NEW LEAF RUST RACES DETECTED ON SA WHEAT

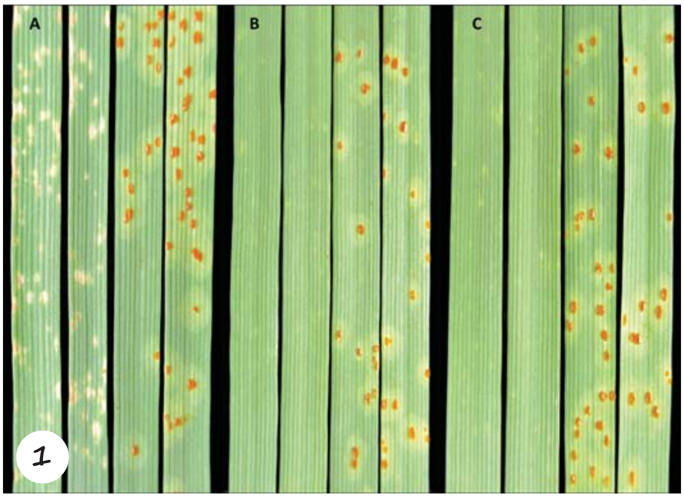
Dr Tarekegn Terefe,
ARC-Small Grain,
Bethlehem

Dr Willem Boshoff,
Department of Plant Sciences, University of the Free State

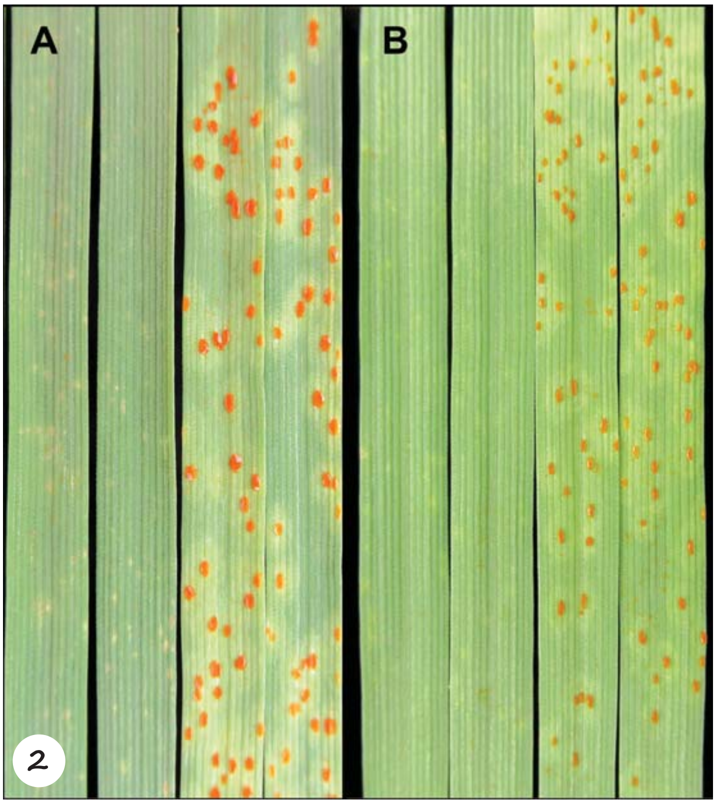
Leaf rust, caused by the fungus *Puccinia triticina* (*Pt*), is an important disease of bread wheat in South Africa. It is frequently found in the winter rainfall wheat growing regions, resulting in localised epidemics and yield loss in some seasons.

The disease can be managed by the timely application of registered fungicides on susceptible cultivars or alternatively by growing resistant cultivars that can provide economical and environmentally friendly leaf rust control. However, durability of single gene resistance is often challenged with continual emergence of new *Pt* races. To reduce the threat and accompanying production risk of the continually evolving leaf rust pathogen, researchers at ARC-Small Grain and the University of the Free State have been monitoring the virulence profile of the *Pt* population in South Africa over the past four decades, with many races of the pathogen characterised on wheat and triticale. These studies played a crucial role in the early detection of new races which were subsequently used to identify resistance sources and determine the response of commercial cultivars and breeding lines.

As part of ongoing rust monitoring, surveys were conducted during the 2020 and 2021 seasons across the major wheat growing regions, including the Free State, KwaZulu-Natal and Western Cape. Leaf samples of wheat and triticale infected with leaf rust were collected from rust trap nurseries and commercial wheat fields and spores collected from the samples were inoculated onto seedlings of standard differential lines. Leaf rust races were identified based on their virulence pattern (comparative low and high infection types) on the differential lines.



Seedling infection types produced by *Puccinia triticina* (*Pt*) races 3SA170 and 3SA100 (two leaves each from left to right) on (A) line RL6092 (*Lr20*), and races 3SA146 and 3SA170 on wheat cultivars (B) SST 0166 and (C) Tredou, respectively. Flecks on the leaves indicate a resistant reaction and large brown pustules indicate susceptibility. On plate A, the *Lr20* resistance gene is effective (necrotic flecks) to race 3SA170 and susceptible to 3SA100, (B) and (C) cultivars SST 0166 and Tredou are resistant to 3SA146 with increased susceptibility to *Pt* race 3SA170.



Seedling infection types produced by previously described races of *Puccinia triticina* (*Pt*) to (A) line RL6010 (*Lr9*), and (B) SST 0177 (two leaves left on each plate showing small resistant flecks). The new *Pt* isolates were found virulent (high) to *Lr9* (two leaves right on plate A) and intermediate to SST 0177 (two leaves right on plate B).

Virulence analysis of the isolates collected during 2020 and 2021 revealed the presence of three new *Pt* races. Two of these new races, namely 3SA170 (MFPSJ, North American race notation) and 3SA100 (MFPSK) were first detected in 2020. Race 3SA170 was found in many samples collected from different localities in the Western Cape and Free State, whereas 3SA100 was only detected in a few samples collected from Bethlehem in the Free State. Race 3SA170 is most similar in virulence to the existing race 3SA10 first described from isolates collected during 2016. Based on tests on common differential lines, 3SA170 differs from 3SA10 being virulent (high) on resistance gene *Lr1* and avirulent (low) on *Lr12*. Race 3SA100 differs in virulence from 3SA170 on *Lr20* only (**Photo 1**) and from the existing race 3SA248 on *Lr1* and *Lr12*. Both 3SA170 and 3SA100 are virulent on key resistance genes *Lr24*, *Lr26*, *Lr13* and *Lr37*.

Virulence analysis of the isolates collected during 2020 and 2021 revealed the presence of three new Pt races

The potential threat of the new races to the wheat industry was assessed by evaluating the current commercial cultivars and breeding lines against the new and older races. Seedling infection type data for 113 South African wheat cultivars showed that 69 and 72 entries were susceptible to the new races 3SA100 and 3SA170, respectively, compared to the rest of the races 3SA144 (ten entries susceptible), 3SA145 and 3SA127 (52), 3SA146 (54), 3SA10 (73) and 3SA248 (78). The results further suggest that both 3SA170 and 3AA100 have increased virulence to cultivar SST 0166 (changed from a resistant to an intermediate seedling response) than the remaining races (Photo 1).

Rapid increase in frequency

Race 3SA170 appears to be dominating the leaf rust population in South Africa in just one season. The rapid increase in the frequency of 3SA170 could be due to mutations which may have resulted in this race being more virulent and fitter than older races. Moreover, the steep increase in the hectares planted with SST 0166 in the Western Cape since 2018 may have contributed to the selection for races 3SA170 and 3SA100, as this cultivar showed increased susceptibility to these two races whereas it is immune (produce resistant flecks only) to previously described *Pt* races.

In addition to the aforementioned two races, a few isolates collected in the Western Cape during 2021 were found to be virulent on the resistance gene *Lr9*. As virulence for *Lr9* has not been previously reported in South Africa, these isolates were considered as representing a new race(s) and are currently being characterised further to identify effective resistance sources against them. However, evaluation of the current cultivars and breeding lines confirmed the increased susceptibility of cultivar SST 0117 to these isolates (**Photo 2**).

The response of the current wheat cultivars will be updated in the 2022 production guidelines of ARC-Small Grain to reflect the influence of the new races. With the confirmation of at least three new races during 2020 and 2021, the number of new *Pt* races reported over the past twelve years increased to eleven. The results indicate continued variability of the *Pt* population in South Africa and stress the need for regular surveillance as an early warning system to report the effect of new and more virulent *Pt* races on cultivar response. ●

GEEN TOLERANSIE..

verteenwoordig. Gedurende die periode voor T4 sal die gevoelige opvolggewas deur reste van die onkruiddoder beskadig word, maar na T4 is die reste onder die kritieke 20%-vlak (teoreties) en behoort die gevoelige opvolggewas nie skade te ly weens byvoorbeeld oordraging in grond van reste van die onkruiddoder na die opvolgende groeiseisoen nie.

Groen beeld uit hoe faktore wat onkruiddoderverlies vertraag, soos byvoorbeeld droogte en afname in mikrobe-aktiwiteit, die tempo van verlies dermate verlaag dat die periode van effektiewe onkruidbeheer (T0 tot T2) nou wel verleng word, maar die kritieke wagperiodetyd (T4) word dan nie in die bestemde (verwagte) tyd bereik nie. Sulke faktore kan veroorsaak dat skadelike hoeveelhede reste van onkruiddoder na die opvolgende groeiseisoen oorgedra word en gevoelige gewasse beskadig word. Hierdie situasie is veral van belang by gewasrotasiestelsels waar die opvolgende gewasse moontlik gevoelig is vir die onkruiddoder(s) wat in die voorafgaande gewas gebruik is.

Bruin dui die teoretiese of hipotetiese verliesgedrag van 'n onkruiddoder in grond aan wanneer toediening van 'n onkruiddoder in dieselfde seisoen herhaal word as opvolgtoediening en die dosis daarvan dieselfde is as by eerste gebruik. Met ander woorde, beide grafiekkurwes se beginpunt is 100%. In so 'n situasie kan gesien word dat die kritieke wagperiode voor vestiging van 'n gevoelige opvolggewas nie teen tyd T4 bereik word nie, ten spyte van 'n relatief vinnige verliestempo vir die opvolg- toegediende onkruiddoder.

Die kritieke wagperiode (T4) kan teoreties wel met 'n opvolgtoediening behaal word, maar dan moet die dosis verlaag word. Dit het implikasies vir effektiewe onkruidbeheer, die oortreding van Wet Nr. 36 van 1947 asook die risiko van bevordering van onkruidweerstand teen die betrokke onkruiddoder. Die groot voordeel van opvolgtoediening van onkruiddoders is dat die periode van effektiewe onkruidbeheer daardeur verleng word – die periode T0 tot T3 is aansienlik langer as beide T0 tot T1 en T0 tot T2. Hierdie voordeel se onlosmaaklike nadeel is egter die risiko dat die nienakoming van die wagperiode vir die opvolggewas kan plaasvind.

Sentraal tot die vermyding van (i) swak onkruidbeheer, (ii) die beskadiging van gevoelige opvolggewasse weens oordraging van onkruiddoder in grond, en (iii) die voorkoming van die bevordering van onkruidweerstand teen onkruiddoders, is die streng nakoming van voorskrifte, waarskuwings en gebruiksbeperkings wat op die etikette van onkruiddoderprodukte verskyn. ●

Dr Charlie Reinhardt kan gekontak word by 083 442 3427 of stuur 'n e-pos na dr.charlie.reinhardt@gmail.com.