IMPROVING COTTON ESTABLISHMENT WITH SEED PRIMING

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Establishing a satisfactory stand of cotton is a continuing problem for many growers. Even when the crop is not planted 'too early' in terms of the 9:00 soil temperature there is still a risk involved. A cold snap following planting or numerous different seedling diseases will dramatically reduce the rate of germination and emergence and may even result in the death of many seedlings. The quality of a particular batch of seed will also effect the reliability of stand establishment.

What is seed priming?

It was thought that a seed priming treatment may help to alleviate these problems in cotton establishment by reducing the time taken for germination and also the time spread of germination, resulting in faster and more uniform crop establishment. Priming is a pre-sowing seed treatment which has been found to be useful for tomatoes and other horticultural species.

In a true 'priming' treatment, seeds are held in solutions of concentrated salts for longer than they would normally take to germinate. This allows the seeds to imbibe just enough moisture to begin the metabolic processes that lead to germination but not enough moisture to allow radicle emergence (visible

germination). These seeds can be dried back, sown with conventional equipment and will germinate quickly when they imbibe water after planting. Our studies have found that the salt solutions commonly used for seed priming are toxic to cotton seeds but the effect on the seed is basically the same if the availability of water is restricted by physical rather than osmotic means. For cotton this involved maintaining the seed moisture content at approximately 55%, a level which just prevented radicle emergence. This was be achieved by mixing the seed with a volume of water equivalent to approximately one half of its air dry weight and then sealing it with plastic film permeable to oxygen but not to moisture.

What is the effect of seed priming?

This water priming technique had a dramatic effect on both the rate of germination and the time spread of germination of the treated and dried cotton seeds without any reduction in the maximum germination percentage. At 16^{o}C, 80% of the primed seed had germinated in less than one day, whereas unprimed seed required three days.

Tests carried out on the varieties Deltapine 90, Siokra and Sicala showed the optimum temperature for priming, in terms of maximum improvement in germination rate (time to 80% germination), to be between 26.7 and 32.5^{o}C (which approximates the optimum temperature for

cottonseed germination; 31°C). There was no difference in germination rate between seed primed for 2, 3 or 4 days. Some problems were incurred with fungal contamination where seed was primed for 4 days.

Whilst priming results in a significant improvement in germination, field trials conducted in 1988-89 showed some positive trends but no statistically significant differences between the emergence of treated and untreated seeds indicating that the priming advantage may not be carried through to emergence.

In a replicated experiment with Deltapine 90 seed in pots in a glasshouse we showed that primed seed will in fact emerge up to 24 hours earlier than unprimed seed (figure 1a). The growth of these seedlings was closely monitored as an indication of seedling vigour. It was found that seedlings emerged from primed seed were still ahead six weeks after planting. At this stage the first true leaf was 3.2% longer, the first internode 29.9% longer and the shoot dry weight 13% greater for seeds primed at 26.7°C than for unprimed seed.

Results of a glasshouse emergence experiment with Siokra and Sicala seed were not so positive (figure 1b&c). Primed Siokra seed achieved 5% emergence quicker than unprimed seed but was approximately 24 hours slower to achieve 50% emergence. This means that the time spread of emergence has been increased. The

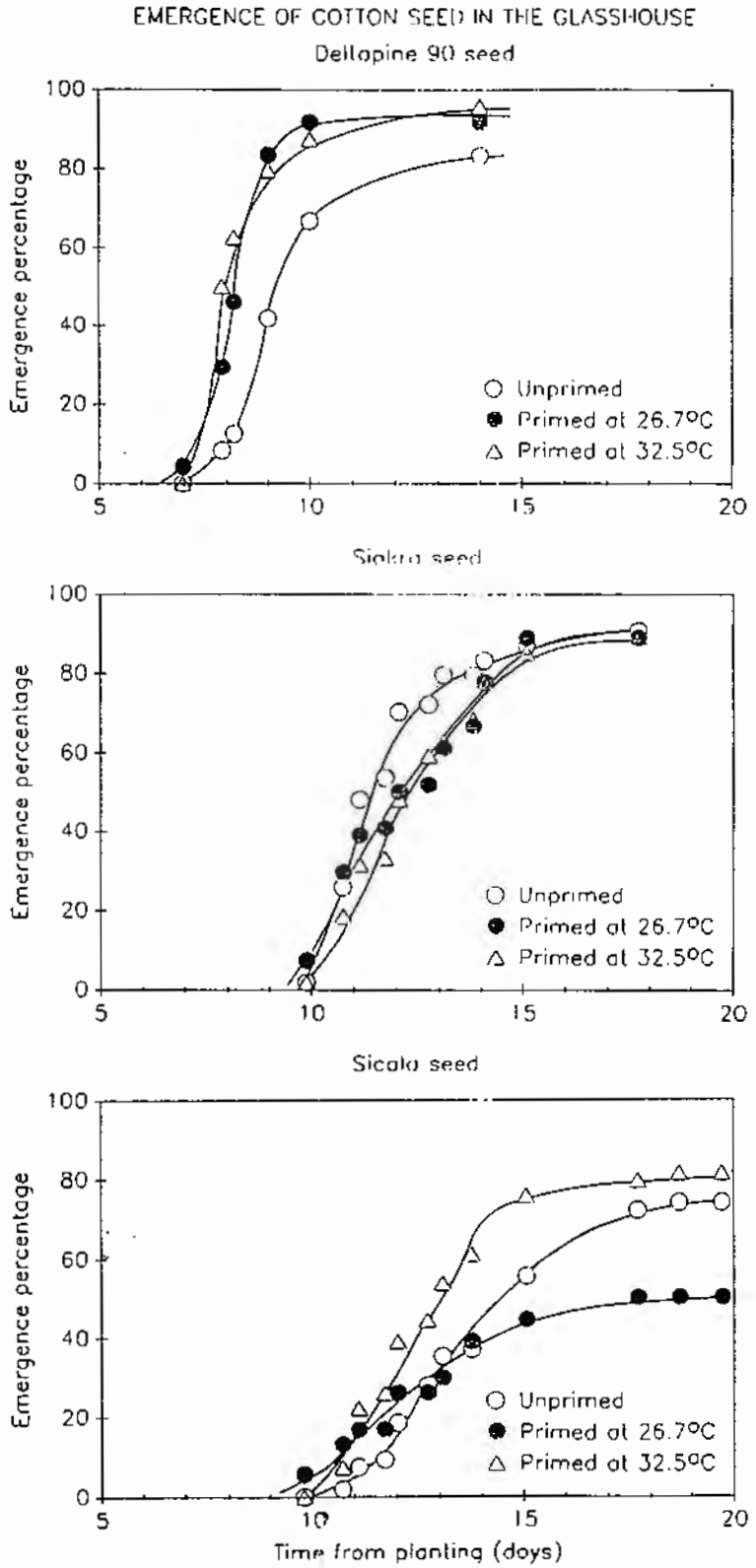

Figure 1. Emergence of three varieties of cotton seed in the glasshouse

shoot dry weight from primed Siokra seed was also 12% lower 20 days from planting. Sicala seed primed at 32.5°C appeared to emerge quicker than unprimed seed while that primed at 26.7°C emerged slower. There was no significant difference in the shoot dry weight for Sicala.

Field trials

In contrast to the glasshouse experiment, results of a field trial in 1989-90 were somewhat disappointing. In an early season planting of Deltapine 90, primed seed emerged approximately 12 hours faster than unprimed seed with only a slight reduction in total emergence. Deltapine 90 seed planted mid season and Siokra and Sicala seed at both planting times, however, showed dramatic reductions in total emergence and no improvement in rate of emergence.

It is still unclear why priming resulted in such a reduced stand count in this experiment but we suspect that it was due, at least in part, to contamination of the seed during the priming treatment. Subsequent laboratory tests on the seed used for the field trials revealed problems even in germination. In addition early experiments indicate that seed of lower quality, or that has already experienced some weathering, may be effected negatively rather than positively by the priming treatment. Further tests are being carried out to test this hypothesis.

If the problems of seed contamination and seedlot variation can be overcome priming has the potential to speed cotton emergence by at least one full day in early to mid-season plantings. This would certainly decrease the level of risk at planting time and thus the likelihood of needing to replant. A 24 hour 'head start' may also mean that the seedlings are able to keep pace with a rapidly receding wetting front in the soil, eliminating the need for an irrigation soon after planting in certain situations. Final laboratory and field trials this year should show whether cotton seed priming is likely to be a viable tool in improving stand establishment.