On-farm Seed Priming: a Key Technology to Improve Crop Establishment and Yield in Semi-arid Tropics

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Introduction

Poor crop stand establishment is a major constraint in smallholder farming in semi-arid areas of Zimbabwe. Observations in Siabuwa (Chiduza et al. 1995) and in Chiredzi (Chivasa 1995) revealed high sorghum seeding rates of 1,200,000 to 1,800,000 seeds ha^{-1}, yet plant populations in farmers' fields ranged from only 22,000 to 160,000 plants ha^{-1} - a 2-9% germination and emergence rate. Farmers replant several times to achieve good stands, often at considerable costs in labor, materials, draught power, and yields lost because of delayed sowing. Poor smallholder farmers in semi-arid areas cannot easily afford these extra costs.

Reasons for poor stand establishment in tropical crops include inadequate seedbed preparation, low quality seed, untimely sowing, poor sowing techniques, inadequate soil moisture, and soil with such adverse physical properties as a propensity to form surface crusts. These constraints can be addressed, but at a cost. One low-cost, low-risk intervention measure is 'on-farm' seed priming; so termed to distinguish it from the energy-intensive, high technology seed priming, seed hardening, or seed conditioning processes available in high-input temperate agriculture (Harris et al. 1999).

Conventional seed priming is well documented (Parera and Cantliffe 1994, Paul and Chaudhury 1991, Taylor et al. 1988). It involves controlled hydration, which induces a series of enzyme systems whose benefits are maintained after seeds have been dried to their original water content and stored normally. Subsequent germination is faster, more uniform, and often more complete. These aspects are very important under cool, damp conditions prevalent where temperate, commercial crops are grown. In contrast, tropical crops are often sown in hot, drying conditions using unsophisticated sowing techniques. 'On-farm seed priming' involves hydration of seed by soaking it in water, usually overnight. This helps counter any adverse effects of the dry environment by promoting fast emergence and vigorous seedling growth (Harris et al. 1999).

Sorghum is one of the major rainfed crops grown in semi-arid Zimbabwe and is quite drought-tolerant. Nevertheless, land allocated to sorghum is often reduced because seed is in short supply. This is because of persistent droughts and low crop yields which lead to the consumption of all the grain that is harvested, so very little is retained for seed. Any agronomic interventions that increase the proportion of sown seed that emerges and also increase the rate of emergence will significantly help farmers reduce costs incurred by seed purchases and labor. The following is a report of participatory on-farm research conducted in Musikavanhu Communal Area, Chipinge, Zimbabwe, with the objective of developing and testing sorghum seed priming techniques.

Participatory Testing of On-farm Seed Priming

Participatory Rural Appraisals (PRAs) conducted in Musikavanhu Communal Area identified poor crop establishment as one of the main problems in sorghum production. This was also confirmed by observations of standing crop characteristics in farmers' fields. On-farm seed priming with water immediately before sowing to speed up emergence was chosen as a low-cost, low-risk intervention to improve sorghum stand establishment. Before the on-farm trials, pot experiments were conducted to obtain information on the performance of different sorghum varieties following seed priming in order to develop recommendations that could be used in the study villages. A 'safe limit' of 10 hours for priming seed of Red Swazi and Muchayeni varieties was established. On-farm trials began during the 1997/98 season in collaboration with Department of Agricultural, Technical, and Extension Services (AGRITEX) extension staff. Participants included 40 sorghum growers (male and female).

Farmers were given 1 kg seed each, half of which they soaked overnight, then surface-dried the seed and sowed it next to non-primed seed in their fields using traditional methods. The trials were evaluated during Focus Group Discussions (FGDs), farm walks, and matrix-ranking exercises. During the FGDs, farmers' opinions were sought on the advantages and disadvantages of seed priming compared to their normal practices in a number of researcher-defined, but mutually agreed categories relating to agronomy, crop development, and grain yield.

Results of the Participatory Testing of On-farm Seed Priming

During the 1997/98 season, the first rains were extremely late, starting in January rather than November. Consequently, only a proportion of crops flowered and formed grains.

Perceptions on performance were therefore from a subset of trials. Farmers who reported that it was easier to sow primed than non-primed seed indicated that heavier primed seed was easier to throw into the planting hole without drifting off-course. This improved control enabled farmers to regulate spacings and number of seeds per station much more accurately. Priming also made it easier for farmers to reject damaged and poor quality seed because it floated during soaking.

Farmers also noticed that primed seed emerged faster (1-3 days), fields sown to the primed seed had better stands, and primed plants grew faster and more vigorously. There was however no consensus on whether priming had advantages in drought conditions or against weeds. Farmers agreed that crops from primed seeds developed faster, flowered, headed and matured earlier than non-primed. Ninety-eight percent of all farmers expressed a wish to prime seed in subsequent seasons.

On-farm seed priming was not unknown to farmers in Musikavanhu communal area. About 37% of farmers reported having tried seed priming with maize, but they were not very successful because they had been poorly informed on priming times. As a result their seed had been damaged due to oversoaking. Also, farmers had only used priming when optimal sowing conditions had been missed as a way to 'catch up'. They saw on-farm seed priming as a 'conditional' practice, to be used only under adverse cropping circumstances. Farmers had not applied the technique under otherwise optimal sowing conditions.

Importance of Farmer Participation in Technology Testing and Adoption

Although on-farm seed priming was not a new technology in Musikavanhu communal area, we were unable to detect any systematic use of the technology for either sorghum or maize. Farmers will not appreciate the wide range of benefits from this low-cost, low-risk practice unless they have an opportunity to experiment with the practice on their own. Hence our choice of the participatory approach in this study. It is highly effective in empowering farmers to test, develop and adapt seed priming and to appreciate its effects. It exposes farmers to a wide range of crop-by-environment interactions within their own context, which they would otherwise not be able to see in researchers' trials.

Acceptance of on-farm seed priming by farmers has been very good in the Musikavanhu communal area. Almost all farmers who tested the technology said that they would continue with the practice. This suggests that simple, paired-plot participatory trials are effective for extension as well as for adaptive research. On-farm seed priming is a good example of a 'key technology' - a simple, low cost intervention whose impact is large enough to induce farmers to adopt it. Seed priming is clearly good insurance for farmers. There virtually has been no negative effect on crops; although sometimes there is no effect, mostly there are profound benefits.

Future work should be to disseminate the technology more widely and to quantify its effects on farmer livelihoods. In drier years there is potential for on-farm seed priming to contribute a great deal to food security in marginal areas. Future work should also seek to exploit this potential. There is potential for priming other crops once their safe limits have been determined.

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