Research into Use: Pocket Guide No. 9

A sure bet: **seed priming** and participation

Research Into Use

Seed priming is a proven technique that can bring huge gains to resource-poor farmers growing crops on marginal lands. Participatory learning can help them to harvest the benefits.

Above: The productivity of many crops that are grown from seed—including wheat, rice, barley, maize, sorghum, millet, chickpea, mungbean, and others—can be greatly improved using a simple, overnight technique: on-farm seed priming. Photo: D. Harris

On-farm seed priming is a simple technique that involves little or no extra costs, no risk and little effort. Yet what it has to offer in the way of stronger, faster maturing crops with better yields is simply enormous. Participatory methods can help farmers to realize the contribution this technique can make to their welfare, while ensuring that they use it properly—and widely.

This guide offers an overview of the impressive results that have been seen to date using on-farm seed priming, and the implications they have for improving a range of crops that farmers in the semi-arid tropics depend on for food and income.

Why prime?

Resource-poor farmers in the semi-arid tropics depend on marginal, rain-fed land to grow their crops. Soils on these lands are often low in nutrients and over-worked, and rainfall is scarce.

Under these conditions, it is particularly difficult for seeds to grow. The results can be observed in farmers' fields: 'patchy' emergence of crops, or even total crop failure. These are telltale signs that the seeds that were planted did not have the strength to sprout or to grow efficiently under the challenging circumstances of dry-land agriculture. Although sparse crops can be re-sown, the expense involved in this process can lead farmers into crippling debt—and there is no guarantee of success.

On-farm seed priming helps seeds to grow rapidly and evenly in the field, producing healthier, faster maturing crops with better yields. The fact that crops mature early means more options for farmers: they can take advantage by planting other crops, or even by looking for off-season job opportunities. In some crops—chickpea and mungbean in particular—priming has also been associated with better resistance to important pests and diseases.

What is priming?

'Priming' is simply a means of preparing seed to make it perform better. Seed companies regularly use priming for their products. Commercial seed priming, however, is a technology- and labour-intensive process that promotes sprouting by creating a range of biochemical changes in the seed. This seed is too expensive for resource-poor farmers, however, who depend on materials saved from their own crops, traded or bought locally from other farmers.

The type of priming promoted in this Pocket Guide—on-farm seed priming—is much simpler and is especially designed for conditions in which lack of water and dry, compacted soils are the main problems. It involves simply soaking seeds in water and then letting them dry, after which they can be sown immediately in the normal way or stored for several days if necessary—because bad weather delays sowing for example.

Interestingly enough, many farmers in the tropics have used seed priming for generations. They don't do this, however, as a regular practice, but only when severe weather conditions throw planting schedules off. They also don't know how long to soak the seed for, and so get unpredictable results.

Above: Crops emerge faster and more completely when seed is primed overnight, as seen in this maize field in India. The seeds planted on the left were primed, while the ones on the right were not. Photo: D. Harris

How does on-farm priming work?

For seeds to develop into seedlings, and then into a healthy crop, they must undergo a growth process that depends on environmental factors. The challenging conditions of the semi-arid tropics make this transition very delicate.

For a crop to succeed, its seeds must sprout and produce seedlings quickly and uniformly throughout the field so that they can take advantage of the light, water and soil nutrients available. In the semi-arid tropics, seeds are sown directly into hot, dry soils that have often been compacted by a previous crop (rice, for instance).

Seeds that are pre-hydrated and then surface-dried have a better chance of absorbing water from the soil because they germinate more quickly and the roots they produce grow faster, seeking moisture deep in the ground. They also have a better chance of survival above-ground, as seeds that are slow to sprout—or sprout unevenly—give weeds, pests and diseases a better chance to take hold.

What are the 'safe limits'?

Optimal soaking times—known as 'safe limits'—have been established for many crops through wide participatory research. If crops are soaked for less than this time, the process may not be effective. If they are soaked for longer, seeds can sprout before planting, leading to disastrous results under dry-land conditions. When seeds are properly primed—within the safe limits—they will germinate only after planting, when they are able to take up additional moisture in the soil.

'Priming' is simply a means of **preparing seed** to make it perform better

Above: Soaking seeds overnight (priming) gives higher yields of yellow chickpea (right) than planting non-primed seeds (left). Farmers and researchers have worked together to determine the optimum soaking time for many of the crops that smallholders in the semi-arid tropics depend upon for food and income. Photo: D. Harris

Prime results: crops, soaking times, countries and benefits to date

Crop	Soaking time (hours)	Countries	Largest yield benefits consistently observed to date (%)
Crops in which benefits have been repeatedly confirmed			
Wheat	12	India, Nepal, Pakistan	37
Barley	12	Pakistan	40
Upland rice	12-18	India, Nigeria, Sierra Leone, Gambia, Cameroon	70
Maize	12-18	India, Nepal, Pakistan, Zimbabwe	22
Sorghum	10	Pakistan, Zimbabwe	31
Pearl millet	10	Pakistan	56
Chickpea	6-8	Bangladesh, India, Nepal, Pakistan	50
Mungbean	6-8	Pakistan	206
Finger millet	8	India	15
Crops in which preliminary research has shown benefits			
Cowpea	8	Zimbabwe	
Bambara groundnut	8	Zimbabwe	
Linseed	8	Bangladesh	
Horsegram	8	India	
Pigeonpea	8	India	
Groundnut	8	India, Vietnam	

Above: **To prime or not to prime:** The results of on-farm trials are convincing. Farmers report that primed crops emerge faster, grow stronger, flower earlier, mature sooner and give higher yields. In some cases, they even show greater resistance to diseases and pests. What's more, in no case are the results with primed seed worse than those with un-primed seed. This, combined with next to no investment in time, labour and money, makes on-farm seed priming a hard technology to resist.

How can value be added?

Although on-farm priming alone has proven to be extremely successful in raising crop yields per hectare, even greater gains can be made by adding some key nutrients to the priming water. The types of nutrient added will depend on the specific circumstances of each crop and planting area. They can include major nutrients such as phosphorus, or bacteria such as *Rhizobia* that help legumes to capture nitrogen from the air. Micronutrients such as molybdenum can make all the difference for legumes grown in acid soils. If soils are, on the other hand, too alkaline, zinc can be added.

Not only does this type of 'nutrient priming' give farmers better control because micronutrients are difficult to apply evenly to the soil, it also makes the amounts needed (e.g. zinc, molybdenum) much smaller, as they are absorbed directly by the primed seed. Adding zinc, for instance, offers a plus for human and animal health by raising zinc concentrations in the foods they eat.

Nutrient priming can help farmers to save money, as fertilisers can be expensive to buy and transport, making it difficult for smallholders to afford them. Priming with small amounts of phosphorus can increase the efficiency with which fertilisers added to the soil are recovered by the crop.

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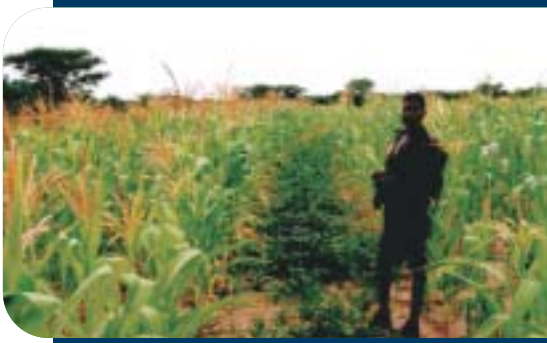

Right: In this maize field in Zimbabwe, the primed crop on the left grew taller and flowered earlier than the non-primed plot on the right.
Photo: D. Harris

Good things in small packages

Crop	Additive	What the additive does
Chickpea, mungbean	*Rhizobia*	'Fix' atmospheric nitrogen allowing plants to use it
Maize, wheat, chickpea, pearl millet	Phosphorus	Boosts growth, improves uptake of fertilizer
Chickpea, mungbean	Molybdenum	Increases yield of legumes in acidic soils
Maize, wheat, chickpea	Zinc	Increases yields and zinc content of grains

Above: **All this and much more:** This table illustrates some of the examples of nutrient seed priming that have been tested to date and shown to be effective. The possibilities are enormous. Once researchers work out the best concentrations of priming solutions, this method could be used effectively with many major tropical and sub-tropical crops.

Seeing is believing: the participatory approach

Experience has shown that farmers are much more likely to adopt and routinely practice on-farm seed priming when they participate in its testing—and can see the results for themselves. This also allows them to modify the approach to fit their own particular circumstances. What's more, farmer participation promotes farmer-to-farmer exchange of information: a fundamental means of spreading the use of this technology.

On-farm seed priming can be included as part of a set of tools that address basic problems in specific cropping systems. Farmers find it particularly easy to try seed priming, for instance, when they are testing new varieties.

Above: A farmer points to a vigorous chickpea crop produced by primed seed. On the right, non-primed seed failed to establish. Although 'safe limits' have been established for many crops, on-farm trials are needed to validate the seed priming methods that will give the best results for each crop in each location. These trials also help farmers to adapt the technique to other crops. Most important of all, on-farm demonstrations give visible evidence of how effective on-farm seed priming is, contributing enormously to its uptake and spread. Photo: D. Harris

Tools, guidelines and contacts

If you want to find out more about on-farm seed priming you can find a wealth of resources, including information on different crops and contact details for experts in South Asia and Africa, at **www.seedpriming.org**.

Or, visit the Plant Sciences Research Programme website at **www.dfid-psp.org**.

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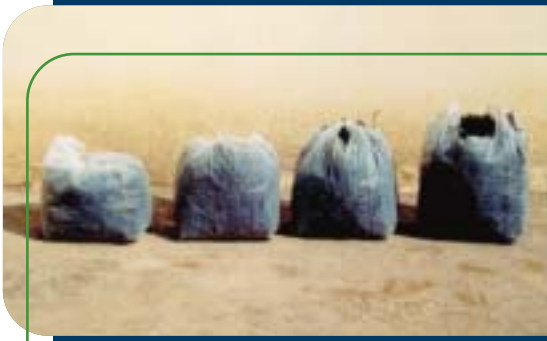
Farmer participation promotes farmer-to-farmer **exchange of information**



Above, right: These mungbean pods were harvested from same-sized plots. The smallest yield (left-hand bag) was produced from non- primed seed. Progressively greater yields were obtained with seed primed for 4, 6 and 8 hours. Photo: D. Harris

About this series

Research into Use *Pocket Guides* showcase new technologies that have been tried and tested, and have proven successful in the field. They were produced to demonstrate the importance of high-quality scientific communication.

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