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A CASE STUDY

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Seed priming - An effective method for crop production

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INTRODUCTION

Seed may be considered as the most important and vital factor which is structurally a fertilized matured ovule consisting of an embryonic plant along with a store of food in the form of endosperm and a protective seed coat. Seed quality has been taken as an essential and important factor in the improvement of agriculture from the time immemorial. The agrarian societies are very much aware about the fact and the evidences are found in the old Vedic literatures. The old scripture, Manu Smriti says "Subeejam Sukshetre Jayate Sampadyathe" *i.e.* good seed in good soil yields abundantly. The Rigveda, 2000 BC indicate the importance accorded to seed and the mother earth. Fifth century "Kautilya Artha Shasthra" and "Surapalas Vrikshayurveda" mentioned about the importance of seed and its protection from the harmful factors in the initial stage by seed dressing with cow dung, milk, honey and vidanga. In recent era, the need for good quality seed was identified at the beginning of 20th century when Royal commission of Agriculture (1928) recommended spread of improved varieties and seed distribution.

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Importance of quality seed :

- Seed is an essential and vital input in crop production.
- It is the cheapest and key input in crop production for agricultural progress.
- Crop production and productivity largely depends on the seed materials used for sowing.
- The performance of the other inputs in crop production depends on seed material used.
- In comparison to the other agricultural inputs like fertilizers, insecticides, fungicides, bactericides etc., the cost of seed is relatively less. This emphasizes the need for increasing the area under quality seed production.
- It has been estimated that good quality seeds of improved varieties can enhance the agricultural productivity by 20-25 per cent.
- The advent of modern plant breeding methods

and biotechnological advances in seed industry plays a significant role in developing high yielding varieties and hybrids.

Unpredictable and inconsistent rainfall, deteoriated soils, inferior quality seed and changing climatic scenario, limited access to reliable draft power contributes to a situation where good crop establishment is often the exception rather than the rule. This unfortunate event ultimately leads to crop failure, which makes crop production expensive and can lead poor farmers into crippling debt. For improving the livelihoods of the farmers, solutions must be found through simple and effective means. Fortunately, such solutions are available, among which seed priming is one of the important and effective measure to establish the crop successfully in the crop field.

Seed priming :

Seed priming is a process of controlling the hydration level within seeds so that the metabolic activity necessary for germination can occur but radicle emergence is prevented. It is a physiologically based, seed enhancement process for improving the germination characteristics of seeds. Seed priming is accomplished by partially hydrating seeds and maintaining them under defined moisture, temperature and aerated conditions for a prescribed period of time. In this state, seeds are optimally hydrated and desirable metabolic activity is attained, thereby allowing important pre-germination steps to be accomplished within the seeds. These include repair of membranes, DNA and RNA synthesis and repair, development of immature embryos, alteration of tissues covering the embryo, destruction or removal of dormancy blocks and general pre-germination metabolism enhancement. At the conclusion of the priming process, seeds are re-dried to their storage moisture levels. Following the priming process, seeds are physiologically closer to germination and therefore, have fewer steps to complete than unprimed seeds in order to accomplish germination and growth after planting.

Importance of seed priming :

Crops are like children – give them a good start in life and they usually grow tall, strong and healthy. But if crops emerge and grow slowly after germination, they often become stunted and unhealthy. As such plants are easily attacked and damaged by pests and diseases, they produce less grains and straw. Giving crops a good start is, therefore, of crucial importance in crop production. After sowing the seeds, they spend a considerable duration of time just to absorb water from the soil. If the duration can be minimised, seed germination and seedling emergence will speed up. The easiest way to do this is seed priming.

Steps in seed priming :

- Soak the seeds when you are about to sow.
- Soak the seeds for definite time period.
- Do not soak the seeds longer than the required duration. If they are allowed to do so, they will start to germinate and the seeds might be lost.
- The soaked seeds should be surface dried in the next day by sun drying.
- Sowing should be done on the same day. But if sowing could not be done due to bad weather, the seeds can be stored in a dry place for several days.

Types of seed priming :

Several types of seed priming methods are developed and used successfully. Among them the most commonly used are given below :

Osmopriming or osmoconditioning :

It is the most easiest and standard priming technique. Seeds are incubated in well aerated solutions with a low water potential, followed by washing and drying. The low water potential of the solutions can be achieved by adding osmotica like mannitol, polyethylene glycol (PEG) or salts like KCl etc. seeds are placed on a layer of cotton wool imbibed with a solution of PEG-8000 at –2.0 MPa for various durations up to 14 days at 25°C or for 2 and 7 days at various temperatures ranging from 5°C to 35°C (± 0.5°C). Following incubation, treated seeds are rinsed and dried to their original moisture content.

Hydropriming (drum priming) :

It is done by continuous or successive addition of limited amount of water to the seeds. A drum is used for this purpose and the water can also be applied by humid air. Washing of the seeds with Millipore water for 4 hours at 20°C is done to remove germination inhibitors from the seed coats, followed by re-drying in air at 20°C for twelve (12) hours to the initial moisture content. A controlled hydration of the washed seeds at various temperatures ranging from 5°C to 36°C (± 1°C) for

various durations up to 5 days and a dehydration of the treated seeds to the initial moisture content is achieved by this process.

Matrix priming (matriconditioning) :

Incubation of seeds is done in a solid, insoluble matrix like vermiculite, diatomaceous earth, cross-linked highly water-absorbent polymers etc. in a limited amount of water. This method confers a very slow imbibition.

Bio priming :

Bio-priming is the process of biological seed treatment that refers combination of seed hydration and inoculation of seed with beneficial microorganisms to protect the seed. It is an ecological approach using selected fungal or bacterial antagonists against the soil and seed-borne pathogens. Biological seed treatments may serve as an alternative to chemical control.

Advantages of seed priming :

- It helps to overcome or alleviate phytochrome-induced dormancy.
- It reduces the time necessary for germination and for subsequent emergence to occur.
- It improves the stand uniformity in order to facilitate production management and enhance uniformity at harvest.
- It extends the temperature range at which a seed can germinate.
- Priming enables seeds of several species to germinate and emerge at supra-optimal temperatures.
- Priming has also alleviated secondary dormancy mechanisms that can be imposed if exposure to supra-optimal temperatures lasts too long or in photo-sensitive seed varieties.
- It increases the rate of germination at any particular temperature.
- Priming has been commercially used to eliminate or greatly reduce the amount of seed-borne fungi and bacteria.

Seed priming risks :

The primed seed cannot be stored for a long period of time. The shelf-life of seed is reduced drastically after priming. The seeds must be sown as soon as possible to get the good result. Depending on the species, seed lot vigour, the temperature and humidity at storage, a primed seed remains viable up-to one year. If the primed seeds are stored in hot and humid conditions, it will loss its viability much more quickly.

Present status of seed priming :

Seed priming is a simple but successful solution. The seed priming concept is an old wine in a new bottle. Hydro priming is an usual and most commonly used practice among the farmers of India, Nepal, Pakistan, Botswana, Malawi and Zimbabwe. In collaboration with resource-poor farmers, the researchers from the Centre for Arid Zone Studies (CAZS), have taken a fresh look at "on-farm" seed soaking or "priming". They calculated "safe limits" (the maximum length of time for which seeds can be soaked and which, if exceeded could lead to seed or seedling damage) for maize, upland rice, wheat, chickpea and sorghum. Similar work on seed priming was also done by Farooq *et al.* (2006 a and b); Bradford *et al.* (1990) and Pattar *et al.*(2013).

On-farm seed priming seems to be a reliable, widely applicable technology and its effects are generally independent to the crop variety used. Priming can be used to add value to the benefits achieved by using improved as well as modern varieties. The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) has been promoting the use of chickpea in fallow cultivable areas of Bangladesh using on-farm seed priming. Average fifty per cent increase in yield had been observed in a recent set of 30 on-farm trials. On-farm seed priming was found to be effective in increasing yields in all the crops and countries listed in Table 1.

Table 1 : Yield increase after seed priming in different countries

Crop	Country	Yield increase (%)
Maize	Zimbabwe and India	22
Sorghum	Pakistan and Zimbabwe	31
Wheat	India, Pakistan	37
Upland rice	West Africa	70

Conclusion :

Priming is a very promising strategy in modern crop production and management. A number of on farm seed priming research projects are successfully running around the globe, with a positive prospect. Seed priming is a simple, safe and effective technology which can be easily adopted by resource-poor farmers and moreover it has the potential to benefit such farmers in a numbers of other ways. Commercialisation of the seed priming technology has been expanded rapidly in recent years. For example, in North America more than 20 companies are actively involved in seed priming technology which is found to have fruitful effect over fifty vegetable, herb, flower, reclamation, forage and turf species. But, further research is needed in this aspect, in order to clarify the mechanisms by which priming affects development, growth and disease resistance.

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