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Effect of Various Priming Treatments on Vigour and Growth of Ginger Transplants (*Zingiber officinale* Rosc.) in Nursery

Ann Sneha Baby*, Jalaja S Menon and Ashwini S
Department of Plantation Crops and Spices,
Kerala Agricultural University, Vellanikkara, Thrissur - 680 656, Kerala, India

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ABSTRACT

Priming techniques improve seed vigour by enhancing rapid and uniform germination and growth and thus imparts invigoration to seedling. The objective of the present study was to investigate the effect of various priming treatments viz. hydropriming, priming with ethephon, *Trichoderma* sp. and *Pseudomonas fluorescens* in enhancing the vigour and growth of protray raised ginger transplants. Results obtained from the study reveals that priming treatments has a significant effect in improving the initial vigour in ginger sprouts, which can render a stimulatory effect in growth of transplants. Emergence of sprouts were early in rhizomes primed with *Pseudomonas fluorescens* 10 g L^{-1} for 0.5 hour (6.33 days) followed by hydropriming for one hour (6.83 days). Vigour parameters such as higher emergence index, lower time for 50 per cent emergence and lower mean emergence time were seen in primed rhizomes, when compared to unprimed control. Hydropriming and priming with ethephon 200 ppm for one hour resulted in significantly superior survival per cent of 85.16 and 84.16 respectively. Significantly higher seed vigour index was noticed in sprouts subjected to hydropriming and bioprimed with *Pseudomonas fluorescens* (3167.95 and 3011.99 respectively).

Key words: Ginger transplants, Priming, Vigour, growth, Nursery

Ginger is a major spice crop in India, esteemed for its aroma, pungency and medicinal properties. Rhizome being the part of commercial importance as well as the planting material for next season, possess high demand in market. However, there are several constraints in ginger production, the major one is high seed rate. A dearth in availability of healthy and good quality planting material is highly pronounced for ginger, especially for the newly released high yielding varieties. As a remedy for this, a transplant technique, utilizing ginger sprouts raised from small rhizome bits of 3 to 5 g grown in protrays, has been proven to yield on par with conventional planting of 20 g seed rhizome (Prasath *et al*. 2018). Priming of seed, prior to planting has reported to enhance seedling vigour, which indeed has a positive influence on growth (Banjobpudsa *et al*. 2017). Chittaragi (2018) reported that priming treatments had significant effect in growth and yield of transplanted ginger. The objective of the present study is to evaluate the potential of priming treatments to improve the vigour and growth of transplants in nursery and thus ensuring better establishment of transplanted ginger.

***Corresponding author:** Ann Sneha Baby, Department of Plantation Crops and Spices, Kerala Agricultural University, Thrissur, Kerala

e-mail: annsneha02@gmail.com

MATERIALS AND METHODS

Priming methodology

Ginger var. Aswathy, a green ginger variety released by Kerala Agricultural University was used for the study. Seed rhizomes of ginger were cut into small pieces of 3 to 5 g, ensuring at least one viable bud in each bit. Then rhizome bits were subjected to various priming treatments viz. priming with ethephon 200 ppm for one hour, hydropriming for one hour, biopriming using *Trichoderma* sp. 4 g L^{-1} for 30 minutes and *Pseudomonas fluorescens* 10 g L^{-1} for 30 minutes, keeping the unprimed rhizome bits as control. Thereafter, primed rhizomes were spread on a clean surface during overnight for air drying, in order to bring the rhizomes to initial moisture level. Then seed rhizomes were planted in portrays of 1.5 cm cavity depth, after filling the potting mixture. These portrays were maintained in rain shelter for 45 days and observations were taken periodically. The experiment was laid out in completely randomized block design (CRBD), with six replications for each treatment.

Nursery characteristics of ginger transplants

Data on number of days for emergence was recorded from the date of sowing until first sprout was seen, in each treatment. Emergence index (EI) was calculated according to the formula suggested by AOSA (1983).

$$EI = \frac{\text{Number of sprouted rhizomes}}{\text{Days of first count}} + \ldots\ldots + \frac{\text{Number of sprouted rhizomes}}{\text{Days of final count}}$$

Time to 50% emergence (T_{50}) was calculated as described by Coolbear *et al*. (1984).

$$T_{50} = t_i + \left(\frac{(N + 1)/2 - n_i}{(n_j - n_i)}\right) \times \ t_j - t_i$$

Where N is the final number of seed rhizomes sprouted and n_i and n_j are total number of sprouted rhizomes by adjacent counts at time t_i and t_j respectively, where $n_i < (N + 1)/2 < n_j$.

Mean emergence time (MET) was calculated using formula suggested by Ellis and Roberts (1981).

$$MET = \frac{\sum Dn}{\sum n}$$

Where, n is the number of sprouts emerged on day D and D is the number of days counted from the beginning of emergence.

On day 45 after sowing, percent survival of sprouts and growth parameters such as plant height, root length and number or leaves and roots were recorded. Seed vigour index (SVI) was calculated by multiplying the emergence percentage (%) and seedling length (cm) i.e. the sum of shoot length and root length (Abdul-Baki and Anderson 1973).

Seed vigour index (SVI) = emergence % × (shoot length + root length)

Statistical analysis

Data was statistically analyzed by using WASP 1.0 online statistical software to find out the effect of priming treatments on vigour and growth of ginger transplants in nursery. The rankings are indicated by superscripts in the significant tables, with 'a' denoting the highest position.

RESULTS AND DISCUSSION

Priming treatments exhibited a significant improvement in performance of ginger transplants in nursery. The emergence of sprout was superior in rhizomes primed with *Pseudomonas fluorescens* (6.33 days), followed by hydropriming (6.83 days) (Table 1). The sprouting was advanced by 1.84 days in rhizomes primed with *Pseudomonas fluorescens,* than the unprimed rhizomes. Seed vigour of rhizomes was analyzed by computing emergence index (EI), time taken for 50% emergence (T_{50}) and mean emergence time (MET). Priming treatments exhibited a positive influence in improving the vigour of ginger transplants grown in nursery as evident from the high emergence index, lesser time taken for 50 per cent emergence and low mean emergence time, when compared to the unprimed control. Priming of rhizomes with *Pseudomonas fluorescens* 10 g L^{-1} for 30 minutes and ethephon 200 ppm for one hour, resulted in superior emergence index (11.33, 10.97 respectively) and significantly lowest T_{50} (14.01 and 14.53 days respectively). With respect to MET, significantly lowest time was observed in rhizomes primed with *Pseudomonas fluorescens* (17.51 days), ethephon (18.03 days) and *Trichoderma* sp. (18.57 days). Data pertaining to seed vigour parameters are given in (Table 1).

Table 1 Effect of priming on days to sprout, emergence index, time to 50% emergence and mean emergence time in protray raised ginger transplants

Priming treatments	Days to sprout	Emergence index	Time to 50% emergence (days)	Mean emergence time (days)
Control	8.17^{a}	7.84^{c}	16.28^{a}	21.21^{a}
Ethephon 200 ppm	7.5^{ab}	10.97^{a}	14.53^{c}	18.03^{b}
Hydropriming	6.83^{bc}	9.75^{b}	15.60^{ab}	20.38^{a}
Trichoderma sp.	7.83^{a}	9.35^{b}	14.96^{bc}	18.57^{b}
Pseudomonas fluorescens	6.33^{c}	11.33^{a}	14.01^{c}	17.51^{b}
CD (0.05)	0.99	1.18	0.95	1.19

Priming also exhibited a significant influence in improving the percent survival of sprouts (Fig 1). The highest per cent survival of sprouts was found in rhizomes given hydropriming for one hour (85.16%) and rhizomes subjected to priming with ethephon (84.16%), followed by priming with *Pseudomonas fluorescens* (81.67%). Priming treatments were also found effective in promoting the growth characters of ginger sprouts under nursery conditions, though not significant. Plant height ranged from 24.35 cm to 26.90 in primed rhizomes compared to 24.20 in unprimed material. The root length ranged from 8.5 to 10.60 cm in primed plants. Seed vigour index (SVI) was calculated from percent survival of sprout and length of root and shoot. Highest seed vigour index was found in hydroprimed sprouts and rhizomes subjected to biopriming with *P. fluorescens* (3167.95 and 3011.99 respectively) (Fig 2).

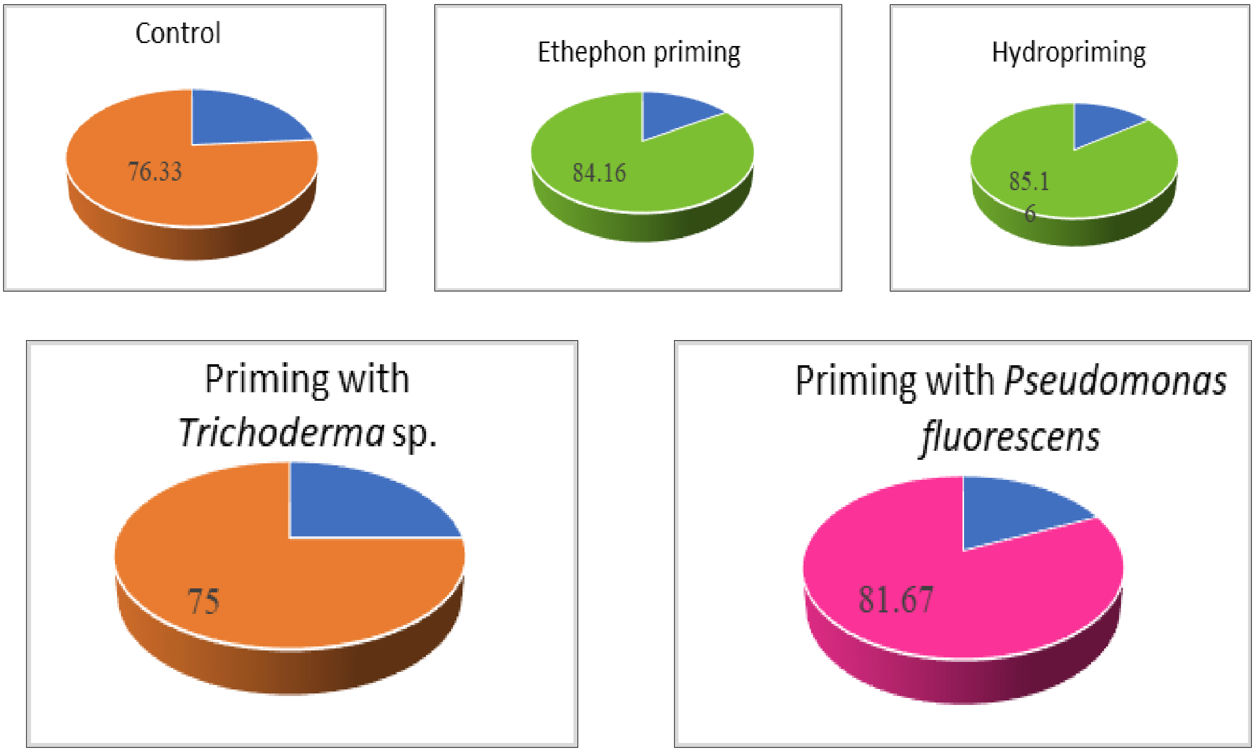

Fig 1 Effect of priming treatments on percent survival of sprouts

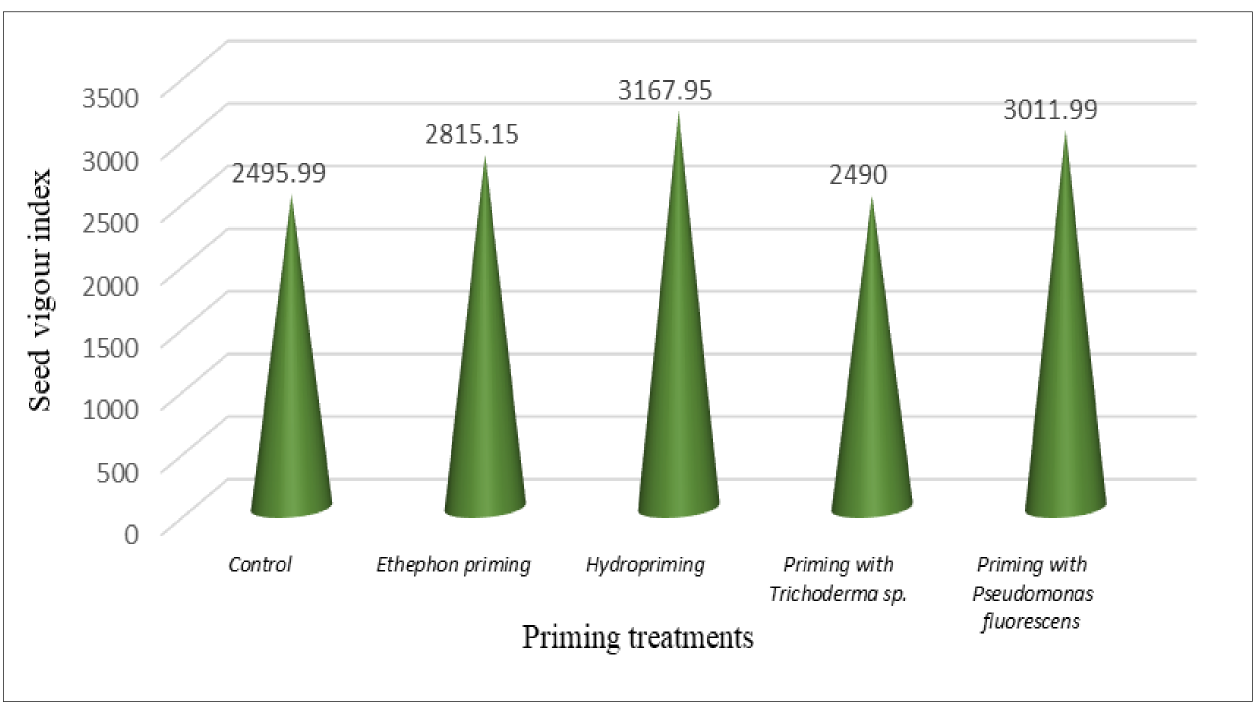

Fig 2 Effect of priming on seed vigour index of ginger sprouts

From the study it is clear that, priming treatments can invigorate the growth of ginger sprouts, as evident by the early emergence, superior vigour parameters such as higher emergence index and lower T_{50} and lower MET, higher percent survival and superior seed vigour index when compared to the control. Reddy *et al.* (2011) stated that, seed priming can result in rapid establishment of healthy seedlings. Effect of *Pseudomonas fluorescens* in improving the germination was also reported in chilli by Ananthi *et al.* (2014) and in tomato by Srivastava *et al.* (2010). According to Moeinzadeh *et al.* (2010), priming of sunflower seeds with *Pseudomonas fluorescens* improved germination index, germination percentage, germination rate and vigour index and enhanced the growth parameters thereafter. Chittaragi

(2018) found than hydropriming of seed rhizomes for one hour prior to planting, resulted in higher survival percentage of 88% in transplanted ginger planted in May. Hamidreza *et al*. (2013) observed significantly higher germination percentage of 74 per cent in hydroprimed rye seeds. Ethephon priming also exhibited a significant role in stimulating the emergence percentage in ginger transplants. This is in line with the studies of Chittaragi (2018) in ginger transplants, recording highest per cent survival of sprouts in plants raised from rhizomes treated with 200 ppm ethephon during the planting season of April and May. Similar results are observed by Adams and TeBeest (2016) in sunflower, in which soaking of seeds in 25 ppm ethrel increased the germination rate. Lingyun *et al.* (2017) studied the effect of biopriming with *Trichoderma harzianum* in eggplant. It was observed that the treatment resulted in a significant improvement in vigour, emergence index and vitality index. It also accelerated seedling emergence and enhanced the height and weight of seedlings.

From this study, it is discernible that priming of rhizomes prior to planting invigorate the growth of ginger transplants in nursery. So, priming can be a recommended for raising healthy and vigorous ginger transplants, which is essential for rendering a stimulatory effect throughout the crop growth period.

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