Food and Agriculture Organization of the United Nations

Soaking seeds (seed priming) to improve crop yields

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Summary

Crop establishment is often poor in the semi-arid tropics. However, good crop stand establishment is essential for the efficient use of water and light, and a uniform stand is a pre-requisite for cropping success. Seeds that germinate quickly produce viable seedlings that are not dependent on rapidly declining moisture in the soil that may occur in rain fed systems. Soaking seeds in water before sowing gives the germinating seeds a head start and speeds up seed establishment with a corresponding increase in survival rates and yields. This practice explains as well how farmers can improve the nutrient supply to crops at a low-cost and effective way.

Description

1. What is seed priming?

Standard methods of seed priming in which seeds are soaked then dried back to their original water content, were developed for temperate horticultural and agricultural crops. The approach is useful for crops where germination, emergence and seedling vigour are constrained by cool, wet soils.

Farmers can prime their own seeds if they know the safe limits. The safe limits are calculated for each variety so that germination will not continue once seeds are removed from the water. A primed seed will only germinate if it takes up additional moisture from the soil after sowing.

It is important to note, the distinction between priming and pregermination-sowing pre-germinated seeds under dry land conditions can be disastrous. In most cases seeds can be primed overnight and are simply surface-dried and sown the same day. Apart from swelling slightly and weighing more, primed seeds can be treated in the same way as nonprime seed. Occasionally, sowing may be unavoidably delayed by heavy rain, for example. If primed seeds are surface-dried and kept dry they can be stored for several days then sown as usual and still perform better than non-primed seeds.

Research suggested that some of the effects of on-farm seed priming can be obtained by using sophisticated methods of seedbed preparation and sowing. Planters that ensure good seed-soil contact encourage good establishment. This may partly explain why the benefits from seed priming are often more evident in farmers' fields than on research stations. Fast germination and emergence result in rapid development of seedling root systems while soil conditions in the surface layers are still relatively favourable. Without early checks to growth, vigorous crops result.

Table 1 shows the required soaking time for different

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Table 1. Summary of crop responding positively to on-farm priming

Site and year	No. of trials	Mean yield of non-primed plots (kg/ha)	Meanyield difference (primed minus unprimed (kg/ha)	Mean yield increase due to seed priming (%)
Gujarat, India, 1997/98	108	4 298	221	5
Gujarat, India, 1998/99	97	4 200	187	5
East Chitwan, Nepal, 1998/99	9	2 273	384	17
West Bangal, India, 1998/99	20	1 224	162	13
Bihar, India, 1998/99	21	1 209	152	13
Ahmadwala, Pakistan, 1998/99 (siane conditions)	20	1 420	505	36

Source: FAO 2014

crops and the percentage of benefits observed after soaking the crops.

2. A low-cost and effective way of improving nutrient supply to crops

Soil nutrients such as nitrogen (N) and phosphorus (P) limit crop growth over huge areas of Asia and Africa but are expensive to buy and transport. Legumes such as chickpea, mung bean and groundnut ‘fix’ their own nitrogen from the air. They do this when they become infected by soil bacteria called rhizobia but this infection is beneficial rather than haphazard in the field. A more thorough infection (giving higher rates of nitrogen fixation) occurs if rhizobia inoculum is added to the seeds prior to sowing. Although this simple technology is common in well developed areas, it is rare for farmers in marginal areas to use it. Studies in eastern India, Nepal and Bangladesh have shown that adding rhizobia to the water used to prime legumes is an effective way of inoculating seeds and is more readily adopted by farmers.

In Pakistan, maize seeds primed with a weak solution of phosphate (P) produced 24 percent more grain than nonprime crops. The cost per hectare of the additional phosphate is negligible. The results suggest that priming with tiny amounts of phosphate can substitute for substantial amounts of phosphate fertilisers. This has enormous implications for resource poor farmers, particularly in Africa where soil phosphate is a major constraint on crop growth.

Some nutrients are only required in small quantities by crops. However if their availability is limited, crop growth is very poor, even in the presence of ample nitrogen and phosphate. These nutrients are known as micro-nutrients. In acidic soils that are widespread over eastern India, Nepal, western Bangladesh and many parts of East Africa, legumes do not grow well because they cannot take up enough molybdenum (Mo). It is possible, and rather expensive, to add salts such as sodium molybdate to the soil. It is also quite difficult to spread it evenly over large areas due to the small

Table 2. Results from on-farm trials of seed priming in wheat in South Asia, 1997 - 1999

Crop	Soaking time (hours)	Countries	Largest yield benefits consistency observed to date (%)
Wheat	12	India, Nepal, Pakistan	37
Barley	12	Pakistan	40
Upland rice	12 - 18	India, Nigeria, Sierra Leone, Cameroon	70
Maize	12 - 18	India, Nepal, Pakistan, Zimbabwe	22
Sorghum	10	Pakistan, Zimbabwe	31
Pearl	10	Pakistan	56
Chickpea	8	Bangladesh, India, Nepal, Pakistan	50
Mungbean	8	Pakistan	206
Finger millet	8	India	16

Source: FAO 2014

quantities involved. Substantial yield benefits (20 to 90 percent) can result from the addition of tiny amounts of Mo to the priming water. Costs are negligible and this simple approach has been adopted by thousands of farmers who otherwise would not be able to grow a profitable crop of chickpea. In contrast, many of the soils of Pakistan are alkaline and farmers are often faced with a different problem, a lack of zinc. Priming with weak zinc solutions increased yield in chickpea by almost 50 percent, in wheat by over 20 percent and in maize by over 30 percent, again at a negligible cost.

3. DFID disclaimer

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4. Agro-ecological zones

- Tropics, warm

5. Objectives fulfilled by the project

5.1 Resource use efficiency

The technology allows for good crop stand establishment and efficiently uses water and light in semi-arid regions. It also allows increases seed planting, sprouting and survival rate.

5.2 Pro-poor technology

The technology improves the nutrient supply to crops at a low-cost and effective way.