The successful intensification of smallholder farming in Zimbabwe

Ten years ago, soyabeans were promoted with smallholder farmers in Zimbabwe to help offset problems of soil fertility, introduce diversity into cropping systems dominated by maize production, and increase incomes. A mix of soyabeans can now be seen in most smallholder farming areas in suitable agroecologies throughout the country. This success is due to a solid multi-institutional effort that included establishment of local input facilities, as well as market and transport opportunities.

Ken Giller

Maize is the dominant staple crop across most of southern Africa, and takes up more than 80 percent of the smallholder planted land area. Soyabean was identified as a crop with potential to address the need for diversification in cropping systems, to assist in overcoming soil fertility constraints, and one that could increase incomes of smallholder farmers. An initiative was launched in 1996/97 in Zimbabwe to test out soyabean as a potential smallholder crop. From the initial five villages, soyabean production expanded rapidly – from 50 farmers in the first year to an estimated 10,000 farmers three years later. Since then, soyabean has diffused spontaneously into most of the higher rainfall areas of Zimbabwe. Its adoption by a large number of smallholders thus exploded the long-held belief that soyabean was an inappropriate crop for smallholders.

Photo: Author

Farmers evaluating soyabean varieties in adaptive trials run through the Soyabean Promotion Task Force in Zimbabwe. The tall leafy variety centre of the picture is the promiscuously-nodulating variety Magoye. The variety in the foreground is a specifically-nodulating variety Nyala.

Soyabeans in Africa

Soyabean is known to have been cultivated in Africa since the early 1900s, although it is likely that the crop was introduced much earlier through extensive trade around the Indian Ocean. Although nodulation of soyabean by rhizobia (see Box) in the absence of inoculants had been observed earlier, it was not until 1981 that an intensive varietal screening programme in Zambia identified one exceptionally promiscuous local variety which was named Magoye. Magoye nodulates readily in virtually all soils in southern Africa where it has been tested. This characteristic, together with its good and consistent yields, has led to its widespread promotion in Southern Africa for use by smallholder farmers. Magoye is a good variety for production by smallholders when rhizobial inoculants are not available, and it has some other advantages. Magoye is a very leafy, indeterminate variety that can supply a lot of nitrogen for subsequent crops. It also seems to be more resistant to environmental stresses, such as poor soil fertility and mid-season drought, than the specific varieties that are available commercially. On the down side, because Magoye is an "unimproved" variety, it is susceptible to some diseases (such as bacterial pustule) as opposed to modern varieties in which resistance has been incorporated. Many new high-yielding "promiscuous" cultivars developed by the International Institute for Tropical Agriculture at Ibadan, in Nigeria, are currently being tested with farmers throughout Africa.

Rhizobia

Rhizobial inoculants – which are used to deliver the nitrogen fixing bacteria (collectively termed rhizobia) – have been on the commercial market for over 100 years. More than 90 percent of rhizobial inoculants worldwide are used with soyabean. Soyabean differs from many other tropical legumes such as cowpea, groundnut and common beans as it has "specific" requirements in terms of the types of rhizobia that are able to form nodules on its roots and actively fix nitrogen, while others form nodules with a wide range of rhizobia that are present in most soils. These are termed "promiscuous" or "naturally-nodulating" grain legumes, and they make effective use of the inherent soil biodiversity of rhizobia.

Complementarity of promiscuous and specific soyabeans

Although the initial aim was to promote the promiscuously-nodulating Magoye, farmers were keen to grow both types of soyabeans. The specifically-nodulating varieties have a greater yield potential as a cash crop, while the promiscuous varieties are considered more robust as they do not need inoculants, and have greater potential for fodder and soil fertility improvement. The programme therefore assisted farmers with timely access to seeds of specifically-nodulating varieties, together with careful education of smallholder farmers in the use of rhizobial inoculants. Specifically-nodulating varieties were promoted together with rhizobial inoculation because there was no system for seed production of the promiscuous varieties to meet the rapid increase in farmers' demand. Another key part of the input package was a small amount of lime and P:K:S fertilizer. This would help to overcome the other nutrient constraints on

the highly-weathered sandy granitic soils that are predominant in the smallholder farming areas of Zimbabwe. Farmers were able to afford all of the inputs themselves. Farmers also paid the transport costs when their produce was collectively delivered and sold at the factory gate.

In on-farm experiments, maize grown after maize commonly yielded only 0.5 t/ha whereas yields of maize after soyabean were more than 1.5 t/ha. Effectively growing soyabean was sufficient to replace the basal nitrogen fertilizer, but to achieve yields of 3-4 t/ha of maize, extra nitrogen fertilizer as top-dressing was required. We also found that the inoculant strains tended to decline in numbers within a few years on the coarsest sandy soils, but that a moderate rate of cattle manure, that could also serve as a basal fertilizer for soyabean, could enhance persistence of the rhizobia.

Local inoculum production

Farmers' continuous access to inoculants was ensured due to the inoculum production facility at the Soil Productivity Research Laboratory in Marondera. This semi-commercial operation was established in 1964 and largely served the commercial farming sector until the expansion of smallholder soyabean production. The long history of inoculant production means that there is a solid body of expertise in inoculant production, including expert technical staff. More than 90 percent of the inoculants produced are for soyabean, although inoculants are also made for other crops. The soyabean inoculants are made from pure cultures of *Bradyrhizobium japonicum*. The inoculants have a shelf life of up to six months when refrigerated at 4°C – and a shelf life of four months when stored at room temperature in clay pots.

Production of inoculants increased until the collapse of commercial agriculture in 2001 to a peak of 136,000 sachets (see Figure). Since 2000, many of the inoculants produced have been used in smallholder agriculture, with production gradually gaining ground in response to demand until 2006. During the past season (2007/2008) problems of intermittent electricity supply have hampered production, but the committed staff have worked at night when power was available to ensure production. The facilities are well-maintained under the circumstances, but are in dire need of reinvestment.

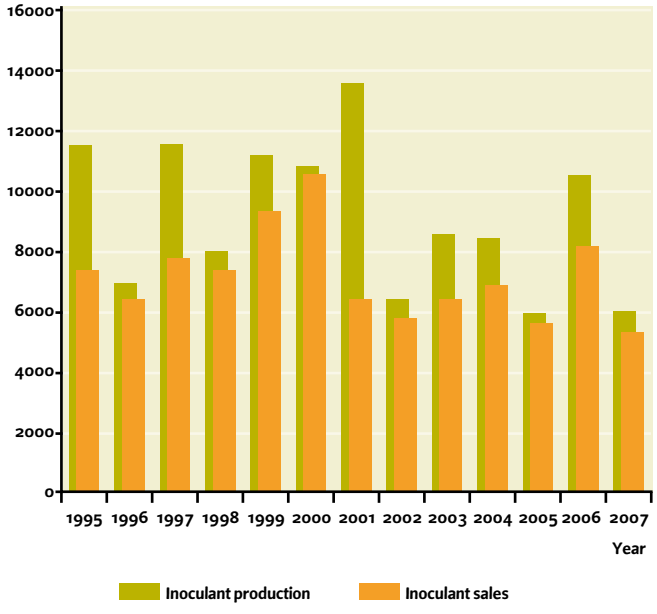

Figure 1: Production of soyabean inoculants (indicated in number of 80 g sachets) at Soil Productivity Research Laboratory, Marondera, Zimbabwe, since 1995.

Keys to successful soyabean adoption

A key to the successful adoption of soyabean as a smallholder crop in Zimbabwe was the formation of a Soyabean Promotion Task Force (SPTF). The task force comprised members of the University of Zimbabwe, the Department of Research and Specialist Services, the extension service, the Zimbabwe Farmers' Union, the Commercial Farmers' Union, and the main company purchasing soyabean, a vegetable oil producer, Olivine. The SPTF arranged for leaflets to be printed. These were written for development workers (extension and NGOs) in English and in the local vernacular directly for farmers with guidance on simple agronomy, how to handle inoculants and pest and disease management. Besides the income benefits of selling soyabeans to Olivine, local extension staff gave training in local processing of soyabean for food: milling soya with maize meal for a fortified porridge for children, baking soya bread, making soya milk and as a relish.

Before the SPTF embarked on an extensive promotion campaign, an economic study was conducted to assess models for the involvement of farmers' organisations, and to confirm the market demand for soyabean. Olivine tested a wide range of samples of soyabean grain from smallholders and was so impressed with the quality that they agreed to change the grading of smallholder soyabeans from "D" grade to "B" grade with the associated higher price. The smallholder grain was found to be cleaner (less chaff and stalk) than commercially-produced grain because it was hand-harvested and cleaned. Soyabean as a potential crop was publicised widely by radio, television and in the popular press. The SPTF gave substantial assistance in marketing soyabean from communal farming areas to Harare in the first years when production was expanding rapidly. Technical staff employed by the Task Force through a small grant assisted groups of smallholders to consolidate their production at rural centres. Once a group had managed to collect together 30 tonnes of soyabean they contacted the SPTF, who in turn phoned a haulage contractor to collect the soyabean load by truck and deliver it for sale to the oil-processing factory in Harare. From the payment for the load, the Task Force then deducted the cost of transport and arranged to repay the farmers in proportion to their contributed produce – quantities which ranged from as little as seven kg from one smallholder to more than three tonnes from wealthier farmers. This was a complex process, the transaction costs being borne by the project, but was a necessary step to take soyabean from being an "orphan" crop to fully established marketing. As funding dried up and the promotion activities were scaled back, other traders have come in to take up the role of buying smallholder produce and delivering it to the central markets.

Commitment

Travelling through Zimbabwe during the current growing season I have been amazed to see how widespread soyabean now is as a smallholder crop. This success owes much to the drive and commitment of Professor Sheu Mpepereki of the University of Zimbabwe and his committed staff within the Soyabean Promotion Task Force in championing production of soyabean in the smallholder farming sector. ■

Ken Giller. Plant Production Systems, Department of Plant Sciences, Wageningen University. P.O. Box 430, 6700 AK Wageningen, the Netherlands.
E-mail: ken.giller@wur.nl

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