43 550ha of dry beans planted in 2013 in SA, compared to 2.7 million ha of maize

304% increase in yield from dry bean production in South Africa, from 0.62t/ha in 1979 to 1.89t/ha in 2013

On-farm value of dry bean crops grew from R30.5 million in 1979 to R1.1 billion in 2013

56% of dry bean research funding comes from parliamentary grants, compared to 98% in 1993

Red speckled bean production has decreased from 62 102 tonnes in 1986 to 58 500 tonnes in 2014

Small white canning bean production has increased from 5 183 tonnes in 1986 to 22 000 tonnes in 2014

37 cultivars were produced by the ARC's dry bean breeding programme between 1980 and 2012

New cultivars have a 13% better yield on average

The ARC's dry bean breeding programme improved dry bean yield by 11.65kg per hectare every year, an 18% increase due to genetic improvements from 1982 to 2014

This yielded annual economic benefits for farmers of R31.8 million from 1992, R51.3 million from 2000, or R71.2 million snce 2010

There is R5.67 in economic growth for every R1 spent on dry bean research

Dry bean research priorities at the ARC

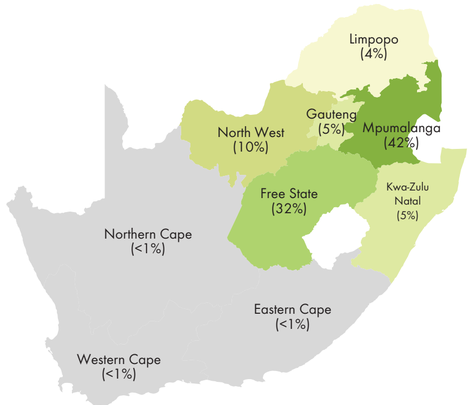
Initial breeding efforts in South Africa focussed on large white kidney beans, such as Bombust, which were intended for export. However, due to low demand for exports, the popularity of large beans has decreased among South African commercial bean farmers. There is more demand from farmers for small white canning (SWC) and red speckled beans (RSS), and in 1980 a formal dry bean breeding programme was established by the ARC to address that demand.

The priorities of the breeding programme are RSS and SWC beans that are:

1. high yielding and disease resistant
2. suitable for combine harvesting
3. adaptable to a wide range of growing conditions

In addition, researchers hoped to develop cultivars that could replace the drought-tolerant Tepary bean (*Phaseolus acutifolius*) grown in the Northern Cape, and have a short cultivation period so that they could be rotated with wheat.

The disease resistance breeding programme has aimed to address a number of viral, fungal and bacterial diseases. These include Bean common mosaic virus, common bactarial blight, halo bacterial blight, bacterial brown spot, rust, angular leaf spot, anthracnose, root rot, ascochyta and powdery mildew.



Area under dry bean cultivation in South Africa, by province. One of the goals of the dry bean breeding programme is to create cultivars that can thrive in the different growing conditions found around South Africa.

Funding dry bean research and development

Up until the early 1990s, dry bean breeding research in ARC was funded by matched grants from the government and from the Dry Bean Board (which collected farmer levies for research). In 1993, when the Dry Bean Board became the Dry Bean Producers' Organisation (DPO), the matched grants covered 98% of dry bean breeding research at the ARC, but that number dropped to 56% in 2014. The rest of the funding comes from private sources such as royalties and ARC services. In return for funding and a 2% royalty payment to the ARC, the DPO has first rights to commercialise ARC cultivars.

Funding for the programme was at R1.7 million in 2014, down from a high of R2.8 million in 2006. Since 2006, government funding for the programme has fallen away despite increased demand for new cultivars, rising costs and aging research infrastructure.

written and designed by ScienceLink

This brochure is based on Dlamini TS (2016) The Genetic and Economic Impacts of the National Dry Bean Breeding Programme in South Africa: 1980 – 2014. ARC Economic Analysis Unit technical report

The economic value of dry bean research in South Africa

Compiled by the Agricultural Research Council's Economic Analysis Unit for the ARC Grain Crops Institute

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The history of dry bean research in SA

Dry bean breeding in South Africa started in the 1950's with Bombust, a white bean that combined the disease resistance of B'omba beans with the productive, bushy growth of Michigan Robust. Bombust was not well-received commercially, but provided a genetic basis for further breeding.

Government plant breeders released Teebus, a small white canning (SWC) bean cultivar, in 1976, and this provided the source of all modern South African SWC cultivars. This cultivar was high-yielding, grew upright and had excellent canning qualities. However, it was susceptible to many diseases and did not grow well in marginal conditions.

A formal breeding programme was established by the ARC in 1980. Separate bacterial and fungal resistance breeding programmes feed into a combined programme that has produced 37 cultivars of both red speckled and SWC bean varieties. These beans are mostly resistant to Bean common mosaic virus, and show varying levels of resistance to other common diseases like halo bacterial blight, common bactarial blight, rust and angular leaf spot.

The social value of dry bean farming

Beans are an important food source in South Africa, especially in poor and/or rural communities. Red speckled beans in particular are a staple for dishes such as umngqusho or samp and beans and many other meals.

Beans provide an excellent source of protein, fibre, low-glycaemic index carbohydrates and a range of nutrients and minerals, as well as being very low in fat. There is evidence that beans reduce risk of heart disease and cancer as well as lowering cholesterol levels.

Disease-resistant bean cultivars that can grow in a wide variety of soils and weather conditions would provide a reliable source of nutritious food for millions of South Africans in the face of climate change and widespread food insecurity.

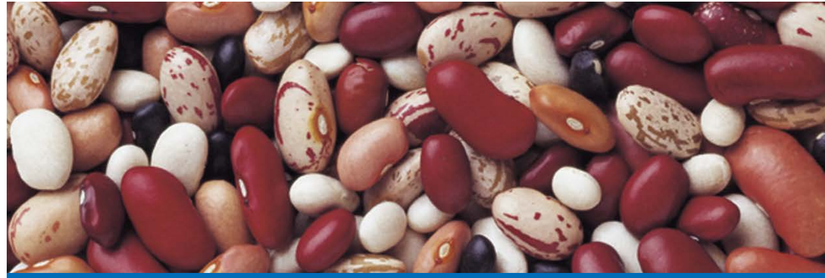
The dry bean breeding programme run by the ARC for the last 30 years has produced new high-yielding cultivars and encouraged economic returns in the sector. Despite this, dry bean farming is still not a priority for commercial farmers in South Africa.

Dry beans are an incredibly important crop for South Africa – they are a crucial source of protein for South Africa's low-income bracket, and are full of important nutrients and low-glycaemic index carbohydrates.

However, a miniscule area of land is dedicated to dry bean farming when compared to another South African staple crop: maize. Competition with grain crops like maize and wheat, as well as variable funding for dry bean breeding, are blamed for the lack of commercial dry bean farming.

Overwhelming evidence of the economic value of dry bean breeding research is now available. Since 1980, yields per hectare have tripled thanks to genetic improvements in disease resistance, hardiness and productivity of dry bean cultivars. Thirty-seven cultivars have been released in that time, with an average yield increase of 13% compared to the original cultivars.

Perhaps more importantly, an economic study showed that the country benefitted R5.67 from every R1 invested in dry bean breeding research. This demonstrates that dry bean research is hugely beneficial to the South African economy. Considering that dry beans offer a lasting solution to food security issues in South Africa, the value of continued dry bean research support is clear.



Measuring the genetic and economic returns on dry bean research

This study used a number of different methods to estimate the positive effects of dry bean breeding at the ARC on the dry bean industry and on South Africa's economy in general. It looked at data from 1982 to 2014, available due to National Dry Bean Cultivar Trials conducted over that period.

The study looked at two aspects: improvements to the genetics of the beans – things like yield changes and improved disease resistance – as well as the economic benefits of the research programmes.

Genetically, almost every cultivar produced by the ARC over this time improved in terms of disease resistance, either through better resistance to a specific disease or through resistance to multiple diseases. Other improvements included cultivars that could grow in more difficult conditions, cultivars that were easier to harvest, and improved yields. As an example of yield improvements, ARC cultivars since 1982 have yielded on average 13% more than the cultivar they were bred from.

To measure the economic value of the programme, the study used a mathematical model to relate financial inputs to the financial value of outputs from a process. In this case, the relationship between the release year of a cultivar and changes in yield provided a way to estimate the value of the programme.

This model found that the breeding programme adds approximately 11.65kg per hectare of dry bean yield each year. This is equivalent to an 18.3% increase in yield due to genetic enhancements from the ARC-GCI dry bean breeding programme during the period 1982 to 2014.

The model also provided standard estimates of economic value such as a benefit-cost ratio, net present value and modified internal rate of return (MIRR), which takes into account the value of the money if it had merely been saved. The benefit-cost ratio was 5.67:1, which means a return of almost R6 for every R1 invested. The MIRR was 8.92%, while the net present value of the programme was estimated at R210 million. All of these figures point to the dry bean breeding programme as an extremely successful and financially viable enterprise.