Some Recent Advances in Vegetable and Flower Seed Technology

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The reasons for variation in seed viability, and for the variation in the size of plants grown from seed are described, together with a basis for selecting seed lots to give high germination and uniform stands of plants. The use of seed priming by polyethylene glycol, combined with fungicides and plant growth regulator treatment to improve subsequent seed performance, is outlined.

INTRODUCTION

Module and tray systems, introduced in the 1970s, were a major advance in the production of transplanted vegetable crops. Large numbers of plants can be produced relatively cheaply and both plant quality and ease of handling are greatly improved compared with systems used for producing bare-root plants. However, for all crops a critical factor influencing the efficiency of the system is the proportion of cells sown with a single seed leading to a "plantable" plant.

As the environment in module systems can be controlled to provide optimum conditions for germination and emergence the major factor influencing efficiency is seed quality. Despite improvements in the quality of vegetable and flower seeds offered for sale it is still difficult to reliably achieve more than 85% to 90% of cells filled with a "plantable" plant by sowing a single seed per cell. Variability in the size of plants in a batch is also an important quality factor directly related to germination times of seeds in a lot which can vary over several days.

FACTORS AFFECTING QUALITY

Variability in performance from seed lot to seed lot arises as a result of characteristics in common with the species' wild relatives, for example, highly branched inflorescences, a wide range of seed maturity times, dormant seeds, and fruit and seed structures giving efficient dispersal but which make harvesting difficult.

SEED PRODUCTION AND SELECTION TECHNIQUES

In some species, such as carrot, it is possible to improve seed quality by growing plants at high density to reduce side branching of flower shoots, which improves the uniformity of seed maturity times. This, coupled with the use of the statutory germination test, can do much to ensure that high quality seed is made available to the grower (Gray, 1983).

The adoption of improved production techniques alone will not ensure a reliable supply of high quality seed, as the environment influences seed viability and level of dormancy; treatment of the seed after harvest may be necessary to improve quality further.

PHYSIOLOGICAL TREATMENTS OF SEEDS

Physiological treatments can improve the quality of poorer seeds or induce germination in dormant seeds. Some species which do not exhibit true dormancy can be induced into a "dormant" state by high temperature. On return to low temperature they start to germinate again but over a protracted period. This dormancy can be overcome by the use of growth regulators such as gibberellic acid and cytokinins applied to the seeds. Treatments using these or materials with similar activity are being used commercially.

Induced dormancy can also be prevented by priming seeds in polyethylene glycol (PEG). When seeds are placed in PEG solutions of a given concentration (osmotic potential) the rate of water uptake by the seed and the total seed moisture content can be controlled. During this period, the events in the seed that prepare it for actual germination take place but the emergence of the radicle is prevented—it is unable to take up sufficient water to enable it to extend through the seed coat. Priming allows "poor" seeds in the batch to "catch up" in development with the good seeds. Once the seeds are removed from the PEG and given water to germinate they do so more rapidly, and closer together in time, than untreated seeds.

Table 1. Effect of priming on germination responses.

	Mean germination time (days)	Spread of germination (days)	Percentage germination
Impatiens			
Control(C)	7.9	4.3	92
Primed(P)	5.0	4.1	89
Primed & dried (P&D)	5.9	3.6	89
Salvia			
C	8.9	6.5	66
P	4.0	5.4	76
P&D	8.5	7.1	64
Verbena			
C	7.7	5.3	69
P	4.0	4.7	68
P&D	3.8	4.9	67
Petunia			
C	5.6	3.1	94
P	2.0	3.2	94
P&D	2.3	3.5	94

Priming in *Primula* (-1.5MPa, 10 days), *Impatiens* (-0.75 MPa, 14 days), *Salvia / Verbena* (-1.5 MPa, 14 days), *Petunia* (-1.0 MPa, 14 days) all at 15C.

Techniques to scale-up this process to a commercial scale have been developed (Gray et al., 1992) and processes using a solid matrix, PEG in bioreactors and drum priming are in widespread use in the seed industry. The potential of the technique is illustrated by recent work at Horticulture Research International, Wellesbourne, on bedding plants. This work has emphasized the potential for combining priming with plant growth regulator treatment.

Reductions in mean germination time and spread of emergence without loss of viability have been obtained in *Impatiens*, *Salvia*, *Verbena,* and *Petunia,* although in *Salvia* difficulties have been encountered in drying the seeds successfully without loss of the benefits of priming (Table 1). In *Primula*, priming depressed viability and increased the mean germination time and clearly in this species, which requires light for germination, other treatments are required.

Table 2. Effect of combined priming and growth regulator treatment.

	Mean germination time (days)	Percentage germination (%)
Primula		
Control untreated seeds,(CD) germinated in the dark	no data	23
Control, untreated seeds (C)	11	56
Primed (as Table 1) (P)	10	39
Primed + $GA_{4/7}$ 10-4M*(P+GA)	3.5	56
Verbena		
C	15	65
P	3	70
P+GA	3	70

* = $GA_{4/7}$ added to the PEG.

Until recently, very little work had been done to combine different physiological seed treatments. It has been shown now that seeds can be pre-treated with fungicide soaks to control seed-borne disease, followed by priming in PEG solutions to which growth regulators are added. When this was done with *Primula,* positive responses to priming were obtained (Table 2) and, also, with *Verbena* and *Impatiens,* suggesting that this type of approach would be applicable to a wider range of seeds including "difficult" seeds of tree and hardy ornamental nursery stock species.

CONCLUSION

The potential benefits of priming seeds and of combining this with other seed treatments such as fungicide and plant growth regulator seed soaks is now established (Finch-Savage, 1991). In addition, as a result of collaboration between HRI and the seed industry it is evident that these treated seeds can be successfully dried, pelleted or coated in "fluidised bed" coaters, and then stored from one season to another without significant loss of viability or loss of benefit of the seed treatment.

A major outlet for these primed seeds is in the plant raising industry, where control of the post-sowing environment can be achieved. Clearly there are many opportunities to expand its use for flower seeds and for HONS material sown into nursery beds, offering the potential to substantially improve production practices.

LITERATURE CITED

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