Pre-sowing treatments for the improvement of germination of onion seeds

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Introduction

Because the marketable quality of onion bulbs is based on closely defined size grades, it can be reduced by slow, uneven or incomplete field establishment. Consequently, seed priming treatments designed to improve germination performance of onion have been the subject of much interest overseas (e.g., Brocklehurst and Dearman, 1983 a,b; Haigh and Barlow, 1987). The primary objective of this study was thus to clarify the best priming conditions for onion seeds in New Zealand.

Materials and Methods

The two most favoured pre-sowing treatment (priming) conditions reported in the literature, i.e., holding the seeds imbibed in either a -1.5 MPa polyethylene glycol (PEG) solution at 15°C for 14 d (as per Brocklehurst and Dearman, 1983 a,b) or a -1.25 MPa mixed salt solution (KH_2PO_4 + KNO_3) at 10°C for 7 d (as per Haigh *et al.*, 1986), were applied to seeds with or without subsequent air drying to near original seed moisture contents. The responses of seven different seed lots of onions from a variety of commercial sources in New Zealand were examined in this study. All lots were of the cultivar Pukekohe Long Keeper or related lines, which constitute over 80% of the present national crop.

Seed germination performance (rate and uniformity of radicle emergence, percentage normal seedling production) was evaluated by germinating seeds on moist blotters at 15°C, adapting the procedures set out by ISTA (1985). The effects of PEG priming on two of the seed lots which differed in quality were also evaluated in a glasshouse trial (temperature 20-25°C) by planting the seeds in root trainers in a sand-potting compost mix. In order to determine the potential interactions between treatment and storage on primed seed, seed from these two lots were subjected to a controlled deterioration (CD) artificial ageing treatment either before or after priming. The CD treatment involved raising the seed moisture contents to 20% before incubating the seed in sealed packages for 2 d at 40°C. Laboratory germination testing was then carried out as previously described.

Results and Discussion

For all seven seed lots priming increased the rate of radicle emergence compared to that of untreated seeds without any losses in seed germinability. In all but one seed lot, PEG treatment was preferable to salt treatment, losses in germination advantage due to drying after salt treatment being much greater than after treatment with PEG (Fig. 1). Median radicle emergence times (T50's) of PEG primed seeds showed a close positive relationship with the initial T50's of seeds before treatment (R^2=75% for primed, dried seeds). This means that a greater absolute advancement in germination may be expected when seeds of poorer quality are treated. Uniformity of radicle emergence was only improved by PEG treatment followed by drying in one of the seven seed lots tested (lot 4), however, dried, primed seed of this lot did not show any improvement of uniformity of emergence when sown in the glasshouse trial. This loss of response may be a combined function of a warmer sowing temperature and the increased variability of the micro-environment around each seed in the sand compost mix.

One requirement of a commercially successful seed treatment is that treated seed should have good storability. Seeds of lots 4 and 5 were tested for their responses to CD applied either before or after priming. A surprising result was that in the lower quality seed lot (5) which was more susceptible to artificial ageing, priming before ageing protected the seeds from the major losses of both viability and germinability which occurred in unprimed aged seed. In both seed lots, priming before

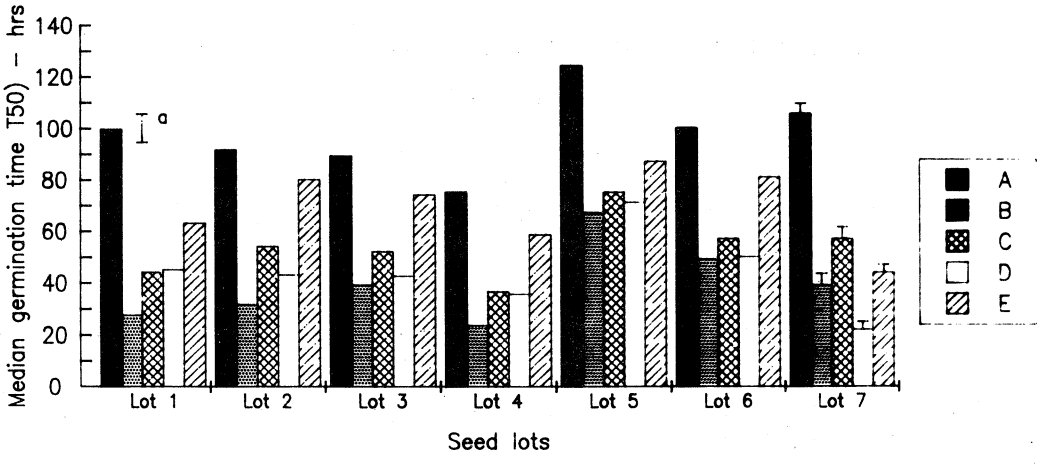

Figure 1. Effects of priming treatments on median radicle emergence times in seven different onion seed lots. a) Untreated control; b) PEG, -1.5 MPa, 15°C, 14 d without drying; c) PEG, -1.5 MPa, 15°C, 14 d, dried; d) Salts, -1.25 MPa, 10°C, 7 d without drying; e) Salts, -1.25 MPa, 10°C, 7 d, dried. a: LSD $_{0.05}$ for lots 1-6. S.E.'s for individual means are shown for lot 7 (data obtained from a separate experiment).

CD still resulted in reduced T50's, but in lot 5 priming after CD was ineffective in repairing a decrease in rate of germination. This is an unusual result (cf., for example, Dearman *et al.*, 1986) and requires further investigation, but clearly it cannot be assumed that all seed lots of onion respond in the same way. Losses of uniformity of radicle emergence caused by CD treatment were generally restored by priming.

Conclusions

These results indicate that pre-sowing seed treatments do have the potential to improve the planting value of New Zealand onions in terms of improving rates of establishment. Priming with polyethylene glycol is likely to be more advantageous than priming with salt solutions, especially when seeds are to be dried back to near original moisture contents for conventional handling. However, the economics of the process need careful evaluation for cell transplant systems, especially when variation in responses between seed lots must be taken into account.

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