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Amaranth as super-food

ARC identifies indigenous crop of interest

The indigenous and traditional vegetables crop development program of the Agricultural Research Council (ARC) started by doing baseline studies in different provinces in South Africa to identify the most popular species, consumer preference and to document knowledge. As part of the ARC research programme on indigenous and indigenized crops, amaranth was identified as one of the crops of interest due to its wide use and nutritional attributes. Although it is not always the most popular one, it was always in the top five. It is consumed all over South Africa as a leafy vegetable crop in contrast with crops like spider plant and jute that have limited distribution.

Characterization and evaluation of amaranth (Figure 1) was done at the Roodeplaat campus of the ARC, namely the ARC-Vegetable, Industrial and Medicinal Plants (ARC-VIMP), Gauteng Province. Basic agro-morphological characterization and yield trials were carried out.

The study showed high concentration of multiple nutrients in lines selected based on yield performance. The genotypes selected from the field trials were then evaluated using farmers' participatory variety selection methods.

Participatory trials were carried out in five of the nine provinces of the country over the course of the last ten years.

The most successful trials were in North-West Province, Gauteng and KwaZulu Natal. The selected lines were planted within rural community gardens and members of the community evaluated them based on their personal preference and taste.

Taste is influenced by ethnic background and geographical representations. In certain areas more bitter genotypes are preferred (typical in areas where spider plant and night shade are popular) and in other areas the sweeter genotypes are preferred.
People who like bitter genotypes also tend to like the red amaranths.

Amaranth is rich in neutraceuticals (particularly phytochemicals, antioxidants and micronutrients such as zinc, copper, iron, vitamin A/beta-carotene and vitamin C) but low in anti-nutritional factors such as tannins, phytic acid, alkaloids and oxalate.

Characterization of amaranth genotypes using agro-morpho-nutritional traits will help in the selection of candidate amaranth lines with desirable trait(s) that will be used to develop a target product through controlled breeding.

Different genotypes of amaranths were tested in different agro-ecological zones, which showed significant variation for desirable agronomic traits (leaf, and grain yield) as well as nutritional quality traits specially microelements (iron and zinc), ascorbic acid, beta carotene, total phenolic and flavonoid concentrations.

This suggests that developing the target product for increased leaf yield, iron and zinc towards reduced malnutrition as well as lowering of the concentration of anti-nutritional components to increased bioavailability through breeding are possible.

The breeding programme is also looking at increasing leaf size through mutation breeding to enable increased fresh leaf yield. The larger leaf size reduces harvesting time and will also further enable

Photo by Ms Lindiwe Khoza at Nkandla farmers' participatory selection of amaranth

packaging into bunches as is done for other leafy vegetables such as Swiss chard. This makes it easier to handle for markets purposes, e.g. transportation to marketing for small scale and commercial farmers. Bigger leaves also reduce labour because it is easier to harvest and post-harvest sorting and cleaning is easier.

Leaf size and plant architecture is closely linked to species. Most South African consumers are used to the smaller-leaved species like A. thinbergi and A. graecizans and some initial resistance was observed in certain areas, however, the resistance was overcome after consumers participatory studies demonstrated the marginal benefits of growing varieties with superior vegetative growth. In Africa, the taller large-leaved A. cruentus, which also have a much longer lifespan, is more popular. Whereas in south-east Asia A. tricolor, which are a smaller plants with soft leaves and a very short season, are preferred. Leaf colour also plays a role. Green leaves are preferred to red leaves. In certain areas red amaranth is regarded as a medicine and can be used to treat cancer.

The amaranth lines currently planted and used are highly responsive to short days. As soon as short days set in in the Southern Hemisphere, amaranth plants flowers. This limits the production of amaranth to summer months with long days.

One of the focus areas for the current amaranth mutation-breeding project will also be to produce day length insensitive. From our own research, it is clear that certain genotypes do have longer seasons as well. A. tricolor lines can only be harvested once or twice, whereas certain A. cruentus lines can be harvested up to five times depending on harvesting method and intervals between harvesting. Frequent harvesting leads to a longer vegetative phase.

The impact of climate change on food and nutritional security is evident in South Africa and sub-Saran Africa and beyond. Farmers, particularly those in vulnerable communities with limited resources in tropical and sub-tropical regions of the world, need resilient climate smart agriculture and resilient crops to mitigate the impact of climate change on food, nutrition and health security.

To this effect, the amaranths breeding programme characterized different amaranth genotypes in drought screening trials using rainout shelters. The leaf yield and nutritional components were determined when subjected to different levels of irrigation. This enhances understanding of the influence of different levels of soil moisture on leaf yield and nutritional composition towards selecting potential candidate lines for production recommendation and breeding. This way, high leaf yielding amaranth cultivar(s) can be developed for smallholders and commercial farmers in drought prone areas of South Africa.

The ARC research has shown that amaranths are quite efficient water use crop; however, as expected there is large variation among genotypes in absorption and translocation of water into the plant system.

Although amaranth is well adapted to marginal agricultural conditions, it reacts favorably to agricultural inputs. Irrigation, fertilizer and pest and disease management will increase the yields.

However, low inputs and adverse conditions do not have such an adverse effect on amaranth yields as it has on some commercial vegetables.

Amaranth is an indigenous and traditional crop that is well adapted to local environmental conditions and has a genetic potential to enhance the efficiency of production and productivity by increasing the cultivated land and yields in marginal areas, where the effect of climate change is expected to be more aggravated.

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