat ekwivalent (KKE(HCl)) 'n minimum van 70% wees.

## TIPE KALK

Indien die magnesiumstatus (Mg) van die grond laag is (<40 mg  $\text{kg}^{-1}$ ), of relatief laag in vergelyking met die kalsium (Ca) status is, word 'n dolomitiese kalk bo 'n kalsitiese kalk aanbeveel, tensy die Mg-voedingsbehoefte deur misstofmengsels of Mg-verbindings aangevul kan word.

## KALKBEHOEFTE

Aangesien die kwaliteit van verskillende kalkbronne kan varieer, word bekalkingsaanbevelings deur LNR-IGG op die verlangde suurversadigingveranderinge in die grond, drie kalkkwaliteitsmaatstawwe [5 deeltjiegroottes, KKE

(HCl), pH (KCl)] en die gesommeerde kationuitruikapasiteit (KUK) van die grond, gebaseer.

Aanbevelings op grond van verskillende bronne se kalkkwaliteit vir 'n reeks grondkationuitruikapasiteite word in Tabel 1 getoon. Die kalkprys,

vervoerkoste, inwerkoste en voginhoud van die kalk behoort egter bykomend in ag geneem te word. Aanbevelings in Tabel 1 geld slegs vir die 0 – 150 mm grondlaag en indien bekalking effektief tot dieper grondlae uitgevoer wil word, moet proporsionele aanpassings gemaak word.

**Tabel 1. Kalkaanbevelings (ton ha<sup>-1</sup>) volgens verlangde suurdersadigingsverandering (ΔSV), gesommeerde kationuitruikapasiteit (KUK) van die grond en kwaliteit van sekere kalkbronne soos in 2002**

ΔSV (%)	KUK (cmolc kg <sup>-1</sup> )	Hiqua (Witbank)	Marico (Zeerust)	Bjrhamsdrif* (Zeerust)	Meyerton (Vereeniging)	Sappi* (Germiston)	Immerpan (Pietersburg)	Calmasil (Middelburg)	Vaalbrug (Orkney)	Britten (Christiana)	Mooiplaas (Pretoria)
<b>10</b>	1	0.3	0.6	0.5	0.4	0.2	0.4	0.4	0.4	0.5	0.4
	2	0.6	1.2	1.1	0.8	0.5	0.7	0.7	0.7	1.1	0.9
	3	0.8	1.8	1.7	1.3	0.7	1.1	1.1	1.1	1.7	1.3
	4	1.1	2.5	2.3	1.7	0.9	1.5	1.5	1.5	2.3	1.8
<b>20</b>	1	0.6	1.3	1.2	0.9	0.5	0.8	0.8	0.8	1.2	1.0
	2	1.3	2.8	2.6	2.0	1.0	1.7	1.7	1.7	2.6	2.0
	3	2.0	4.4	4.0	3.1	1.6	2.6	2.7	2.7	4.1	3.2
	4	2.7	6.1	5.5	4.2	2.2	3.6	3.6	3.7	5.6	4.3
<b>30</b>	1	1.0	2.2	2.0	1.5	0.8	1.3	1.3	1.4	2.1	1.6
	2	2.2	4.8	4.3	3.3	1.7	2.8	2.9	2.9	4.4	3.4
	3	3.4	7.5	6.8	5.2	2.7	4.4	4.5	4.5	6.9	5.3
	4	4.6	10.3	9.3	7.1	3.7	6.0	6.1	6.2	9.5	7.3
<b>40</b>	1	1.5	3.2	2.9	2.2	1.2	1.9	1.9	1.9	3.0	2.3
	2	3.1	6.9	6.3	4.8	2.5	4.1	4.1	4.2	6.4	4.9
	3	4.9	10.8	9.8	7.5	3.9	6.4	6.5	6.5	10.0	7.7
	4	6.7	14.9	13.5	10.3	5.3	8.8	8.9	8.9	13.8	10.6
<b>50</b>	1	1.9	4.3	3.9	3.0	1.6	2.5	2.6	2.6	4.0	3.1
	2	4.1	9.2	8.3	6.4	3.3	5.4	5.5	5.5	8.5	6.6
	3	6.5	14.4	13.1	10.0	5.2	8.5	8.6	8.7	13.4	10.3
	4	8.9	19.9	18.0	13.7	7.1	11.7	11.9	11.9	18.4	14.2

\* Kalsitiese kalke, alle ander kalke is dolomitiese kalke

## TOEDIENINGSPRAKTYK

Afgesien van kalkkwaliteit is kalkreaksie in die grond baie sterk afhanklik van deeglike vermenging van die kalk met die grond. Deeglike vermenging word verseker deur die kalk eers in te sny en dan in te ploeg. Kalktoediening behoort ten minste twee maande voor plantyd te geskied ten einde te verseker dat die kalk teen plantyd volledig gereageer het.

## ONDERGRONDSUURHEID

Segmentele bekalking met diepbekalkers, spesiaal aangepaste dieprippers of diep ploegbewerkings is effektief, maar nie altyd ekonomies haalbaar nie. Oppervlaktodiening van gips in die orde van 4 ton ha<sup>-1</sup> is 'n ekonomies effektiewe alternatief vir die ameliorering van ondergronduurheid waar aluminiumoksied of ysteroksied teenwoordig is. Dolomitiese kalk behoort saam met dié gips toegedien te word aangesien gips Mg uit die bogrond na die ondergrond verplaas en 'n tekort aan Mg in die bogrond tot gevolg kan hê. Gips sal een of selfs twee seisoene neem voordat dit die ondergrond bereik en daarom is meganiese inkorporering van kalk soms 'n vinniger oplossing.

## STROOKBEKALKING

Strookbekalking word aanbeveel onder omstandighede waar strookversurings deur Grondmonsternemingsmetode 2 geïdentifiseer is, of vir gronde wat algeheel versuur is en waar beheerde spoorverkeerpraktyke toegepas kan word. Strookversurings ontstaan gewoonlik by

beheerde spoorverkeerpraktyke waar stikstof gebandplaas en as kantbemesting toegedien word. Strooktoedienings van kalk behoort ten minste twee maande voor plantyd ±30 cm oor die ry uitgestrooi en in die grond ingewerk te word.

## BRAKGRONDE

Brakgronde is alkaliese gronde wat gewoonlik hoë natrium (Na), kalsium (Ca) en magnesium (Mg) konsentrasies bevat. Indien die geleidingsvermoë van die grond hoër as 500 mS m<sup>-1</sup> is, of die Na-konsentrasies meer as 15% van die katione is, kan probleme met mielieproduksie ontstaan.

'n Voorvereiste vir die herwinning van brakgronde is goeie dreinerings. Gronde wat slegs 'n hoë geleidingsvermoë het en nie hoë natriumkonsentrasies bevat nie, kan herwin word deur oorbesproeiing waardeur die oormaat sout uitgeloo word, mits die besproeiingswater van 'n goeie kwaliteit is.

Gipstoedienings teen 2.9 ton ha<sup>-1</sup> of swaweltoediening teen 0.54 ton ha<sup>-1</sup> vir elke 230 mg Na kg<sup>-1</sup> sal Na na die ondergrond verplaas waar dit deur oorbesproeiing dreineer moet word. Gipstoedienings word egter nie aanbeveel indien die kalsiumkonsentrasies reeds baie hoog is nie, in welke geval swawel gebruik kan word.

## VOEDINGSBEHOEFES

Verskillende benaderings tot bemesting van gewasse word toegepas. Twee

benaderings wat veral aandag geniet is die genoegsaamheidsbenadering waar voedingstofvlakke in grond oor 'n relatief kort periode opgebou word tot 'n vlak wat enige verwagte opbrengs kan ondersteun en die opbrengsmikpuntbenadering waar slegs voldoende bemes word om 'n spesifieke ekonomiese opbrengsmikpunt te haal. Die kationbalansbenadering wat ook soms gebruik word, word nie deur LNR-IGG ondersteun nie.

Die opbrengsmikpuntbenadering word tans die meeste gebruik omdat aanvaar word dat die hoeveelheid wat bemes moet word, deur die opbrengsmikpunt bepaal word. Dit impliseer dus dat die voedingstowwe wat deur 'n oes verwyder word, vervang word en dat indien daar opbou van voedingstowwe plaasvind, dit geleidelik oor jare sal geskied. Voordele van dié benadering is dat ekonomiese optimum peile relatief maklik behaal kan word. 'n Nadeel van die benadering is dat wat N betref, die plantbeskikbare N in die grond voor bemesting nie in aanmerking geneem word nie.

Die genoegsaamheidsbenadering berus op die verwantskap tussen voedings-elementkonsentrasies of -hoeveelhede in die grond en relatiewe graanopbrengs. Hiervolgens word die vlakke van voedingstowwe in die grond sodanig bestuur dat 'n bepaalde persentasie van die opbrengspotensiaal van 'n bepaalde seisoen bereik sal word. Indien die voedingselementresidue homogeen in die grond versprei is, is Grondmonster-nemingsmetode 1 van toepassing.

Indien dit nie die geval is nie is Grondmonster-nemingsmetode 2 van toepassing. Volgens hierdie metode word grondvolumes waarvan die verwagte konsentrasies aansienlik sal verskil, afsonderlik ontleed, verwerk na hoeveel-hede eerder as konsentrasies, byme-kaargetel en uitgedruk in terme van kg voedingselement  $\text{ha}^{-1}$  in die grond tot 'n bepaalde diepte.

'n Voordeel van hierdie benadering is dat plantvoedingstowwe nooit opbrengsbeperkend behoort te wees nie, selfs in baie gunstige seisoene wanneer opbrengste besonder hoog is. 'n Verdere voordeel is dat die beskikbare N in die grond in berekening gebring word omdat grondstikstofontledings gewoonlik vereis word vir dié benadering. 'n Nadeel is dat aanbevole hoeveelhede bemesting soms nie ekonomies regverdigbaar is nie.

'n Databasis van grondontledings van elke produksie-eenheid of land wat oor tyd gehou word, sal duidelik toon of onder- of oorbemes word. Alle gronde het die vermoë om voortdurend plantvoedingstowwe te lewer. Grondontledings kan beskou word as die netto resultaat van die grond se lewering, plus dit wat deur bemesting voorsien is, minus dit wat deur die gewas verwyder is. Die ideaal sal wees as alle plantvoedingstowwe stadig maar seker oor tyd toeneem tot 'n punt waar daar geen twyfel bestaan dat voldoende van 'n gegewe element in die grond teenwoordig is nie. Sodra hierdie punt bereik is, kan bemesting van die spesi-

fieke element verminder word om die vlak daarvan in die grond konstant te hou, dit wil sê onderhoudsbemesting.

Die beginsel geld vir die meeste elemente, maar is veral van toepassing op P omdat die meeste Suid-Afrikaanse gronde van nature arm daaraan is. P word ook deur baie gronde vasgelê en het dus dikwels 'n negatiewe leweringsvermoë vir P. Dit word aanbeveel dat gronde wat nog nie by die optimum fosforvlak is nie, oor tyd opgebou word. Die produsent behoort op die tydramwerk te besluit wat sy finansiële posisie ook in aanmerking neem, aangesien dit 'n duur proses is.

**MAKROVOEDINGSELEMENTE**

STIKSTOF (N)

**Opbrengsmikpuntbenadering**

Die mees algemene benadering wat

tans met stikstofbemesting gevolg word, is om die hoeveelheid N wat bemes moet word, van die verwagte opbrengs of opbrengsmikpunt af te lei. Hiervolgens word 15 kg ha<sup>-1</sup> N toegeleen vir elke 1 t ha<sup>-1</sup> opbrengs wat verwag word. Hierdie metode oorskakel die hoeveelheid N benodig vir opbrengste onder 3 t ha<sup>-1</sup>, terwyl die hoeveelheid N benodig moontlik onderskat word vir opbrengste bo 4 t ha<sup>-1</sup>. Dit is ook bekend dat die tekstuur van grond die stikstofleweringsvermoë daarvan bepaal. Hiervolgens lewer gronde met 'n hoë kleipersentasie meer N as sanderige gronde. Stikstofbestedingsriglyne wat aangepas is om hiervoor voorsiening te maak, word in Tabel 2 aangetoon (Bloem, 2004). Die riglyne in Tabel 2 is bedoel vir situasies waar grondstikstofontledings nie beskikbaar is nie en neem dus die N-leweringsvermoë van gronde in ag.

**Tabel 2. Stikstofvoedingspeil (kg N ha<sup>-1</sup>) vir opbrengsmikpunte en klei-inhoud**

Klei-inhoud (%)	Opbrengsmikpunt (ton ha <sup>-1</sup> )									
	2,0	2,5	3,0	3,5	4,0	4,5	5,0	5,5	6,0	
5	23	41	58	75	92	109	126	143	160	
10	17	35	52	69	86	103	120	137	154	
15	10	28	45	62	79	96	113	133	147	
20	4	22	39	56	73	90	107	124	141	
25	0	16	33	50	67	84	101	118	135	
30	0	9	26	43	60	77	94	111	128	
40	0	0	14	31	48	65	82	99	116	
50	0	0	0	18	35	52	69	86	103	

**Genoegsaamheidsbenadering**

In gevalle waar daar grondontledingsresultate vir anorganiese N beskikbaar is, kan die volgende benadering gevolg word. Hiervolgens behoort die anorganiese N-inhoud in die boonste 600 mm grond by  $100 \pm 20 \text{ kg ha}^{-1}$  vir 100% opbrengs oor alle lokaliteite bestuur te word. Onder vergelykbare omstandighede was die optimum N in die grond bv.  $80 \text{ kg ha}^{-1}$  by 11% klei, maar  $120 \text{ kg ha}^{-1}$  by 3% klei. Meer verwantskappe word egter op nasionale vlak benodig alvorens grondeienskappe met optimum N-grondontledings binne vasgestelde produksiepraktyke, in verband gebring kan word. Opbrengsonderdrukking weens te hoë N-grondontleding het tot dusver voorgekom wanneer hierdie ontledings  $170 \text{ kg N ha}^{-1}$  oorskry het. Onder besproeiing behoort die anorganiese N-inhoud naby  $170 \text{ kg ha}^{-1}$ , maar nie hoër as dit, tot en met blomtyd, bestuur te word nie.

Algemene verwagte grondreaksies op

N-toedienings word in Tabel 3 aangebied. Ooreenkomstig die N-leweringsvermoë van gronde word baie meer N op sanderige gronde as op kleierige gronde benodig om die N-inhoud in die grond met een eenheid te verhoog (Tabel 3). Hoewel hierdie riglyne steeds bruikbaar is, sal die afbakening van gronde volgens klei-inhoud (Tabel 3) deur 'n glyskaal van N-behoeftefaktore volgens klei-inhoud, indien moontlik, vervang moet word, soos wat data van meer lokaliteite beskikbaar word. Hierdie riglyne (Tabel 3) is egter slegs geldig indien die meeste plantmateriaal verwyder word. Die inwerking van groot hoeveelhede plantmateriaal of organiese misstowwe sal die N-behoeftefaktore in 'n baie groot mate beïnvloed. Verder sal die toediening van kalk die omsetting van organiese N na anorganiese N versnel. Weens die potensiële bydrae van anorganiese N uit die organiese poel is dit meer akkuraat om anorganiese N gedurende die seisoen te meet aangesien die meeste N teen daardie tyd reeds omgesit is.

**Tabel 3. Riglyne wat die verband tussen N-toedienings en veranderinge in anorganiese N-grondontledings volgens tekstuurklasse, by verwydering van die meeste plantmateriaal aantoon**

Klei (%)	NBF* (kg N per ha toediening/kg N per ha ontleding; 0-600 mm)
<15	2.0
15-20	1.5
>20	1.0

\* N behoefte faktor, dit wil sê die hoeveelheid N wat per hektaar toegedien moet word om die nitraat-N plus ammonium-N ontledings in die boonste 600 mm grond met 1 kg per hektaar te verhoog



**Plante met 'n stikstofgebrek langs plante wat voldoende stikstof ontvang het.**

### Delta-opbrengsbenadering

'n Alternatiewe manier om die stikstofbestedingsbehoefte te bepaal, staan bekend as die delta-opbrengs metode. Delta-opbrengs, is die opbrengs van mielies by die ekonomiese optimum minus die opbrengs van 'n aanliggende kontrole perseel mielies wat geen stikstof ontvang het nie. Die delta-opbrengs toon 'n baie goeie verwantskap met die optimale stikstofbestedingsvereiste afgesien van die lokaliteit, grondsoort en of dit droëland of produksie onder besproeiing is. Die gevolg is dat een formule of tabel oor die hele mielieproduksiegebied van toepassing is sonder dat die grondtektuur of ander faktore in ag geneem hoef te word. Trouens, dit wil voorkom of dié formule universeel is en nie net tot Suid-Afrika beperk is nie, aangesien dit baie goed ooreenstem met dit wat in die VSA gevind is.



**Stikstofgebrekssimptome op ouer blare.**

### Delta-opbrengsmetodiek

Die delta-opbrengsmetodiek is eenvoudig en vereis slegs kontrole stroke of -persele. Op sowat 1.6% van die oppervlakte van 'n melieland, moet geen stikstofkunsmis toegedien word

**Tabel 4. Die stikstofbestedingsbehoefte van mielies volgens die delta-opbrengsmetode**

<b>Delta-opbrengs</b>	<b>N-behoefte</b>	<b>Delta-opbrengs</b>	<b>N-behoefte</b>
<b>(kg ha<sup>-1</sup>)</b>			
250	28	4250	153
500	42	4500	158
750	54	4750	163
1000	64	5000	169
1250	73	5250	174
1500	82	5500	179
1750	90	5750	183
2000	97	6000	188
2250	104	6250	193
2500	111	6500	197
2750	118	6750	202
3000	124	7000	206
3250	130	7250	211
3500	136	7500	215
3750	142	7750	219
4000	147	8000	224

nie, maar wel die aanbevole P, K en ander voedingstowwe. Dié kontrole gedeelte (of zero N gedeelte) kan enkele vollengte mielierye wees of 'n aantal aanliggende rye vir 'n beperkte lengte, byvoorbeeld vier rye van 20 m. Kontrolepersele moet oor 'n land versprei wees en van jaar tot jaar van posisie gewissel word. Die res van die land word, soos gewoonlik, met stikstof bemes om die ekonomiese optimum opbrengs te bereik. Teen oestyd word die opbrengs van die kontrolepersele bepaal en ook dié van die bemeste gedeelte. Die verskil in opbrengs tus-

sen dié gedeelte en die kontrole is die delta-opbrengs. Met presisieboerdery is die prosedure byna outomaties en word aanbeveel dat elke vier ha 'n kontroleperseel bevat.

Die stikstofbestedingsbehoefte van die mielies kan dan vanuit Tabel 4 bepaal word. Die delta-opbrengs moet oor seisoene per grondsoort (of land as die grond redelik homogeen is) en vir 'n spesifieke gewasstelsel bepaal word en die gemiddelde oor tyd bereken word. Sodoende kan die stikstofbestedingsbehoefte oor tyd verfyn word.

## Voordele

Afgesien daarvan dat die delta-opbrengsprosedure belofte inhou omdat dit akkurater as die tradisionele metodes kan wees, hou dit ook ander voordele in naamlik:

- Die opbrengs van die kontrole is 'n meting van die hoeveelheid gewas-besikbare stikstof in die grond in terme van die graanopbrengs.
- Dit raak dus oorbodig om grond-monsters te neem vir N-inhoudsbepaling en die moontlike foute wat daarmee gepaardgaan, word dus uitgeskakel.

Die produsent is nou self in beheer van die bepaling van sy mielies se stikstofbestedingsvereiste. Die opbrengs wat prysgegee word deur die kontrole persele sal na raming minder as 0.5% van die opbrengs beloop indien 1.6% van die oppervlakte daarvoor gebruik word. Die voordeel van doeltreffender bemesting gaan waarskynlik dié opbrengs wat met die kontrole persele verbeur word, in waarde oortref, aangesien beide oorbemesting en onderbemesting tot die minimum beperk word.

## Plantontledings

Blare onder en teenoor die boonste mieliekop tydens blomtyd behoort tussen 2.4 en 2.9% N te bevat. N-tekorte veroorsaak dat jong plantjies bleek lig-groen of geelgroen vertoon. Teen later stadiums sal die oer blare eerste vergeel met 'n kenmerkende omgekeerde

V-vorm. Pitte aan die punte van mielie-koppe ontbreek in 'n skielike oorgang tussen goed gevulde pitte en geen pitte. Die pitlose punt van die stronk is gewoonlik skerp.

## TOEDIENINGSPRAKTYKE

### Plasing

Die volgende toedieningspeile in die band, 50 mm weg van die ry en 50 mm dieper as die saad, behoort nie oorsky te word nie.

0.9 m wye rye: nie meer as 40 kg N ha<sup>-1</sup>

1.5 m wye rye: nie meer as 30 kg N ha<sup>-1</sup>

2.1 m wye rye: nie meer as 20 kg N ha<sup>-1</sup>

Saam met kalium is die totale hoeveelhede vir die onderskeie rywydtes 70, 50 en 30 kg ha<sup>-1</sup>. Groter hoeveelhede kan egter wel met veiligheid teen planttyd gebandplaas word, mits dit 70 tot 100 mm weg van die saad en ten minste 50 mm onder die saad geplaas word. Bo-bemestingtoedienings van alle N-draers word gewoonlik as 'n kantbemesting, 100 tot 150 mm vanaf die rye toegedien, wat in die grond ingewerk moet word om potensiële verliese te verminder of te voorkom.

### Tye van toediening

N moet altyd in 'n plantmengsel ingesluit word, maar klimaatsfaktore en residuele N-inhoud in die grond bepaal wanneer die meeste N toegedien behoort

te word. Die meeste N behoort vroeg gegee te word indien die seisoenale reënval minder as 700 mm is en die N-loweringvermoë van die grond laag is (soos in sandgronde), teenoor laat toediening (nie later as agt weke na plant nie) indien seisoenale reënval meer is

as 700 mm en die N-lowering van die grond hoog is (soos in kleigronde).

Gelyke verdelings tussen vroeë en laat toedienings behoort gemaak te word indien die seisoenale reënval hoër is as 700 mm en die N-lowering van die grond laag is. Drie tot vyf toedienings

**Tabel 5. Optimum ekstraheerbare P volgens Ambic 1 en Bray 1 in die boonste 150 mm grond by verskillende klei+slik inhoude ten einde 90% opbrengs te bereik**

Klei+Slik %	Ambic 1 mg kg <sup>-1</sup>	Bray 1 mg kg <sup>-1</sup>	Klei+Slik %	Ambic 1 mg kg <sup>-1</sup>	Bray 1 mg kg <sup>-1</sup>
13	25.3	33.5	37	9.9	17.9
14	23.6	31.8	38	9.7	17.6
15	22.1	30.3	39	9.5	17.4
16	20.8	29.0	40	9.3	17.2
17	19.7	27.8	41	9.1	17.0
18	18.7	26.8	42	8.9	16.9
19	17.8	25.9	43	8.7	16.7
20	17.0	25.1	44	8.6	16.5
21	16.2	24.3	45	8.4	16.4
22	15.6	23.6	46	8.3	16.2
23	15.0	23.0	47	8.1	16.1
24	14.4	22.4	48	8.0	15.9
25	13.9	21.9	49	7.8	15.8
26	13.4	21.4	50	7.7	15.7
27	13.0	21.0	51	7.6	15.5
28	12.6	20.6	52	7.5	15.4
29	12.2	20.2	53	7.4	15.3
30	11.8	19.8	54	7.3	15.2
31	11.5	19.5	55	7.2	15.1
32	11.2	19.2	56	7.1	15.0
33	10.9	18.9	57	7.0	14.9
34	10.6	18.6	58	6.9	14.8
35	10.4	18.3	59	6.8	14.7
36	10.1	18.1	60	6.7	14.6

wat gelyk verdeel word, word op sanderige gronde, onder besproeiing aanbeveel, maar hierdie toedienings behoort verkieslik teen twee weke voor blomtyd afgehandel te wees.

### FOSFOR (P)

P-aanbevelings berus op ontledings van ekstraheerbare P, sowel as klei plus slik inhoud in die boonste 150 mm grond. Ekstraksiemetodes wat algemeen vir mielieproduksie gebruik word is Bray 1 en Ambic 1. Hiervolgens word die optimum ekstraheerbare P in die grond in Tabel 5 aangetoon. Volgens die huidige prysverhoudings en risiko's ter sprake word die bereiking van 90% opbrengs en nie hoër as dit nie, aanbeveel. Indien die klei plus slik inhoud minder as 13% is word tans aanbeveel dat die optimum waardes by 13% klei plus slik gebruik word. Net so behoort die optimum P-waardes by 60% klei plus slik gebruik te word vir klei plus slik waardes hoër as 60%. Waar konsentrasies laer as die optimum is, kan met inagneming van die finansiële implikasies vir die produsent, 'n opbou program gevolg word waarvolgens die P-status oor 'n aantal jare opgebou word. Die hoeveelheid fosfor wat per hektaar toegedien moet word om die grondkonsentrasie met 1 mg P kg<sup>-1</sup> (Bray 1) te verhoog is 5, 7 en 9 kg P ha<sup>-1</sup> vir tekstuurklasse van <10%, 10-20% en 21-35% klei onderskeidelik. P-toedienings wat benodig word vir instandhouding van die grond P-status word bereken teen 4 kg P ton<sup>-1</sup> graan geproduseer.



**'n Gebrek aan fosfor beperk groei en die tekortsimptome is rooierige pers blaarpunte en -rande.**

### Plantontledings

'n Ontleding van blare onder en teenoor die boonste kop tydens blomtyd behoort tussen 0.22 en 0.30% P te wees. Tekortsimptome word gewoonlik deur jong plante vertoon, veral onder koel, nat toestande. Blare is donkergroen met rooierige-pers punte en rande.

### Toedieningspraktyk

Die algemene praktyk is dat P-bemesting gewoonlik 50 mm weg van die saad en 50 mm dieper as die saad gebandplaas word. Indien die hoeveelheid om praktiese redes nie eenmalig gebandplaas kan word nie kan 'n tweede toediening kort na plant op dieselfde wyse, maar verder weg van die plantry saam met maontlike bykomende N of K gebandplaas word. Breedwerpigse toedienings van P is veral by kleierige gronde baie meer onderworpe aan vaslegging as bandgeplaaste toedienings.

## KALIUM (K)

Reaksie op K-bemesting kan in die grootste mielieproduserende gebiede, dit wil sê op suur gronde met relatiewe lae Ca-inhoude, slegs verwag word indien die uitruilbare K-ontleding in die boonste 600 mm grond, minder as  $300 \text{ kg ha}^{-1}$ , dit wil sê  $29 \text{ mg kg}^{-1}$  by 3% klei of  $38 \text{ mg kg}^{-1}$  by 56% klei, is. Indien hierdie ontleding wel laag genoeg is, behoort  $1.5 \text{ kg K ha}^{-1}$  toegedien te word vir elke  $1 \text{ kg ha}^{-1}$  waarmee die grondontleding oor die diepte verhoog moet word. Die optimum boggrond (0 - 150 mm) K-ontleding vir kaolinitiese kleigronde (53% klei) in KwaZulu-Natal is  $125 \text{ mg kg}^{-1}$  onder omstandighede waar die ondergrond tot by 'n diepte van 600 mm,  $20 \text{ mg kg}^{-1}$  voor planttyd was. Toedienings van  $3 \text{ kg K ha}^{-1}$  behoort die boggrondontledings in die gronde met  $1 \text{ mg kg}^{-1}$  te verhoog. K-gebreksimptome is al by boggrond K-ontledings van so hoog as  $200 \text{ mg kg}^{-1}$ , onder alkaliese toestande, waar die boggrond Ca-ontledings meer as  $3000 \text{ mg kg}^{-1}$  was, waargeneem. Navorsing in die verband ontbreek, maar K word tans wel onder sulke toestande volgens verwagte graanverwydering aanbeveel, dit wil sê  $4 \text{ kg K ton}^{-1}$ , gebandplaas.

### Plantontledings

'n Ontleding van blare onder en teenoor die boonste kop tydens blomtyd behoort tussen 1.5 en 1.9% K te wees. K-tekorte word aanvanklik waargeneem as geel of nekrotiese blaarrande beginnende by die onderste blare, gevolg deur verspreiding

na die boonste blare. Volwasse plante val makliker om indien K-voorsiening onvoldoende is omdat die stamme onder sulke toestande makliker deur siektes besmet word. Die pitte op die punt van die kop is kleiner en verkrimp.

### Toedieningspraktyk

K word gewoonlik deur middel van mistofmengsels gebandplaas.

Die volgende toedieningspeile in 'n band, 50 mm weg van die saad en 50 mm dieper as die saad met plant behoort nie oorskry te word nie.

0.9 m wye rye: nie meer as  $40 \text{ kg K ha}^{-1}$

1.5 m wye rye: nie meer as  $30 \text{ kg K ha}^{-1}$

2.1 m wye rye: nie meer as  $20 \text{ kg K ha}^{-1}$

Saam met N is die totale hoeveelhede vir die onderskeie rywydtes 70, 50 en  $30 \text{ kg ha}^{-1}$ .

Groter hoeveelhede kan egter wel met veiligheid teen planttyd gebandplaas word, mits dit 70 tot 100 mm weg van die saad en ten minste 50 mm onder die saad geplaas word.

### MAGNESIUM (Mg)

Die boggrondontledings van Mg behoort ten minste  $40 \text{ mg kg}^{-1}$  te wees. Mg-tekorte word gewoonlik met grondsuurheid geassosieer en ook deur dolomitiese kalk reggestel. Indien grondsuurheid nie 'n probleem is nie, behoort Mg deur kunsmengsels wat Mg bevat, aangevul te word, of deur produkte soos magne-

siumsulfaat of magnesium-oksied. Mg-tekorte word baie maklik op sandgronde deur hoë toedienings of hoë vlakke van kalium in die grond geïnduseer.

'n Ontleding van blare onder en teenoor die boonste kop tydens blomtyd behoort tussen 0.15 en 0.25% Mg te wees. Die eerste tekens van magnesiumtekorte is geel tot wit tussennerfse strepe wat eerste by die ouer blare voorkom. Strepe word opgevolg deur dooie ronde kolle in die strepe, met 'n kenmerkende krale voorkoms.



**Tipiese tussennerf vergeling weens 'n magnesiumgebrek op die ouer blare.**

### KALSIUM (Ca)

Ca-gebreksimptome is sover bekend nog nie onder veldtoestande waargeneem nie. Proewe wat gedoen is op gronde met Ca-ontledings by 100 mg kg<sup>-1</sup> het geen reaksie op kalsium getoon nie. Lae Ca-vlakke word gewoonlik met grondsuurheid geassosieer en ook deur kalktoedienings reggestel.

'n Ontleding van blare onder en teenoor die boonste kop tydens blomtyd behoort tussen 0.2 en 0.25% Ca te wees. Ca-tekorte verhoed die verskyning en

ontvoing van nuwe blare waarvan die punte feitlik kleurloos is en met 'n taai jellieagtige stof bedek is, wat tot gevolg het dat hulle aan mekaar vas kleef.

### SWAWEL (S)

Stekorte kom veral voor na die langdurige gebruik van misstowwe wat nie S bevat nie, soos byvoorbeeld heleroplossings en hoë konsentrasie fosforverbindinge. Reaksie op S kan beslis verwag word indien die anorganiese S-konsentrasies minder as 3 mg kg<sup>-1</sup> is, terwyl dit redelik seker is dat S-reaksies nie by ontledings hoër as 10 mg kg<sup>-1</sup> sal voorkom nie. Reaksie op S bemesting op grond met 'n S inhoud tussen 3 en 10 mg S kg<sup>-1</sup>, is afhanklik van die atmosferiese bydrae tot die grond se S-reserwe en die ondergrondse S-inhoud.

'n Ontleding van blare onder en teenoor die boonste kop tydens blomtyd behoort nie minder as 0.2% S te wees nie. S-gebreksimptome by jong plante word gekenmerk aan 'n algehele ligte vergeling van blare sonder 'n vaste patroon. By ouer plante sal die basisse van die nuwe blare eerste vergeel. Die herinstelling van die gebruik van misstofmengsels of verbindinge wat S bevat is gewoonlik voldoende om tekorte aan te vul.

### MIKROVOEDINGSELEMENTE

#### SINK (Zn)

Zn is die mikrovoedingselement wat die meeste toegedien word deurdat dit in

baie misstofmengsels ingesluit word. Tekorte kan verwag word indien die grondontledings minder as  $1.5 \text{ mg kg}^{-1}$  is, of indien blaarontledings van blare onder en teenoor die boonste kop tydens blomtyd minder as  $20 \text{ mg kg}^{-1}$  is.

Zn-gebreksimptome word gekenmerk deur ligte tussennerfse strepe wat by mekaar aansluit om bande te vorm wat vanaf die basisse tot die punt van die blare kan strek. Die rande, midriwwe en blaarpunte bly egter groen. 'n Lengtesnit deur die stamme toon donker verpersing van die onderste nodes. Onder koel, bewolkte weer, kom hierdie simptome skielik voor, maar verdwyn weer net so vinnig wanneer die son uitkom. Hoë P-konsentrasies inhibeer Zn-opname terwyl hoë N-konsentrasies Zn-opname bevorder. Alkaliëse toestande [ $\text{pH} (\text{H}_2\text{O}) > 7.5$ ] kan ook Zn tekorte induseer.

Misstofmengsels wat Zn bevat, het heeltemal genoeg Zn in om tekorte in die grond aan te vul. Indien die grond tot aanvaarbare Zn-vlakke opgebou is, is die herhaalde gebruik van mengsels wat Zn bevat, onnodig.

### **MOLIBDEEN (Mo)**

Mo-tekorte kom selde nog voor aangesien saad met Mo behandel word en saadproduseerders die inhoud van Mo in die saad verhoog deur blaarbespuitings met Mo.

Gebreksimptome word gekenmerk deur ligte groen plante waarvan die blaar-

punte en -rande terugsterf. Mo-tekorte word vererger deur grondsuurheid en word geassosieer met uitloop van graan op die kop. Mo-konsentrasies in die blare onder en teenoor die boonste kop tydens blomtyd, behoort ten minste  $0.2 \text{ mg kg}^{-1}$  te wees.

### **BOOR (B)**

B is in 'n groot mate onderworpe aan logging onder hoë reënval toestande, maar kan net so maklik tot toksiese vlakke, onder lae reënval omstandighede opbou. Verder kan oorbekalking ook B-tekorte, weens verminderderde toeganklikheid induseer. Optimum warm water B-ontledings in die bogrond is tussen  $1$  en  $2 \text{ mg kg}^{-1}$ , maar vanaf  $5 \text{ mg kg}^{-1}$  kan B-toksisiteit verwag word.

B-tekorte word veral gekenmerk deur misvormde koppe en onegalige verspreiding van pitte as gevolg van swak bestuiwings. B-tekorte word verwag indien blaarontleding van blare onder en teenoor die boonste kop tydens blomtyd tot minder as  $5 \text{ mg kg}^{-1}$  gedaal het. B-tekorte kan reggestel word deur toedienings van  $0.5 - 2 \text{ kg B ha}^{-1}$ , verkieslik voor planttyd.

B-toksisiteit word gekenmerk deur vergeling van blaarpunte, gevolg deur progressiewe nekrose, wat by die blaarpunte en rande begin en dan tussen die nerwe tot by die midrib versprei. Blare kan uiteindelik 'n gebrande voorkoms vertoon en kan afsterf voordat dit volledig ontwikkel is.

### MANGAAN (Mn)

Die meeste gronde bevat voldoende Mn, maar weens ontoeganklikheidsprobleme word gebreksimptome veral by alkaliese gronde wat baie organiese materiaal bevat, waargeneem. Onder sulke omstandighede word breedwerpige grondtoedienings nie aanbeveel nie, maar wel bandplasing teen nagenoeg 6 kg Mn ha<sup>-1</sup>. Blaartoedienings van 1 tot 5 kg Mn ha<sup>-1</sup> is gewoonlik ook voldoende om tekorte op te hef.

Mn-tekortsimptome gaan soos in die geval van Mg-tekorte in vroeë stadiums gepaard met tussennerfse vergeling wat ook liggroen van kleur mag wees, maar met die verskil dat dit eerste by die jonger blare voorkom. Mn-tekorte word verwag indien blaarontleding van blare onder en teenoor die boonste kop tydens blomtyd tot minder as 15 mg kg<sup>-1</sup> gedaal het.

Mn-toksiseiteite kom voor onder suur toestande op Mn-ryke gronde en word gekenmerk deur silwer-vaal tot bruin kolle op veral ouer blare. Onder omstandighede waar beide Al- en Mn-toksiseiteite voorgekom het, is beide toksiseiteite geneutraliseer deur bekalking tot suurversadigingsvlakke van <20%.

### KOPER (Cu)

Grondrempelwaardes van 4 mg Cu kg<sup>-1</sup> vir HNO<sub>3</sub>-ekstraksies en 0.2 mg Cu kg<sup>-1</sup> vir DTPA-ekstraksies, is vir graangewasse gerapporteer. Die meeste gronde

bevat voldoende Cu, hoewel hoog-geloogde sandgronde arm is aan Cu. Die toeganklikheid van Cu vir plante is egter laag onder alkaliese toestande.

Gebreksimptome word gekenmerk deur bleek geel tot wit verkleuring van jonger blare wat ook tot nekrose van blaarpunte en rande kan lei. Cu-tekorte word verwag indien blaarontleding van blare onder en teenoor die boonste kop tydens blomtyd tot minder as 5 mg kg<sup>-1</sup> gedaal het.

Grondtoedienings van Cu word bo blaartoedienings aanbeveel. Die inkorporering van Cu in die wortelsone word by voorkeur aanbeveel aangesien bandplasing toksies kan wees. Die algemene grense waarbinne aanbevelings gemaak word strek van 1 tot 10 kg Cu ha<sup>-1</sup>, maar dit kan so hoog as 22 kg Cu ha<sup>-1</sup> wees. Organiese bemesting bevat gewoonlik genoeg Cu om die noodsaaklikheid van addisionele Cu toedienings uit te skakel.

### YSTER (Fe)

Die meeste suur gronde het heeltemal voldoende opgeloste yster wat vir gewasproduksie beskikbaar is. Hoog-geloogde sandgronde mag uitsonderings op hierdie reël wees. By pH (H<sub>2</sub>O) waardes tussen 6.5 en 8.0 word yster ontoeganklik vir plante en hoe hoër die pH hoe groter die ontoeganklikheid.

Gebreksimptome word gekenmerk deur prominente tussennerfse chlorose van die hele blaar wat eerste by die jongste

blare begin. Die hele plant kan hierdie voorkoms vertoon en die geel tussennerfse strepe kan onder erge toestande in wit strepe verander. Die plant is oor die algemeen verpot.

Ystertekorte wat weens ontoeganklikheidsprobleme ontstaan, word die beste deur blaarbespuitings van 'n 2% ystersulfaat oplossing behandel. Verskeie bespuitings, twee weke uit mekaar, mag nodig wees. 'n Toename in die gebruik van versurende misstowwe soos ammoniumsulfaat word onder alkaliese toestande aanbeveel waardeur die toeganklikheid van Fe verbeter sal word.



**Tussennerf vergeling weens 'n ystertekort op jonger blare.**

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## FERTILISATION

Fertilisation is one of the biggest cost items faced by grain producers. It is also one of the most difficult inputs to handle, because the decision on the type and quantity of fertiliser can be influenced by many factors. A common practise is to relate fertiliser recommendations to expected yields or yield targets. Many other factors however, influence the reaction of the crop to the fertiliser. These include: clay percentage, clay mineral, organic matter, nutrient levels before fertilisation, rainfall and rainfall distribution, soil depth and acid saturation.

### SOIL SAMPLING METHODS

The main objective with a fertiliser/liming programme is to neutralise any kind of soil chemical restriction in the most economically viable manner, i.e. to maximise profit above input costs. This is only possible if the extent of all soil chemical limitations can be determined effectively by soil sampling and laboratory analyses for nutrients.

Fertiliser recommendations are based on soil analyses of these nutrients. Plant nutrients are usually not distributed evenly throughout the soil because of the band placing of fertiliser and because cultivation practices usually do not mix the fertiliser effectively with the soil. It is thus vital to take care that soil samples are taken correctly. The Fertiliser Handbook (MFSA, 2003) gives excellent guidelines on methods to take soil samples

and should therefore be used as a guide by every grain producer. Only a few important aspects are highlighted here:

1. If a field consists of more than one soil form, a soil sample should be taken from each soil form.
  2. One representative sample for every 50 ha should be sufficient.
  3. Each sample should consist of at least 20 sub-samples taken randomly throughout the land unit or soil form.
  4. Sub-samples should be properly mixed before a representative sample is taken.
  5. Topsoil samples are taken from 0 - 150 mm and sub soil samples from 150 - 600 mm.
  6. It is not necessary to take more than five sub-samples per land unit when sub-soils are sampled.
  7. In precision farming samples are taken in a predetermined grid, for example one sample per 5 ha, but usually one sample per one or two hectares is required.
- Smart sampling is a process where specific locations are identified, up to three years in advance, to take soil samples. Satellite images, yield monitor data and physical inspections are used to identify the sites for sampling.
8. The reliability of a soil analysis depends on how representatively the soil samples were taken on a field.

**METHOD 1**

This method is recommended where residual nutrients and soil acidity are distributed homogeneously, for example in uncultivated soils or where residual bands have been removed by tillage. Twenty to forty topsoil (0 - 150 mm) sub-samples are taken, at random, per unit (<50 ha), preferably using a soil augers with a diameter of at least 75 mm. Five sub-samples for the deeper increments (150 - 300 mm and 300 - 600 mm) that are taken at random over the same area is suffice. If nitrogen analyses are required, separate but single samples taken from 0 - 600 mm depth, should be taken.

**METHOD 2**

This method is recommended under conditions where residual nutrients and soil acidity are not homogeneously distributed, for example after harvesting and before the first tillage operation of the coming season.

This method is applicable to most maize producing areas, since fertilisers for maize production in South Africa are banded at planting and are usually followed by a N fertiliser side-dressing. Orders for fertilisers and lime should be placed well in advance of the first tillage operation.

Representative samples of a 300 mm wide band over maize rows are analysed separately from between-row samples, as illustrated for a row width of 900 mm in the figure below.

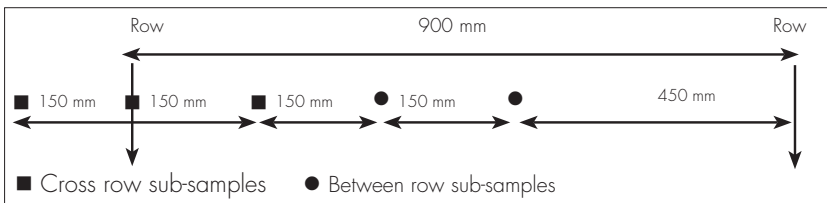
Cross row sub samples (■)

Three samples are taken across the row so that the fertiliser band can be sampled. The three samples represent a band of ±300 mm.

Between row sub-samples (●)

One soil sample is taken exactly in the middle of two rows (450 mm from the row for a row width of 900 mm). A second soil sample is taken exactly in the middle of the cross row sub-sample (■) and the between row sub-sample (●) (300 mm from the plant row for a row width of 900 mm).

All soil samples are taken either with Thompson, Edelman or soil augers with similar dimensions. Depth increments are the same as for the previous method, namely 0 - 150 mm, 150 - 300 mm and 300 - 600 mm. The sampling procedure is repeated five times per 50 ha soil unit. The five 0 – 150 mm samples are mixed thoroughly and one subsample taken from the mixture for analysis. The same procedure is followed for the 150 – 300 mm and 300 – 600 mm samples.



Samples should be air-dried or frozen if N analysis is required and samples cannot be delivered to the laboratory within 24 hours. Samples should in all instances not be exposed to direct sunlight. A soil mass of between 500 and 1000 g is required for each sample for analysis.

## THE AMELIORATION OF SOIL ACIDITY

Maize production is limited by soil acidity only when toxic levels of elements such as aluminium (Al) and manganese (Mn) are present. A high concentration of hydrogen (H) ions, i.e. a low pH is not necessarily yield limiting. Al toxicity is predominantly associated with soil acidity, while Mn toxicity is rarely associated with soil acidity, although both forms of toxicity can sometimes occur simultaneously.

The danger of Al toxicity in maize only exists when the pH (KCl) <4.5, or the pH (H<sub>2</sub>O) <5.5. Even under these low pH levels, Al toxicity may not prevail. Al toxicity is characterised by short thick roots devoid of root hairs. Al toxicity is determined by the ratio of Al and H, to the total of potassium (K), calcium (Ca), magnesium (Mg), as well as Al and H. This ratio, expressed as a percentage, is known as acid saturation. Yield losses will increase as acid saturation increases above 20%, since water and nutrient uptake are then impaired. No grain yield is expected at 80% acid saturation. Under conditions where both Al and Mn toxicity occur, Mn toxicity will be sufficiently neutralised if soils are managed below 20% acid saturation.

Lime requirement is aimed at reaching acid saturation levels of between 0 and 1.5% in order to provide a buffer against re-acidification and Al toxicity. A large buffer against re-acidification (e.g. acid saturation of 0%) can be justified if: a) the rate of re-acidification is high; b) the variation in soil acidity in the field is high; c) more acid sensitive crops, e.g. wheat and dry beans are included in a rotation system, and d) the planning is such as to lime every three or more years. The cost implications of managing acid saturation at below 1.5%, should however be thoroughly considered. Lime application, more than what is necessary, to lower acid saturation to 0% for instance can usually not be justified.

Lime requirement calculation methods based on pH, such as the pH (KCl), texture and SMP buffer methods, can only be used to eliminate possible risks. Calculated lime requirements with pH based methods to increase the pH of an acid soil to a pH (KCl) of 5 for instance, are usually not economical. The use of pH based lime requirements calculations are therefore not recommended.

It is however important to determine up to what depth soil acidity prevails in the soil and to what depth it should be neutralised before the lime and gypsum rate is calculated.

## LIME QUALITY

Laboratory determinations for lime quality, currently used, include: a) calcium carbonate equivalent (CCE) in hydro-

chloric acid (HCl); b) CCE in a resin (Rh method); c) particle size, and d) pH (KCl). These individual values cannot be directly related to soil acidity neutralisation under field conditions, but only through multidimensional, mathematical equations. However, liming materials with the highest CCE (HCl), CCE (Rh), the largest portion of fine particles and the highest pH (KCl) should be the best to neutralise soil acidity under field conditions.



**Acidification and the accompanying aluminium toxicity initially appear in small areas. Plant growth is poor with a pale green colour.**

Act No. 36 of 1947 determine that 100% of the particles of a standard lime should be  $<1700 \mu\text{m}$  and 50%  $<250 \mu\text{m}$ . In case of microfine lime, 95% of particles should be  $<250 \mu\text{m}$  and 80%  $<106 \mu\text{m}$ . The minimum allowable calcium carbonate equivalent (CCE (KCl)) for both limes is 70%.

## TYPE OF LIME

Dolomitic lime is recommended in favour of calcitic lime when the Mg status of the soil is low ( $<40\text{mg kg}^{-1}$ ) or relatively low in comparison with the Ca status, unless the Mg requirement can be met by the use of Mg containing fertilisers.

## LIME REQUIREMENT

Lime recommendations at the ARC-GCI are based on the required change in acid saturation in the soil, lime quality criteria [5 particle sizes, CCE (HCl), pH (KCl)] and the cation exchange capacity (CEC summation) of the soil.

Liming recommendations, accounting for the quality of limes from some sources are presented in Table 1. The price of lime, transport costs, soil incorporation costs and moisture content of the lime should also be taken into consideration. These calculations were only done for the 0-150 mm soil layer and when liming needs to be done effectively to deeper soil layers, proportional adjustments should be made.

## APPLICATION METHOD

Apart from quality, lime reaction in the soil is highly dependant on mixing the lime thoroughly with the soil. This is achieved by first disking, followed by ploughing. Lime should be applied at least two months prior to planting to ensure that lime reaction is complete at planting.

**SUBSOIL ACIDITY**

Liming in segments, using implements that deposit lime deeply (i.e. specially adapted rippers or deep ploughing) is effective but not always economically justifiable. A surface application of gypsum at a rate of 4 ton ha<sup>-1</sup> is an economically alternative method for ameliorating subsoils containing aluminium or iron oxides. Gypsum replaces Mg from the top to the subsoil and dolomitic lime should therefore be applied with gypsum to restore the topsoil Mg. Gypsum will need one or two seasons before it reaches the subsoil and therefore, deep incorporation of lime is often a quicker solution.

**STRIP LIMING**

Strip liming is recommended when strip acidification has been identified by Soil Sampling Method 2, or when the whole field is acidic and under controlled traffic practices. Strip acidification usually occurs under controlled traffic practices where N is applied in a band at planting, but also as a side-dressing during the season. Lime should be applied at least two months prior to planting in a strip of 300 mm over the row and incorporated into the soil.

**SALINE SOILS**

Saline soils are alkaline soils that usually contain high concentrations of sodium (Na), calcium (Ca) and magnesium (Mg). If soil conductivity is higher than 500 mS m<sup>-1</sup>, or the Na concentration is

more than 1.5% of the sum of all cations, maize production may be impaired.

A prerequisite for reclaiming saline soils is proper drainage. Soils that have a high conductivity, but not a high Na concentration, can successfully be reclaimed by over-irrigation. This only applies if the irrigation water is of acceptable quality.

Application of gypsum at 2.9 ton ha<sup>-1</sup> or an application of sulphur at 0.54 ton ha<sup>-1</sup> for every 230 mg Na kg<sup>-1</sup> will displace sodium to the subsoil, from where it can be leached by over irrigation. The application of gypsum is, however, not recommended if the calcium concentration is already very high, in which case sulphur should be applied.

**NUTRIENT REQUIREMENTS**

Various approaches for the fertilisation of crops are followed. Two approaches that receive a lot of attention are the so-called sufficiency approach where nutrient levels of the soil are brought to a level to achieve any expected yield in a relative short period, and the target yield approach where sufficient fertiliser is applied to obtain a certain economic target yield. The basic cation saturation ratio concept (or soil balancing system), a third approach to fertilisation, is not supported by the ARC-GCI.

The target yield approach is the most widely used as it is commonly believed that the required fertiliser depends on the grain yield. This implies that only the nutrients removed by the crop are

**Table 1. Lime recommendations (ton ha<sup>-1</sup>) according to required change in acid saturation ( $\Delta$ AS), the cation exchange capacity (CEC summation) of the soil and quality of some lime sources as determined in 2002**

$\Delta$ AS (%)	CEC (cmolc kg <sup>-1</sup> )	Hiqua (Witbank)	Marico (Zeerust)	Bühmannsdrif* (Zeerust)	Meyerton (Vereeniging)	Sappi* (Germiston)	Immerpan (Pietersburg)	Calmasil (Middelburg)	Vaalbrug (Orkney)	Britten (Christiana)	Mooiplaas (Pretoria)
<b>10</b>	1	0.3	0.6	0.5	0.4	0.2	0.4	0.4	0.4	0.5	0.4
	2	0.6	1.2	1.1	0.8	0.5	0.7	0.7	0.7	1.1	0.9
	3	0.8	1.8	1.7	1.3	0.7	1.1	1.1	1.1	1.7	1.3
	4	1.1	2.5	2.3	1.7	0.9	1.5	1.5	1.5	2.3	1.8
<b>20</b>	1	0.6	1.3	1.2	0.9	0.5	0.8	0.8	0.8	1.2	1.0
	2	1.3	2.8	2.6	2.0	1.0	1.7	1.7	1.7	2.6	2.0
	3	2.0	4.4	4.0	3.1	1.6	2.6	2.7	2.7	4.1	3.2
	4	2.7	6.1	5.5	4.2	2.2	3.6	3.6	3.7	5.6	4.3
<b>30</b>	1	1.0	2.2	2.0	1.5	0.8	1.3	1.3	1.4	2.1	1.6
	2	2.2	4.8	4.3	3.3	1.7	2.8	2.9	2.9	4.4	3.4
	3	3.4	7.5	6.8	5.2	2.7	4.4	4.5	4.5	6.9	5.3
	4	4.6	10.3	9.3	7.1	3.7	6.0	6.1	6.2	9.5	7.3
<b>40</b>	1	1.5	3.2	2.9	2.2	1.2	1.9	1.9	1.9	3.0	2.3
	2	3.1	6.9	6.3	4.8	2.5	4.1	4.1	4.2	6.4	4.9
	3	4.9	10.8	9.8	7.5	3.9	6.4	6.5	6.5	10.0	7.7
	4	6.7	14.9	13.5	10.3	5.3	8.8	8.9	8.9	13.8	10.6
<b>50</b>	1	1.9	4.3	3.9	3.0	1.6	2.5	2.6	2.6	4.0	3.1
	2	4.1	9.2	8.3	6.4	3.3	5.4	5.5	5.5	8.5	6.6
	3	6.5	14.4	13.1	10.0	5.2	8.5	8.6	8.7	13.4	10.3
	4	8.9	19.9	18.0	13.7	7.1	11.7	11.9	11.9	18.4	14.2

\* Calcitic limes. All other limes are dolomitic.

applied. If a build-up of nutrients takes place, it will happen gradually over years. The advantage of this approach is that optimum economic levels can easily be reached. However, a disadvantage of this approach in the case of nitrogen, is that the plant available N, before fertilisation, is not taken into account.

The sufficiency approach is based on the relationship between nutrient element concentrations or quantities in the soil and relative yield. Nutrient levels in the soil should be managed to obtain a certain percentage of the expected yield. Soil Sampling Method 1 should be used when the residual nutrients are homogeneously distributed. Should it not be the case, Soil Sampling Method 2 is applicable. According to this method, soil volumes of which the expected concentration differs substantially will be analysed separately, expressed as quantities rather than concentrations summed, and then expressed in terms of kg nutrient elements ha<sup>-1</sup> in the soil at a specific depth.

A benefit of this approach is to ensure that plant nutrients should never be yield restricting, as is the case during certain seasons when yields are very high. A further benefit is that available N in the soil is accounted for, because nitrogen analysis is needed for this approach. A disadvantage is that the recommended amount is not always economically justifiable.

A database of soil analyses accumulated for each production unit over a period of seasons is an excellent aid for producers. Soils have the ability to continuously supply plant nutrients. Soil analysis

can be regarded as the net result of the supply from the soil, plus the amount applied through fertilisation, less the amount removed by the crop. Soil analyses can thus be used to determine whether a certain nutrient is over or under supplied through fertilisation. The ideal would be that all nutrients are gradually increased to a level where, beyond doubt, sufficient amounts of specific nutrients are present in the soil. When this point has been reached, fertilisation of this nutrient can be lowered to maintain the level.

This principle is real for most nutrients, but especially for P, as most soils in South Africa are low in phosphorus. Phosphorus is immobilised by many soils and therefore the availability of P is restricted in such soils. It is recommended that soils which have not reached the optimum P level, should gradually be built-up with P over time. Since this is an expensive operation, producers should decide on an affordable time schedule to fit in with their cash flow.

## MACRO NUTRIENT ELEMENTS

### NITROGEN (N)

#### Target yield approach

The most common approach to determine the amount of nitrogen to be applied, is to link it to the expected yield. According to this method, 15 kg ha<sup>-1</sup> N is applied for each 1 t ha<sup>-1</sup> yield expected. This method overestimates the application rate for yields lower than 3 t ha<sup>-1</sup> and probably underestimates the

application rate for yields higher than 4 t ha<sup>-1</sup>. It is also commonly known that texture influences the nitrogen supply rate of the soil. Soils with a high clay content supply more N than sandy soils. Guidelines for nitrogen fertilisation, adapted to compensate for it, are presented in Table 2 (Bloem, 2004). The guidelines presented in Table 2 are for use when no soil N analyses are available and take into consideration the ability of the soil to supply nitrogen.

**Sufficiency approach**

Where inorganic N analyses are available, the following approach can be followed. According to this approach, the inorganic N in the soil to a depth of 600 mm should be managed at 100 ± 20 kg ha<sup>-1</sup> over all localities to obtain 100% yield. Under similar conditions, optimum N in the soil was, e.g. 80 kg N ha<sup>-1</sup> at 11% clay, but 120 kg N ha<sup>-1</sup> at

3% clay. More relationships are however required nationally before soil criteria can be related to soil N optima within specific production practices. Yield suppression due to too much N has thus far occurred when these measurements exceeded 170 kg N ha<sup>-1</sup>. Under irrigation, inorganic N should be managed at levels approaching 170 kg N ha<sup>-1</sup> during the growing period until flowering, but should not exceed that level.

General expected soil responses to N applications are presented in Table 3. More N is required on a sandy soil, compared with a clayey soil, to increase the soil N by one unit (Table 3). Although these guidelines are used, the demarcation of soils according to clay content (Table 3) using a sliding scale of N requirement, factors according to clay content will have to be redefined when more data of more locations are available. Furthermore, the guidelines in Table 3 are only valid when most

**Table 2. Nitrogen application levels (kg N ha<sup>-1</sup>) at various yield levels and clay contents**

Clay content (%)	Yield (ton ha <sup>-1</sup> )								
	2,0	2,5	3,0	3,5	4,0	4,5	5,0	5,5	6,0
5	23	41	58	75	92	109	126	143	160
10	17	35	52	69	86	103	120	137	154
15	10	28	45	62	79	96	113	133	147
20	4	22	39	56	73	90	107	124	141
25	0	16	33	50	67	84	101	118	135
30	0	9	26	43	60	77	94	111	128
40	0	0	14	31	48	65	82	99	116
50	0	0	0	18	35	52	69	86	103

plant material is removed. Incorporation of large amounts of organic fertilisers or organic material will have a major effect on N requirement factors. Liming will also enhance the conversion of organic N to inorganic N. Since most organic N will be mineralised shortly after planting, it is more accurate to measure inorganic N during the season.

**Delta yield approach**

An alternative method to determine the requirement of N fertiliser, is the delta yield method. Delta yield measures the difference between the optimum economic yield and the yield of an adjacent control that did not receive any N fertiliser. Delta yield correlates well with optimal N fertiliser requirement, regardless of location, soil type or whether it is dry land or irrigated maize. The consequence is that only one formula (or table) is needed for the South African maize production area, without the need of considering

soil texture or any other factors. In fact, it seems that only one universal formula is needed, since the South African derived formula is in agreement with that of the USA.

**Delta yield method**

The delta yield method is simple and requires some control plots of strips in a maize field. It is recommended that approximately 1.6% of the area of the maize field should not receive any N fertiliser, but only the recommended amount of P, K and other nutrients. This control unit (zero N) may be a single row, or a few adjacent rows of a predetermined length, for example 4 rows of 20 m. The control plots should be evenly distributed over the whole field. These control plots/rows should be rotated every year. The rest of the field should be fertilised to reach the economic optimum yield. At harvesting time, the yields of the control plots and

**Table 3. The relationship between clay content and N soil response when most of the plant material is removed**

Clay (%)	NRF* (kg N per ha <sup>-1</sup> application/kg N ha <sup>-1</sup> analysed; 0-600 mm)
<15	2.0
15-20	1.5
>20	1.0

\* N requirement factor, i.e. the amount of N that should be applied per ha to increase the nitrate N plus ammonium N analyses in the top 600 mm soil by 1 kg per ha<sup>-1</sup>

fertilised field are determined independently. The difference in yield between the N fertilised and zero N plot is the delta yield. In precision farming, these practices are followed almost automatically and it is recommended that every four ha should contain a control plot.

The fertiliser requirement for maize in the following season, can be determined from Table 4. The mean delta yield for every specific crop system over seasons per soil type, or per field (if the soil is homogeneous) should be calculated. In

this way, the nitrogen fertiliser requirement can be refined over time.

**Advantages**

Except for the promising accuracy of the delta yield approach, other advantages are:

- The yield of the control plot is a measurement of the plant available nitrogen or soil supply in terms of yield.
- It is thus not necessary to take soil samples for N analyses eliminating the probability of errors in doing so.

**Table 4. Nitrogen fertiliser requirements for maize according to the delta yield approach**

Delta yield	N requirement	Delta yield	N requirement
(kg ha <sup>-1</sup> )			
250	28	4250	153
500	42	4500	158
750	54	4750	163
1000	64	5000	169
1250	73	5250	174
1500	82	5500	179
1750	90	5750	183
2000	97	6000	188
2250	104	6250	193
2500	111	6500	197
2750	118	6750	202
3000	124	7000	206
3250	130	7250	211
3500	136	7500	215
3750	142	7750	219
4000	147	8000	224

The farmer is now fully in control of determining the nitrogen fertiliser need of his maize. Yield loss due to the control plots will be lower than 0.5% of the yield when 1.6% of the surface area is used for trial purposes. The advantages of more efficient N fertilisation will most likely exceed the yield loss as a result of the control plots, hence both under and over fertilisation can be limited to a minimum.

**APPLICATION METHODS**

**Placement**

The following rates of N application, in a band at planting 50 mm away from the seed and 50 mm below the seed, should not be exceeded:

0.9 m rows: not more than 40 kg N ha<sup>-1</sup>

1.5 m rows: not more than 30 kg N ha<sup>-1</sup>



**Deficient plants next to plants with a sufficient supply of nitrogen.**

**Leaf analysis**

Analysis of leaves below and opposite the uppermost ears at flowering should be between 2.4 and 2.9% N. N deficiency is characterised in young plants as a pale green or yellow green appearance. At later stages the older leaves turn yellow with a distinctive reversed V form lesion. No kernels develop at the tip of the maize ear and is stubbed.



**Nitrogen deficiency on older leaves.**

2.1 m rows: not more than 20 kg N ha<sup>-1</sup>.  
N plus K applications should not exceed 70, 50 and 30 kg ha<sup>-1</sup> for the respective row widths. Larger quantities can however be banded, provided they are placed

70 to 100 mm away from and below the seed. Top-dressings of all N sources are usually applied as a side-dressing, 100 to 150 mm from the rows. These applications should be incorporated into

**Table 5. Optimum extractable P according to Ambic 1 and Bray 1 in the top 150 mm soil for different clay+silt contents, aimed at achieving 90% of the yield target**

Clay+Silt %	Ambic 1 mg kg <sup>-1</sup>	Bray 1 mg kg <sup>-1</sup>	Clay+Silt %	Ambic 1 mg kg <sup>-1</sup>	Bray 1 mg kg <sup>-1</sup>
13	25.3	33.5	37	9.9	17.9
14	23.6	31.8	38	9.7	17.6
15	22.1	30.3	39	9.5	17.4
16	20.8	29.0	40	9.3	17.2
17	19.7	27.8	41	9.1	17.0
18	18.7	26.8	42	8.9	16.9
19	17.8	25.9	43	8.7	16.7
20	17.0	25.1	44	8.6	16.5
21	16.2	24.3	45	8.4	16.4
22	15.6	23.6	46	8.3	16.2
23	15.0	23.0	47	8.1	16.1
24	14.4	22.4	48	8.0	15.9
25	13.9	21.9	49	7.8	15.8
26	13.4	21.4	50	7.7	15.7
27	13.0	21.0	51	7.6	15.5
28	12.6	20.6	52	7.5	15.4
29	12.2	20.2	53	7.4	15.3
30	11.8	19.8	54	7.3	15.2
31	11.5	19.5	55	7.2	15.1
32	11.2	19.2	56	7.1	15.0
33	10.9	18.9	57	7.0	14.9
34	10.6	18.6	58	6.9	14.8
35	10.4	18.3	59	6.8	14.7
36	10.1	18.1	60	6.7	14.6

the soil to reduce or eliminate potential N losses.

### Time of application

N should always be included in fertiliser mixtures, but climatic conditions and residual N in the soil will dictate when the most N should be applied. The largest quantity of N should be applied early in the season where the seasonal rainfall is less than 700 mm and the N supply capacity of the soil is low (as on sandy soils). If the seasonal rainfall is more than 700 mm and the soil N supply capacity is high (as in clayey soils), most of the N should be applied later (not later than eight weeks after planting) during the season.

An equal division between early and late applications should be made if the seasonal rainfall is more than 700 mm and the N supply capacity of the soil is low. Three to five equal applications are recommended for sandy soils under irrigation, but should preferably be completed two weeks prior to flowering.

### PHOSPHORUS (P)

P recommendations are based on the analysis of extractable P, as well as the clay plus silt content in the top 150 mm soil. Optimum extractable P in the soil either according to Bray 1 or Ambic 1, which is generally used for maize production, is presented in Table 5. According to current price ratios and risks involved, soil P management to achieve

90% relative yield and no higher is recommended. If the clay plus silt content is less than 13%, optimum soil P values at 13% clay plus silt should be used. Similarly, the optimum soil P values at 60% clay plus silt, is to be used for clay plus silt values of more than 60%.

When soil P levels are lower than the optimum, a programme aimed at increasing soil P levels over a number of years, can for financial reasons, be followed. The amount of P that should be applied to increase the soil P by 1 mg kg<sup>-1</sup> (Bray 1) is 5, 7 and 9 kg P ha<sup>-1</sup> for soil textures of <10%, 10-20% and 21-35% clay respectively. P applications required for maintaining P levels are calculated at 4 kg P ton<sup>-1</sup> grain produced.

### Leaf analysis

An analysis of leaves below and opposite the uppermost ears during flowering should be between 0.22 and 0.30% P. Deficiency symptoms are normally exhi-



**Phosphorus deficiency limits growth and symptoms are reddish to purple leaf tips and edges.**

bited by young plants, especially under cool, wet conditions. Leaves are dark green with reddish-purple tips and edges. Plants with a phosphorus deficiency grow slower and are therefore stunted.

### Application methods

The general practice is to band-place P at 50 mm away and 50 mm below the seed. If for practical reasons the quantity cannot be band-placed, a second application can be done shortly after planting, but further away from the plant row. This can be done in combination with additional N and K. Broadcasted applications of P will be more dependent on fixing than band-placed applications, especially on clayey soils.

### POTASSIUM (K)

Yield response to K fertilisation, in the larger maize producing areas, i.e. under acidic soils with relatively low Ca content, can only be expected if the exchangeable K content in the top 600 mm soil is less than 300 kg ha<sup>-1</sup> that is, 29 mg ha<sup>-1</sup> at 3% clay or 38 mg kg<sup>-1</sup> at 56% clay. The K requirement factor for this depth (0 to 600 mm) is 1.5 kg K ha<sup>-1</sup> for an increase in exchangeable K of 1 kg ha<sup>-1</sup>. The optimum topsoil (0-150 mm) K content for kaolinitic clay soils (53% clay) in KwaZulu-Natal, was established at 125 mg kg<sup>-1</sup> where the subsoil up to a depth of 600 mm, was 20 mg kg<sup>-1</sup> at commencement of the trial. Applications of 3 kg K ha<sup>-1</sup> should increase the topsoil

content with 1 mg kg<sup>-1</sup>. Under alkaline conditions where the topsoil Ca content was in excess of 3000 mg kg<sup>-1</sup> and the K content as high as 200 mg kg<sup>-1</sup> and higher, K deficiency symptoms have been reported. Research in this respect is lacking, but the band-placement of K is currently recommended under such conditions at a rate of 4 kg K ton<sup>-1</sup> of expected grain yield.

### Leaf analyses

An analysis of leaves below and opposite the uppermost ears during flowering should show between 1.5 and 1.9% K. Potassium deficiencies initially appear as yellow or necrotic leaf edges beginning at the lower leaves followed by a spreading to the upper leaves. Mature plants lodge more easily, if the potassium supply is insufficient, due to disease infection of the stems. Kernels towards the tip of the ear are small and have a shrunken appearance.

### Application methods

The accepted method is to band-place K, 50 mm away and 50 mm below the seed in a fertiliser mixture at planting. The following rates of application should not be exceeded:

0.9 m rows: not more than 40 kg K ha<sup>-1</sup>

1.5 m rows: not more than 30 kg K ha<sup>-1</sup>

2.1 m rows: not more than 20 kg K ha<sup>-1</sup>

K plus N applications should not exceed

70, 50 en 30 kg ha<sup>-1</sup> for the respective row widths.

Larger quantities can however be banded, provided they are placed 70 to 100 mm away and below the seed.

**MAGNESIUM (Mg)**

An analysis of the topsoil should record at least 40 mg Mg kg<sup>-1</sup>. Mg deficiencies are usually associated with soil acidity and are therefore rectified when soil acidity is ameliorated by dolomitic lime applications. If soil acidity is not a problem, Mg can be replenished using fertiliser mixtures containing Mg or alternatively, by products such as Mg oxide or Mg sulphate. On sandy soils Mg deficiencies are induced by large applications of K or high levels of K in the soil.

An analysis of leaves below and opposite the uppermost ears during flowering should be between 0.15 and 0.25% Mg. The first indication of a Mg deficiency is interveinal chlorosis on the lower leaves. This is followed by the develop-



**Typical interveinal chloroses due to a magnesium deficiency on older leaves.**

ment of necrotic spots in the chlorotic area and a distinctly beaded appearance.

**CALCIUM (Ca)**

Ca deficiencies have thus far not been observed under field conditions. Soils with a Ca content of 100 mg kg<sup>-1</sup> have not shown any response to Ca applications. Low Ca levels are usually associated with soil acidity and are therefore rectified when lime is applied to ameliorate soil acidity.

An analysis of leaves below and opposite the uppermost ears at flowering should be between 0.2 and 0.25% Ca. Calcium deficiency prevents the emergence and unfolding of new leaves, the tips of which are almost colourless and are covered with a sticky gelatinous material that causes them to adhere to one another.

**SULPHUR (S)**

Sulphur deficiencies usually occur as a result of the prolonged use of fertilisers containing no S, e.g. clear solutions and other products containing high P concentrations. A response to S can be expected if the inorganic S concentration in the topsoil is less than 3 mg S kg<sup>-1</sup>, while it is reasonably sure that a S response will not occur at concentrations higher than 10 mg kg<sup>-1</sup>. Reaction on the application of S on soil with a S content between 3 and 10 mg kg<sup>-1</sup> will depend on the contribution of S from the atmosphere to the soil

reserve and the S content of the subsoil.

An analysis of leaves below and opposite the uppermost ears during flowering should be approximately 0.2% S. Overall light yellowing of leaves without a definite pattern is typical of S deficiencies in young plants. However, in older plants yellowing of younger leaves is more pronounced. The base of these younger leaves is the first to show yellowing. The reintroduction of fertiliser mixtures containing S is usually sufficient to augment shortages.

## MICRO NUTRIENT ELEMENTS

### ZINC (Zn)

Zn is the micro nutrient element that is applied the most, because it is included in many fertiliser mixtures. Deficiencies can be expected if an analysis of the topsoil shows less than 1.5 mg Zn kg<sup>-1</sup> or if an analysis of the leaves below and opposite the uppermost ear at flowering shows less than 20 mg kg<sup>-1</sup>.

Zinc deficiency appear as light interveinal chlorosis which join together to form bands which can stretch from the base to the tip of the leaves. The edges, mid-ribs and leaf tips, usually remain green. As a rule plants are stunted and a transverse section through the stems, indicate a dark-purple of the lower nodes. Under cool, overcast conditions deficiency symptoms suddenly appear, but disappear just as quickly once the sun is shining. High levels of P in the soil, inhibit Zn uptake, while high levels of N, enhances Zn uptake. Alkaline conditions [pH (H<sub>2</sub>O)

> 7.5] also induce Zn deficiencies.

The use of fertiliser mixtures containing Zn is usually sufficient to augment shortages in soils. The continuous use of Zn containing fertilisers is unnecessary once the soil concentration has reached acceptable levels.

### MOLYBDENUM (Mo)

Mo deficiencies seldom occur, because seed is treated with Mo and seed producers increase the Mo content of the seed by leaf spraying with Mo.

An analysis of leaves below and opposite the uppermost ears during flowering should be approximately 0.2 mg Mo kg<sup>-1</sup>. Deficient plants are light green, while the youngest leaf tips and edges wither. Mo shortage is exacerbated by acid soils and is associated with premature germination of seed on the ear.

### BORON (B)

Boron is subjected to leaching under high rainfall conditions, but can accumulate to toxic levels in soils under semi-arid conditions. Over-liming can also induce B deficiencies due to the unavailability of B at high pH. Optimum warm water extractable B in the topsoil is between 1 and 2 mg kg<sup>-1</sup>, but toxic effects may occur from 5 mg kg<sup>-1</sup>.

Boron deficiency is characterised by malformed ears with an uneven distribution of kernels due to poor pollination. Deficiencies are expected

when analyses of leaves below and opposite the uppermost ears at flowering shows less than 5 mg kg<sup>-1</sup>. Deficiencies can be rectified by applications of 0.5 - 2.0 kg B ha<sup>-1</sup> before planting.

Boron toxicity is characterised by yellowing of leaf tips followed by progressive necroses, beginning at the leaf tips and edges and then to the interveinal areas and the midrib. Leaves may take on a scorched appearance and may drop prematurely.

### **MANGANESE (Mn)**

Most soils contain sufficient Mn to support crop growth, but Mn is unavailable under alkaline conditions or when there are high levels of organic matter in the soil. Broadcast applications of Mn are not recommended but band placement at 6 kg Mn ha<sup>-1</sup> should be sufficient to rectify deficiencies. Foliar applications at 1 to 5 kg Mn ha<sup>-1</sup> should also be effective.

Manganese deficiencies, as with Mg deficiencies, are associated with interveinal yellowing which may also be light-green in appearance. Mn deficiencies differ from Mg deficiencies in that symptoms are first shown by the younger leaves. Mn deficiencies are expected when analysis of leaves below and opposite the uppermost ears at flowering is less than 15 mg Mn kg<sup>-1</sup>.

Manganese toxicities occur under acidic conditions on Mn rich soils. Symptoms are characterised by silver-bleak to brown spots, especially on the older leaves. Manganese toxicities will be sufficiently

neutralised if soils containing both high levels of Mn and Al are limed to below 20% acid saturation.

### **COPPER (Cu)**

Soil threshold values of 4 mg Cu kg<sup>-1</sup> for HNO<sub>3</sub> extractions and 0.2 mg Cu kg<sup>-1</sup> for DTPA extractions were reported for grain crops. Most soils contain sufficient Cu but highly weathered sandy soils may be depleted. The availability of Cu may however be very low under alkaline conditions.

Deficiency symptoms are characterised by bleak yellow to white colouring of younger leaves that may result in necrotic leaf tips and edges. Cu deficiencies are expected when leaf analysis of leaves beneath and opposite the uppermost ears is less than 5 mg kg<sup>-1</sup> during flowering.

Soil applications of Cu are preferred to leaf applications. Since band placement of Cu can be toxic, soil incorporation in most of the rhizosphere is preferred. Recommendations are generally between 1 and 10 kg Cu ha<sup>-1</sup> but can be as high as 22 kg Cu ha<sup>-1</sup>. Organic fertilisers usually contain sufficient Cu and will therefore eliminate the need for additional Cu applications.

### **IRON (Fe)**

Most acid soils have adequate available Fe for crop production. Highly weathered sandy soils may however be an exception. Fe becomes unavailable

at pH (H<sub>2</sub>O) of between 6.5 and 8.0 and the higher the pH, the greater the restriction.

Deficiency symptoms are characterised by distinct interveinal chlorosis of whole leaves that begin on the younger leaves. The entire plant can show these symptoms and yellow strips may even turn white. Plants will generally be stunted.

Iron deficiencies that result from Fe unavailability are best rectified by foliar applications of a 2% iron sulphate solution. Several applications, two weeks



**Typical interveinal chloroses due to an iron deficiency on younger leaves.**

apart, may be necessary. An increase in the use of acidifying fertilisers, such as ammonium sulphate, is recommended under alkaline conditions, to increase the availability of Fe.

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## GRONDBEWERKING EN BEWARINGSBOERDERY

### Grondbewerking

Grond word bewerk om verdigting op te hef, onkruid, plaë en siektes te bestry, oesreste en chemikalieë in te werk en 'n saadbed te skep waarin saailinge maklik kan opkom en groei. Grondbewerking is soms selfs nodig om winderosie te bekamp.

Konvensionele bewerkings word met skaar- of skottelploeë uitgevoer om bogenoemde doelwitte te bereik. Met die ploegaksie word plantreste met die grond van die ploeglaag vermeng en die grondoppervlak word met min plantreste gelaat. Sekondêre vlakker bewerkings word dikwels met tand of skottel implimente uitgevoer om een of meer van bogenoemde doelwitte te bereik.

Konvensionele grondbewerking het belangrike nadele. Eerstens veroorsaak dit agteruitgang van die grondkwaliteit soos weerspieël word in die afname van die organiese materiaalinhoud daarvan. Verder vernietig dit die struktuur van die grond, vergroot die erosie-kwesbaarheid en ontwig die lewensiklus van sekere organismes. In baie gevalle word die afloop van water en die gepaardgaande erosie, deur bewerkings verhoog. Grondbewerking en die meganisasie wat dit vereis, maak verder 'n groot deel van die koste van graanproduksie uit.

Op baie grondtekstuurklasse, veroorsaak konvensionele ploegbewerkings wortelbeperkende verdigting in die

ondergrond. Hoe natter en laer die klei-inhoud van die grond, hoe vinniger kompakteer dit gewoonlik onder ploeg- en disbewerkings. Toenemende dieper bewerkings word gevolglik vereis wat koste laat toeneem en die kwaliteit van die grond verder ondermyn. Kleigrond wat swel en krimp, soos dit nat word en weer uitdroog, hef verdigting vanself op.

Die agteruitgang van die grond, die erosie wat dit meebring en stygende energie- en meganisasiekostes het die besef laat posvat dat aanpassings aan bewerkingspraktyke nodig is. So het verminderde bewerking en bewaringsbewerking reeds dekades gelede ontstaan wat deur die koms van onkruidodders moontlik gemaak is en waarvoor hoofsaaklik tandimplimente gebruik word. Bewerkings wat slegs op onkruidbeheer gemik was, kon nou deur die toediening van onkruidodders vervang word en verminderde bewerking tot gevolg hê.

Bewaringsbewerking het ten doel om minstens 30% van die grondoppervlak met gewasreste na bewerking bedek te laat om daardeur erosie te bekamp en die infiltrasietempo van water so lank moontlik hoog te hou. Bewerkings met bytelploeë slaag gewoonlik in dié doel, mits genoeg oesreste aanvanklik teenwoordig was. Die bekende rip-op-ry bewerking wat veral op die sandrige grond van die Vrystaat toegepas word, kan ook as bewaringsbewerking

beskou word, aangesien die meeste oesreste op die oppervlak gelaat word. Bytelploeg, rip en ander meegaande bewerkings, versteur egter die grond genoeg om die kwaliteit daarvan te ondermyn.

Die organiese koolstofinhoud van die grond is die beste aanduiding van die kwaliteit daarvan. Hoe hoër die organiese koolstofinhoud, hoe hoër die kwaliteit. Die organiese koolstofinhoud, van bewerkte grond op die Hoëveld, het met soveel as 75% afgeneem weens bewerking die afgelope 70 tot 100 jaar. Die organiese koolstof speel 'n belangrike rol in die fisiese en chemiese eienskappe van die grond. Hoe hoër die organiese koolstofinhoud, hoe hoër die kation uitruilkapasiteit, waterretensievermoë en hoe moeiliker verdig dit, of word oppervlakkorse gevorm.

Om volhoubaar te produseer is dit

noodsaaklik dat die kwaliteit van die grond nie verder ondermyn word nie, maar alles gedoen moet word om dit eerder te laat toeneem en erosie te stuit. Grondkwaliteit (dikwels ook grondgesondheid genoem) is die somtotaal van die chemiese, fisiese en biologiese vermoë van 'n grond om 'n hoë vlak van gewasproduktiwiteit te handhaaf. Dié doelwitte kan slegs met bewarings-boerdery bereik word.

### Bewaringsboerdery

Die doel met die toepassing van bewaringsboerdery is om die kwaliteit van die grond te maksimaliseer, terwyl erosie en die omgewingsimpak geminimaliseer word. Deur die kwaliteit van die grond te verbeter, word die doeltreffendheid waarmee die natuurlike hulpbronne soos die reënval en grond benut word, ook gemaksimaliseer. Grond



**'n Beitelploeg waar die meeste van die oesreste op die oppervlak gelaat word, word as bewaringsbewerking beskou. Dit voldoen egter nie aan al die vereistes van bewaringsboerdery nie.**

met 'n hoë kwaliteit, het nie chemiese of fisiese beperkings nie. Verder is die mikrobiologiese komponent so divers en die populasie so hoog as wat die klimaat toelaat.

Bewaringsboerdery vereis dat sekere beginsels met graanproduksie toegepas moet word, naamlik:

1. Dat die grond met die minimum versteur word.
2. Dat 'n permanente of semi-permanente deklaag van plantreste op die grond gelaat word.
3. Dat wisselbou toegepas word.
4. Dat beheerde spoorverkeer op kompaksie-kwesbare grond toegepas word.

### 1. Minimum grondversteuring

In bewaringsboerdery word 'n primêre grondbewerking nie uitgevoer nie en die enigste "bewerking" is die plantaksie. 'n Belangrike voorwaarde is dat nie meer as 15 cm of 25% (watter een ookal die kleinste is) van die grondoppervlakte versteur moet word nie. Geenbewerking, waar slegs die grond in die plantvoor versteur word, is die ideaal wat nagestreef moet word.

Beperkte ervaring dui egter daarop dat soos die klei-inhoud van die grond afneem en die sandinhoud toeneem, 'n toenemende dieper losmaak-aksie tydens die plantproses nodig is om saailinge suksesvol te vestig en die kunsmis diep genoeg geplaas te kry. Voorskrifte oor hoe diep water grondtekstuurklas versteur mag word, bestaan tans nog nie. Sukses word wel met 'n 150–250 mm versteuring op sommige sandgronde in die Vrystaat en Noordwes behaal.



**Minimum grondversteuring vereis dat die versteurde gedeelte nie meer as 15 cm breed of 25% van die grondoppervlakte (watter een ookal die laagste is) soos gemeet direk na plant, moet wees nie.**

Belangrike voordele en veranderings wat onversteurde grond meebring, is dat die organiese koolstofinhoud daarvan nie verder deur bewerkings verlaag word nie, maar mettertyd moontlik kan toeneem. Die erosie-kwesbaarheid neem ook af. 'n Verdere belangrike voordeel is dat mikro-organismes in die grond nie deur bewerkings ontwig en vernietig word nie. Met minimumversteuring, word die grond gewoonlik deur fungi in plaas van bakterieë gedomineer. Fungi is 'n meer stabiele bron en stoorplek van plantvoedingstowwe as bakterieë. Dit speel ook 'n belangrike rol in die vorming en stabilisering van grondstruktuur en kan plaes soos parasitiese aalwurms onderdruk. Minimum grondversteuring is gevolglik noodsaaklik om die kwaliteits-agteruitgang van die grond te stuit en dit te verbeter.

## 2. Permanente of semi-permanente grondbedekking

Bewaringsboerdery vereis dat minstens 30% van die grond, soos direk na die plantaksie gemeet, met plantreste (vorige gewas en onkruid) bedek moet wees. Plantreste beskerm die grond teen erosie en mag in baie gevalle 'n dramatiese invloed op die behoud van 'n hoë infiltrasietempo van reën- en besproeiingswater tot gevolg hê. Terselfdertyd verminder plantreste die water-afloop en die gevolglike omgewingsimpak. Reste op die grondoppervlak dien ook as 'n stadige maar deurlopende bron van voeding vir grondmikrobes.

Oesreste word gewoonlik gedurende die winter vir veevoer gebruik. Om dit onbenut op lande te laat, strook nie met hoe meeste boerderye tans bedryf word nie. Beperkte benutting van oesreste is moontlik, maar die voordele en nadele met die benutting daarvan moet ernstig oorweeg word. Amerikaanse resultate het getoon dat die opbrengs van mielies met 34 kg ha<sup>-1</sup> toeneem vir elke persentasiepunt toename in die bedekking van die grond. Indien die oesreste wel deur vee benut gaan word, moet toegesien word dat die 30% grondbedekkingsvereiste steeds nagekom word.

Tussen strooptyd en die opvolgende planttyd behoort oesreste onversteurd gelaat te word. In teenstelling met lande wat gerolmoer is, voorkom staande, grondgeankerde mieliestronke wind-erosie beter, waai of spoel reste nie so maklik van die land af nie en vergaan dit stadiger, wat 'n langdurende grondbedekking meebring. 'n Eweredige verspreiding van oesreste, deur stropers, is belangrik om die effektiwiteit daarvan so hoog moontlik te maak.

## 3. Wisselbou

In die ideale wisselboustelsel volg minstens drie verskillende gewasse mekaar op. Byvoorbeeld: voersorghum - peulgewas - mielies. Die grondmikrobe-aktiwiteit en -diversiteit in die grond floreer gewoonlik in sulke stelsels veral weens die insluiting van 'n peulgewas. Die verhoogde aktiwiteit en diversiteit beperk die vermoë van



**Die grondbedekking word gemeet deur 'n maatband of lyn skuins-dwars oor die plantrigting te span en dan op bepaalde punte te kyk of daar grond of plantmateriaal onder die punt is. Die persentasie punte wat oor plantreste geleë is verteenwoordig die bedekking en moet verkielik bo 30% wees om as bewaringsboerdery te kwalifiseer.**

patogene en plae, soos aalwurm, om skade aan die gewas aan te rig. Hierdeur verhoog die kwaliteit van die grond. Graanopbrengste en -kwaliteit is gewoonlik hoër in wisselboustelsels waarvan die gewasse uiteenlopend is.

Weens ekonomiese en ander oorwegings, is dit gewoonlik nie moontlik om drie verskillende gewasse op 'n 1:1:1 oppervlakte-verhouding op 'n plaas te roteer nie. Werkbare alternatiewe, wat ongelukkig nie die ideaal is nie, is om die alternatiewe gewasse tot mielie oppervlakte-verhouding van 1:1 tot 1:4 oppervlakte-verhouding te verbou.

#### **4. Beheerde spoorverkeer**

Trekkers en implemente is die grootste bron van grondverdigting, daarom word beheerde spoorverkeer op grond

wat maklik verdig, aanbeveel. Hoe hoër die klei-inhoud en droër die grond hoe kleiner die kans dat die grond kan verdig. Trekkers en implemente wat onnodig swaar belas is vir die doel waarvoor dit gebruik word, moet vermy word. 'n Groter kontakoppervlakte tussen die band en die grond verklein ook die verdigtingseffek daarvan. Breër en groter bande wat nie onnodig styf gepomp is nie voorkom kompaksie beter as kleiner, smaller en styf gepompte bande.

#### **Voorvereistes en knelpunte van bewaringsboerdery**

Wêreldwye ondervinding het getoon dat die ingesteldheid van die boer deurslaggewend is vir die suksesvolle toepassing van bewaringsboerdery.



**Die invloed van wisselbou met 'n peulgewas op die groei en produksie van mielies is sommige seisoene dramaties. Die mielies aan die linkerkant is in monokultuur verbou terwyl dié aan die regterkant deur 'n peulgewas voorafgegaan is.**

Indien 'n land na bewaringsboerdery oorgeskakel word, moet enige verdigting en grondsuurheid eers deur bewerking en bekalking opgehef word. Die chemiese en fisiese komponente moet gevolglik eers reggestel word voordat die mikrobiologiese komponent van minimum grondversteuring en wisselbou kan gedy.

Bewaringsboerdery vereis 'n doeltreffende planter en onkruidoderspuit wat gewoonlik 'n kapitale uitgawe vereis. Groot besparings word egter deur tyd, arbeid, brandstof en onderhoud van masjinerie teweeg gebring. Die totale kapitale investering (belegging) in trekkers en toerusting is laer as die van konvensionele bewerking en produksiestelsels.

Onkruidbeheer in bewaringsboerdery vereis kennis van onkruid- en -doders, asook die bestuur van die onkruidbeheerproses. Onvoldoende onkruidbeheer is 'n belangrike oorsaak van mislukte pogings tot bewaringsboerdery. Die onkruidspektrum verander gewoonlik met die oorsakeling na bewaringsboerdery en uitgawes aan onkruid-doders neem toe. Sonder die insluiting van 'n glifosaatbestande gewas in die gewasstelsel, gaan die oorsakeling na bewaringsboerdery waarskynlik baie moeilik wees.

Met die verandering na bewaringsboerdery verander die omstandighede vir plae en siektes ook. Sommiges kan afneem terwyl ander kan toeneem. Goeie waarneming en die bestuur van

insekte, siektes en plaë soos knaa-gdiere word gevolglik vereis.

Graanopbrengste kan aanvanklik na die omskakeling na bewaringsboerdery laer wees as dié van konvensioneel geproduseerde graan. Daar word dus aanbeveel dat die eerste gewas wat in onversteurde grond geplant moet word eerder 'n peulgewas moet wees wat die daaropvolgende mielie-opbrengs 'n hupstoot kan gee. Resultate met bewaringsboerdery is omgewings- en grondverwant en dit mag aanvanklik geduld vereis.

Vee op 'n land onder bewaringsboerdery kan tot grondverdigting aanleiding gee en die vereiste deklaag grootliks vernietig. Een siening is dat vee glad nie op bewaringsboerderylande toegelaat moet word nie. 'n Tweede siening is dat vee op die lande toegelaat kan word mits die grond droog genoeg is om kompaksie te voorkom, maar dat genoeg oesreste agter gelaat moet word om steeds aan die vereiste 30% grondbedekking te voldoen.

Stikstofbemesting moet aanvanklik met sowat 10 - 15% opwaarts aangepas word. Grondsuurheid, soos weerspieël in die suurversadigingsontleding, moet behoorlik bestuur word. Kalk en gips moet nie soos in die konvensionele stelsels as regstelling toegedien word nie,

maar as 'n voorkomende aksie. Kleiner en meer gereelde toedienings gaan dus vereis word.

### Slot opmerkings

Bewaringsboerdery word deur baie boere as slegs 'n kostebesparende praktyk eerder as 'n hulpbron- en omgewingsbewarende aksie gesien, wat ook poog om die natuurlike hulpbronne optimaal te benut. Dit beperk nie noodwendig kostes nie. Besparings op brandstof en meganisasie word dikwels deur verhoogde uitgawes aan onkruidodders en ander chemikalieë uitgewis. In baie gevalle styg die opbrengste van gewasse in bewaringsboerdery met tyd bo die van konvensioneel geproduseerde gewasse. Onkruiddruk neem ook af, wat die ekonomie verbeter.

Die plaaslike grond en klimaat bepaal die fyner voetwerk van bewaringsboerdery. 'n Eenvormige suksesresep bestaan nie. Wat met minimumgrondversteuring bedoel word, watter wisselboustelsels die suksesvolste gaan wees, hoe gereeld kalk toegedien moet word, ens., moet gewoonlik proefondervindelik vir plaaslike omstandighede bepaal word.

## SOIL CULTIVATION AND CONSERVATION AGRICULTURE

### Soil cultivation

Soil is cultivated to combat weeds, pests and diseases, to incorporate crop residues, and chemicals and to create a favourable seedbed for seedling emergence and growth. Soil is sometimes cultivated to control wind erosion.

Mouldboard and disc ploughs are used to achieve one or more of the mentioned objectives in conventional cultivation systems. The soil is pulverised and inverted and crop residues are mixed with the soil in the plough layer through the ploughing action. The soil surface is usually left with little, if any residue. Secondary shallower tillage actions are often done with tine or disc implements to achieve one or more of the mentioned objectives.

Conventional cultivation systems have however, some important disadvantages. Due to the disturbance of the soil, its quality deteriorates as reflected by the decline in the organic carbon content. The soil structure is also destroyed or deteriorates, the erosion susceptibility increases and the life cycle of some micro-organisms is disrupted. In many instances water runoff and the consequential erosion are enhanced by soil cultivation. Soil cultivation and its fuel and mechanisation requirement is a major portion of the costs associated with crop production.

On many soil texture classes, conven-

tional ploughing usually results in compaction in the sub-soil which limits root growth. Sandier and wetter soils usually compact faster under plough and disc cultivation actions than drier and more clayey soils. In such cases, deeper and more costly tillage methods are usually required which results in further deterioration of the soil quality. Clay soils that shrink and swell under drying and wetting spells usually can alleviate compaction naturally.

Deterioration of soils, resulting erosion and ever increasing energy and mechanisation costs have resulted in an awareness that alternative cultivation practices are required. As a result, reduced and conservation tillage practices, where only tine implements are used, were introduced some decades ago with the inception of herbicides. Tillage actions, previously primarily aimed at weed control, were replaced by herbicide application resulting in reduced tillage.

The objective with conservation tillage is to leave at least 30% of the soil surface covered with crop residues after cultivation whereby erosion is restricted and the initially high water infiltration rate is prolonged. Chisel plough cultivation usually succeeds in these objectives, provided that the initial amount of crop residue was sufficient. The well-known rip on row cultivation that is practiced, especially on the sandy soils of the Free State, can also be consi-

dered as conservation tillage since most of the residue is left on the soil surface. However, chisel plough, rip and other comparable tillage actions, disturb the soil enough to undermine its quality.

The best indicator of soil quality is its organic carbon content and a higher content indicates a higher quality. During the past 70 to 100 years the organic carbon content of soils on the Highveld declined by as much as 75% due to conventional tillage methods. The organic carbon content plays an important role in the physical and chemical characteristics of soils. A higher organic carbon content is associated with a higher cation exchange capacity and water retention capacity as well as a lower susceptibility for compaction and surface crusting.

Sustainable future crop production is non-negotiable. Soil quality deterioration should be prevented and everything must be done to rather improve it. Soil quality (also known as soil health) is the sum total of the chemical, physical and biological ability of a soil to sustain crop productivity at a high level. At the same time, erosion must be prevented. These objectives can only be achieved through conservation agriculture.

### **Conservation agriculture**

The objective of conservation agriculture is to maximise soil quality and to minimise soil erosion and the impact on the environment. Through improvement of soil quality, the utilisation of natural

resources such as rainfall and soil are also maximised. Soil of a high quality has no chemical or physical limitations. The microbial population will be as high or diverse as allowed by the climate.

Conservation agriculture consists of the application of certain crop production principles namely:

1. Minimum soil disturbance.
2. The creation and maintenance of a semi- or permanent mulch of plant residue.
3. Crop rotation.
4. Controlled traffic on compact prone soils.

### **1. Minimum soil disturbance**

In conservation agriculture a primary soil cultivation is not done any more and the only "cultivation" that really occurs is the planting action. An important condition is that the disturbed area must be less than 15 cm wide or less than 25% of the cropped area (whichever is lower). The ideal scenario is no-till where the soil is only disturbed within the plant furrow.

Limited experience currently indicates that sandier soils need deeper disturbance than clayey soils at planting to ensure crop establishment and deep placement of fertiliser. Guidelines on the allowable depth of disturbance, in relation to texture class, are not yet available. Disturbance depths of 150–250



**Cultivation with a chisel plough, where most of the stubble is left on the soil surface, is considered conservation tillage. Unfortunately, it does not comply with the principles of conservation agriculture.**

mm appear to be adequate on some sandy soils in the Free State and North-West.

An important beneficial consequence of minimum soil disturbance is that the destruction and consequential decline of the organic carbon content ceases and that it can recover. The erosion susceptibility also decreases and micro-organisms within the soil are not disturbed or destroyed. Minimum disturbed soil is usually dominated by fungi, which is a more stable source and storage environment of plant nutrients rather than bacteria. Fungi also play an important role in the formation and stabilisation of the soil structure and can suppress parasitic nematodes. Minimum soil disturbance is therefore necessary to reverse the quality decline associated with tillage.

## **2. Permanent or semi-permanent soil cover**

Conservation agriculture requires that at least 30% of the soil surface should be covered with plant residue (previous crop and weeds) directly after planting. Plant residues protect the soil against erosion and in many instances can have a favourable effect on water infiltration rate from rain or irrigation. Water runoff and the associated environmental impact are consequently reduced. The cover also serves as a slowly released source of food for soil organisms.

In most cases, crop residues are utilised as animal feed and to leave it intact on the soil is not in line with the custom on most farms. Limited usage of residue is possible, but the advantages and disadvantages thereof must be considered. Results from America have indicated that maize yields increase by 34 kg ha<sup>-1</sup> for every percentage increase



**Minimum soil disturbance entails that the disturbed soil should be less than 15 cm wide or less than 25% of the cropped area (whichever is lower) as measured directly after planting.**

in soil cover. If animals are allowed to graze these residues it is important that the required 30% cover still be maintained.

Residues should be left intact after harvesting until the next planting action. In contrast with fields where residues were shredded and flattened with a knife roller (or “rolmoer”), standing maize stems are better in preventing wind erosion, are not washed or blown away and decompose slower, resulting in a mulch that remains intact much longer. An even spread of residues on the land by combine harvesters is important for its effectiveness.

### 3. Crop rotation

In the ideal crop rotation system, at

least three different crops should follow each other, for example, forage sorghum – legume – maize. Soil microbe activity and diversity usually thrive in such systems especially when a legume crop is included. The increased activity and diversity limit the ability of pests and pathogens, such as nematodes, to harm the crop and as a result increases the soil quality. Grain yield and grain quality are usually higher in crop rotations where the crops are diverse.

Due to economic and other considerations, it usually is not viable to produce three different crops in a 1:1:1 area ratio. Although not ideal, workable alternatives are to use ratios of alternative crops to maize area of 1:1 to 1:4.



**Soil cover is measured with a tape measure or line with pre-marked points diagonally laid over the planting direction and determining if there are bare soil or plant material under these points. The percentage of points which have plant materials, represent the cover and it should preferably be more than 30% to qualify for conservation agriculture.**

#### 4. Controlled traffic

Since tractors and implements are the main source of soil compaction, controlled traffic is recommended on compaction prone soils. Higher clay content and drier soils are less prone to compaction. Tractors and implements which are unnecessarily loaded with weight than for the task it is used for, should be avoided. An increased contact area between tyres and the soil will also reduce the probability for compaction. Wider and larger tyres which are not inflated too high are better than small highly inflated tyres.

#### Requirements and bottlenecks of conservation agriculture

Worldwide experience has shown that

the attitude of farmers is critical for the successful application of conservation agriculture.

Before a land is converted to conservation agriculture, all existing soil compactions and acidity must be alleviated through tillage and liming. The chemical and physical components must therefore first be corrected before the microbial component of minimum disturbance and crop rotation can flourish.

Conservation agriculture requires effective planters and herbicide sprayers that usually result in capital expenditure. Huge savings however, are obtained on time, labour, fuel and maintenance of machinery. The total capital investment in tractors and equipment is lower



**The effect of crop rotation with a legume on the growth and production of maize, can be dramatic in some seasons. The maize on the left was mono-cultured, while that on the right was preceded by a legume crop.**

than those of conventional practices and crop production systems.

Weed control in conservation agriculture requires knowledge of weeds and herbicides as well as the entire control process. Ineffective weed control is an important cause of failed attempts to convert to conservation agriculture. The weed spectrum usually changes when changing to conservation agriculture and expenditure on herbicides usually increases. Without the inclusion of a glyphosate tolerant crop in the rotation system, the conversion to a conservation agriculture system will probably be very difficult.

With the change to conservation ag-

riculture, growth conditions for pests and diseases changes. Some might be enhanced while some might be suppressed. Good observation and management of insects, diseases and pests such as rodents is therefore required for timeous action.

Initially, maize grain yields can be below that of conventionally produced crops after changing to conservation agriculture. It is therefore recommended that the first crop to be planted in undisturbed soil rather be a legume that can boost the follow-up maize crop. Crop responses to conservation agriculture are related to soil and environmental conditions, which often requires patience.

Animals on conservation agriculture lands can cause soil compaction and destruction of the mulch. One view is that animals should not be allowed onto conservation agricultural lands. A second view is that animals be allowed on such lands as long as the soil is dry and the 30% soil cover threshold is maintained.

Initially, nitrogen fertilisation rates should be increased with about 10–15%. Soil acidity, as depicted by the acid saturation, should be strictly managed. Lime and gypsum cannot be administered as a correction measure such as with conventional systems, but should be applied regularly in smaller quantities to prevent the development of excess acidity.

### **Concluding remarks**

Conservation agriculture is seen by many farmers as a cost reducing practice rather than a resource and environmental conservation action with the advantage of optimal resource utilization. It does not necessarily cut costs, since savings on fuel and mechanization is usually balanced out by increased reliance on herbicides and other chemicals. In due time, yields of crops in conservation systems can exceed those of crops in conventional tillage systems. Weed pressure also decreases with time, resulting in a decrease in herbicide application rates and improved economics.

## TREKKRAG TOETS OP GRONDBEWERKINGS IMPLEMENTE

### Inleiding

Die Landbou Navorsingsraad - Instituut vir Landbou-ingenieurswese (LNR-IAE) in samewerking met Graan SA en NWK het 'n projek geloods om grondbewerkings- implemente oor die tydperk September 2010 tot Maart 2011 met die finansiële bystand van die Mielietrust te toets. Die toetse is in die Lichtenburg, Koster en Mareetsane omgewing gedoen op sand, sand-leem en klei leem grond. Die doel van die veld toetse was om die handleiding genaamd "Kostegids vir Landboumasjinerie" op te dateer, wat jaarliks deur die Departement van Landbou uitgegee word. Slegs nuwe masjinerie wat nie in die ou handleiding is nie, is getoets. Die volgende implemente is getoets: wisselgang skotteleg, ondergrond brekers, paraploeg, beitel ploë en 'n rolmoer. Die handleiding is oor die jare baie handig gebruik as 'n hulpmiddel om effektiewe meganisering beplanning toe te pas en dra ook by tot die berekening van die ekonomiese lewensvatbaarheid van bewerkings.

Die opgedateerde handleiding sal beskikbaar wees op die Departement van Landbou se web adres nl: <http://www.daff.gov.za>

### Toets metode

'n Volledige enjin drywingstoets is in 'n

toets laboratorium op 'n dinamometer gedoen teen vol enjin revolusies asook teen 540 krag-as revolusies. Die verhouding tussen die brandstofverbruik en enjin kraglewering is deur 'n regressie-analise bepaal. Die brandstofverbruik aangeteken gedurende veld toetse is dan gekorreleer met die enjin krag resultate van die laboratorium toetse.

Die implemente is in die veld gehaak aan 'n 3-punt dinamometer om die trekstangdrywing te meet wat deur middel radio kommunikasie na 'n mobiele toets-eenheid versend is. (Fig. 1)

Die mobiele toets-eenheid bevat 'n rekenaar met TCE sagteware vir die beheer en verwerking van al die data wat vanaf die data logger wat op die trekker geïnstalleer is, versend word. (Fig. 2)

Daar is gebruik gemaak van sagteware wat op die rekenaar geïnstalleer is, genaamd Glyphworks, om die finale implement toetsverslag te skep en uit te druk. (Fig. 3)

### Bespreking van resultate

Die gemiddelde trekstangdrywing wat aangewend was om die implemente te trek het bestaan uit ongeveer 50% van die maksimum injindrywing. Die Super 25 ripper (1,5 meter breed, 3 tand met 19° volle "Hamerkop" skare) het die



**Fig.1. Implement gehaak aan dinamometer.**

hoogste enjin krag vereis in die reeks implemente wat getoets is. Die rolmoer wat met 'n sleepstang getrek word, het die minste krag vereiste gehad vir die reeks implemente wat getoets is.

Wanneer dieselfde implement se toetsresultate vergelyk word tussen sandleem en kleileem gronde, het die implemente getoets op kleileem altyd 'n hoër trekkragsvereiste gehad. Vogpersentasie speel ook 'n groot rol met trekkragsmetings, en in die geval was die vog in die kleileem grond 2% hoër as in die sandleem grond. Die resultate van die sandleem grond het nie 'n duidelike ver-

houding tot die ander 2 gronde getoon nie. Die enjin drywing benodig om 'n implement te trek is baie belangrik in die bepaling van die grootte van die trekker wat benodig word om sekere bewerkinge te kan doen.

Die volgende faktore beïnvloed die trekkrags van 'n implement: werkspoed, grondtipe, grondvoginhoud, wielgrip, werkdiepte, implementwerkwydte en grootte van implement. Eenvoudige trekkragsvergelykings van al die implemente is dus nie moontlik nie.

Die implemente is getoets onder normale werkstoestand, alhoewel die



**Fig.2. Mobile toetseenheid.**



**Fig.3. Toetsverslag deur nCode.**

verskil in werkspoed en werkdiepte dit nog steeds moeilik maak om resultate te vergelyk.

**Gevolgtrekking**

Die inligting wat versamel is deur die trekkrag toetse is baie belangrik vir die “Kostegids vir Landbou Masjinerie” wat jaarliks deur die Departement van Landbou opgedateer word.

Hierdie inligting van nuwe landbou masjinerie in terme van werk tempo, brandstof verbruik en enjin drywingsveristes is baie belangrik om die boer te help om ‘n ingeligte besluit oor die seleksie van die masjinerie wat geskik is

vir spesifieke omstandighede te maak.

’n Volhoubare boerdery moet ekonomies lewensvatbaar wees.

Verdere toetse is ook belangrik om die effek van spoed, grondtipe, voginhoud, wielglip, werk diepte en implement werkwydte op trekkrag benodig vir elke implement te bepaal.

## TESTING OF DRAWBAR POWER FOR TILLAGE IMPLEMENTS

### Introduction

Agricultural Research Council – Institute for Agricultural Engineering (ARC – IAE) in partnership with Grain SA and NWK tested tillage implements over the period September 2010 to March 2011 with financial assistance from The Maize Trust. The tests were done in Lichtenburg, Koster and Mareetsane on sandy, sand loamy and clay loamy soils. The whole purpose of the field tests was to update a manual called “Guide to Machinery Costs” updated annually by the Department of Agriculture, hence only new machinery not in the old manual was tested. The implements include, offset disc harrow, rippers, paraplough, chisel plough and rolling stalk chopper (rolmoer). Over the years, the manual has proved very useful in farm machinery management hence contributing to the economic viability of farm operations. The manual will be readily available on the Department of Agriculture website: <http://www.daff.gov.za>.

### Testing methodology

Engine power tests at 540 rpm and 1000 rpm were done using a fixed electrical dynamometer in the laboratory to determine the relationship between fuel consumption and engine power output through regression analysis. The fuel consumption recorded during field

tests was then correlated to the engine power results from laboratory tests.

In the field, the implements were hitched to the 3 point linkage dynamometer for recording the drawbar power of the implement through radio communication to the mobile testing unit (Fig. 1). The mobile testing unit includes a computer with a TCE software for processing all data from the data logger installed on the tractor (Fig. 2). Finally, ncode software installed with Glyphworks was used for producing a report of the test results (Fig. 3)

### Results and discussion

On average, 50 % of the engine power was used for draw bar power and Super 25 ripper (1.5 meter width, 3 tine with 19° full “hamerkop” shares) gave the highest engine power requirements of 100 kW. The trailed 2 meter rolling stalk chopper (rolmoer) had the least power requirements of 24 kW.

For some implements tested in sandy soils and clay loamy soils, the latter always gave higher engine power requirements (14 % higher) even though the soil moisture content was 2 % (wet basis) higher in the clay loamy soils. The results from sandy loam soils did not show any clear relationship to the other 2 soils. Engine power output is very im-



**Fig.1. Dynamometer linked to implement.**

portant in determining the size of tractor for pulling the implements.

The following factors are crucial in influencing drawbar power results: speed, soil type, moisture content, wheel slip, working depth, working width and size of implement hence a simple comparison of all the implements is not possible. The implements were tested under normal farm operating conditions hence parameters like speed, width and depth differed making any simple comparison for different implements difficult.

### **Conclusion**

The information obtained from the tests will be very important for the "Guide to Machinery Costs" updated annually by the Department of Agriculture. Such information on performance of the new

machinery in terms of field capacity, fuel consumption, drawbar power requirements is very important in helping the farmer make an informed decision on selection of machinery suitable to particular circumstances. For farming to be sustainable, the farming enterprise has to be economically viable.

Further tests are also important to establish the effect of speed, soil type, moisture content, wheel slip, working depth and working width on draw bar power for each implement under different conditions.



Fig.2. Mobile testing unit.



Fig.3. Test report from n code software.

## ONKRUIDBEHEER IN GEEN-BEWERKINGSTELSELS

Geen-bewerking hou baie voordele in, maar onkruidbeheer bly dié grootste uitdaging in geen-bewerkingstelsels.

Die afwesigheid van meganiese grondbewerking en die teenwoordigheid van gewas-residue (stoppels) in geen-bewerkingstelsels lei tot verhoogde organiese materiaal in die grond, grondvog bewaring, toename in grondfauna (bv. erdwurms) en mikrobiologiese aktiwiteite in die grond, afname in gronderosie en grondtemperatuur asook 'n afname in grondverdigting en kompaksie. Geen-bewerkingstryke het 'n direkte of indirekte invloed op die onkruidspektrum, tyd van onkruidkieming, gewas-onkruid kompetisie, die keuse van onkruidodders, sowel as op die tyd en metode van onkruidodertoediening.

### Wenke vir suksesvolle onkruidbeheer in geen-bewerkingstelsels

1. *Tydige onkruidbeheer:* Onkruidodders word op die blare (na-opkoms van onkruid) of op die grond toegedien en die effektiwste resultate word verkry indien die toestande vir onkruidoder absorpsie en -vervoer optimaal is. Moet nooit onkruidoder toedien indien die gewas of onkruid in enige stremmingstoestand (ekstremes temperature, droogte of versuip-toestande) verkeer nie.
2. *Ewredige verspreiding van gewasresidue (stoppels):* Dit is noodsaaklik vir eenvormige onkruidoder toediening en om te verseker dat 'n konsekwente plant-diepte gehandhaaf word.

### Probleme wat ondervind word indien stoppel onegalig in 'n land versprei is:

- Op etikette van voor-opkoms onkruidodders word dit beklemtoon dat onkruidodders toegedien moet word op 'n fyn, egalige saadbed. Navorsers het verskeie standpunte rakende onegalige stoppelverspreiding byvoorbeeld a) In geen-bewerkingstelsels kan grondtoegedienende onkruidodders wat op die stoppel toegedien word, bind met gewasresidue; b) Blaar toegedienende onkruidodders kan deur die residue onderskep word en so verlaagde onkruidoder-onkruid kontak en verlaagde onkruidoder effektiwiteit tot gevolg hê.
- Stoppel skep 'n koel, vogtige mikro-klimaat wat tot gevolg het dat onkruid en opslag-gewasse vir langer periodes kiem en opkom onder die stoppels as in die res van die veld. Die seisoenslange opkoms van die onkruid maak die enkele toediening van blaar-

- toegediende onkruidodders minder effektief.
- Hoër onkruidpopulasies en opslag-gewasse in dele met baie stop-pel kan selfs die toedien van verhoogde onkruidodderdosisse verlang ten einde effektiewe onkruidbeheer te verseker.
  - Digte lae stoppel verhoed soms goeie saad-grond kontak en het onegalige gewas stand tot gevolg. Laer gewas stand, verlaag die ge-was se potensiaal om te kompe-teer met die onkruid. Onkruid kry gevolglik die oorhand en be-moeilik seisoenslange onkruidbe-heer.
  - Stoppel skep 'n gunstige mikro-omgewing vir grondsiektes, plaë en knaagdiere wat kan lei tot ver-laagde gewas groeikragtigheid en dus weereens 'n swakker ver-moë van die gewas om met on-kruid te kompeteer.
3. Effektiewe onkruidbeheer in vooraf-gaande gewasse: Waar beplan word om geen-bewerkingstelsels toe te pas, is dit noodsaaklik om onkruidsaadproduksie in die voorafgaande gewasse te voor-kom. Verlaagde onkruiddruk in voorafgaande gewasse, met ge-volglike min onkruidsaad in die grondsaaibank, verhoog sukses in geen-bewerkingstelsels.
  4. Effektiewe onkruidodertoedien-ing is noodsaaklik. Gebruik goed toegeruste spuittoerusting vir suksesvolle onkruidbeheer. Maak seker u gebruik die regte tipe spuitpunte, spuitvolumes ens. Lees onkruidodder-etiketie deeglik en volg voorskrifte stiptelik.
  5. Gebruik lande met 'n lae onkruid-druk/onkruidpopulasie. Voordat geen-bewerkingstryke op 'n land toegepas gaan word, moet die onkruidspektrum op die land deeglik geïdentifiseer word. Die afwesigheid van meerjarige on-kruid en die benutting van lande met 'n lae onkruiddruk word sterk aanbeveel.
  6. Bemesting toediening moet aange-pas word vir geen-bewerkingstel-sels. Bandplasing van bemesting bring mee dat plantvoedingstof maklik deur die gewas opgeneem kan word en bevoordeel dus die gewas tydens onkruid-gewas kom-petisie. Die breedwerpige pla-sing van kunsmis kan grasonkru-ide bevoordeel.
  7. Wisselbou. Wisselbou help om onkruid en plaë te beheer. Son-neblom is byvoorbeeld uitstekend vir die beheer van uintjies.
  8. Gebruik skoon, gesertifiseerde saad met hoë groeikragtigheid, wat goed aangepas is in die omgewing waarin u 'n geen-bewerkingstelsel wil toepas. Onkruid gekontameneerde ge-was-saad kan onkruidbeheer bemoeilik. Hoë kwaliteit gewas-

saad lei tot die vinnige opkoms van die gewas. Die gewas het dus voorsprong tydens gewas-onkruid kompetisie.

9. Gewasse wat vroeër saad produseer kan verhoogde opbrengspotensiaal tot gevolg hê weens verlaagde onkruid-gewas kompetisie. Indien gewassaad geoes kan word voor onkruidsaadproduksie, verminder dit gewas saadkontaminasie. Die plantdatum van gewasse hang steeds af van grondtemperatuur, vog en die vermoë van die grond om te kompakteer onder nat toestande ens.
10. Beheer plantsiektes, insekte en knaagdiere. Soos reeds beklemtoon, is 'n gesonde, hoë groei-kragtige gewas, vry van siektes en plaë, 'n sterker kompeteerder met onkruide.
11. Verhoed die storting van onkruidsaad in die grondbank. Die sukses van onkruidbeheer in 'n geen-bewerkingstelsel is om ten alle tye onkruide voor onkruidsaadstorting te beheer. Probeer jong aktiefgroeïende onkruide uitwis voor saadstorting om so-doende onkruid-gewas kompetisie, gewas saadkontaminasie en die storting van die onkruidsaad in die grondbank te vermy. Waar besproeiing toegepas word, moet onkruidbeheer in waterbane tydig toegepas word om onkruidsaadstorting te voorkom.

## **Beginsels van onkruidbeheer in geen-bewerkingstelsels**

Volgens geen-bewerkingstelsels word geen meganiese grondbewerking gedoen vir saadbed voorbereiding voor planttyd nie. Onkruidodders in geen-bewerkingstelsels kan toegedien word voor plant, gedurende planttyd of na opkoms van die gewas.

Voor-plant. Met hierdie metode word onkruidodders toegedien voordat die onkruidsaad gekiem het of indien slegs enkele onkruidsaailinge reeds opgekrom het. Die voor-plant toediening van onkruidodders voorkom dat onkruide vestig in die saadbed.

Twee tipes voor-plant onkruidodertoe-dienings bestaan naamlik: 1) Vroeg voor-plant onkruidodertoe-diening gewoonlik so een maand voor plant en 2) Voor-plant oppervlak toediening van onkruidodder - gewoonlik so 14 dae voor plant.

1. Vroeg voor-plant onkruidodertoe-diening. Gereelde veld inspeksies is noodsaaklik om vas te stel watter onkruidsaad kiem gedurende watter tyd van die jaar. Grasonkruid kiem gewoonlik 7-10 dae later as breëblaaronkruid. Meerjarige onkruid (Kikuyu, Cynodon) moet 4-6 weke voor plant beheer word. Onkruid moet aktiefgroeïend wees om onkruidodder effektief te absorbeer. Gebruik die "Guide to the use of herbicides" van die Nasionale Departement Landbou,

Direkoraat: Landbou Inligtings Dienste, vir 'n volledige lys van die voor-opkoms onkruidodders. Waar voor-opkoms onkruidodders (grondtoegediende doders) gebruik word, moet gelet word op wagperiodes vir die aanplant van gewasse en opvolggewasse. Onkruidodders soos glifosate en paraquat kan gebruik word as 'n vorm van chemiese skoffel.

2. Voor-plant oppervlak toediening. Tot en met 14 dae voor plant kan opslag-onkruide van verskillende groottes teenwoordig wees in die saadbed. Vir die beheer van hierdie onkruide moet onkruidodders met 'n blaarwerking toegedien word om vroeg-somer en laat winteronkruide te verwyder. Gebruik die "Guide to the use of herbicides" van die Nasionale Departement Landbou, Direkoraat: Landbou Inligtings Dienste, vir 'n volledige lys van voor-plant (grondtoegediende doders) en blaar toegediende onkruidodders.

Onkruidodder toediening tydens plant. Grondtoegediende (voor-opkoms) onkruidodders of blaartoegediende onkruidodders of nie-selektiewe onkruidodders kan toegedien word gedurende plant of net na plant, maar voor die opkoms van die gewas. Grondtoegediende onkruidodders met 'n lang residuele werking kan die opkoms van nuwe onkruidsaailinge teenwerk.

Na-opkoms toediening van onkruidodder. Na die opkoms van die ge-

was, het die produsent steeds verskeie keuses t.o.v. onkruidodertoediening. 'n Verskeidenheid selektiewe doders, beide blaartoegediende en grondtoegediende doders is beskikbaar om onkruid na opkoms van die gewas te beheer. Die grootste probleem bly steeds om na die opkoms van 'n breëblaargewas, breëblaaronkruid te beheer of om grasse te beheer na die opkoms van 'n grasgewas. Om optimale onkruidbeheer en minimum gewasskade te verseker moet alle onkruidodders toegedien word volgens die voorgeskrewe dosisse en tydens die regte ontwikkelingsstadium van beide onkruid en gewas.

### **Moontlike gevolge van Geenbewerkingspraktyke op onkruidbeheer**

1. Verskuiwing in onkruidspektrum na meerjarige breëblaar onkruid en geharde grasse (wilde sorghums, kweekgras, Kikuyu) en uintjies. Meerjarige onkruid en uintjies, wat voorheen beheer is deur meganiese bewerking, benodig spesiale behandeling in geenbewerkingstelsels. Geenbewerkingstelsels bevoordeel kleinsadige onkruidspesies (byvoorbeeld grasse) bo breëblaar onkruidspesies. Laasgenoemde skep veral 'n probleem t.o.v die beheer van gras-onkruid binne grasgewasse, soos mielies en sorghum.

2. Onkruidweerstandbiedendheid teen onkruidodders: Die voortdurende gebruik van onkruidodders met dieselfde aktiewe bestanddele bring onkruidweerstandbiedendheid teen onkruidodders teweeg. Dit beklemtoon weereens die belang van wisselbou binne 'n geen-bewerkingstelsel.
3. Organiese materiaal beïnvloed onkruidodderdosisse. Hoë temperature in die grootste gewasproduserende gebiede in Suid-Afrika voorkom die opbou van organiese materiaal in die grond. Dit sal 5 jaar of langer neem voordat organiese materiaal opbou in die grond en die onkruidodder dosisse beïnvloed.

### **Algemeen**

Onkruid-identifikasie lê die grondslag vir effektiewe onkruidbeheer. Vir suksesvolle onkruid-identifikasie is die handboek "Algemene onkruid in gewasse en tuine in Suidelike Afrika, geskryf deur Mnr Chris Botha" beskikbaar vanaf: die LNR- Instituut vir Graangewasse, P/Sak X1251, Potchefstroom, 2520.

## WEED CONTROL IN NO-TILL

Although no till cultivation in certain areas is quite beneficial, weed control is still one of the largest challenges in these systems.

The absence of tillage disruption and the presence of the crop residue cover in no-till systems generally result in an increase in organic matter content, soil moisture, improved earthworm populations and microbiological activity, and a decrease in erosion, soil temperature, surface sealing and compaction. These in turn can have a direct or indirect effect on the weed species present, time of germination and competition, as well as herbicide selection, formulation, timing and method of application.

### Tips for successful no-till weed control

1. Timely weed control. In no-till systems herbicides are applied onto a leaf surface, or into the soil, and will get the best results when the conditions are most favourable for herbicide absorption.
2. Distribute crop residue uniformly over the field. This is necessary for uniform herbicide application, good planter operation and consistent seed placement.

There are several problems associated with concentrated stubble rows:

- Labels of soil-active herbicides stated that these herbicides must be applied on a fine and even seed bed. In no-till systems, soil-active herbicides applied after harvest, can be bound by the crop residue. Foliar-active herbicides can also be intercepted by the residue without coming in contact with emerging weeds.
- The shaded, cool, moist environment under stubble rows results in a longer period of germination and emergence of weeds and volunteer crops, than in the rest of the field. This makes a single application of foliar-active herbicides less effective.
- High populations of weeds and volunteer crops in the stubble rows could require higher herbicide application rates to provide effective control.
- Drill penetration for good seed-soil contact is often inadequate in dense stubble, resulting in reduced or non-uniform crop stands. This provides less crop competition with weeds, which is an important part of effective, season-long weed control.
- Stubble also provides a favourable environment for soilborne crop diseases, pests and rodents, resulting in reduced crop vigour and reduced competition with weeds.

3. Effective weed control in preceding crops: Reducing weed seed production, and thus the future weed population, before practising no-till will improve chances of a successful crop under conservation tillage.
4. Effective herbicide application is required. Using a properly equipped herbicide sprayer is essential for successful weed control in no-till farming. Consult product labels for specific recommendations.
5. Select a well-drained field with low weed density. Absence of perennial weeds is desirable when starting no-till. Careful assessment of potential weed problems will help to achieve initial success with no-till.
6. Fertilizer application should be adjusted for no-till. Banding of fertilizer for increased availability and early access by the crop roots is commonly beneficial for both crop yield potential and weed control. Banding of fertilizer can improve crop yields under given conditions and provide more vigorous crop competition with weeds. Broadcast application of nitrogen fertilizer has been shown to increase populations of some grass weeds, such as wild oats.
7. Crop rotation. Crop rotation may be particularly helpful in controlling numerous weed and disease problems.
8. Use clean, high quality certified seed of varieties best adapted to the area. Weed-contaminated crop seed can be a significant contributor to weed problems. High quality seed is important for rapid emergence and early competition with weeds.
9. Early seeding of spring crops can often improve yield potential and ability to compete with weeds. However, planting date must also be based on soil temperature, soil moisture content, disease potential and the potential for soil compaction under wet conditions.
10. Control plant diseases, insects and rodents: Maintaining a healthy, vigorous crop, relatively free of diseases and pests, increases the crop's ability to compete with weeds.
11. Prevent weed contamination of no-till fields. No weeds should be allowed at any time of the year to seed in the field or surrounding areas. Where irrigation is practised, watercourses should be slashed to prevent seeding.

### **Weed control principles for no-till crop production**

No-till implies that no tillage will be practice for seedbed preparation before crop planting. Herbicide applications in no-till fields may be made

before planting (pre-plant), during planting, or post-emergence.

Pre-plant. With this method, herbicides are applied before planting when weed seed is ready to germinate or when a few weed seedlings have emerged from the soil. The objective is to prevent weeds from becoming established in the seedbed.

Pre-plant herbicide applications are often referred to as: 1) early pre-plant (EPP) treatments which are made one month before planting; 2) pre-plant surface applied (PPSA) treatments which are made up to 14 days before planting.

1. Early pre-plant (EPP). Field scouting needs to be done periodically to determine when weed seed is germinating. Grass weeds germinate seven to 10 days later than broadleaf weeds. Perennial weeds (kikuyu, Cynodon) must be controlled about 4-6 weeks before planting, weeds should be actively growing, so that they can effectively absorb herbicides. Use the "Guide to the use of Herbicides" of the Department of Agriculture, Directorate: Agricultural Information services, for a listing of herbicides which may be applied early pre-plant. Herbicides like glyphosates and paraquat may be used.
2. Pre-plant surface applied (PPSA). Up to 14 days before planting, weeds of varying sizes may be present in the seedbed. Therefore, pre-plant surface herbicide treat-

ments must have foliar activity to remove emerged summer and winter annual weed seedlings. Again use the "Guide to the use of herbicides" for a list of pre-plant and foliar applied herbicides.

Time of planting. Herbicides may be applied during or after planting but before crop emergence. In this case previously emerged weeds must be removed with a foliar applied herbicide or a mixture of a non-selective plus residual herbicide.

Post-emergence. After crop emergence, producers still have several weed control options. A variety of selective herbicides, both foliar-active and soil-active, are available for on-crop application. These herbicides must be applied at the recommended rates and at the correct developmental stages of both weed and crop to achieve optimum weed control while minimizing crop injury.

**Possible effects of no-till practices on weed control**

1. Shift in weed spectrum to perennial broadleaf weeds and tufted grasses (wild sorghums, Cynodon, kikuyu) and sedges: Perennial weeds and sedges previously removed or disrupted by mechanical cultivation, often require special treatment in no-till. Weed population changes seem to favour small-seeded species compared to broadleaf species.

2. Herbicide resistance: Routine over-all sprays of herbicides may cause weeds to develop resistance to herbicides.
3. Organic matter may effect herbicide dosages: The high temperatures in most parts of South Africa prevent the accumulation of organic matter. The build-up of organic material in the soil may take at least 5 years or longer before it will have an effect on herbicide dosages.

### **General**

Weed identification forms the foundation for effective weed control. For weed identification the handbook "Common weeds in the crops and gardens in Southern Africa written by Mr Chris Botha" are available from the ARC-Grain Crops Institute, Potchefstroom.

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# ONKRUIDDODER SKADE AAN MIELIES

## Herbicide damage to maize

Chloroacetamide herbicides  
(ai = acetochlor, alachlor, metolachlor,  
S-metolachlor, S-dimethenamide).



Glyphosate drift.



Paraquat damage



## CHEMIESE ONKRUIDBEHEER

Die foutiewe gebruik van onkruid-doders gee dikwels aanleiding tot oneffektiewe onkruidbeheer en gewasskade. Die meeste probleme kan voorkom word deur die aanwysings op die etikette te bestudeer en streng na te volg. U word wetlik verplig om dit te doen volgens kennisgewing gepubliseer in die Staatskoerant.

Onkruidodders is "wondermiddels" aangesien dit in die natuur geplaas word in komplekse interaksies met grond, omgewingstoestande en/of anderlandbouchemikalië. Wat meer is, onkruidodders is plantdoders wat ongewens-de plante tussen gewasplante moet beheer.

Om die doeltreffendheid van 'n onkruidoder in die praktyk te kontroleer, is dit nodig om op ten minstens een plek in die land 'n kontrole te laat. So 'n kontrole bestaan uit 'n gedeelte van 3-5 meter aan die kant van die land wat nie bespuit word nie. Hierdie onbespuite gedeelte kan ten alle tye met die gespuite gedeelte vergelyk word.

Voordat u onkruidbeheerstrategie gefinaliseer word, neem die volgende in ag:

1. Inspekteer lande gereeld om probleemonkruid te identifiseer.
2. Kry advies rakende die onkruidodders, geregistreer op beide die onkruid en die gewas.
3. Gaan spuittoerusting na en kalibreer spuite akkuraat.
4. Let op etiket voorskrifte rakende spuitpunte, tyd van toediening, spuitlewering, gebruiksbepelings, mengbaarheid met ander produkte, veiligheidsmaatreëls ens.

Vir die effektiewe werking van voor-opkoms onkruidodders moet die saadbed fyn en gelyk wees. Voor-opkoms onkruidodders moet in die grond ingewas word (d.m.v. reën of besproeiing) voordat dit geaktiveer kan word. Na-opkoms onkruidodders moet nooit toegedien word indien die gewas of onkruid onder spanning (bv. droogte of hoë temperature) verkeer nie aangesien dit die effektiewe opname van die doders benadeel. Meeste na-opkoms onkruidodders moet saam met 'n bymiddel toegedien word om die penetrasie, adsorpsie en verspreiding kan verbeter. Verder moet daar ook bedag wees op die pH van die tenkwater en waar nodig moet 'n buffer en/of ammoniumsulfaat bygevoeg word vir die effektiewe beheer van onkruidodders wat na-opkoms toegedien word. Wees versigtig vir spuitnewel tydens die toediening van na-opkoms doders. Reën of besproeiing binne 6-8 uur na die toediening van 'n na-opkoms doders kan die effektiwiteit van die doders verlaag. Etiketvoorskrifte rakende die toediening van onkruidodders op spesifieke onkruid-

groeistadiums moet stiptelik nagevolg word. 'n Aspek wat kommer wek, is die verwagting dat onkruidodders seisoenlange beheer moet gee d.w.s. ses tot sewe maande. Seisoenslange nawerking is slegs moontlik onder uiters ideale toestande. Daarom word aanbeveel dat 'n onkruidbeheerprogram minstens uit twee toedienings moet bestaan. Waar wisselbou toegepas word, let op etiket waarskuwing en wagperiodes rakende opvolggevasse.

Beheer van grasonkruid in mielies (ook 'n grasgewas) bly 'n kopseer. Die nadeel van grasse is dat dit dwarsdeur die seisoen kiem. Vroegseisoen word grasse deur voor-opkoms grasdoders beheer. Kompetisie, graanbesmetting en grassaadstoring het tot gevolg dat laatseisoen grasse 'n probleem bly in die huidige en opeenvolgende seisoene. 'n Moontlike oplossing vir die beheer van eenjarige grasse is om te skoffel en/of om 'n split toediening van onkruidodders te doen. Daar is ook nou na-opkoms grasdoders geregistreer op mielies waar dit verkieslik in 'n program gespuit moet word met voor-opkoms doders met of net na plant opgevolg met na-opkoms onkruidodders wanneer grasse tussen die 4 tot 6 blaar stadium is. Hoe grootter die graspolle egter raak, hoe minder effektief sal chemiese onkruidbeheer wees. Doeltreffende werking van enige onkruidoder hang af van die effektiewe, tydige toediening van die doder sowel as van 'n goed geplande onkruidbeheerprogram. Elke

onkruidoder bevat 'n etiket waarin grasse en/of breë blaaronkruid gelys word wat effektief deur die spesifieke aktiewe bestanddeel (of mengsels daarvan) beheer sal word. Grasse wat moeilik beheerbaar kan wees, word gewoonlik uitgesonder op die etiket en dosis-aanpassings word aanbeveel vir meer effektiewe beheer. Positiewe identifikasie van probleem onkruid is dus die grondslag van 'n goeie chemiese spuitprogram

### **Grasse wat moeilik beheerbaar kan wees**

*Cyperus esculentus* (Yellow nutsedge/ Geeluintjie)

*Cyperus rotundus* (Purple nutsedge/ Rooiuintjie)

*Digitaria nuda* (Naked crabgrass)

*Eleusine coracana* (Goose grass/ Jongosgras)

*Sorghum halepense* (Johnson grass/ Johnsongras)

*Urochloa panicoides* (Herringbone grass/ Beesgras)

*Cynodon dactylon* (Common couch/ Kweekgras)

*Commelina benghalensis* (Wandering Jew/ Wandelende Jood)

**(Sien foto's op bladsy 116)**



*Cyperus esculentus* (Yellow nutsedge/Geel-uintjie)



*Digitaria nuda* (Naked crabgrass)



*Cynodon dactylon* (Common couch/Kweekgras)



*Sorghum halepense* (Johnson grass/Johnsongras)



*Cyperus rotundus* (Purple nutsedge/Rooi-uintjie)



*Eleusine coracana* (Goose grass/Jongosgras)



*Urochloa panicoides* (Herringbone grass/Beesgras)



*Commelina benghalensis* (Wandering Jew/Wandelende Jood)

## CHEMICAL WEED CONTROL

The inaccurate use of herbicides often results in ineffective weed control and crop damage. Most problems can be prevented by strictly following label prescriptions. You are compelled by law to do so, as published in the Government Gazette.

Herbicides are “wonder chemicals” as it is used in nature in complex interactions with soil, extreme environmental and climatic conditions and/or in combination with other agro-chemicals. What’s more - herbicides are plant killers, supposed to control unwanted plants between crop plants.

To check the efficacy of herbicides in practice, leave an untreated control in fields. Such a control is an area of at least 3 - 5 metres, where no herbicides are applied. This untreated area can then be compared with the areas where the herbicides are applied.

### **In finalising your weed control strategy please take note of the following:**

1. Regular field scouting is important to identify problematic weed species.
2. Confirm herbicides registered on both the weeds and the crop.
3. Calibrate herbicide applicators accurately.
4. Take note of label instructions with regard to nozzles, timely herbicide application, drift, usage restrictions, safety warnings, compatibility with other agro-chemicals, directions for use etc.

The efficacy of a pre-emergence herbicide, for example requires a fine and even seedbed. Pre-emergence herbicides must be washed into the soil (rain or irrigation) before the herbicide is activated. Post-emergence herbicides will not be effective if the herbicides are applied when the weeds are under stress (for example drought, extreme high temperatures etc.) as the herbicide won't be absorbed effectively by the weed. Beware of drift during the application of post-emergence herbicides. Adjuvants to enhance penetration, adsorption and spread of herbicides have to be added to most post-emergence herbicides. The pH of tank-water has to be checked and where necessary a buffer and / or ammonium sulphate have to be added to enhance efficacy of post emergence herbicides. Rain or irrigation within six to eight hours after application of post-emergence herbicides may wash off the herbicide, resulting in less effective weed control. Take note of instructions with regard to herbicide application on specific growth stages of the weed. Producers often expect herbicides to provide season long effective

weed control, thus up to six or seven months. Season long weed control is unrealistic as environmental conditions are seldom optimal. For effective weed control during the whole season a minimum of two herbicide applications are recommended. Where crop rotation is practiced, take note of the label instructions with regard to waiting periods for follow up crops.

The control of grass weeds in maize (a grass itself) is one of the producer's largest challenges. A disadvantage is the season long germination of grasses. Early season grasses can be controlled by pre-emergence graminicides (grass herbicides). Due to competition, grain contamination and grass seed present in the soil seed bank, late germinating grasses may still cause problems in the current and subsequent seasons. Annual grass weeds may be controlled by mechanical weeding or by the split application of graminicides. Post-emergence graminicides have also been registered on maize and is usually used in a spray program with pre-emergence herbicides at or just after planting followed by post-emergence herbicides when grasses are at the 4 to 6 leaf stage. The larger the grass tufts the less efficient the post-emergence herbicides will be. The efficacy of a herbicide depends on accurate, timely application of herbicide(s), but also on a most effective weed control programme. Each herbicide has a label in which a table of grass and / or broad leaves

weeds are listed that will be effectively controlled by the active ingredient (or mixtures thereof). Grass weeds that can be difficult to control will be accentuated on the label and usually dosage rates are revised to ensure effective control. Positive identification of weeds is therefore the basis of an effective chemical control spray program.

**Grasses that may be difficult to control:**

*Cyperus esculentus* (Yellow nutsedge/ Geeluintjie)

*Cyperus rotundus* (Purple nutsedge/ Rooiuintjie)

*Digitaria nuda* (Naked crabgrass)

*Eleusine coracana* (Goose grass/ Jongosgras)

*Sorghum halepense* (Johnson grass/ Johnsongras)

*Urochloa panicoides* (Herringbone grass/ Beesgras)

*Cynodon dactylon* (Common couch/ Kweekgras)

*Commelina benghalensis* (Wandering Jew/ Wandelende Jood)

**(See photo's on page 119)**



*Cyperus esculentus* (Yellow nutsedge/Geel-uintjie)



*Digitaria nuda* (Naked crabgrass)



*Cynodon dactylon* (Common couch/Kweekgras)



*Sorghum halepense* (Johnson grass/Johnsongras)



*Cyperus rotundus* (Purple nutsedge/Rooi-uintjie)



*Eleusine coracana* (Goose grass/Jongosgras)



*Urochloa panicoides* (Herringbone grass/Beesgras)



*Commelina benghalensis* (Wandering Jew/Wandelende Jood)

# Onkruidododerlys/Herbicide list

Active ingredient Aktiewe bestanddeel	Formulation* Formulasie*	Concentrate Konsentrasie	Product name Produk naam	Company name Maatskappy
2,4-D (dimethyl amine salt)	SL	480 g/l	2,4D Amine	Arysta Life Sciences
acetochlor	EC	750 g/l	Safier 750	Arysta Life Sciences
acetochlor (+ safener)	EC	700 g/l	Diamant 700 S	Arysta Life Sciences
acetochlor/atrazine/simazine (+ safener)	SC	160/165/165 g/l	Smarag	Arysta Life Sciences
acetochlor/atrazine/terbutylazine	SC	125/187,5/187,5 g/l	Robyn	Arysta Life Sciences
acetochlor/atrazine/terbutylazine	SC	250/225/225 g/l	Emerald	Arysta Life Sciences
atrazine	SC	500 g/l	Atrazine SC	Arysta Life Sciences
atrazine/sulcotrione/related triazines	SC	291/125/9 g/l	Armadillo	Arysta Life Sciences
atrazine/terbutylazine/related triazine	SC	291/291/18 g/l	Combo-Zine 600 SC	Arysta Life Sciences
bromoxynil	EC	225 g/l	Bromoxynil 225	Arysta Life Sciences
EPTC (+safener)	EC	720 g/l	EPTC Plus	Arysta Life Sciences
halosulfuron-methyl	WP	750 g/kg	Cyprex VWP	Arysta Life Sciences
MCPA (potassium salt)	SL	400 g/l	MCPA	Arysta Life Sciences
bendioxide	SL	480 g/l	Basagran	BASF
dimethenamid-P	EC	720 g/l	Frontier Optima	BASF
topramezone/dicamba	SL	50/160 g/l	Stellar Star	BASF
topramezone	SC	336 g/l	Campus	BASF

Active ingredient Aktiewe bestanddeel	Formulation* Formulasie*	Concentrate Konsentrasie	Product name Produk naam	Company name Maatskappy
flufenacet	SC	500 g/l	Tiara 500 SC	Bayer
flufenacet	WG	600 g/kg	Tiara 60 WG	Bayer
MCPA (potassium salt)	SL	400 g/l	MCPA	Bayer
metribuzin	SC	480 g/l	Sable 480 SC	Bayer
tembotrione	SC	420 g/l	Laudis	Bayer
2,4-D (dimethyl amine salt)	SL	480 g/l	2,4-D Amine 480 SL	Dow AgroSciences
acetochlor	EC	900 g/l	Relay Super 900 EC	Dow AgroSciences
acetochlor (+ safener)	EC	700 g/l	Wenner 700 S EC	Dow AgroSciences
atrazine	SC	500 g/l	Atrasion 500 SC	Dow AgroSciences
atrazine/terbuthylazine	SC	300/300 g/l	Suprazine 600 SC	Dow AgroSciences
flumetsulam	WG	800 g/kg	Broadstrike	Dow AgroSciences
glyphosate dimethylamine salt	SL	480 g/l	Mamba DMA 480 SL	Dow AgroSciences
glyphosate isopropylamine salt	SL	480g/l	Mamba Max 480 SL	Dow AgroSciences
MCPA (potassium salt)	SL	400 g/l	MCPA 400 SL	Dow AgroSciences
nicosulfuron	WG	750 g/kg	Accent	DuPont
alachlor/atrazine	SE	336/144 g/l	Atrachlore 33/14 SE	ADAMA
paraquat dichloride	SL	200 g/l	Makrho Paraquat	ADAMA

Active ingredient Aktiewe bestanddeel	Formulation* Formulasie*	Concentrate Konsentrasie	Product name Produk naam	Company name Maatskappy
alachlor	EC	384 g/l	Alanex 384 EC	ADAMA
alachlor	CS	480 g/l	Alanex 480 CS	ADAMA
alachlor/atrazine	SE	336/144 g/l	Atrazine 480 SE	ADAMA
atrazine	SC	500 g/l	Atranex 500 SC	ADAMA
atrazine/terbutylazine	SC	300/300 g/l	Supranex 600 SC	ADAMA
atrazine/terbutryn	SC	250/250 g/l	Aterbutrex 500SC	ADAMA
bromoxynil	EC	225 g/l	Bromatril	ADAMA
bromoxynil	EC	400 g/l	Bromotril 400 EC	ADAMA
bromoxynil	SC	500 g/l	Bromotril P 500 SC	ADAMA
bromoxynil/terbutylazine	SC	150/333 g/l	Bromotril T	ADAMA
EPTC (+safener)	EC	720 g/l	EPTC Plus	ADAMA
fluroxypyr	EC	200 g/l	Tomahawk 200 EC	ADAMA
linuron	SC	500 g/l	Afalon SC	ADAMA
linuron	SC	500 g/l	Linagan SC	ADAMA
sulcotrione/atrazine	SC	125/300 g/l	Sulcozine SC	ADAMA
2,4-D/Dicamba (APM salt)	SL	240/80g/l	Trooper SL	Meridian Agritech
acetochlor	EC	900 g/l	Acetak EC	Meridian Agritech
acetochlor (+ safener)	EC	840 g/l	Prefix S EC	Meridian Agritech
acetochlor/atrazine/terbutylazine	SC	150/225/225 g/l	Rival SC	Meridian Agritech
alachlor	EC	384 g/l	Alachlor EC	Meridian Agritech

Active ingredient Aktiewe bestanddeel	Formulation* Formulasie*	Concentrate Konsentrasie	Product name Produk naam	Company name Maatskappy
bendioxide	SL	480 g/l	Bentamax	Meridian Agritech
EPTC (+safener)	EC	720 g/l	EPTC S EC	Meridian Agritech
acetochlor	EC	900 g/l	Harness	Monsanto
acetochlor (+ safener)	EC	840 g/l	Guardian S	Monsanto
acetochlor/atrazine/terbutylazine (+ safener)	SC	250/225/225 g/l	Bullet	Monsanto
glyphosate - ammonium salt	WG	680 G/kg	Roundup Max	Monsanto
glyphosate - potassium salt	SL	360 g/l	Roundup	Monsanto
glyphosate - potassium salt	SL	450 g/l	Roundup Turbo	Monsanto
glyphosate - potassium salt	SL	540 g/l	Roundup Ready Plus	Monsanto
2,4-D (dimethyl amine salt)	SL	480 g/l	2,4D Amien 480	Nulandis
acetochlor (+ safener)	EC	700 g/l	Acetochlor 700	Nulandis
acetochlor/atrazine/terbutylazine (+ safener)	SC	125/187,5/187,5 g/l	Squadron	Nulandis
alachlor	EC	384 g/l	Alachlor EC	Nulandis
atrazine	SC	500 g/l	Atraflo 500 SC	Nulandis
atrazine	SC	500 g/l	Atrazine SC	Nulandis
atrazine/terbutylazine	SC	250/250 g/l	Atraflo Super 500 SC	Nulandis
atrazine/terbutylazine	SC	250/250 g/l	Terazine SC	Nulandis

Active ingredient Aktiewe bestanddeel	Formulation* Formulasie*	Concentrate Konsentrasie	Product name Produk naam	Company name Maatskappy
atrazine/terbuthylazine	SC	300/300 g/l	Atraflo 600 Super SC	Nulandis
atrazine/terbuthylazine	SC	300/300 g/l	Terbuzin 600 SC	Nulandis
bromoxynil	EC	225 g/l	Brominex EC	Nulandis
paraquat dichloride	SL	200 g/l	Paragone SL	Nulandis
pyridate	W/P	450 g/kg	Lentagran W/P	Nulandis
pyridate	EC	640 g/l	Lentagran EC	Nulandis
acetochlor (+ safener)	EC	700 g/l	Acetochlor	RT Chemicals
metolachlor	EC	915 g/l	Erintrade Metolachlor 915	RT Chemicals
metolachlor	EC	960 g/l	Metolachlor 960 EC	RT Chemicals
atrazine	WG	900 g/kg	Gesaprim 90 WG	Syngenta
atrazine/S-metolachlor	SC	370/290 g/l	Primagram Gold	Syngenta
atrazine/S-metolachlor/ terbuthylazine	SC	249/102/249 g/l	Gardomil Gold	Syngenta
atrazine/terbuthylazine	SC	300/300 g/l	Gesaprim Super 600 SC	Syngenta
atrazine/terbuthylazine	SC	300/300 g/l	Terbuzin 600 SC	Syngenta
dicamba (dimethyl amine salt)	SL	480 g/l	Banvel 480 SL	Syngenta
diquat dibromide/ paraquat dichloride	SL	80/120 g/l	Preeglone	Syngenta

Active ingredient Aktiewe bestanddeel	Formulation* Formulasie*	Concentrate Konsentrasie	Product name Produk naam	Company name Maatskappy
flumetsulam/S-metolachlor	EC	20/630 g/l	Bateleur Gold 650 EC	Syngenta
glyphosate	SL	500 gae/l	Touchdown Forte Hi Tech	Syngenta
halosulfuron-methyl	WG	750 g/kg	Servan	Syngenta
mesotrione	SC	480 g/l	Callisto	Syngenta
mesotrione/S-metolachlor/ glyphosate	SC	25/250 g/l / 25g ae /l	Halex GT	Syngenta
paraquat dichloride	SL	200 g/l	Gramoxone	Syngenta
proflufenuron	WG	750 g/kg	Brons	Syngenta
S-metolachlor	EC	915 g/l	Dual Gold	Syngenta
S-metolachlor	EC	960 g/l	Metagan Gold	Syngenta
S-metolachlor/terbutylazine	SC	102.8/497.2 g/l	Sorgomil Gold 600 SC	Syngenta
atrazine/cyanazine	SC	250/250 g/l	Reflex SC	Technichem
2,4-D (dimethyl amine salt)	SL	480 g/l	2,4-D Amine SL	Universal Crop Protection
2,4-D Ester (iso-octylester)	EC	500 g/l	2,4-D Ester	Universal Crop Protection
acetochlor (+ safener)	EC	840 g/l	Acetochlor 840 g/l	Universal Crop Protection
acetochlor/atrazine/terbutylazine (+ safener)	SC	250/225/225 g/l	Gatling 700 SC	Universal Crop Protection
alachlor	EC	384 g/l	Alachlor EC	Universal Crop Protection
atrazine	SC	500 g/l	Agrazine SC	Universal Crop Protection
atrazine/terbutylazine	SC	250/250 g/l	Agrazine Plus SC	Universal Crop Protection

Active ingredient Aktiewe bestanddeel	Formulation* Formulasie*	Concentrate Konsentrasie	Product name Produk naam	Company name Maatskappy
bromoxynil	EC	225 g/l	Bromoxynil EC	Universal Crop Protection
EPTC (+safener)	EC	720 g/l	EPTC Plus EC	Universal Crop Protection
halosulfuron-methyl	WDG	750g/kg	Crown 750 WDG	Universal Crop Protection
linuron	SC	500 g/l	Universal Linuron	Universal Crop Protection
MCPA (potassium salt)	SL	400 g/l	MCPA 400 SL	Universal Crop Protection
metolachlor	EC	800 g/l	Metolachlor 800 EC	Universal Crop Protection
metolachlor	EC	915 g/l	Metolachlor 915 EC	Universal Crop Protection
metolachlor	EC	960 g/l	Metolachlor 960 EC	Universal Crop Protection
metolachlor/atrazine/terbuthylazine	SC	252/174/174 g/l	Metazine 600 SC	Universal Crop Protection
nicosulfuron	WDG	750 g/kg	Nicosulfuron 750 WDG	Universal Crop Protection
paraquat dichloride	SL	200 g/l	Skoffel SL	Universal Crop Protection
paraquat dichloride	SL	200 g/l	Skoffel Super	Universal Crop Protection
atrazine/metazachlor/ terbuthylazine	SC	210/60/210 g/l	Reep	Universal Crop Protection
2,4-D Ester (isooctylester)	EC	500 g/l	2,4-D Ester	Villa Crop Protection
acetochlor	EC	750 g/l	Valkyri 750 EC	Villa Crop Protection
acetochlor (+ safener)	EC	840 g/l	Leap EC	Villa Crop Protection
acetochlor/atrazine/simazine (+ safener)	SC	160/165/165 g/l	Pawnee SC	Villa Crop Protection
acetochlor/atrazine/terbuthylazine	SC	125/187.5/187.5 g/l	Stuka	Villa Crop Protection

Active ingredient Aktiewe bestanddeel	Formulation* Formulasie*	Concentrate Konsentrasie	Product name Produk naam	Company name Maatskappy
acetochlor/atrazine/terbuthylazine (+ safener)	SC	250/225/225 g/l	Brenno 700 SC	Villa Crop Protection
alachlor	CS	480 g/l	Alachlor 480 CS	Villa Crop Protection
alachlor	CS	480 g/l	Villa-Klar 480 CS	Villa Crop Protection
atrazine/terbuthylazine	SC	270/270 g/l	Ammo SC	Villa Crop Protection
atrazine/terbuthylazine	SC	300/300 g/l	Terbusien Super 600 SC	Villa Crop Protection
bendioxide	SL	480 g/l	Hornet	Villa Crop Protection
bromoxynil	EC	225 g/l	Campatop 225 EC	Villa Crop Protection
EPTC (+safener)	EC	720 g/l	Esculentus EC	Villa Crop Protection
glyphosate/isopropylamine salt	SG	710g/kg	Glygran SG	Villa Crop Protection
halosulfuron-methyl	WDG	750g/kg	Halo 750 WDG	Villa Crop Protection
linuron	SC	500 g/l	Villa Linuron	Villa Crop Protection
mesotrione	SC	480 g/l	Cantron SC	Villa Crop Protection
metolachlor	EC	800 g/l	Metolachlor 800 EC	Villa Crop Protection
metolachlor	EC	915 g/l	Platinum Plus	Villa Crop Protection
metolachlor	EC	960 g/l	Platinum 960 EC	Villa Crop Protection
metolachlor/atrazine/terbuthylazine	SC	252/174/174 g/l	Tetramet SC	Villa Crop Protection
nicosulfuron	WDG	750 g/kg	Nicaron WDG	Villa Crop Protection
S-metolachlor	EC	915 g/l	Dubbel-S-Goud 915 EC	Villa Crop Protection
S-metolachlor	EC	960 g/l	Mustang 960 EC	Villa Crop Protection
terbuthylazine	SC	500 g/l	Terbuvon 500 SC	Villa Crop Protection

Active ingredient Aktiewe bestanddeel	Formulation* Formulasie*	Concentrate Konsentrasie	Product name Produk naam	Company name Maatskappy
acetochlor	EC	900 g/l	Acetochlor 900 EC	Villa Crop Protection / Universal Crop Protection
acetochlor (+ safener)	EC	700 g/l	Acetochlor	Villa Crop Protection / Universal Crop Protection
2,4-D (dimethyl amine salt)	SL	480 g/l	2,4-D 480	Volcano Agrosience
2,4-D (dimethyl amine salt)	SL	480 g/l	Wildebees	Volcano Agrosience
acetochlor	EC	750 g/l	Crocodile	Volcano Agrosience
acetochlor	EC	900 g/l	Acetochlor 900 EC	Volcano Agrosience
acetochlor (+ safener)	EC	700 g/l	Acetochlor S 700	Volcano Agrosience
acetochlor (+ safener)	EC	700 g/l	Hippo	Volcano Agrosience
acetochlor (+ safener)	EC	700 g/l	Lion	Volcano Agrosience
acetochlor (+ safener)	EC	840 g/l	Buffalo	Volcano Agrosience
acetochlor/atrazine/terbuthylazine	SC	125/187,5/187,5 g/l	Rhino	Volcano Agrosience
alachlor	EC	384 g/l	Alachlor	Volcano Agrosience
alachlor	EC	384 g/l	Eland	Volcano Agrosience
atrazine	WG	900 g/kg	Atrazine 900 WVDG	Volcano Agrosience
atrazine/propazine/acetochlor	SC	202/202/96 g/l	Etna	Volcano Agrosience
atrazine/terbuthylazine	SC	300/300 g/l	Atrazine Xtra 600	Volcano Agrosience
atrazine/terbuthylazine	SC	300/300 g/l	Cheetah	Volcano Agrosience
MCPA (potassium salt)	SL	400 g/l	MCPA	Volcano Agrosience

Active ingredient Aktiewe bestanddeel	Formulation* Formulasie*	Concentrate Konsentrasie	Product name Produk naam	Company name Maatskappy
MCPA (sodium salt)	W5G	700 g/kg	MCPA 700 W5G	Volcano Agrosience
metolachlor	EC	840 g/l	Tolla 840 S	Volcano Agrosience
metolachlor	EC	960 g/l	Tolla 960	Volcano Agrosience
acetochlor/atrazine/simazine (+ safener)	SC	160/165/165 g/l	Erupt	Volcano Agrosiences

**Formulations\* / Formulasies\***

- CS: CAPSULE SUSPENSION
- EC: EMULSIFIABLE CONCENTRATE
- SC: SUSPENSION CONCENTRATE
- GR: GRANULE
- WG: WATER DISPERSIBLE GRANULE (WDG)
- SL: SOLUBLE CONCENTRATE
- SE: SUSPO-EMULSION
- SG: WATER SOLUBLE GRANULE (WSG)

## Breëblare / Broadleaves

Wetenskaplik / Scientific	Afrikaans	English
<i>Acanthospermum australe</i>	Agtسادige kruipsterklits	Eight-seeded prostrate starbur
<i>Acanthospermum glabratum</i>	Vyfsadige kruipsterklits	Five-seeded prostrate starbur
<i>Acanthospermum hispidum</i>	Regopsterklits	Upright starbur
<i>Amaranthus deflexus</i>	Meerjarige misbredie	Perennial pigweed
<i>Amaranthus hybridus</i>	Gewone misbredie	Common pigweed
<i>Amaranthus spinosus</i>	Doringmisbredie	Thorny pigweed
<i>Amaranthus thunbergii</i>	Roويمisbredie	Red pigweed
<i>Bidens bipinnata</i>	Spaanse knapsekêrel	Spanish blackjack
<i>Bidens formosa</i>	Kosmos	Cosmos
<i>Bidens pilosa</i>	Gewone knapsekêrel	Common blackjack
<i>Chenopodium album</i>	Wilhoedebossie	White goosefoot
<i>Chenopodium carinatum</i>	Groenhondebossie	Green goosefoot
<i>Cleome monophylla</i>	Rusperbossie	Singlepod
<i>Crotalaria sphaerocarpa</i>	Mielie-Crotalaria	Mealie Crotalaria
<i>Datura ferox</i>	Groot stinkblaar/Olieboom	Large thorn apple
<i>Datura stramonium</i>	Stinkblaar/Olieboom	Thorn apple
<i>Emex australis</i>	Kaapse dubbelijie	Spiny Emex
<i>Galinsoga parviflora</i>	Knopkruid	Gallant soldier
<i>Gisekia pharmacoides</i>	Gisekia	Gisekia
<i>Hibiscus cannabinus</i>	Wildestokroos	Kenaf
<i>Hibiscus trionum</i>	Terblansbossie	Bladderweed

Wetenskaplik / Scientific	Afrikaans	English
<i>Ipomoea purpurea</i>	Purperwinde	Common morning glory
<i>Nicandra physalodes</i>	Basterappelliefie	Apple of Peru
<i>Physalis angulata</i>	Wilde-appelliefie	Wild gooseberry
<i>Portulaca oleracea</i>	Porslein	Purslane
<i>Richardia brasiliensis</i>	Tropiese-Richardia	Tropical Richardia
<i>Schkuhria pinnata</i>	Kleinkakiebos	Dwarf marigold
<i>Sonchus oleraceus</i>	Gewone sydlissel	Sowthistle
<i>Tagetes minuta</i>	Kakiebos	Khakiweed
<i>Tribulus terrestris</i>	Dubbelijie	Dubbelijie
<i>Xanthium strumarium</i>	Kankerroos	Cocklebur

## Grasse / Grasses

Wetenskaplik / Scientific	Afrikaans	English
<i>Bracharia eruciformis</i>	Lijtie-sinjaalgras	Sweet signal-grass
<i>Chloris virgata</i>	Witpluim-Chloris	Feathertop Chloris
<i>Digitaria nuda</i>	Kruisvingergras	Naked crabgrass
<i>Digitaria sanquinalis</i>	Hannepootimanna	Crab fingergrass
<i>Echinochloa crus-galli</i>	Jongosgras	Barnyard grass
<i>Eleusine coracana subsp. africana</i> [= <i>E. indica</i> (L.)	Gewone buffelsgras	Goose grass
<i>Panicum maximum</i>	Soetbuffelsgras	Common buffalo grass
<i>Panicum schinzii</i>	Rooiborselgras	Sweet buffalo grass
<i>Setaria pallide-fusca</i>	Kliitsborselgras	Red bristle grass
<i>Setaria verticillata</i>	Wilde Sorghums	Sticky bristle grass
<i>Sorghum</i> spp.	Klein wortelsaadgras	Wild Sorghums grass
<i>Tragus berteronianus</i>	Groot wortelsaadgras	Small carrotseed
<i>Tragus racemosus</i>	Bosveldbeesgras	Large carrotseed grass
<i>Urochloa mosambicensis</i>	Beesgras	Bushveld herringbone grass
<i>Urochloa panicoides</i>		Herringbone grass

## Uintjies / Sedges

Wetenskaplik / Scientific	Afrikaans	English
<i>Cyperus esculentus</i>	Geeluintjie	Yellow nutsedge
<i>Cyperus rotundus</i>	Rooiuintjie	Purple nutsedge
	<b>ANDER / OTHER</b>	
<i>Commelina benghalensis</i>	Bengaliese wandelende Jood	Benghal wandering Jew

## GEWASBESKERMING/CROP PROTECTION

### Plagdoders

Die nuutste inligting rakende geregistreerde plagdoders teen aalwurmen en insekplae van mielies word in die meegaande tabelle aangedui. Producente moet daarop let dat dieselfde aktiewe bestanddeel onder verskillende handelsname beskikbaar is.

By die aankoop van 'n plagdoder moet die pryse van die middels, asook die prys van 'n spesifieke middel onder verskillende handelsname vergelyk word waar toepaslik. Dit word beklemtoon dat die prys van 'n plagdoder nie noodwendig verband hou met die middel se doeltreffendheid nie.

Voordat enige beheeraksie geneem word, moet die plaagstatus van die spesifieke organisme bepaal word. Inligting oor elke plaagspesie wat in die meegaande tabel genoem word, kan verkry word van kundiges wat agter in hierdie gids genoem word. Hierdie inligting kan van hulp wees in die besluitnemings proses.

Die LNR verskaf hierdie inligting in die hoedanigheid as onafhanklike adviseur en die LNR verskaf geen uitdruklike of stilswyende waarborge van gebruiklikheid of gepastheid van enige agrochemikalie vir enige spesifieke doel nie. Die gebruiker van hierdie brosjure vrywaar en stel die LNR, sy werknemers en agente skadeloos teen enige eise of aanspreeklikhede wat uit die gebruik van hierdie inligting mag ontstaan.

### Pesticides

The latest information concerning pesticides for nematodes and insect pests of maize is provided in the accompanying tables. Producers should note that a particular active ingredient may be available under different trade names.

When purchasing pesticides, note must be taken of the cost of different pesticides as well as price differences between trade names with the same active ingredient. It needs to be emphasized that the cost of a pesticide is not necessarily correlated with its efficacy.

Before any control actions are taken, the pest status of the specific organism has to be determined. Information regarding different pest species can be obtained from experts mentioned in the back of this information guide. This information can be useful in the decision-making process.

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**PLAAGDODER FORMULASIES / PESTICIDE FORMULATIONS**

Plaagdoders / Pesticides	Maatskappy/ Company name	Plaagspesies/ Pest species
		1) Aduurms/ Nematodes
		2) Bladspringers/ Leafhoppers (Strepsieteel/ (Streak disease)
		3) Bolwurm/ Bollworm
		4) Bonmtielekewer/ Spotted maize beele (larf/ (larva)
		5) Bonmtielekewer/ Spotted maize beele (Kewer/ (Beetle)
		6) Chilo-border/ Chilo-borer
		7) Doodhouertje/ Ground weevils
		8) Lentekewer/ Charter beele
		9) Mieliestamruspe/ Maize stalk borer
		10) Prekstamborder/ Pink stalk borer
		11) Plantuise/ Aphids
		12) Snywurms/ Cutworms
		13) Spinnmyte/ Spider mites
		14) Swartmielekewer/ Black maize beele
		15) Wortelwurm/ Rootworm
		16) Valsdradwurm/ False wireworm
<b>SPIUITFORMULASIES/ SPRAYS</b>		
Alfasipermietrien/ Alphacypermethrin 100 g/l EC		
Bestox EC	FMC	
Fastac EC	BASF	
Sentry EC	Volcano Agrosiences	
Alfasipermietrien/ Alphacypermethrin 100 g/l SC		
Alpha-Thrin 100 EC	Villa Crop Protection	
Alpha-Thrin 100 EC	Universal Crop Protection	
Avalandhe	Klub M5	
Fastac SC	BASF	
Magnum Super	Technichem Oesbeskerming	

Plaaagdoders/ Pesticides	Maatskappy/ Company name	Plaaagspesies/ Pest species
		1) Aalwurms/ Nematodes 2) Bladspringers/ Leafhoppers (Strepsiekte)/ (Streak disease) 3) Bolwurm/ Bollworm 4) Bontmellekewer/ Spotted maize beetle (larf)/ (larva) 5) Bontmellekewer/ Spotted maize beetle (keur)/ (beetle) 6) Chilo-boorder/ Chilo-borer 7) Doodhouertjie/ Ground weevils 8) Lentekewer/ Charter beetle 9) Mieliestamruspe/ Maize stalk borer 10) Pienkstamboorder/ Pink stalk borer 11) Plantuise/ Aphids 12) Snywurms/ Cutworms 13) Spinyte/ Spider mites 14) Swartmellekewer/ Black maize beetle 15) Wortelwurm/ Rootworm 16) Valsdradawurm/ False wireworm
Benturacarb-Fenvaleraat/ Benturacarb-Fenvalerate 220g/l EC	Dow AgroSciences	X
Oncol Super 220 EC	Dow AgroSciences	X
Betasiflurien/ Betacyfluthrin 125 g/l EC	Bayer CropScience	X
Bulldock	Bayer CropScience	X
Betasipermethrien/ Betacypermethrin 100 g/l EC	Arysta Lifescience	X
Akito	Arysta Lifescience	X
Bifenitrien/ Bifenthrin 100 g/l EC	Makhshim-Agan SA	X
Seizer	Makhshim-Agan SA	X
Chlorpyrifos/ Chlorpyrifos 480 g/l EC	Arysta Lifescience	X
Agrapyrifos 480 EC	Arysta Lifescience	X
Avi-Klorpyrifos	Avima	X
Chlorpyrifos	Villa Crop Protection	X



Plaaagdoders/ Pesticides	Maatskappy/ Company name	Plaaagspesies/ Pest species
Demeton-Smetiel/ Demeton-S-methyl 250 g/l EC Demetox EC Demeton Demeton EC	Avima Cropchem Universal Crop Protection	1) Aalwurms/ Nematodes 2) Bladspringers/ Leafhoppers (Streepsiekte)/ (Streak disease) 3) Bolwurms/ Bollworm 4) Bontmielekewer/ Spotted maize beetle (larf)/ (larva) 5) Bontmielekewer/ Spotted maize beetle (keur)/ (beetle) 6) Chilo-boorder/ Chilo-borer 7) Doodhouertjie/ Ground weevils 8) Lentekewer/ Charter beetle 9) Mieliestamruspe/ Maize stalk borer 10) Pienkstamboorder/ Pink stalk borer 11) Plantuise/ Aphids 12) Snywurms/ Cutworms 13) Spinnye/ Spider mites 14) Swartmielekewer/ Black maize beetle 15) Wortelwurm/ Rootworm 16) Valsdraadwurm/ False wireworm
<b>SPUITFORMULASIES/ SPRAYS (Vervolg/ Continued)</b>		
Esfenvaleraat/ Esfenvalerate 50 g/l EC Sumicidin Super	Philagro South Africa	X
Esfenvaleraat/ Esfenvalerate 50 g/l EC Sumi-Alpha 200 EC	Philagro South Africa	X
Fenvaleraat/ Fenvalerate 200 g/l EC Fenvalerate 200 EC Agrovate Fenvalerate EC Fenvalerate EC	Avima Agropharm Villa Crop Protection Universal Crop Protection	X X X X X







Plagddoders/ Pesticides	Maatskappy/ Company name	Plaggespesies/ Pest species
Sipermetrien/ Cypermethrin 200 g/l EC	Avima	1) Adwurms/ Nematodes
Avi-Sipermethrin	Nulandis	2) Bladspringers/ Leafhoppers (Strepsiekte)/(Streak disease)
Cyperin	Agropharm	3) Bolwurm/ Bollworm
Cypermethrin 200 EC	Bitrad Consulting	4) Bontmelleke/ Spotted maize beetle (larf)/(larva)
Cypermethrin 200 EC	Aryta Lifescience	5) Bontmelleke/ Spotted maize beetle (keur)/(beetle)
Cypermethrin	Universal Crop Protection	6) Chilo-boorder/ Chilo-borer
Cypermethrin EC	WPK landbou	7) Doodhouertjie/ Ground weevils
Doodsboot	Kempton Chemicals	8) Lentekewer/ Charter beetle
Kemprin	Technikum Oesbesterming	9) Mieliestamruspe/ Maize stalk borer
Magnum	Makhshim-Agan SA	10) Fenkstamboorder/ Pink stalk borer
Makhro Cyper	Global AgroSciences	11) Plantuise/ Aphids
Novacord		12) Snywurms/ Cutworms
		13) Spinnmisse/ Spider mites
		14) Swartmelleke/ Black maize beetle
		15) Wortelwurm/ Rootworm
		16) Valsdraadwurm/ False wireworm



Plaggoders/ Pesticides	Maatskappy/ Company name	Plaggespesies/ Pest species
Benfurakarb/ Bentfuracarb 200 g/l EC + lambdasihalotrien/ lambda-cyhalothrin 50 g/l EC		1) Aalwurms/ Nematodes 2) Bladspringers/ Leafhoppers (Strepsiekie)/ (Streak disease) 3) Bolwurm/ Bollworm 4) Bonntieliekeker/ Spotted maize beetle (larf)/ (larva) 5) Bonntieliekeker/ Spotted maize beetle (Kewer)/ (Beetle) 6) Chilo-boorder/ Chilo-borer 7) Doodhouertjie/ Ground weevils 8) Lentiekeker/ Chafer beetle 9) Mieliestamruspe/ Maize stalk borer 10) Pienkstamboorder/ Pink stalk borer 11) Plantuise/ Aphids 12) Snywurms/ Cutworms 13) Spinnmyle/ Spider mites 14) Swartmieliekeker/ Black maize beetle 15) Wortelwurm/ Rootworm 16) Valdsradddwurm/ False wireworm
Benfurakarb/ Bentfuracarb 200 g/l + Lambdasihalotrien/ Lambda-cyhalothrin 6 g/l Arena 206 EC		X
<b>SUITFORMULASIES (MENGSELS)/ SPRAYS (MIXTURES) Gereed vir gebruik/ Ready for use</b>		
Benfurakarb/ Bentfuracarb 200 g/l EC + Fenvaleraat/ Fenvalerate 20 g/l EC Oncol Super 220 EC	Dow AgroSciences	X
Chlorpyrifos/ Chlorpyrifos 450 g/l EC + Sipermetrien/ Cypermethrin 50 g/l EC Cyperfos 500 EC (500 g/l)	Nulandis	X
Chlorpyrifos/ Chlorpyrifos 338 g/l + Lambdasihalotrien/ Lambda-cyhalothrin 12 g/l Linear 350 EC	Universal Crop Protection	X

<b>STUIFPOEIRS/ DUST POWDERS</b>											
Karbariel/ Carbaryl 50 g/kg DP											
Karbadust											
Efekte										X	
Merkaptoion/ Mercaptation 50 g/kg DP											
Malathion DP (Kleinmaatverpakking/ Small package)										X	
Efekte											
<b>KORRELFORMULASIES/ GRANULES Vir toediening in die grond/ For soil application</b>											
Foraat/ P horate 100 g/kg GR											
Thimet											X
BASF											
Karbofuran/ Carbofuran 100 g/kg GR											
Alvuran 100 GR					X				X		X
Carboden 10 G					X				X		X
Carbofuran 10 G					X				X		X
Carbofuran 100 GR					X				X		X
Curaterr 100 GR					X				X		X
Carboterr 100 GR					X				X		X
Furadan					X				X		X
Terbufos/ Terbufos 100 g/kg GR											
Ortofos					X				X		X
Terburops 15 GR					X				X		X
Terbufos/ Terbufos 150 g/kg GR											
Counter FC 15 G					X				X		X
Ortofos 15 G					X				X		X
Terbufos 15 G					X				X		X
Terbufos 15 GR					X				X		X
Terfos 15 G					X				X		X
Volcano Agrosciences											
Ortus Chemicals					X				X		X
Rotam					X				X		X
Villa Crop Protection					X				X		X
Ortus Chemicals					X				X		X
Arysta Lifescience					X				X		X
Bitrad Consulting					X				X		X
Volcano Agrosciences					X				X		X

Plagdoders/ Pesticides	Maatskappy/ Company name	Plagspesies/ Pest species
<b>KORRELFORMULASIES/ GRANULES Vir toediening in die plantkeel/For plant funnel application</b>		
Betasiflutrien/ Betacyfluthrin 0,5 g/kg GR	Bayer CropScience	1) Aalwurms/ Nematodes 2) Bladspringers/ Leafhoppers (Strepsiekte)/ (Streak disease) 3) Bolwurms/ Bollworm (larf)/ (larva) 4) Bontrieliekeker/ Spotted maize beetle 5) Bontrieliekeker/ Spotted maize beetle (keker)/ (beetle) 6) Chilo-boorder/ Chilo-borer 7) Doodhouertjie/ Ground weevils 8) Lentiekeker/ Chofter beetle 9) Mieliestamruspe/ Maize stalk borer 10) Pienkstamboorder/ Pink stalk borer 11) Plantluise/ Aphids 12) Snywurms/ Cutworms 13) Spinmyte/ Spider mites 14) Swartmeliekeker/ Black maize beetle 15) Wortelwurm/ Rootworm 16) Valsdraddawurm/ False wireworm
Bulldock 0,05 GR	Bayer CropScience	6) Chilo-boorder/ Chilo-borer
Karbariel/ Carbaryl 25 g/kg GR	Kombat	9) Mieliestamruspe/ Maize stalk borer
Stalkborer Granules	Kombat	9) Mieliestamruspe/ Maize stalk borer
Stalkborer Granules (Kleinmaatverpakking/ Small package)	Efekto	9) Mieliestamruspe/ Maize stalk borer
<b>SAADBEHANDELINGSFORMULASIES/ SEED DRESSINGS</b>		
Benturakarb/ Benturacarb 900 g/l SL	Dow AgroSciences	7) Doodhouertjie/ Ground weevils 8) Lentiekeker/ Chofter beetle 9) Mieliestamruspe/ Maize stalk borer 10) Pienkstamboorder/ Pink stalk borer 11) Plantluise/ Aphids 12) Snywurms/ Cutworms 13) Spinmyte/ Spider mites 14) Swartmeliekeker/ Black maize beetle 15) Wortelwurm/ Rootworm 16) Valsdraddawurm/ False wireworm
Oncol 900 IS	Dow AgroSciences	7) Doodhouertjie/ Ground weevils 8) Lentiekeker/ Chofter beetle 9) Mieliestamruspe/ Maize stalk borer 10) Pienkstamboorder/ Pink stalk borer 11) Plantluise/ Aphids 12) Snywurms/ Cutworms 13) Spinmyte/ Spider mites 14) Swartmeliekeker/ Black maize beetle 15) Wortelwurm/ Rootworm 16) Valsdraddawurm/ False wireworm
Clothianidin	Dow AgroSciences	7) Doodhouertjie/ Ground weevils 8) Lentiekeker/ Chofter beetle 9) Mieliestamruspe/ Maize stalk borer 10) Pienkstamboorder/ Pink stalk borer 11) Plantluise/ Aphids 12) Snywurms/ Cutworms 13) Spinmyte/ Spider mites 14) Swartmeliekeker/ Black maize beetle 15) Wortelwurm/ Rootworm 16) Valsdraddawurm/ False wireworm
Poncho 600FS	Bayer CropScience	7) Doodhouertjie/ Ground weevils 8) Lentiekeker/ Chofter beetle 9) Mieliestamruspe/ Maize stalk borer 10) Pienkstamboorder/ Pink stalk borer 11) Plantluise/ Aphids 12) Snywurms/ Cutworms 13) Spinmyte/ Spider mites 14) Swartmeliekeker/ Black maize beetle 15) Wortelwurm/ Rootworm 16) Valsdraddawurm/ False wireworm
Imidacloprid/ Imidacloprid 600 g/l FS	Bayer CropScience	7) Doodhouertjie/ Ground weevils 8) Lentiekeker/ Chofter beetle 9) Mieliestamruspe/ Maize stalk borer 10) Pienkstamboorder/ Pink stalk borer 11) Plantluise/ Aphids 12) Snywurms/ Cutworms 13) Spinmyte/ Spider mites 14) Swartmeliekeker/ Black maize beetle 15) Wortelwurm/ Rootworm 16) Valsdraddawurm/ False wireworm
Ronsek 600 FS	Villa Crop Protection	7) Doodhouertjie/ Ground weevils 8) Lentiekeker/ Chofter beetle 9) Mieliestamruspe/ Maize stalk borer 10) Pienkstamboorder/ Pink stalk borer 11) Plantluise/ Aphids 12) Snywurms/ Cutworms 13) Spinmyte/ Spider mites 14) Swartmeliekeker/ Black maize beetle 15) Wortelwurm/ Rootworm 16) Valsdraddawurm/ False wireworm



## INSEKPLAE/INSECT PESTS

### Mieliestamboorder

#### *Busseola fusca*

#### (Lepidoptera: Noctuidae)

**Larf:** Klein larfies donkerbruin word ligter namate hul ouer word. Volgroeide larwes 5 cm.

**Mot:** Koperkleurig met donker merke op die voorvlerke

**Skade:** Larwes voed in die kelk. Die vreetskade vertoon soos “venstertjies” as die kelkblare uitgroei. Groter larwes vreet regdeur die kelkrol sodat kelkblare ‘n ry gate vertoon wat ook bekend staan as “haelkorrelskade”. Larwes boor aan die kante van mielie-stamme in en vreet tunnels in die binnekant van die stamme. Larwes wat die groeipunt deurboor kan die groeipunt afvreet. Hierdie skade staan bekend as ‘n “doeiehart”. Larwes kan ook in koppe inboor. Die larwes vreet koppitte en veroorsaak direkte skade. Die oes kan afgegradeer word a.g.v. beskadigde pitte.



Larf/Larva



Mot/Moth

### Maize stem borer

#### *Busseola fusca*

#### (Lepidoptera: Noctuidae)

**Larvae:** Small larvae dark brown become paler as they get older. Mature larvae 5 cm.

**Moths:** Have a copper color with darker markings on the forewings

**Damage:** Larvae feed in the whorls. Damage can be observed as small “windows” after the leaves grow out. Larger larvae feed right through the leaves that are rolled up. This damage is commonly known as “shot hole damage”. Larvae tunnel into stem and inside the stem. Larvae that tunnel in at the region of the growing tip can cause dying-off of whorl leaves. This damage is known as “dead heart”. Larvae can also tunnel into ears. Larvae feed on kernels and cause direct yield losses. Feeding on kernels may also lead to down-grading of the harvest.



Beskadigde kelk/Whorl damage

**Chilo-boorder**  
***Chilo partellus***  
**(Lepidoptera: Crambidae)**

**Larf:** Roomwit van kleur met vier rye kolletjies op liggaam. Larwes word omtrent 3 cm lank.

**Mot:** Vaalbruin met donker merke op die voor-lerke.

**Skade:** Blaar- en stamskade dieselfde as mieliestamboorder. Oesverlies a.g.v. kopskade deur hierdie boorder is minder as die mieliestamboorder.



Larf/Larva



Mot/Moth

**Chilo borer**  
***Chilo partellus***  
**(Lepidoptera: Crambidae)**

**Larva:** Cream white in color with four rows of dark dots on body. They are about 3 cm long.

**Moths:** Grey brown in color with darker markings on forewings.

**Damage:** Leaf and stem damage are the same as for the maize stem borer. Yield loss due to ear damage by this borer is less than that of the maize stem borer.



Beskadigde stam/Stem damage

**Pienkstamboorder**  
***Sesamia calamistis***  
**(Lepidoptera: Noctuidae)**

**Larf:** Boonste deel van die larf se lyf is lig tot donker-pienk. Onderste deel is ligkleurig en kan effens geel getint wees.



Larf/Larva

**Motte:** Voorvlerke se kleur varieer vanaf vaal grysbruin tot rooibruin. In die middel van die vlerk is 'n lengte-verlopende strook wat donkerder vertoon as die res van die vlerk.



Mot/Moth

**Skade:** Dooiehartstiptome (verlepte of dooie kelk) is die eerste teken van pienkstamboorderskade, wat verskil van die mieliestamboorder en die chilo-boorder waaraan gewoonlik eers "haelkorrelskade" sigbaar is en dan volg die dooiehart. Larwes boor direk in die stam in en vreet nie eers aan die kelblare soos die ander stamboorders nie. Larwes verkies die onderste gedeelte van die stam en kan die hele stam uithol. Larwes wat die kop aanval, vreet en vernietig gewoonlik 'n paar rye mieliepitte.

**Pink stem borer**  
***Sesamia calamistis***  
**(Lepidoptera: Noctuidae)**

**Larva:** Upper part of the larval body is light to dark pink. Lower part of the body is light colored and can even have a yellowish color.

**Moths:** Front wings vary from greyish brown to reddish brown. In the middle of the wing is a longitudinal stripe that appears darker than the rest of the wing.

**Damage:** Dead heart symptoms (wilted or dead whorl leaves) are the first symptoms of pink stem borer, which differ from the maize stem borer and the chilo borer where first shot hole damage is observed and then followed by a dead heart. Larvae penetrate stems directly and do not feed on whorl leaves like the other stem borers. Larvae prefer the lower part of the stem and the whole stem can be damaged. Larvae that attack ears usually damage a few rows of maize kernels.



"Dooiehart" simptome/"dead heart" simptome

**Afrika bolwurm**

***Helicoverpa armigera***

**(Lepidoptera: Noctuidae)**

**Larf:** Kenmerkende patroon van drie donker lyne geskei deur 'n bleekwit lyn. Donker lyne kan geel, groen, pienk, bruin of swart wees. Daar is een prominente bleekwit lyn op elke sy van die liggaam.

**Motte:** Bruin, groen, geel- of grysbruin met donker merke op voorvlerke. Agtervlerke is vaal met donker vlerkare.

**Skade:** Larwes kan groot gate regdeur die kelkrol vreet maar verkies om op die kop te vreet. Kenmerkende uitskeidings is altyd by vreetskade teenwoordig. Larwes op die kop vreet die baard van jong koppies af tot so 'n mate dat bestuiwing nie kan plaasvind nie. Larwes vreet ook die punte van reeds bestuifde koppe oop, wat lei tot kopvrot wanneer reënwater by die oop punte inloop.



**Larf/Larva**



**Mot/Moth**

**Africa bollworm**

***Helicoverpa armigera***

**(Lepidoptera: Noctuidae)**

**Larvae:** Characteristic patterns of three longitudinal dark bands separated by pale ones. Color of bands may vary between yellow, green, pink, brown and black. There is one prominent pale band on each side of the body.

**Moths:** Forewings of moths are brown, green, yellow brown or grey brown in color with darker brown markings. The hind wings are pale with dark veins.

**Damage:** Larvae can eat large holes through the whorl leaf roll but prefer ears. The presence of fecal granules near feeding sites is characteristic of bollworm presence. Larvae feed on silks of young ears to such an extent that pollination cannot occur. Larvae also open the tips of pollinated ears by feeding on the top part of leaves and kernels that can lead to ear rot when rain enters the ear.



**Beskadigde kop/Stem damage**

**Valsbolwurm**  
***Acantholeucania loreyi***  
**(Lepidoptera: Noctuidae)**

**Larf:** Larwes het ook die kenmerkende vaal streep aan die sye soos die Afrika bolwurm maar is gewoonlik vaalpienk van kleur.

**Motte:** Voorvlerke is vaal van kleur en are loop prominent in die lengte. Agtervlerke is wit met are dieselfde vaalkleur as voorvlerke.

**Skade:** Jong larwes kan blare tot so 'n mate beskadig dat slegs blaarnerwe oorbly terwyl ouer larwes die hele plaar kan opvreet. Skade kan ook aan mieliekoppe aangerig word wat ooreenstem met die skade van die Afrika bolwurm.



Larf/Larva



Mot/Moth

**False bollworm**  
***Acantholeucania loreyi***  
**(Lepidoptera: Noctuidae)**

**Larvae:** Larvae have the characteristic white bands along the sides similar to the African bollworm but their color is pale pink.

**Moths:** Forewings of moths are pale with longitudinal veins. Hind wings are white with the same pale color veins as fore wings.

**Damage:** Leaves are skeletonized by young larvae, and later older larvae become gregarious and feed voraciously, eating entire leaves. Damage to maize ears is similar to that caused by the African bollworm.



Blaar skade/Leaf damage

**Gewone snywurm**  
***Agrotis segetum***  
**(Lepidoptera: Noctuidae)**

**Larf:** donker-vuilgrys of bruin van kleur met 'n gladde, wasagtige voorkoms. Wanneer gesteur word rol larf soos 'n ringtjie op. Larwes word gewoonlik 20-50mm onder die grondoppervlak naby 'n afgevrete saailinge aangetref.

**Mot:** dofgrys, bruin of soms byna grysswart van kleur en het wit agtervlerke. Die voorvlerke van die mot het 'n kring- en niervormige merkie op.

**Skade:** Larwes vreet jong saailinge op grondvlak af. Hulle beskadig ondergrondse stamme van ouer saailinge deur 'n netjiese skoon gat daarin te vreet.



Larf/Larva



Mot/Moth

**Common cutworm**  
***Agrotis segetum***  
**(Lepidoptera: Noctuidae)**

**Larvae:** dark dirty grey or brown in color with a smooth, waxy appearance. When disturbed, the larva usually curls itself into a ring shape. It is usually found 20-50mm below the soil surface near severed seedlings.

**Moths:** grey, brown or sometimes grey black in color and have white hind wings. The forewing of the moth has a circular and kidney shaped marking.

**Damage:** larvae sever young seedlings at soil level. They damage subterranean stems of older seedlings by eating a neat and clean hole in it.



Beskadigde saailing/  
 Seedling damage

**Swartmieliekewer**  
***Heteronychus arator***  
**(Coleoptera: Scarabaeidae)**

**Larf:** tipiese miswurms. Larwes is wit en het bruin koppe en is gewoonlik C-vormig gekrul. Derminhoud gee aan die punt van die agterlyf 'n kenmerkende blou-grys kleur.

**Kewer:** blinkswart en 12-15 mm lank. Dieselfde voorkoms as miskruiers.

**Skade:** larwes rig geen skade aan nie en voed op organiese materiaal in die grond.

Kewers beskadig ondergrondse stamme van saailinge deur uitgerafelde gate daarin te vreet. Gedurende herfs word stamme van ower plante bo die grond oppervlak uitgerafel en stutwortels afgevreet.



Larf/Larva



Kewer/Beetle

**Black maize beetle**  
***Heteronychus arator***  
**(Coleoptera: Scarabaeidae)**

**Larvae:** typical white grubs. They are white with brown heads and are usually curled into a C shape. Gut contents give a conspicuous blue-grey color to the tip of the abdomen.

**Beetles:** shiny black and 12-15 mm long. They resemble dung beetles.

**Damage:** larvae do not cause damage and feed on organic material in the soil.

Beetles damage subterranean stems of seedlings by eating freyed holes in it. During autumn, stems of older plants are freyed above the soil surface and brace roots are destroyed.



Beskadigde saailing/  
 Seedling damage

**Valsdraadwurm**  
***Somaticus angulatus***  
**(Coleoptera: Tenebrionidae)**

**Larf:** roomwit en die kop vertoon rooi-bruin.

**Kewer:** tipiese toktokkies, grys-swart, met 'n duidelike afgebakende kop, bors en agterlyf.

**Skade:** Larwes beskadig ondergrondse stamme van saailinge deur uitgerafelde gate daarin te vreet.

Kewers rig geen skade aan nie.

**False wire worm**  
***Somaticus angulatus***  
**(Coleoptera: Tenebrionidae)**

**Larvae:** creamy white and the heads appear reddish brown.

**Beetles:** typical toktokkie or tapping beetles, grey black, with head, thorax and abdomen clearly separated by constrictions.

**Damage:** Larvae damage subterranean stems of seedlings by eating freyed holes in it.

Beetles do not cause damage.



Larf/Larva



Kewer/Beetle



Saailingskade (regs) in vergelyking met saailing met saadbehandeling (links)/ Seedling damage (right) compared to seedlings with seed dressing (left).

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## AFRIKA KOMMANDOWURM

**Die Afrika kommandowurm,  
*Spodoptera exempta*  
(Lepidoptera: Noctuidae)**

Die Afrika kommandowurm is wyd verspreid in Afrika suid van die Sahara en is 'n ernstige plaag in lande noord van Suid-Afrika. Kenmerkend van kommandowurm is die onverwagse plaaguit-

brake wat voorkom en lei tot die naam "mystery worm". Groot areas van weiding, grasperke en gras gewasse (bv. mielies en sorghum) word selde aangetref deur groot kolonies van larwes. Klein uitbrake kom gereeld voor veral in hoë-reënval areas van Mpumalanga en KwaZulu-Natal maar groot uitbrake soos vanjaar kom slegs elke 6-10 jaar voor. Die ergste uitbrake in Suid-Afrika



**Kommandowurmmigrasie/Armyworm migration**

kom voor in seisoene waar laat somer reën geval het na droogte-toestande.

Die mot is bruin van kleur met wit agtervlerke en kenmerkende donkerder patrone aan die voorvlerke. Motte kan migreer oor duisende kilometers veral tydens die jare wat daar plaag uitbrake is. Die groot migrasie motvlugte begin vroeg aand en motte kan 'n hoogte

van tussen 300-1000m bo grondvlak bereik. Motte beweeg windaf op lugstrome gewoonlik vanaf warmer, noordelike buurstate soos Zambië, Zimbabwe of Mozambiek na Suid-Afrika. Motte lê eiers in groepies van 100-400 en 'n enkele wyfie kan tot sowat 1000 eiers lê. Eiers broei uit binne 3-6 dae ahangend van temperatuur en



**'n Tipiese kommandowurm/A Typical armyworm**

humi-diteit. Larwes groei tot 'n lengte van sowat 25 mm, kom swart voor met groen/geel strepe oor die lengte van die lyf en het 'n kenmerkende V-vormige merk op die kopkapsule. Uitgegroeide larwes word papies in die grond.

Vir doeltreffende beheer moet die larwes vroegtydig waargeneem word. Indien larwes eers waargeneem word as hulle al amper uitgegroeï is, is dit

gewoonlik te laat om chemies te beheer aangesien skade al klaar aangerig is en daar nie noodwendig 'n tweede generasie sal wees nie. Waar larwes nog beweeg van een land na 'n ander kan 'n voor geploeg word waarin larwes vasgevang word en waar hulle dan toegeploeg kan word of chemies beheer kan word.



**Kommandowurms wat vreet aan gras/Armyworms feeding on grass**

## AFRICAN ARMYWORM

### **The African Armyworm, *Spodoptera exempta* (Lepidoptera: Noctuidae)**

The African Armyworm is widely distributed in Africa south of the Sahara, and is a serious pest in countries north of South Africa. A characteristic feature of armyworm outbreaks is their unexpected sudden appearance, and this has led to the common name of "mystery worm". Often, large areas of lawn, pasture or grass crops (like maize and sorghum) are seen to be covered in dense colonies of larvae, virtually overnight. Small outbreaks occur frequently in the high-rainfall areas of Mpumalanga and KwaZulu-Natal, but a large outbreak such as the one this year occurs only once in every 6-10 years. The worst outbreaks in South Africa occur in seasons where there are "late summer rains" after drought conditions.

Moths have brown forewings and whitish hind wings with recognized dark brown patterns on the forewings. Moths are capable of migrating thousands of kilometers especially during outbreak years. The main migration flights of the moths start in early night time, and moths

ascend to a height of anything between 300-1000m above ground level. Moths move downwind on prevailing air currents. In most parts of South Africa the infestations are usually due to moths migrating from warmer, more northerly areas, often from Zambia, Zimbabwe or Mozambique to South Africa. The eggs are laid in groups of 100-400. A single female lays several egg masses and up to 1000 eggs. The eggs hatch within 3-6 days depending on temperature and humidity. Larvae can grow to about 25mm long, are blackish with green/yellow lines running along the length of the body and have a characteristic V-shape mark on the front of the head capsule. Fully grown larvae pupate in the soil.

For effective control measures larvae need to be detected early. If larvae are discovered when fully grown, the use of insecticide control is often not recommended as most of the damage to crops will already have been done, and the likelihood that a second generation will emerge is very small. Where larvae move from one field to another a furrow can be ploughed to create a pitfall where larvae can be trapped, ploughed under or controlled with insecticides.

## MIELIEWORTELVORM

**Hierdie minder bekende plaag** is al gerapporteer in KwaZulu-Natal (Vryheid, Bloedrivier, Greytown en Howick) en Mpumalanga (Bethal en Piet Retief). Onlangs is daar ook 'n geval aangemeld in Noord-Wes, Koster distrik waar tot 42% van die mielieplante op landerye beskadig is. Die omgewing het 'n groot rol gespeel want die skade het voorgekom in 'n nuut-voorbereide land wat voorheen 'n grasveld was. Sodra die grasvelde vernietig word is daar geen bron van voedsel nie en dit het waarskynlik

daartoe gelei dat die mieliewortelvorms die gewas aangeval het.

Die mieliewortelvorm is die larfstadium van 'n kewer. Die kewer rig egter geen skade aan mielies aan nie. Die kewer is donkergrys van kleur en die wyfies word tot 7 mm lank en 2.3 mm breed. Die mannetjies is gewoonlik kleiner. Eiertjies is bleek-oranje van kleur, langwerpig en ongeveer 0.9 mm lank en 0.6 mm breed. Die larwes is bottergeel van kleur en silindervormig. Die volgroeiende larwes is ongeveer 10 mm lank. Die kop en laaste agterlyf segment se bo-



**Skade kom kol-kol in die land voor/Damage in the field**



**Tipiese mieliewortelwurm/Maize rootworm**

kant is donkerbruin, terwyl die res van die lyf ligbruin kolle het.

Die eiers word enkel of in groepe van 12 gelê aan graswortels of net onder die grondoppervlak. 'n Wyfiekewer kan tot ongeveer 30 eiers lê wat ongeveer 15 – 18 dae neem om uit te broei. Gedurende die wintermaande verkeer die eiers in 'n rustoestand en broei eers uit gedurende die lente. Hierdie pasuitgebroeide larwes boor dan in die ondergrondse stamme van saailing in. Die larwes vervel drie keer, waarna papiesselle in die grond gevorm word. Die papiestadium duur 7 – 19 dae. Daar is drie tot vier generasies

per jaar, en kewers is veral volop waar digte grasstand voorkom in lande en dan vandaar waar mielie plante vroeër in die seisoen deur mieliewortelwurms aangeval kan word.

Mieliesaaillinge kan so beskadig word dat die plantestand so afneem dat dit nodig mag wees om oor te plant. Plantestand kan tot met soveel as 80% verminder word, maar die besmetting kom gewoonlik kol-kol in die land voor. Die plaag is veral ernstig in jare wanneer goeie lentereën opgevolg word deur 'n relatiewe droë periode. Die eerste waarneembare bogrondse skade stem oor een met die van die Swartmiel-



Larf besig om papiesel te vorm/Larvae making pupal cell.



'n Papie/Pupa.



Waarneembare bo-grondse skade/First visible damage symptoms observed



Ondergrondse skade/Damage symptoms under the soil surface

iekewer en die Valsdraadwurm. Die kelkblare van die mielieplant verwelk en verdroog, en daarna sterf die hele plant af. Plante kan wel hierdie skade wat aangerig is oorleef maar 'n bos nuttelose spruite word dan gevorm. Die skade onder die grond word aangerig deur die larwes wat die ondergrondse stam van die mieliesaailinge binnedring en verskeie gate daarin boor. Indien meer as een larf per plant voorkom, mag die larwes die plant verlaat, oor die grondoppervlak kruip en naburige plante beskadig.

Die larwes vreet net op plante wat aan die grasfamilie behoort. Dit is daarom belangrik om lande waarop mielies geplant gaan, vry te hou van grasagtige onkruid. Dit kan gedoen word deur bewerking of, in die geval van bewaringboerdery, deur bespuiting. Die beste chemiese beheer wat gebruik kan word is saadbehandelings, wat voorkomende beheer bied. Dis egter 'n moeilike plaag om te beheer as skade reeds aan ondergrondse stamme aangerig is omdat dit dan moeilik is om die larf te bereik met chemiese beheer.

## MAIZE ROOTWORM

This less known pest has been recorded in KwaZulu-Natal (Vryheid, Bloedrivier, Greytown and Howick) and Mpumalanga (Bethal and Piet Retief). Recently it is also recorded in the North Wes province, Koster district, with 42% damage to maize plants. The environment played a role because the damage was reported in a new prepared field which previously was a grass field. As soon as the grass was destroyed the only source of food was the maize plants which lead to the rootworm attacking the crop.

The maize rootworm is the larval stage of a beetle. The beetle does not cause damage. The beetle is dark-grey and the female can become 7 mm in length and 2.3 mm in width. The male is usually smaller. Eggs are pale orange, oblong and on average 0.9 mm in length and 0.6 mm in width. The larvae are a butter-yellow colour and cylindrical in shape. The fully grown larvae are about 10 mm long. The head and the last abdominal segment are dark brown, the rest of the body is covered with pale brown spots.

The eggs are laid singly or in clusters of up to 12, either attached to grass roots or just below ground level. The female beetle can lay up to 30 eggs and hatch in about 15 – 18 days. During the winter months the eggs remain in a dormant state and hatch during spring. After hatching, the larvae start feeding

and burrow into the subterranean stem of the maize seedling. The larvae moult three times after which pupal cells are constructed in the soil. The pupal stage is from 7 to 19 days depending on weather conditions. There is three to four generation per year, and the beetle is dense in grass fields where the maize plants had been depleted earlier in the season by maize rootworm.

Maize rootworm could cause serious damage to maize seedlings and reduce plant density to such an extent that it might be necessary to re-plant. Plant density could be reduced by as much as 80%, but infestation usually only affects certain patches in the field. The pest becomes particularly serious during years when good spring rains are followed by a long, relatively dry period. The first visible damage symptoms observed are similar to those of maize infested by black maize beetles or false wireworms. Firstly, the whorl wilts and dries after which the entire plant wilts and dies. Some plants survive these attacks by producing a lot of useless tillers. Damage symptoms under the soil include larvae burrowing a tunnel into the mesocotyl of the maize seedlings and feed a range of holes into the stem below the soil surface. When more than one larva is on a plant, some larvae may leave the plant, crawl over the soil surface and bore into neighbouring plants.

Maize rootworm only feed on plants belonging to the grass family. Therefore, it is important to keep fields free from weed grasses where maize will be planted. This can be accomplished by cultivation or in the case of conservation farming, with spray applications. The best chemical control that can be used is seed dressing insecticides which can

be applied as a preventative control. However, this is a difficult pest to control with insecticides when under soil surface damage has already take place.

## BAGRADA BESIE

'n **Onbekende insekplaag** op mielies is onlangs in die Noordwes-provinsie opgemerk. Die spesie is geïdentifiseer as die Bagrada besie (*Bagrada hilaris*). Oor die algemeen is hierdie spesie 'n plaag op koolgewasse en geen geval is bekend waar mielies al in die verlede aangeval is nie. Die skade kom kol-kol in landerye voor. Die voorafgaande gewasse kon moontlik 'n rol gespeel het in die uitbraak van hierdie plaag. Voorafgewasse was rape, lusern en hawer wat moontlik die bron van infestasië kon veroorsaak.

Die Bagrada besie is 'n suigbesie. Die primêre plantgasheerspesies waarop hi-

erdie besie voed behoort aan die Brassicaceae familie. Dit is ook al gerapporteer dat die besies ander gewasse (sekondêre gewasse) aan val wat naby 'n brassica gewas met besie-besmetting geplant word.

Nimfe is 1 mm in lengte as hulle uitbreei en ontwikkel vinnig in volwasse besies wat 5 – 7 mm groot is. Die besie is swart met rooi-oranje opvallende patrone. Die volwasse besie het vlerke maar vlieg selde en kan lang afstande loop om gewasse aan te val. Wyfies lê die eiers op die grond en soms op blare. Die eiers is vir eers wit en word later oranje. 'n Wyfie kan meer as



**Skade kol-kol in landerye/Damage only recorded in certain patches in the field.**

100 eiers lê waarna die eiers in sowat 'n week se tyd uitbroei. Die nimfe wat sowat twee tot drie weke om volwasseheid te bereik. 'n Paar generasies kan tydens 'n seisoen voorkom as omstandighede gunstig is.

Bagrada besies kom in swarms voor en vreet in groepe. Die volwasse besie en die nimfstadium val alle bo-grondse plantdele aan. Die besie het suigende monddele waarmee sap uit plantweefsel onttrek word. Hulle dra egter geen toksiene oor na die plant nie. Skadesimptome verskil tussen verskillende gewasse. Oor die algemeen is daar tekens van blaarverkleuring, waar sap uit die blaar gesuig word en geel en wit vlekies kom op blare voor waar

die besies voed. Hierdie vlekies kom oor die algemeen op die rand van die blaar voor. Die rand het dan 'n uitgedroogte voorkoms en kan ook opkrul namate die skade erger word.

Die bewerking van grond waar brassyca gewasse geplant was sal help om eiers wat op die grond gelê is te verminder. Ou plantmateriaal wat op die grond lê en die nimfe huisves kan ook verwyder word om sodoende te voorkom dat nog 'n generasie ontwikkel. In die geval van bewaringsboerdery waar grond nie bewerk word nie, kan daar gebruik gemaak word van 'n kontakinsedoder wat op die grond gespuit kan word om nimfe en volwasse besies te beheer.



**Bagrada besie met suigende monddele/Bagrada bug with sucking mouthparts.**



**Blaarskade/Leaf damage.**

### **Verdere leesstof**

Annecke, D.P. and Moran, V.C. 1982. Insects and Mites of Cultivated Plants in South Africa. Butterworths, Durban/Pretoria.

Visser, D. 2009. A Complete Guide to

Vegetable Pests in South Africa. Agricultural Research Council, Roodeplaat Vegetable and Ornamental Plant Institute, Pretoria. Pp 102 – 106.

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## BAGRADA BUG

**An unknown insect pest** on maize is recently reported in the North West province. The species is identified as the Bagrada bug (*Bagrada hilaris*). This species is usually a pest on cabbage crops with no reports of maize being attacked. Damage is only recorded in certain patches in the field. The previous crop planted, radish, lucerne and oats, can explain the possible source of infestation.

The Bagrada bug has sucking mouthparts. The primary host plants on which this bug feeds belong to the Brassicaceae family. It is also reported that this pest can attack other crops (secondary crops) where brassica crops do have high infestation levels.

Hatchlings are 1 mm in length and develop quickly into adults that reach 5 – 7 mm. The bug is black with orange-red markings over the entire body. Adults have wings, but rarely flies and can walk considerable distances to infest new plants. Females lay their eggs on the ground or less commonly, on foliage. The eggs are white and then turn orange. A female bug can lay more than 100 eggs which can hatch within a week's time. The nymphs take two to three weeks to reach maturity. A few generations may be produced per season if conditions are favourable.

Bagrada bugs are gregarious and feed in groups. The adults and nymphs attack above-ground plant parts. The

bugs have sucking mouthparts with which plant fluids are sucked from green plant material. However, they do not inject toxins to the plant. Damage symptoms differ between different crops. Feeding results in white or yellow markings where feeding has taken place. The damage can usually be seen at the outer edges of the leaves. The outer edges may dry out and turn brown if damage is severe.

The cultivation of soils where brassica crops have been planted may help reduce the viability of eggs that are laid on the soil. Old leaves or harvested crops should be destroyed which can be a source where nymphs survive. In the case of conservation farming where no or minimal soil disturbance takes place the use of a contact insecticide being sprayed on the soil can be used to control nymphs and adult bug.

### Further reading:

Annecke, D.P. and Moran, V.C. 1982. *Insects and Mites of Cultivated Plants in South Africa*. Butterworths, Durban/Pretoria.

Visser, D. 2009. *A Complete Guide to Vegetable Pests in South Africa*. Agricultural Research Council, Roodeplaat Vegetable and Ornamental Plant Institute, Pretoria. Pp 102 – 106.

**VOORDELIGE INSEK SPESIES / BENEFICIAL INSECT SPECIES****Wespe/wasp*****Cotesia sesamiae***

Klein wespes (4-6mm) val stamboorder-larwes aan. Nadat die wyfie die stamboorder geparasiteer het deur eiertjies binne in die liggaam van die larf te lê, ontwikkel klein wespe-larfies in die stamboorder. Daarna kom die wespe larwes uit die stamboorder uit en vorm kokonne waaruit die wespes dan weer kom. Daar kan ongeveer 20 - 30 wespe larwes uit een stamboorder kom.

Small wasps attack stem borer species. After the female wasp has parasitized the stem borer larvae by laying eggs inside it, wasp larvae develop in the stem borer. Wasp larvae then emerge from the stem borer to spin cocoons. From these cocoons wasps again emerge. Approximately 20 - 30 wasps can come from one stem borer.



**Kokonne voordat wespes uitkom/Cocoons before wasps emerge**

**Parasitiese vlieg / Parasitic fly*****Sturmiopsis parasitica***

Hierdie parasitiese vlieg val ook verskeie plaë aan tydens die larf stadium. Daar kom oor die algemeen slegs een vlieg maaier uit 'n larf wat aangeval is deur 'n vlieg maar daar is al gerapporteer dat tot vyf maaiers uit een larf kan kom. Sodra vliegmaaiers byvoorbeeld uit 'n stamrusperlarf kom word hulle papies wat weer oorsprong gee aan 'n vlieg.

This parasitic fly attacks various pests during their larval stage. Overall only one fly maggot emerges from a pest larva but up to five maggots have been reported. Maggots emerge from for example stem borer larvae and pupate to become flies again.



**Maaier besig om uit stamboorder larf te kom/Maggot emerging from stem borer larva**

**Oorkruipers / Earwigs**

Oorkruipers het kouende moddele en is goeie predatore wat 'n wye reeks insekplae aanval. Oorkruipers gebruik hul knypers om hul prooi te vang en begin dan vreet aan die prooi. Wyfies lê so-wat 50 eiers in 'n nes onder die grond en voorsien die nimfe van kos totdat hul groot genoeg is om die nes te verlaat.

Earwigs are good predators with chewing mouth parts. They attack various kinds of insect pests. Earwigs use their pincers to attack prey and then start feeding. Females lay about 50 eggs in burrows and care for their early nymphs by providing them with food until they are big enough to survive on their own.



**Oorkruiper wat stamboorder aanval/Earwig attacking stem borer**

**Tierkewers / Tiger beetles**

**Carabidae**

Tierkewers is ook predatore wat kouende monddedele het waarmee hulle hul prooi aanval. Tierkewers is ingestel op beweging en kan prooi selfs groter as hulself aanval. Hul prooi kan bestaan uit sekere ander kewers, larwes, miere, sprinkane en spinnekoppe.

Tiger beetles are also predators with chewing mouth parts with which they attack their prey. Their vision is acute, as any movement causes the beetle to turn and face the source of motion, they can also attack prey that may be larger than themselves. Beetles, larvae, ants, grasshoppers and spiders are just a few of their reported prey.



**Tipiese tierkewer/Typical tiger beetle**

## PLANT PARASITIESE AALWURMS OP MIELIES

### INLEIDING

Die meeste produsente is bewus van die teenwoordigheid van plantparasitiese aalwurms maar aalwurmsimptome is nie altyd spesifiek nie en kan maklik verwar word met tipiese simptome wat deur plaagdoderskade, versuiptoestande en voedingstekorte veroorsaak word. Die impak wat aalwurms op 'n mielieoes kan hê, word daarom dikwels nog onderskat. Uit 'n opname wat tydens die 2008/2009 seisoen regoor die mielieproduksie gebied uitgevoer is, is sewentien aal-

wurm-groepe op die mielies geïdentifiseer. Vir die doel van hierdie handleiding sal daar egter net op twee groepe wat die mees algemeenste op mielies voorkom, gefokus word.

### BELANGRIKE PLANTPARASITIESE AALWURMS OP MIELIES

#### 1. Knopwortelaalwurms (*Meloidogyne* spp.)

Knopwortelaalwurms is die mees



Foto: Dr. Chris Schmidt: Sidi Parani

**Fig.1. Bogronde simptome by mielies in 'n aalwurm besmette land.**

prominente groep wat in die mielie produksiegebied voorkom. 'n Tipiese knopwortelaalwurm populasie in 'n mielieland bestaan uit 'n mengsel van *M. incognita* en *M. javanica*. Beide spesies het 'n wye gasheerreeks, wat beteken dat hulle ook op ander gewasse kan parasiteer en ontwikkel. Onder optimale toestande kan 'n knopwortelaalwurmwyfie uit die eier uitbroei en binne 20 tot 25 dae gereed wees om eiers te lê. 'n Enkele wyfie is in staat om oor die 1 000 eiers in haar leeftyd te produseer.

**Simptome wat met knopwortelaalwurm besmetting geassosieer word**

Die bogrondse gedeeltes van plante wat met knopwortelaalwurm besmet

is, lyk verdwerg, geel en groei oneweredig. Hierdie simptome vertoon tipies as geel kolle in die land en is nooit eweredig versprei nie (Fig. 1). In lande met baie hoë knopwortelaalwurm besmettings sal die plante vrek voordat hulle nog geoes kan word.

Galle wat op die wortels deur voedende knopwortelaalwurm wyfies (Fig. 2) gevorm word, is nie altyd sigbaar nie en hang van die spesies en die hoeveelheid aalwurms wat op die plant voed, af. Die afwesigheid van galle is dus nie noodwendig 'n aanduiding dat daar nie 'n knopwortelaalwurm populasie in die land teenwoordig is nie. As die galle wel sigbaar is (Fig. 3) kan dit redelik maklik op die wortels geïdentifiseer word en varieër in



**Fig.2.** Knopwortelaalwurm wyfies (wit) in wortelweefsel.



(Foto: Dr Chris Schmidt: Sidi Parani)

**Fig.3.** Galle wat deur knopwortelaalwurms op mieliewortels veroorsaak is.

grootte en hoeveelheid. Galle word gevorm deur reuse selle wat deur die wyfie geïnduseer word terwyl sy voed. Skade wat dus reeds op die wortels teenwoordig is, is onomkeerbaar. Die skade- en voortplantingspotensiaal van knopwortelaalwurms verhoog dikwels gedurende die reënseisoen, veral as daar 'n buitengewone hoë reënval gedurende die seisoen voorgekom het.

### Oorlewing

As daar nie 'n geskikte gasheer beskikbaar is nie, kan knopwortelaalwurms wel op verskeie onkruid wat algemeen in 'n mielieland voorkom, voortplant en oorleef. Knopwortelaalwurms se belangrikste oorlewingsstrategie gedurende die winter is egter om in onuitgeboreide eiers wat in die grond en in plantreste wat na oes in die land agter gelaat is voorkom, te oorleef. Die eiers is instaat om vir 'n onbepaalde tyd in die rustoestand bly en sal slegs uitbloeï as die toestande weer gunstig vir die aalwurm is.

## 2. Letselaalwurms (*Pratylenchus spp.*)

Letselaalwurms is sporadies maar as hulle wel voorkom, is dit gewoonlik in hoë getalle en daarom kan hierdie aalwurm nie onderskat word nie. Plaaslik kom *P. zae* en *P. brachyurus* die mees algemeenste voor op mielies en word naas knopwortelaalwurm as die belangrikste aalwurms op mielies geag. Van die twee letselaalwurmspesies rig

die meer patogeniese *P. brachyurus* die meeste skade aan. In gevalle waar altwee spesies egter in dieselfde land voorkom, sal die minder patogeniese *P. zae* 'n groter deel van die bevolking uitmaak omdat sy lewenssiklus korter is, hy vinniger kan voortplant en 'n hoër tolleransie vir 'n wyer reeks temperature het. Beide spesies floreer egter in 'n wye reeks grondtipes. Vog is 'n faktor wat 'n belangrike rol speel in die voortplanting en skadepotensiaal van letselaalwurms, wat dikwels gedurende die reënseisoen kan verhoog.

### Simptome wat met letselaalwurm besmetting geassosieer word

Gewoonlik is daar 'n beduidende verlaging in die chlorofil inhoud van die blare en die plante is verdwerg. Bognondse simptome is egter nie baie spesifiek nie omdat die voorkoms van die simptome bepaal word deur die spesies teenwoordig, die hoeveelheid aalwurms wat op daardie tydstip voorkom (populasie digtheid) en omgewingstoestande. Bognondse simptome wat wel sigbaar is sal, net soos die simptome by die knopwortelaalwurm, in kolle voorkom en nooit eweredig regoor die land versprei wees nie.

Wortelskade deur letselaalwurms kan dikwels geïdentifiseer word deur die teenwoordigheid van klein letseltjies wat op die worteloppervlakte voorkom. Die epidermis waar al die

wortelhare gevorm word, word vernietig as die aalwurm voed. Dit kan tot erge nekrose lei wat dan veroorsaak dat die plant water en voedingstowwe swak opneem. Letsels kan ook deur fungi en bakteriële geïnfecteer word (sekondêre infeksie). Dit is dus baie moeilik om die simptome van letselaalwurm besmetting te identifiseer omdat dit maklik met simptome wat deur ander biotiese en abiotiese faktore veroorsaak is, verwar word.

### Oorlewing

As klam grond toegelaat word om stadig uit te droog, kan beide letselaalwurm spesies in anhidrobiose ingaan. Anhidrobiose is 'n rustoestand waarmee die letselaalwurm in staat is om vir byna ses maande deur droogteperiodes te oorleef. Hierdie oorlewingsstrategie stel die aalwurm in staat om die tydperk tussen twee mieliegroeienseisoene suksesvol te kan oorleef. Anhidrobionte sal weer aan die begin van die reënseisoen ten volle herstel sodra die mielies begin ontkiem. Die oorgrootte meerderheid van die populasie oorleef egter die droë seisoen in onuitgeboreide eiers. Die eiers sal slegs uitbroei as die mielies begin ontkiem en die omgewingstoestand gunstig is vir die aalwurm om te oorleef en te ontwikkel.

### VERSPREIDING VAN AALWURMS

Aalwurms is mikroskopies klein en kan nie vreeslik ver op eie stoom beweeg nie. Hulle moet dus op ander maniere staatmaak om te kan versprei van een land na 'n ander toe. Water is waarskynlik een van die mees effektiëste metodes wat die aalwurm gebruik om mee te kan versprei. Water vanaf lande wat reeds met aalwurms besmet is asook water van besproeiingskanale en damme kan lande wat deur die kanale en damme bedien word, herbesmet. Aalwurms kan ook op die mens reken om hom rond te dra en te versprei. Grond en soms ook plantreste wat aan implemente of skoene van werkers wat in besmette lande gewerk het vassit, kan eiers bevat wat dan weer na 'n volgende land toe oorgedra word.

### DIE BESTUUR VAN AALWURMS OP MIELIES

Dit is feitlik onmoontlik om die hele aalwurmpopulasie in 'n land uit te roei. Daar sal altyd 'n klein hoeveelheid eiers en/of wurmpies oorleef, ongeag die beheermaatreël wat 'n produsent toepas om hulle te probeer beheer. Die hoof doel van aalwurmbeheer is eerder om die aalwurmgatelle in 'n land laag genoeg te hou sodat die skade wat deur hulle veroorsaak word nie lei tot ekonomiese verliese vir die produsent nie (hou die aalwurmpopulasie onder skade- en ekonomiese

drumpelwaardes). Die volgende beheermaatreëls kan gebruik word om aalwurmpopulasies onder skade- en ekonomiese drumpelwaardes te hou. As twee of meer van hierdie beheermaatreëls met mekaar gekombineer word, sal dit net nog meer voordele vir die produsent inhou:

### **Chemiese beheer**

Die meeste produsente steun nog steeds swaar op chemiese beheer om aalwurms in bedwang te hou. Huidiglik is carbofuran, carbosulfan en terbufos as nematisiedes op mielies geregistreer en kan slegs met plant toegedien word. Dit is uiters belangrik om die instruksies op die etiket tot op die letter na te volg om sodoende die minimum impak op menslike en dierlike gesondheid sowel as op die omgewing uit te oefen.

Onvoorspelbare omgewingstoestande (bv 'n onnatuurlike hoë reënval) lei daartoe dat die effektiwiteit van chemiese middels vir die beheer van aalwurms nie altyd gewaarborg kan word nie. Produsente word dus ten sterkste aangeraai om die gebruik van nematisiedes verkieslik met nog 'n beheermaatreël te kombineer.

### **Wisselbou**

Wisselbou is een van die belangrikste beheermaatreëls beskikbaar vir die produsent. Nie net kan wisselbou die aalwurmgetalte onder beheer hou nie

maar dit kan ook die mikrobiële diversiteit in die grond verhoog en die natuurlike vyande wat die aalwurms weer op hulle beurt aanval, vermeerder. Die beplanning van 'n effektiewe wisselboustelsel hang egter af van die aalwurmspesies wat teenwoordig is en om bewus te wees van die gasheer voorkeure van daardie spesifieke aalwurmspesies. 'n Suksesvolle wisselboustelsel sal die vatbare gewas (bv mielies) opvolg met swak gasheer of met gewasse wat glad nie gasheer vir die aalwurmspesies is nie.

### **Weerstandbiedende kultivars**

Weerstandbiedende kultivars is 'n koste effektiewe, omgewingsvriendelike beheermaatreël wat maklik in reeds bestaande plaagbeheerprogramme ingesluit kan word. Dit is weereens essensieël om te weet watter aalwurmspesies in die land voorkom omdat kultivars slegs weerstand teen een van die spesies mag hê. Waar moontlik en indien beskikbaar is dit 'n goeie keuse om weerstandbiedende kultivars in 'n bestaande produksiesisteam in te sluit.

### **SAMEVATTING**

Onvoorsiene faktore soos uitermatige hoë reënval of die gebrek daaraan, onvoorspelbare temperatuurkommelinge en grondtekstuur kan gunstige toestande vir die aalwurm skep om in te floreer al het die produsent al die reëls tot op die letter nagevolg. As 'n

produsent dus vermoed dat aalwurms die beperkende faktor is wat voorkom dat hy die maksimum oesopbrengs van sy gewas verhaal, word dit aanbeveel dat daar grond en wortelmonsters na die LNR-Instituut vir Graangewasse

toe gestuur word sodat dit geanaliseer kan word vir die teenwoordigheid van plantparasitiese aalwurms.

## PLANT-PARASITIC NEMATODES ON MAIZE

### INTRODUCTION

Most producers are aware of the presence of plant-parasitic nematodes but symptoms resulting from nematode damage are not always specific and can easily be confused with symptoms typically associated with damage caused by pesticides, water logging and nutrient deficiencies. The impact of nematodes on maize yields is, therefore, often under estimated. From a survey conducted all over the maize production area during the 2008/2009 growing season, seventeen nematode groups have been identified to be as-

sociated with maize. However, for the purposes of this information guide only the two most important genera commonly present in maize fields will be discussed.

### IMPORTANT PLANT-PARASITIC GENERA ASSOCIATED WITH MAIZE

#### 1. Root-knot nematodes (*Meloidogyne* spp.)

Root-knot nematodes are the most prominent genera throughout the maize



Foto: Dr Chris Schmidt: Sidl Parani

**Fig.1. Aboveground symptoms of maize in a nematode infested field.**

production area. A typical root-knot nematode population in a maize field consists of mixed *M. incognita* and *M. javanica* populations. Both species have a wide host range, which means that they can parasitise and develop on crops other than maize. Under optimal conditions a root-knot nematode female can hatch from its egg and be ready to lay eggs in approximately 20 to 25 days. A single female can produce over 1 000 eggs during her lifetime. Damage that is already inflicted on the roots will, therefore, remain irreversible. The damage and reproduction potential of root-knot nematodes often increase during the rainy season, especially in seasons where an unnaturally high rainfall occurs.

**Symptoms associated with root-knot nematode infestation**

Aboveground parts of plants infested with root-knot nematodes are stunted, yellow and patchy in growth. These symptoms can typically be seen as yellow patches in the field that will never be evenly distributed (Fig. 1). In severely root-knot nematode infested fields plants may die before harvest.

Galls formed on the roots by feeding root-knot nematode females (Fig. 2) are not always visible and depends on the species as well as the number of nematodes feeding on the plant. Therefore, the absence of galls is not always indicative of the absence of root-knot nematode populations. If the galls are indeed



**Fig.2. Root-knot nematode females (white) inside root tissue.**



(Foto: Dr Chris Schmidt: Sidi Parani)

**Fig.3. Galls formed by root-knot nematodes on maize roots.**

visible (Fig. 3), it can be identified fairly easily on the roots and range in size and numbers. The galls are formed from giant cells induced from normal plant cells through feeding of the female.

### Survival

In the absence of a suitable host crop root-knot nematodes are able to survive and reproduce on many weed species commonly found in maize fields. However, the main survival strategy of root-knot nematodes during the winter months is to survive in unhatched eggs present in the soil and in plant residue left behind in the field after harvesting. These eggs may stay in this resting phase for an unpredictable time and only hatch when conditions are favourable.

## 2. Lesion nematodes (*Pratylenchus* spp.)

Lesion nematodes occur sporadic but when they do occur, it is usually in high numbers and can therefore not be underestimated. *P. zaeae* and *P. brachyurus* are the most common lesion nematode species associated with maize and second only to root-knot nematodes. Of these two lesion nematode species, *P. brachyurus* is the most pathogenic and causes the most damage. However, when both species occur together in a field, the less pathogenic *P. zaeae* will dominate *P. brachyurus* because of its shorter life cycle, faster reproductive

rate and higher tolerance to a wider range of temperatures. Both species thrive in a wide range of soil types. Moisture is an important factor affecting the reproduction and damage potential of these lesion nematodes, which can increase during the rainy season.

### Symptoms associated with lesion nematode infestation

Plant height and chlorophyll content in the leaves are generally considerably reduced. Aboveground symptoms are, however, not highly specific because symptom expression is affected by the species present, the number of nematodes present at the time (population density) and environmental conditions. If aboveground symptoms do occur, it will be in patches like that of root-knot nematode symptoms.

Root damage by lesion nematodes can often be diagnosed by the presence of small lesions on the root surface. The feeding of the nematodes on the roots causes destruction of the epidermis, which is where the root hairs are formed. This may cause severe necrosis and damage to root hairs, which leads to a poor uptake of nutrients and water by the plant. Lesions caused by lesion nematodes can also be infected with fungi and bacteria (secondary infection). Symptoms caused by lesion nematodes on the roots are difficult to identify because it can be masked by and confused with symptoms other than that caused by nematodes.

## Survival

When moist soil is allowed to dry out slowly, both lesion nematode species are able to enter anhydrobiosis. Anhydrobiosis is a resting phase in which the lesion nematodes are able to survive almost six months of drought. This survival strategy enables the nematode to effectively survive the period between two maize-growing seasons. Anhydrobionts will return to full activity at the start of the rainy season when maize seeds start to germinate. Most of the population however, survives the dry seasons in unhatched eggs, which will only hatch when the seed starts to germinate and environmental conditions are favourable for the nematode to survive and develop.

## DISTRIBUTION OF THE NEMATODES

Nematodes are microscopically small and cannot move long distances on their own. They must, therefore, rely on factors other than their own locomotion to move them from one field to another. Water is probably the most effective agent in distributing nematodes. Water from nematode infested fields and even that from irrigation channels or dams can re-infest fields serviced by those channels or dams. Nematodes can also rely on humans to carry them around. Soil and sometimes also plant rests on implements and on shoes of workers working in infested fields can contain eggs, which will then be transferred to the next field.

## MANAGEMENT OF NEMATODES ON MAIZE

It is almost impossible to completely eradicate a nematode population in a field. A small number of eggs and/or nematodes will always survive, irrespective of the means by which a producer tries to control them. The main aim of nematode management is, therefore, to keep the numbers of the nematodes in the field low enough so that the damage they cause do not translate into economical losses for the producer (keeping the nematode populations below damage and economic threshold levels). The following management tools will help the producer to keep nematode populations below damage and economic threshold levels. Using two or more of these tools in combination with each other will provide even more advantages to the producer and will lessen the risk:

### Chemical control

Most producers still rely heavily on chemical control to keep nematodes in check. Carbofuran, carbosulfan and terbufos are currently registered nematocides for nematode control on maize and can only be applied at planting. Care should be taken to follow the instructions on the label to the letter to ensure minimum impact on human and animal health as well as on the environment.

However, with unpredictable environmental conditions (eg. an unnatural high rainfall) the efficacy of nematicides for nematode control cannot always be guaranteed. Producers are therefore strongly urged to preferably combine the use of nematicides with another management tool.

### **Crop rotation**

Crop rotation is one of the most important management tools available to the producer. Not only can crop rotation keep the nematode numbers under control, it can also increase the microbial diversity in the soil and increase the numbers of natural enemies that attack the nematodes. However, an effective crop rotation system depends on the nematode species present and to know the host preferences of the nematode specie. A successful rotation system will then include the susceptible crop (eg maize) followed up by poor or non-host crops.

### **Resistant cultivars**

Resistant cultivars are a cost-effective, environmentally friendly management tool that can easily be incorporated into existing pest management programmes. Once again it is essential to know the nematode species in the field since cultivars may only be resistant to one of the species. It will be a good choice to incorporate a resistant cultivar in the production system where possible and when available.

### **CONCLUSIONS**

Even though a producer may follow every detail to the letter, factors such as a high rainfall or total lack thereof, unpredictable temperature ranges and soil texture may provide favourable conditions for nematodes to thrive. If a producer therefore suspects that nematodes might be a limiting factor in obtaining the maximum yield from his crop, it is recommended to send soil and root samples to ARC-Grain Crops Institute to be analysed for the presence of plant-parasitic nematodes.

## MONSTERNEMING VIR PLANT PARASITIESE AALWURMANALISES

Omgewingsfaktore en selfs bewerkingspraktyke kan veroorsaak dat aalwurmpopulasies dikwels handuit ruk en groot skade aan gewasse aanrig. As 'n produsent vermoed dat aalwurms die sondebok is wat veroorsaak dat hy 'n verlaagde opbrengs en/of oeskwaliteit afhaal, kan hy grond- en wortelmonsters na die LNR-Instituut vir Graangewasse toe stuur sodat dit vir plantparasitiese aalwurms geanaliseer kan word.

### Wanneer is dit die beste tyd om monsters vir aalwurmanalises te trek?

Aalwurmpopulasies bereik hulle piek in terme van aalwurmgetalle sodra 'n eenjarige gewas begin blom. Daarna begin die populasie stadig maar seker af te neem as gevolg van verskeie faktore soos byvoorbeeld 'n kompetisie tussen mekaar vir kos en minder gunstige omgewingstoestande. Die beste tyd om aalwurmmonsters te neem, is dus wanneer die gewas begin blom. Die enigste uitsondering is grondbone. Anders as die ander aalwurmspesies, piek peul-aalwurmpopulasies (die belangrikste grondboonparasiet) eers met oes tyd wanneer die oorgrote meerderheid van die populasie in die peule voorkom. Grondbone moet dus eers met oes gemonster word.

### Hoe moet die monsters getrek word?

Dit is baie belangrik dat daar grond en wortels teenwoordig moet wees. As daar net grondmonsters ingestuur word, kan net die aalwurms wat op daardie tydstip in die grond voorkom, geïdentifiseer word. Op so 'n manier gaan baie van die wortelparasiete wat meestal net in die wortels voorkom, verlore. Die tellings sal dan nie 'n betroubare weerspieëling van die werklikheid gee nie. As dit 'n gewas soos grondbone of groente is wat hulle oes onder die grond dra, moet daar van die peule/knolle ook ingesluit word. Hoe meer monsters van 'n land af getrek word, hoe beter die kans dat daar 'n ware weerspieëling van die aalwurmbevolking gekry kan word. Monsters kan in 'n zig-zag patroon getrek word, veral in kolle wat simptome vertoon. Koste kan 'n rol speel, daarom verkies baie produsente om van hierdie monsters bymekaar te gooi, dit te meng en dan 'n verteenwoordigende monster(s) te stuur.

### Hoe moet die monster gehanteer word?

Die hele plant moet uitgespit word sodat die grond rondom die wortelstelsel behoue kan bly (Fig. 1). Die aalwurms sal in die grond direk om die wortelstelsel voorkom omdat dit is waar hulle kos kry. Die laboratorium het ongeveer 200 cm<sup>3</sup> (200 ml) grond per monster

nodig vir ekstraksie. As die hoeveelheid grond rondom die wortelstelsel baie meer as dit is, kan die oortollige grond liggies afgeskud word (Fig. 2). As daar nie genoeg grond rondom die wortelstelsel is nie, skep nog bietjie grond met die hand uit waar die plant uitgespit was en plaas dit in 'n plastieksak (Fig. 3). Bogrondse gedeeltes van die plant moet afgeknip word omdat dit nie nodig is vir aalwurmekstraksies nie (Fig. 4 & 5). Plaas nou die wortelstelsel met die grond in 'n plastieksak (Fig. 6). Merk die oorsprong van die monster op die plastieksak duidelik aan die buitekant met 'n merkpen, want dit is die verwysing wat die laboratorium sal gebruik (Fig. 7). Van hier af moet die monster in die koelte gehou word. As dit nie dadelik na die laboratorium toe gestuur kan word nie, kan dit vir 'n dag of twee in die yskas gehou word.

Monsters kan per koerier gestuur word na of afgelewer word by: LNR-Instituut vir Graangewasse, Hendrik Schoeman Gebou, Chris Hani 114, Potchefstroom, 2520. 'n Folio met die kontaknommers en e-pos adresse of besigheidskaartjies moet in die pakkie ingesluit word sodat die kliënt gekontak kan word. Merk die pakkie vir aandag: Sonia Steenkamp.

### **Wat gebeur met die monster nadat dit afgelewer is?**

Die grond en wortels word nou verwerk (Fig. 8) sodat die aalwurms uit die grond en wortels geekstraer kan word (Fig. 9). Vir elke grond en wortelmonster, sal daar drie ekstraksies gedoen word:

1. Aalwurms sal met behulp van die suiker flotasiemetode vanuit die grondmonster geekstraer word.
2. Al die plantparasitiese endoparasiete (die aalwurms wat in die wortel self voorkom) behalwe die knopwortelaalwurms sal uit 'n 5g wortelmonster geekstraer word, ook met die suiker flotasiemetode.
3. Die metode wat gebruik word om knopwortelaalwurms vanuit 50g wortelmonsters te ekstraer (die aangepaste NaOCl metode) is spesiaal aangepas omdat die knopwortelaalwurm wyfie sakagtig is en kan nie soos die res van die wurmagtige aalwurms geekstraer word nie.

Die aalwurms wat uit die grond en wortelmonster geekstraer is, word dan geïdentifiseer en getel (Fig. 10).

### **Wat is die kostes hieraan verbonde?**

Die koste van elke ekstraksie sal R250.00 (BTW ingesluit) beloop. Dus, die groototaal van 'n volledige wortel en grondmonster sal R750.00 beloop (R250.00 x 3 ekstraksie metodes).

### **Wanneer sal die resultate beskikbaar wees?**

Die analise van die monsters sal tussen drie en vyf werksdae neem waarna die kliënt 'n verslag van die resultate sal ontvang.



**Fig.1. Spit die wortelstelsel met grond rondom uit.  
Remove the plant with the soil intact around the roots.**



**Fig.2. As daar baie meer as 200 cm<sup>3</sup> grond teenwoordig is, kan die oortollige grond liggies afgeskud word.  
Access soil (more than 200 cm<sup>3</sup>) can be removed by carefully shaking it off the root system.**



**Fig.3. As daar nie genoeg grond rondom die wortelstelsel is nie, skep nog bietjie met die hand uit waar die plant uitgespit was en plaas dit in 'n plastieksak.  
If there is not enough soil present around the root system additional soil can be sampled in the spot where the plant was removed and placed in a plastic bag.**



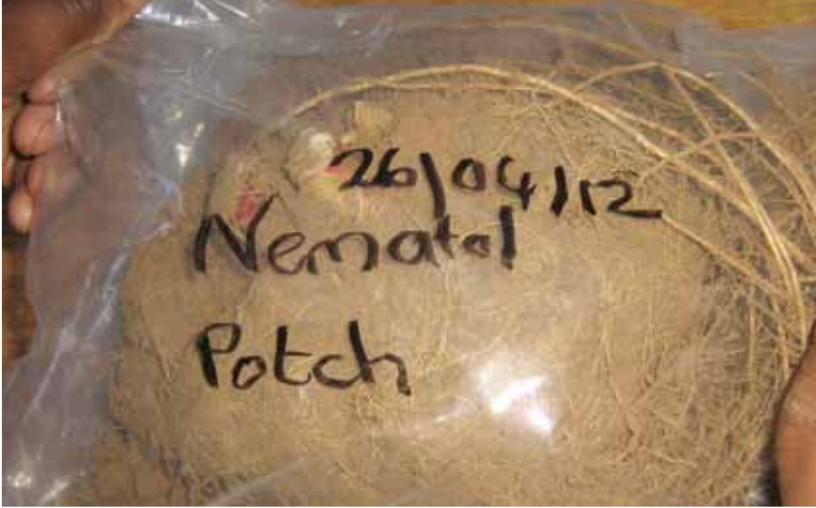
**Fig.4. Knip die bogrondse gedeelte van die plant af.  
Remove the above ground parts of the plant.**



**Fig.5. Dis net die wortelstelsel en grond wat van belang is, die bogrondse gedeeltes van die plant kan afgesny word. Only the root system and the soil will be used in the extraction, the above ground parts of the plant can be removed.**



**Fig.6. Plaas die wortelstelsel met die grond in 'n plastieksak. Place the root system together with the soil in a plastic bag.**



**Fig.7. Merk die plastieksak duidelik sodat die verwysing deur die laboratorium gebruik kan word.  
Mark the plastic bag so that the reference can be used by the laboratory.**



**Fig.8. Wortels en grond word verwerk voordat die aalwurms daaruit geekstraer kan word.  
Roots and soil will be processed before the nematodes are extracted.**



**Fig.9. Aalwurms word uit die grond en wortels geekstraer deur van spesifieke tegnieke gebruik te maak.  
Nematodes will be extracted from the soil and roots using specific techniques.**



**Fig.10. Die aalwurms wat uit die monsters uit geekstraer is, word geïdentifiseer en getel.  
Nematodes extracted from the samples will be identified and counted.**

## SAMPLING FOR PLANT PARASITIC NEMATODE ANALYSIS

Environmental conditions and even cultivation methods often cause nematode populations to increase and cause significant damage to crops. If a producer suspects that nematodes could be the reason for a decline in yield and/or yield quality, soil and root samples can be sent to the ARC-Grain Crops Institute for plant-parasitic nematode analyses.

### When should samples be taken for nematode analyses?

Nematode populations reach their peaks in terms of numbers as soon as annual crops start to flower. After that the population will steadily decline as a result of factors such as intra competition for food sources and less favourable environmental conditions. The best time for nematode sampling will, therefore, be at flowering of the crop. The only exception is groundnut. Compared to most of the other nematode species, pod nematode populations (the most important nematode on groundnut) only peak at harvesting where the main portion of the population will be present in the pods. Groundnut must therefore be sampled at harvesting.

### How should the samples be taken?

It is important that soil as well as roots is included in the sample. If only soil samples are analysed, only those para-

sites present in the soil at that time can be identified. Root parasites that are present only in roots will then be lost and the counts will not reflect a reliable indication of the nematode population in the field. If the crop e.g. groundnut or vegetables carries its yield below the soil surface, pods/tubers must also be included. A high number of samples ensure a more reliable reflection of the nematode population. Samples can be taken in a zig-zag pattern, especially in patches with sick plants. Costs of the analysis can play a role so producers can mix the samples and then take a sub-sample for analysis.

### How should the sample be treated?

The whole plant should be removed from the soil in such a way that the soil around the root system remains intact (Fig. 1). The nematodes will be present in the soil directly around the root system because that is the zone where they will feed. The laboratory will need approximately 200 cm<sup>3</sup> (200 ml) soil per sample for nematode extractions. Excess soil can be lightly shaken off the root system (Fig. 2). If there is not enough soil available around the root system, soil can be collected from the area in which the plant has been sampled and placed in a plastic bag (Fig. 3). Above ground parts of the plant can be removed since it is not needed for

nematode extraction (Figs 4 & 5). Place the root system together with the soil into the plastic bag (Fig. 6). Mark the origin of the sample in the bag on the outside of the bag using a marker (Fig. 7). This information will be used as reference by the laboratory. From this step on forward, the sample must be kept in the shade. If it cannot be send immediately to the laboratory, it can be stored in the refrigerator for one or two days.

Samples can be couriered or delivered at: ARC-Grain Crops Institute, Hendrik Schoeman Building, Chris Hani 114, Potchefstroom, 2520. Please include a folio or business card with contact numbers and e-mail addresses so that the client can be contacted. Mark the package for attention: Sonia Steenkamp.

**What happens to the samples after delivery?**

The soil and roots will now be processed (Fig. 8) so that the nematodes can be extracted (Fig. 9). For each soil and root sample, three extractions will be conducted:

1. Nematodes will be extracted from the soil using the sugar flotation method.
2. All plant-parasitic endoparasites (nematodes present in the root tissues) except root knot nematodes will be extracted from 5g root samples using the sugar flotation method.

3. An adapted NaOCl method will be used to extract root knot nematodes from 50g root samples. This specially adapted method is used to extract the root-knot nematodes because the sack like female cannot be extracted from the roots like the other, vermiform nematodes.

The extracted nematodes will then be identified and counted (Fig. 10).

**How much will the extractions cost?**

Each extraction will cost R250.00 (VAT included). The total of a complete soil and root extraction will amount to R750.00 (R250.00 x 3 extraction methods).

**When will the results be available?**

The analyses of the samples will take between three and five working days after which the client will receive a report.

## BAKTERIESE SIKTES VAN MIELIES

In hierdie uitgawe word inligting verskaf rakende bakteriese blaarstreep (BBS) sowel as bakteriese kelk- en stamvrot. Daar is die afgelope paar jaar 'n toename in die erns en voorkoms van BBS in mielies, vandaar die behoefte om hierdie siekte intens te bestudeer om beheerstrategieë te bepaal. Bakteriese kelk- en stamvrot kan regdeur die mielieproduksie areas van Suid-Afrika gevind word, en veroorsaak periodiek ernstige gelokaliseerde besmettings soos tans ondervind word in die Vaalharts omgewing. Gedurende die vorige- en in die huidige seisoen, is navrae ook ontvang vanuit die mielieproduksiegebiede in die Noord-Kaap, Noordwes-, Noord-Vrystaat en Limpopo.

### Bakteriese blaarstreep (BBS) van mielies

Die veroorsakende patogeen van bakteriese blaarstreep (BBS) is *Xanthomonas campestris* pv. *zeae*. Hierdie siekte is die eerste keer in 1949 in Suid-Afrika gerapporteer. Sover bekend, is mielies (*Zea mays*) die enigste bekende gasheer.

### Voorkoms en verspreiding

Vandat die siekte vir die eerste keer waargeneem is tot vandag, is daar beperkte inligting beskikbaar aangaande hierdie siekte. Bakteriese blaarstreep is

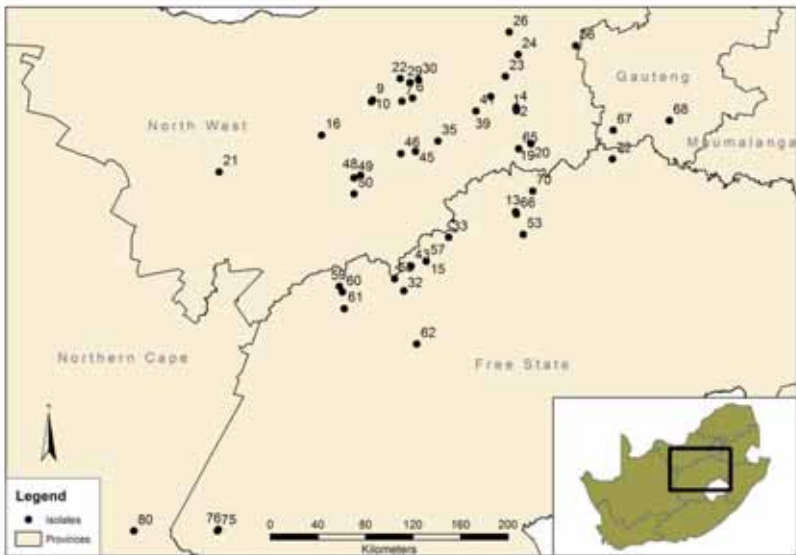
tot dusver nog net in Suid-Afrika aangemeld en kom hoofsaaklik in warm, droë mielieproduksiegebiede (Figuur 1) soos die Noordwes Provinsie, noord Vrystaat en suid-westelike dele van Gauteng voor. Dit is verder ook al opgemerk in sekere saadproduksiegebiede van die land. Die siekte is wisselvallig en daar is groot seisoenale effekte opgemerk rakende die siektegraad. Navorsing word tans uitgevoer om die siekte se potensiele opbrengsverliese oor tyd te bepaal.

### Ekonomiese belangrikheid en epidemiologie

BBS kan in sommige gevalle tot 40% voortydige verbruining en uitdroging van blare tot gevolg hê (Figuur 2), wat moontlik tot verliese in graanopbrengs kan lei. Tot op hede is verlies aan opbrengs as gevolg van BBS nog nie gekwantifiseer nie. Beperkte inligting is bekend oor die epidemiologie van die siekte. Daar is baie bespiegelings maar min gepubliseerde bewyse rakende die faktore wat die siektesiklus beïnvloed. Tans maak ons staat op algemene visuele waarnemings en die beperkte navorsing wat reeds daarop gedoen is om die siekte beter te verstaan en moontlike beheermaatreëls in plek te stel. BBS kan moontlik vir maande in oesreste oorleef en dus jong mielieplantte infekteer wanneer omgewingstoestand gunstig is. Bykomende bronne

van inokulum kan in besproeiingswater asook reën teenwoordig wees. Die patoogeen kan ook versprei deur plantluise, wind en wanneer plante met mekaar in aanraking kom as gevolg van wind, diere, meganisasie en menslike beweging. Ons is tot dusver nog nie seker of hierdie bakterie saadgedraag is nie. Dit hou belangrike ekonomiese implikasies vir die saadbedryf en komersiële uitvoere na ander lande toe in. Primêre infeksies vind plaas in saailinge, terwyl sekondêre infeksies plaasvind op jonger blare tydens die

groeiproses. Die bakterie sal die blaar binnedring deur natuurlike openinge soos huidmondjies. Dit is dus waarskynlik dat die hoogste infeksie in die middel van die dag sal plaasvind wanneer huidmondjies heeltemal oop is. Kort nadat letsels ontwikkel, vorm bakteriese uitskeidings op die letsels. Verdere navorsing om die verspreiding van die patoogeen, asook die moontlikheid van saadgedraagtheid beter te verstaan, word benodig.



**Fig.1. Die verspreiding van bakteriese blaarstreep in Suid-Afrikaanse mielieproduksiegebiede (J. Nienaber, 2014).**

## Simptome

Simptome kan tydens alle groeifases van die mielieplant in die veld waargeneem word, alhoewel dit meer intens is tydens- of net na blom. Aanvanklike blaarsimptome is donkergroen, olie-deurdrenkte strepe. Letsels is aanvanklik klein en vergroot later om smal geelverkleurde (Figuur 3), deurskynende strepe van 2 tot 3 mm wyd oor die hele blaar te vorm. Waar vroeër infestaties op jong plante voorkom en waar fotosintese ingeperk word, sal dit latere graanvul negatief beïnvloed. BBS kan maklik verwar word met grysblaarvlek (GBV) van mielies. GBV en BBS word deur are in die blaar beperk. GBV letsels het 'n reghoekige voorkoms (Figuur 4), terwyl BBS se letselrande meer oneweredig is. Dit word ook soms verwar met sonbrand skade wat op sekere kultivars voorkom. BBS letsels sal naderhand inmekaar vloei om verlengde kolle of strepe te vorm wat bruin tot grys-wit kan vertoon met 'n geel rand. Blare wat erg besmet is met BBS sal uitmekaar skeur en dit sal soos haelskade lyk. Die maklikste manier om BBS uit te ken is deur bakteriële uitskeidings in die vorm van klein druppeltjies wanneer blare nat is of tydens periode van hoë humiditeit.

## Beheermaatreëls

Omdat daar min inligting oor BBS beskikbaar is, is dit moeilik om spesifieke beheermaatreëls neer te pen. Daar word tans navorsing gedoen deur die LNR-IGG in samewerking met die

Noordwes Universiteit om die siekte beter te verstaan. Op die oomblik is daar steeds nie bestaande kommersiële mielie-basters geïdentifiseer nie, maar groot verskille tussen basters in kommersiële aanplantings is al waargeneem. Navorsers soek kultivar proewe (wat statisties uitgelê is) wat bogenoemde simptome toon, om verskille in weerstand te monitor. Aangesien mielies die enigste gedokumenteerde gasheer van BBS is, sal gewasrotasie help om inokulum van BBS laag te hou. Nog 'n metode om BBS inokulum te probeer beperk, is deur sanitasie praktyke soos die verwydering of vernietiging van oesreste en opslagplante. Dit sal die inokulum aan die begin van die plantseisoen verminder. Die braak- en drooglé van landerye word ook aanbeveel as maonlike beheermaatreël. Neem kennis dat geregistreerde mielie-swamdoders nie hierdie siekte onder beheer sal bring nie. Duur bespuitingsprogramme sal dus nie ekonomies regverdigbaar wees nie. Dit is baie belangrik dat die siekte korrek geïdentifiseer moet word alvorens daar op beheermaatreëls besluit word. Die LNR-IGG ontvang menige navrae en klagtes van produsente wat verkeerde middels spuit om die siekte te beheer. Let wel: Daar is geen middel wat geregistreer is op bakteriële blaarstreep nie.



**Fig.2. Erge verbruining en uitdroging van blare.**



**Fig.3. Geelverkleurde strepe word op die blare gevorm.**



**Fig.4. Reghoekige blaarletsels deur grysglaarvlek veroorsaak.**



**Fig.5. Sonbrandskade op mielieblare (Foto: Dr. R. Kloppers, PAN-NAR).**

## Bakteriese kelk- en stamvrot van mielies

Die veroorsakende patogeen van bakteriese kelk- en stamvrot van mielies is *Erwinia chrysanthemi* pv. *zeae* (*Erwinia carotovora* f.sp. *zeae*), 'n beweeglike, gram-negatiewe, staafvormige bakterie.

### Voorkoms en verspreiding

Die siekte word regdeur die mielieproduksie-areas van Suid-Afrika gevind, en veroorsaak periodiek ernstige gelokaliseerde besmettings. Alhoewel die aanplantings wat gereeld simptome toon en waar infeksies hoër is, meestal onder besproeiing was, word daar ook besmettings in droëland aanplantings aangemeld. Besmettings wissel gewoonlik van 0 tot 20%. In sommige gevalle in die Vaalharth gebied, is daar tot 30% besmetting waargeneem. Hierdie patogeen het 'n wye gasheerreëks wat beide monokotiel- en dikotielplante insluit. Bakteriese-stam en kelkvrot van mielies kom meestal in gebiede voor met 'n hoë reënval en/of besproeiing, veral waar grond swak dreineer. Hoë temperature (32-35°C) en -relatiewe humiditeit bevorder die ontwikkeling van die siekte. Vog wat in die kelk vergader as gevolg van oorhoofse besproeiing (veral waar stikstof toegedien is), of oormatige reën/dou is die hooforsaak vir kelkvrot. Dis onvoorspelbaar waar hierdie siekte gaan toeslaan, gevolglik, is dit moeilik om te beheer.

## Ekonomiese belangrikheid en epidemiologie

Die bakterie oorwinter in stamreste op die grondoppervlak. Daar is 'n moontlikheid dat die bakterie in grond-besproeiingsdamme voorkom en so deur besproeiing oorgedra word na mielieplante. Plantwonde wat deur hael, sterk winde en insekte soos stamboorders veroorsaak word, verskaf openinge vir infeksie. Bakterieë kan ook die plant binnedring deur natuurlike openinge soos huidmondjies. Die bakterie is nie saadgedraag nie. Stamboorders is moontlike vektore (draers) van die bakterie.

### Siekte simptome

#### Kelkvrot

Dié siekte infekteer kelke van mielieplante gedurende die vegetatiewe groeistadium. Simptome kom voor van saailing tot blom maar meestal by die 6 – 8 blaarstadium. Water en bakterie lê in die kelk en as gevolg van hoë temperature en vinnige vermeerdering van die bakterie vind infeksie dan plaas. Die nuwe kelkblare begin verwelk en 'n slymerige verrotting verskyn by die basis van die kelk (Figuur 6). 'n Kenmerkende vrot reuk (amper soos vrot kuilvoer) in die basis van die kelk kan waargeneem word. In sommige gevalle sal die groeipunt afsterf en die siekte kan ook afwaarts versprei wat veroorsaak dat die plant omval. Die verrotting in die kelk het tot gevolg dat die blare "afgesny"

word en die groeipunt aanhou groei. In sulke gevalle is daar nie voldoende voedingsstowwe vir die plant vir graanul nie, wat dan die opbrengs benadeel (Figuur 7).

### **Stamvrot**

Primêre simptome verskyn in die mid-seisoen wanneer plante skielik omval. Besmetting van die stamme word waargeneem vanaf die 12-blaar groeistadium. Aanvanklike simptome is verkleuring van die blaarskede en stam (Figuur 8) by internodes (litte). Soos wat die siekte in die stam ontwikkel, gewoonlik vanaf een tot drie internodes bokant die grond-oppervlak, word die stam bruin, waterig en pap (Figuur 9). Die stam sal dan omval (Figuur 10) met die mielieplant se vaskulêre sisteem nog in plek. Besmette internodes gee 'n tipiese sterk, vrot reuk af (weereens soos vrot kuilvoer). Bakteriële stamvrot kan die mielieplant vanaf enige internode van die grondoppervlak tot by die blare en pluim affekteer. Infeksies hoër op in die plant kan pluime nadelig beïnvloed en dus ook 'n negatiewe uitwerking op bestuiwing hê.

### **Beheermaatreëls**

Kies goed-gedreineerde lande of verbeter dreinerings om water akkumulering te voorkom. Voorkom plantbeskadiging tydens meganiese onkruidbeheer, bespuitings en bemesting. Verminder oormatige vloedbesproeiing van lande en oorhoofse besproeiing, veral by hoë temperature (32-35°C). Besproei eerder gedurende koeler ure in die dag. Waar moontlik ploeg dieper om alle plantreste goed in die grond in te werk. Plaaslike kultivars is nog nie getoets vir bakteriële stam en kelkvrot weerstand of vatbaarheid in Suid-Afrika nie. Vanuit waarnemings en verslae is dit duidelik dat daar genotipiese verskille rakende bakteriële stam en kelkvrot weerstand is. Dit was duidelik waar saadmielies geproduseer word in die Limpopo Provinsie wanneer óf die moeder- óf vaderlyn vatbaar was en die ander geen simptome getoon het nie. Geen landbou-chemikalieë is geregistreer of bekend wat siektevlakke kan verminder nie.



**Fig.6. 'n Slymerige verrotting word by die basis van die kelk waargeneem.**



**Fig.7. Opbrengs word benadeel deur blare wat "afgesny" word.**



**Fig.8. Verkleuring van blaarskede en stam by internodes.**



**Fig.9. Bruin, waterige pap stam as gevolg van Erwinia.**



**Fig.10. Stam val om met vaskulêre weefsel nog in plek.**

## BACTERIAL DISEASES OF MAIZE

This publication will aim to provide information regarding bacterial leaf streak (BLS) as well as bacterial whorl and stalk rot of maize. An increase in the incidence and spread of BLS was observed and reported. From this, it is important to understand this disease in order to develop management practices for its control. Bacterial whorl and stalk rot can be found throughout the maize production areas of South Africa and periodically causes severe, localised outbreaks. Several enquiries regarding bacterial whorl and stalk rot has been received from maize production areas in the Northern Cape, North West, North of the Free State and Limpopo.

### Bacterial leaf streak (BLS) of maize

The causal organism of BLS is *Xanthomonas campestris* pv. *zeae*. BLS was reported in South Africa for the first time during 1949. To our knowledge, maize (*Zea mays*) is the only host of *X. campestris* pv. *zeae*.

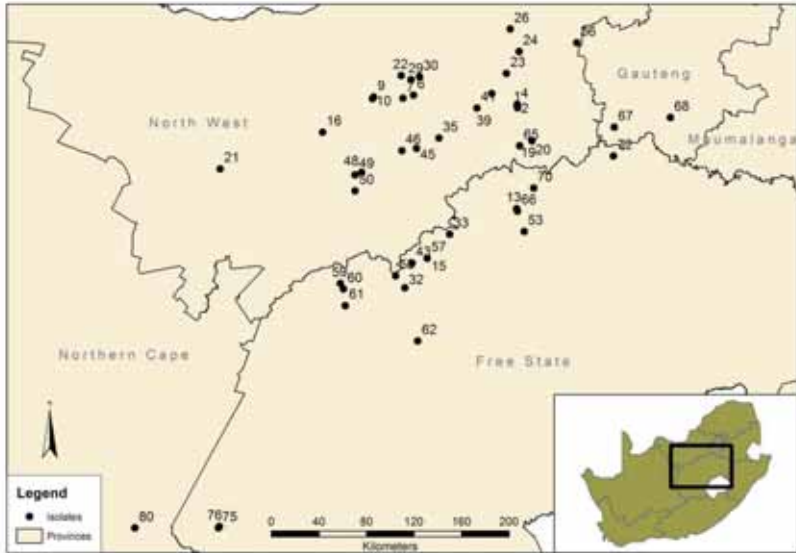
### Incidence and distribution

There is a paucity of information regarding BLS and it seems as if this disease occurs only in South Africa. BLS can be found in warm, and dry maize production areas such as the North West Province, North of the Free State and south-west areas of Gauteng

(Figure 1). Through surveys, we also observed BLS infections in some of the fields used for maize seed production. This disease can occur sporadically and environmental conditions play a role in the disease intensity.

### Epidemiology

Up to 40% of leaves can brown and dry prematurely (Figure 2), resulting in reduced grain production. Co-operative research between ARC-GCI and North-West University (Potchefstroom Campus) are attempting to establish potential yield losses. Worldwide, little is known regarding the epidemiology of this disease. It is possible that BLS can survive on maize stubble and infect maize seedlings (primary infection) when environmental conditions are favourable. Additional sources of inoculum for secondary infection on maize leaves may be bacteria present in irrigation water. Within fields, it is likely that BLS is disseminated by wind, rain and irrigation. It may also be disseminated through feeding of aphids and plant to plant contact. The bacterium can penetrate maize leaves through natural openings (stomata). Therefore, it is likely that the highest infection occurs at midday, during which the leaf stomata are fully opened. It is not yet known whether BLS is seedborne. This should be investigated as it could play an important role in seed production and future exports.



**Fig. 1. Map indicating the incidence of BLS in South African maize production areas.**

### Disease symptoms

Symptoms can be observed during all growth stages but is most severe at or after flowering. Initial leaf symptoms appear as dark, oil-drenched streaks. Initial small lesions will enlarge to form narrow, yellow (Figure 3) translucent streaks, 2-3 mm wide over the whole leaf area. Early infestations of leaves will limit photosynthesis which leads to limited grain fill. BLS disease symptoms can easily be confused with that of a fungal disease named grey leaf spot (GLS). Although both diseases are restricted by leaf veins, the margins of BLS lesions are irregular whilst those of GLS have a rectangular appearance (Figure 4). Irregular yellow translucent

streaks caused by BLS can also be confused with sunburn symptoms (Figure 5). Leaves can be examined for the presence of bacterium or fungi to distinguish between BLS and GLS. During severe drought conditions BLS infection causes paper-thin lesions that may extend across all or much of the leaf blade to form large, necrotic areas resembling drought injury. Infected leaves can appear tattered and shredded following windy conditions.

### Control measures

With limited information regarding BLS, researchers can only make recommendations from experience

and knowledge regarding other maize leaf diseases. Presently no commercial hybrids with resistance are available on the market although huge differences are recorded in fields. Researchers are currently trying to identify cultivar trials (statistically sound) showing BLS symptoms, in order to record resistance levels. Because maize is the only host of BLS, rotation with non-hosts will therefore reduce inoculum levels. Sanitation of fields is very important since crop debris

and volunteer seedlings are removed – this will reduce the primary inoculum in the following growing season. It is also recommended to leave fields fallow and let them dry thoroughly to reduce inoculum levels in the soil. Take note that registered fungicides will not control this bacterial disease. The correct identification of a disease, whether it is fungal or bacterial, will be critical in establishing control measures.



**Fig.2. Browning and drying of leaves.**



**Fig.3. Yellow translucent streaks caused by BLS.**



**Fig.4. The rectangular appearance of GLS symptoms.**



**Fig.5. Sun burn symptoms on maize leaves (Photo: Dr. R. Kloppers, Pannar)**

### **Bacterial whorl and stalk rot of maize**

*Erwinia chrysanthemi* pv. *zeae* (*Erwinia carotovora* f.sp. *zeae*) are motile, gram-negative, rod shaped bacteria which cause bacterial whorl and stalk rot of maize.

### **Incidence and distribution**

This disease occurs throughout the maize production area in South Africa, periodically causing severe, localised outbreaks. This pathogen has a wide host range which includes both monocots and dicots. Bacterial whorl and stalk rot of maize is prevalent and damaging in areas with high rainfall and/or irrigation, particularly in poorly

drained soils. Moisture collected in the whorl of the plant after overhead irrigation (particularly where nitrogen is applied) or rain/dew is believed to be the major factor causing whorl and stalk rot. More recently reports of bacterial whorl and stalk rot were also received from dryland fields. Infections during the last and current planting seasons ranged from 0-20 %. Vaalharts irrigation scheme infections of up to 30% were observed. High temperatures (32-35°C) and relative humidity favour development of this disease. Moisture collected in the whorl of the plant after overhead irrigation (particularly where nitrogen is applied) or rain/dew is believed to be the major factor causing whorl and stalk rot. The unpredictable occurrence of this disease makes it difficult to control.

## Epidemiology

These bacteria overwinter in stalk tissue on the soil surface. Wounds caused by hail, strong winds and insects (e.g. stalkborers) provide entry sites for infection. Bacteria also enter plants through natural openings such as stomata and hydathodes. These bacteria have not been reported to be seedborne.

## Disease symptoms

### Whorl rot

This disease infects whorls of maize plants during the vegetative growth stage. Symptoms can be observed from seedling to flowering stage, but occurs mainly from the 6 – 8 leaf stage. Water and bacteria accumulate in the whorl. Under extremely warm temperatures a rapid increase of the bacteria occurs and infection will take place. The uppermost leaves wilt and a slimy, soft rot which imparts a pungent recognisable smell in the base of the whorl (Figure 6). The growth point of the maize plant dies and the decay spread down the stalk causing the plant to collapse. Disease surveys conducted in infected fields showed that rotting of the whorls had a “cut off” effect on leaves. Although the growth point still grew, a lack of nutrients due to loss of leaves resulted in poor grain fill and negatively affected yield (Figure 7).

### Stalk rot

Primary symptoms generally appear in midseason when plants suddenly lodge. Initial symptoms are the colouration of leaf sheaths and stalk at internodes. As the disease develops in the stalk,

usually from the first to third internode above the soil line, the stalk appears water soaked (Figure 8), turns tan to brown, and becomes soft and mushy (Figure 9). The stalk will then collapse with vascular strands still intact (Figure 10). Infected internodes emit a typical strong rotting odour similar to the smell of silage. Bacterial stalk rot can infect the maize plant from any internode at soil level upwards to the leaves and plumes. Infections higher up in the plant can have a negative effect on plumes and thus also negatively affect pollination.

## Control measures

Unfortunately the unpredictable occurrence of this disease makes it difficult to control. The following points can serve as guidelines to reduce the risk of infestations. Choose well-drained fields or improve drainage to prevent water accumulation. Prevent damage to maize plants during mechanical activities such as weeding, irrigation and fertilizer application. Avoid excessive flooding and irrigation of fields, especially during high temperature (32-35°C) hours of the day and attempt to schedule irrigation times to be restricted to cooler hours of the day. Ploughing to incorporate infected debris into the soil is recommended. Cultivars have not been screened for resistance or susceptibility to bacterial whorl and stalk rot in South Africa. It is obvious, however, from observations and reports that there are genotypic differences regarding stalk and whorl rot resistance. It is important to note that no agrochemicals are registered or are known to reduce disease levels.



**Fig.6.** A slimy soft rot can be observed at the base of the whorl.



**Fig.7.** Poor yield can be expected due to leaves being "cut off".



**Fig.8. Water soaked appearance of the maize stalk at the 1-3 internode.**



**Fig.9. The maize stalk becomes brown and soft due to Erwinia.**



**Fig.10. Collapse of the stalk with vascular bundles still intact.**

## PROBLEME MET LANDBOUMIDDELS: WAT STAAN DIE BOER TE DOEN?

Voordat die afleiding gemaak kan word dat 'n landbouchemiese-middel nie aan die verwagtinge volgens registrasie voldoen nie, moet die produsent sekere feite nagaan. Daar moet verseker word dat aan al die inligting, gebruiksaanwysings en waarskuwings wat op die etiket verskyn, voldoen is.

Byvoorbeeld:

1. Stem die weerstoestand tydens en na die toediening ooreen met die toestand soos voorgeskryf?
2. Is die tyd van toediening nagekom, byvoorbeeld vroeg in die oggend of laat namiddag?
3. Val die toestand en aard van die grond waarop die gewas verbou is binne die raamwerk van die voorskrifte, byvoorbeeld tipe grond en grondvog?
4. Is die beheermaatreëls teen die onkruid toegepas op die groeistadium soos deur die gebruiksaanwysings voorgeskryf?
5. Is die aanbevole dosis van die middel toegedien soos voorgeskryf?
6. Is die landboumiddel wel geregistreer op die betrokke gewas en teen die spesifieke onkruid, swam of plaag?

### WANNEER U NOG OORTUIG IS U HET IN PROBLEEMI BLY BY DIE GOUE REEL: MOENIE PANIEK- ERIG RAAK NIE.

1. Kontak so gou as moontlik die verteenwoordiger of agent van wie u die middel gekoop het;
2. Bevestig u klage dadelik skriftelik aan die betrokke maatskappy;
3. Dring daarop aan dat daar ter plaatse 'n ondersoek ingestel word;
4. Indien die probleem nie opgelos word nie: (volg waar moontlik skriftelik op)
  - (a) Reël dadelik, nie eers nadat die simptome weg is of by oestyd nie, dat 'n neutrale wetenskaplike (nie 'n regs persoon) soos iemand van 'n landboukoöperasie, Landbounavorsingsraad, Universiteit of die Staat, saam met die maatskappy na die klage kom kyk en dit bespreek.
  - (b) Stel die Registrateur: Wet 36 van 1947, Privaatsak X343, Pretoria 0001 in kennis van u probleem. Telefoon (012) 319 7303.
  - (c) Indien die maatskappy nie reageer nie, stel die Landbou en Veertse nykundige Chemikalieë Vereniging van Suid-Afrika (LVCVSA) by Posbus 1995, Halfweghuis 1685, in

kennis. Telefoon (011) 805 2000,  
E-mail: info@croplife.co.za

(d) Stel GSA (012) 807 6023 /  
08600 47246 of die LNR - Institu-  
ut vir Graangewasse (018) 299  
6100 in kennis van die probleem  
en stappe wat gedoen is.

5. Indien u steeds nie tevrede is Die  
staan dit u vry om 'n siviele hofge-  
ding te begin.

(a) Ondersoeke en bevindinge van die  
Registrateur: Wet 36 van 1947  
gaan net daaroor of daar krimineel  
of strafregtelik vervolgt gaan word  
volgens die wet.

(b) Die LVCVSA kan net sy lede (die  
chemiese maatskappy) versoek  
om te reageer op 'n klagte indien  
die boer 'n probleem het dat hy  
geïgnoreer word.

6. Onthou dat die siviele hofgeding  
wat u teen die maatskappy aanhan-  
gig maak heeltemal losstaan van die  
kriminele of strafregtelike aksie van  
die Registrateur (Wet 36 van 1947).

Die Registrateur se inligting is net vir sy  
eie gebruik, tensy 'n hof anders gelas.

**BELANGRIKE PUNTE VOORDAT  
U IN OESBESKERMINGSMIDDEL  
TOEDIEN**

a) Lees die etiket en gebruik die produk  
slegs soos die etiket voorskryf. U  
word wetlik verplig om dit so te  
doen volgens kennisgewing soos  
gepubliseer in die staatskoerant.

b) Indien 'n aanbeveling deur 'n ver-  
teenwoordiger of agent gedoen  
word, dring daarop aan dat dit  
skriftelik is.

c) Bewaar die lotnommer en die  
vervaardigingsdatum op die hou-  
ers. Onthou ook dat geen ampte-  
like monster sal uit 'n oop houer of  
houer waarvan die seël gebreek is  
geneem kan word nie, aangesien  
die resultate onder verdenking sal  
wees.

U aandag word gevestig op die vol-  
gende artikels van die Wet op Mis-  
stowwe, Veevoedsel, Landboumiddels  
en Veemiddels no. 36 van 1947 (Wet  
36 van 1947).

**Artikel 7 (1) (d)**

Niemand mag 'n misstof, veevoedsel,  
landboumiddel of veemiddel verkoop  
nie, tensy dit so saamgestel en so  
doeltreffend is as wat in die aansoek  
om registrasie daarvan gespesifiseer  
is, alle chemiese, fisiese en ander  
eienskappe aldus gespesifiseer, besit  
en aan die voorgeskrewe vereistes vol-  
doen.

**Artikel 7 (2) (a) (i)**

Niemand mag teen vergoeding of in die  
loop van 'n bedryf, handel of besigheid  
'n landboumiddel of veemiddel gebruik,  
of die gebruik daarvan aanbeveel vir 'n  
ander doel of op 'n ander wyse as die  
wat aangedui word op die etiket op die  
houer daarvan of as wat op sodanige  
houer gespesifiseer word nie.

## PROBLEMS WITH AGROCHEMICALS: WHAT SHOULD THE FARMER DO?

Before assuming that an agrochemical does not comply with the expectations of registration, the producer should first establish certain facts. It should be ensured that all directions and warnings appearing on the label were followed. For example:

1. Did the environmental conditions during and after application correspond with those as prescribed?
2. Was the time of application complied with, i.e. early in the morning or late afternoon?
3. Did the conditions and nature of the soil where the crop was grown fall within the framework of the prescribed conditions, i.e. soil type and soil moisture?
4. Were the control measures against the problem applied to the crop growth stage prescribed in the instructions?
5. Was the recommended dosage of the chemical applied as prescribed?
6. Was the agrochemical definitely registered on the specific crop and against the specific weed, fungus or pest?

### **IF YOU ARE STILL CONVINCED THAT YOU HAVE A PROBLEM, FOLLOW THE GOLDEN RULE: DO NOT PANIC.**

1. Immediately contact the representative or agent where the chemical was purchased.
2. Confirm your complaint in writing to the relevant company.
3. Insist on an in loco investigation.
4. If the problem is not solved:
  - (a) Immediately arrange that a neutral scientist (not a legal person) i.e. someone from an agricultural co-op, Agricultural Research Council, University or the Government visit the site together with the relevant company to discuss the problem. This should not be done when the symptoms have disappeared or at harvesting.
  - (b) Notify the Registrar: Act 36 of 7947, Private Bag X343, Pretoria, 0007 of the problem. Telephone (012) 319 7303.
  - (c) If the company does not respond, notify AVCASA at PO Box 1995, Halfway House, 1685. Telephone (012) 805 2000. E-mail: info@croplife.co.za (Follow up in writing).
  - (d) Notify GSA (012) 807 6023 /

08600 47246 or the ARC-Grain Crops Institute (018) 2996100 of the problem and what steps have been taken. (Follow up in writing)

5. If you are still not satisfied, you are free to commence with legal action.

(a) Investigations and findings by the Registrar Act 36 of 1947, only determine whether criminal or penal action should be taken.

(b) AVCASA can only request their members (chemical companies) to react to a claim if a producer feels that he is being ignored.

6. Remember that a civil court action which has been taken against a company is completely separate from criminal actions by the Registrar: Act 46 of 1947.

Information gathered by the Registrar is for his office use only, unless ruled otherwise by the court.

**IMPORTANT POINTS TO OBSERVE BEFORE APPLYING AN AGROCHEMICAL:**

(a) Read the instructions and apply the product only as prescribed. You are compelled by law to do so, as published in the government gazette.

(b) If a recommendation is made by a representative or agent of a company, insist that it be put in writing.

(c) Save the lot number and manufacturing date stipulated on the containers. Remember that no official sample may be taken from an opened container or where the seals have been broken, as results will be suspect.

Your attention is drawn to the following articles on the Act of Fertilizers, Farm Feeds, Agricultural Remedies and Stock Remedies no 36 of 1947 (Act 36 of 1947), [www.croplife.co.za](http://www.croplife.co.za)

**Article 7 (1) (d)**

No person shall sell any fertilizer, farm feed, agricultural remedy or stock remedy unless it is of the composition and efficacy specified in the application for registration thereof possesses all chemical, physical and other properties so specified, and complies with the prescribed requirements.

**Article 7 (2) (a) (i)**

No person shall for reward or in the course of any industry, trade or business use, or recommend the use of any agricultural remedy or stock remedy for a purpose or in a manner other than that specified on the label on a container thereof or described on such container.

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