SEED TREATMENT TECHNOLOGY IN CROP PRODUCTION – A REVIEW

S.S. Kulkarni and B.M. Chittapur

Department of Agronomy,
College of Agriculture, U.A.S. Dharwad - 580 005, India

ABSTRACT

Presowing seed treatment soaking with water, mineral solutions (viz., CaCl₂, ZnSO₄, cobalt sulphate/chloride, K₂SO₄, KH₂PO₄, CuSO₄, sodium molybdate, boric acid, manganous sulphate and other) or growth regulators (viz., ascorbic acid, kinetin, benzyl adenine, GA, CCC and other) alone or in combination found to speed up germination process, increased germination rate and seedling vigour, improved resistance to water and salinity stress and increased crop yields. Being a low cost, easy to understand and simple technology, location specific and crop specific recommendation are needed. The available information, therefore, has been reviewed.

Physiological induction as a seed conditioning treatment is a well-known feature exemplified in the process of vernalization. However, the effect of repeated soaking and drying of seed, although reported as early as 1883 and 1887 by Will and deSausure, was not widely investigated until 1934. According to May et al. (1934), the subject received serious attention by Henckel and Kolotova (1934) who suggested a method of pre-sowing seed treatment for increasing drought and frost resistance in crops. Since then attempts were made at different places world over, however, the available information did not form a sound base for technology development. Nor there are any favours reports. Probably, the fact that crop production begins only after reliable soil moisture situations are achieved, this technology did not get the required momentum. Nevertheless, the growing water scarcity and loss of rhythm in the on set of monsoon make us think on this low-cost sustainable production technology. Hence an attempt is made here to review the work on seed treatment as an effective tool of efficient resource use technology.

1.0 Seed Hardening

Pre-sowing seed treatment is a simple technique where seeds are soaked in water for a given period of time and at the time of commencement of the signs of germination they are dried back to the original moisture level. Such treated seeds are referred to as hardened seeds. In U.S.S.R., wheat, cotton and sunflower are subjected to the pre-sowing treatment before sowing as routine practice. Salim and Todd (1968) adopted this method in wheat and barley and found that treated seeds are capable of germination in higher concentrations of mannitol and recorded higher yields. Austin et al. (1969) recorded 50 per cent increase in the length of the carrot embryos in seeds, which were hardened compared to the untreated seeds. Higher yields were also observed due to pre-sowing seed treatment. Hardened wheat seeds exhibited high percentage of germination and dry weight of seedlings when compared to untreated seeds (Jaiswal et al. 1997).

1.1 Seed germination and vigour

Dawson (1965) Subjected the seeds of finger millet to seed hardening treatment and found that seedlings developed from hardened seeds showed quicker germination and an initial seedling vigour by enhanced root growth. Mehrotra et al. (1968) reported that soaking wheat seeds in water for 12 hrs resulted in early germination.

In soybean, Nalwadi et al. (1973) found that seed soaking in water for 24 hrs
increased the germination percentage significantly. In groundnut field experiments conducted using hardened and unhardened seeds indicated the response by way of increased yield (Laxmi et al., 1972). Germination percentages of freshly harvested sunflower seeds were markedly increased by soaking them in water (Mohammad et al., 1982). In case of pop sorghum, soaking of seeds for 24 hrs recorded over 80 per cent germination in a single day while untreated seeds took over three days (Chittapur and Kulkarni, 2002). Thus, the results revealed that the simple method of pre-sowing seed hardening with soaking and drying of seeds enhanced germination rate. This has practical applicability in dry areas and post rainy season cropping where optimum condition for sowing prevailed for a very short period and any delay costs the farmer very clearly.

2.0 Chemical treatment

Similar to water, treating seeds with cow urine is a traditional wisdom under village folklore. Of late, some organic solutions have been developed by organic growers. This indicated usefulness of chemical solutions besides water for seed treatment. Infact, Chinoy (1960, 1962) has shown in a series of experiments in barley and wheat that seed soaking and drying using ascorbic acid has resulted in increased yield.

2.1 Effect of mineral elements

Studies conducted with finger millet using CaCl₂ have shown to have a greater beneficial effect in terms of germinability and seedling growth under simulated stress conditions or salinity (Sastry et al., 1969 and Vishwantha et al., 1972). Soaking finger millet seeds in ZnSO₄ solution who shown to be beneficial and increased seed yield (Govindarajan and Gopalarao, 1954). Soaking rice seeds in ZnSO₄ solution gave higher dry matter yield (Kang and Okaro, 1976). Seedling dipping in ZnSO₄ is a recommended practice in Karnataka. Semina (1968) reported that soaking buck wheat in 0.1 per cent solution of ZnSO₄ increased the seed yield from 10.2 to 12.8 q per ha. Noakov and Anisimov (1971) observed that pre-sowing treatment of maize seeds with 0.1 per cent ZnSO₄ and cobalt sulphate solutions markedly increased the yield.

In groundnut, out of 10 varieties subjected to soaking and drying using CaCl₂, ascorbic acid and water, four varieties responded to CaCl₂ treatment by way of increased yield. This indicated varietal differences and hence the need for development of specific technologies. Earlier studies by Henckel et al. (1964) had also shown that seed treatment with CaCl₂ induced heat tolerance. Idris and Aslam (1976) reported that in wheat, seed soaking in CaCl₂ or water and drying stimulated germination and growth of seedlings. In the northern dry region of Karnataka seed treatment with 1% CaCl₂ solution in sorghum that recommended couple of years back (Anonymous, 1998).

In wheat, soaking the seeds in potassium dihydrogen phosphate solution of r12 hrs. increased yield components such as number of ears per plant number of grains per ear and also 1000-grain weight (Mehrothra et al., 1968 and Narayan et al., 1958). Vanangamudi and Kulandaivelu (1989) observed higher field emergence percentage (98%) when sorghum seeds were soaked in 0.5% KH₂PO₄ when compared to unsoaked seeds (93%). Similar studies in wheat, pre-sowing treatment with 1% KH₂PO₄ resulted in higher germination percentage.

In sunflower, treatment with cobalt and copper showed higher resistance to drought compared to boron treatment (Pirzol-Savulescu, 1976). Pre treatment with copper sulphate has been found to result in quicker seedling emergence in barley (Zaitseva, 1976). Similarly, soaking peas and Vicia faba in 0.1 per cent solution of cobalt chloride recorded
Table 1. Effect of seed treatment on germination and seedling growth of different crops

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Dose/period</th>
<th>Crop</th>
<th>Effects</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>Soaking for 12 hrs</td>
<td>Wheat</td>
<td>Early germination</td>
<td>Mehrotra et al. (1968)</td>
</tr>
<tr>
<td>Water</td>
<td>Soaking for 24 hrs</td>
<td>Soybean</td>
<td>Increased germination %</td>
<td>Nalwad et al. (1973)</td>
</tr>
<tr>
<td>ZnSO_4</td>
<td>Soaking in 0.1%</td>
<td>Buckwheat</td>
<td>Increased seed yield</td>
<td>Semina (1968)</td>
</tr>
<tr>
<td>ZnSO_4</td>
<td>Soaking in 0.1%</td>
<td>Maize</td>
<td>Increased seed yield</td>
<td>Anisimov (1971)</td>
</tr>
<tr>
<td>CaCl_2</td>
<td>Soaking in 1.0%</td>
<td>Sorghum</td>
<td>Early germination and increased seed yield</td>
<td>Anonymous (1998)</td>
</tr>
<tr>
<td>KH_2PO_4</td>
<td>Soaking for 12 hrs</td>
<td>Wheat</td>
<td>Improved yield and yield parameters</td>
<td>Mehrotra et al. (1968) and Narayan et al. (1958)</td>
</tr>
<tr>
<td>KH_2PO_4</td>
<td>Soaking in 0.5%</td>
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<tr>
<td>CaCl_2</td>
<td>Soaking in 0.1%</td>
<td>Peas and Vicia faba</td>
<td>Increased yield</td>
<td>Leshina (1970)</td>
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<td>GA</td>
<td>Soaking in 200 ppm</td>
<td>Cotton</td>
<td>Improved seedling growth</td>
<td>Karansingh and Afria (1990)</td>
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<tr>
<td>GA</td>
<td>Soaking in 500 ppm</td>
<td>Maize</td>
<td>Increase germination and vigour</td>
<td>Lin (1985)</td>
</tr>
</tbody>
</table>

increased yield (Leshina, 1970).

In maize, effect of seed treatment with boron and manganese salt solutions increased the fresh weight and seed yield by 15.7 per cent. These treatments also increased the carotene and chlorophyll content and bound water thus inducing drought to tolerance in the crop (Popov, 1971). When seeds were soaked for 5 to 24 hrs in 0.1 manganese sulphate and 0.05 % boric acid, the increase in grain yield was 20 per cent in water, 14 per cent with manganese, 5 per cent with boron and 24 per cent with boron + manganese (Vorisek and Marivelkava, 1966). Similarly, studies in cotton (Singh, 1961) and potato (Levrivoka, 1968) revealed favourable effects of ferrous sulphate and boric acid.

Misra and Dwivedi (1980) reported the effect of pre-sowing treatments on growth and dry matter accumulation in 12 wheat varieties under rainfed conditions. The seed treatments with potassium and distilled water increased dry weight of shoot and yield straw and grain significantly compared to controls.

2.2 Influence of growth regulators.

In finger millet, ascorbic acid, kinetin and benzyl adenine seed treatment improved germination and seedling vigour under simulated stress condition (Sastry et al., 1969 and Viswanath et al., 1972). Karansing and Afria (1990) observed an increased germination. Seedling growth and field emergence in cotton seeds treated with GA at 200 ppm. Speed of germination and seedling growth were highest with 500 ppm. GA and ascorbic acid treatment respectively in Gossypium hirsutum (Sharma et al., 1984). Rice was also strongly influenced by GA in terms of increased germination (Ramesh Babu, 1985). Pre-soaking with 500 ppm GA was reported to increase germination and vigour in maize under salt stress conditions (Lin, 1985). Germination after 8 to 16 days investigated by Harada (1988) in wheat...
cultivars with or without GA treatment.

3.0 Effect of seed treatment on stress tolerance

In sunflower, Filatov and Frolova (1975) found that hardening induced heat tolerance and hardened plants gave an increased seed yield of 150 to 300 kg per ha more than unhardened crop. Viswanath et al. (1972) found that seeds of finger millet hardened using water or solution of cytokinins germinated in soil with an ESP of 29 per cent. Research conducted on paddy indicated that plants from hardened seeds could withstand salinity as shown by higher per cent germination and increase seedling growth in solution of NaCl (Veeraraju et al., 1970).

Radi et al. (1989) based on their experiment with maize and safflower seeds using different concentration of GA and IAA with varying drying periods reported that these growth regulators were effective in reducing the deleterious effects of NaCl on seed germination.

4.0 Seed treatment to prolong viability and vigour

Seed soaking and drying has also been shown to be of advantage in increasing the yield and extending the viability of seeds. Basu et al. (1978) observed a significant increase in seedling vigor and extended seed viability in jute plants. Kapur et al. (1990) studied preconditioning of different cultivars of groundnut seeds to relieve dormancy. They observed that, soaking the seeds in water partially released the dormancy, increased the germination rate and seedling growth.

CONCLUSION

Seed treatment using water, mineral or organic solutions reduced germination period, increased germination percentage and seedling vigour, improved resistance a low cost, easy to understand and simple technology, influenced the field crop and enhanced production. Location and crop specific recommendations are needed to develop in view of growing problems in stand establishment under different conditions.

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