Journal of Tropical Agriculture 57 (1): 92-96, 2019

Short Communication

Pre-sowing treatments in mango: Regression analysis between germination parameters and vigour

U. R. Reshma* and S. Simi

College of Agriculture, Vellayani, Kerala Agricultural University, Thiruvananthapuram 695522, Kerala, India

Received 31 January 2019; received in revised form 30 April 2019; accepted 01 June 2019

Abstract

A study was undertaken during the year 2017-18 at the Department of Pomology and Floriculture, College of Agriculture, Vellayani, Thiruvananthapuram to assess the germination behaviour of mango stones as influenced by various pre-sowing treatments. The mango stones were soaked for 24 hours in aqueous solutions of GA_3 (100 and 200 ppm), KNO_3 (1 and 2 ppm), cow dung slurry, water and control. The vigour index-I and vigour index-II had linear negative relationship with number of days taken for initiation of germination and number of days taken for 50 per cent germination. The germination percentage and rate of germination had very high degree of association with vigour index-I (R^2 = 0.95 & 0.89) and vigour index-II (R^2 = 0.89 & 0.95) respectively. The seedling length and dry weight had almost similar degree of association with vigour index-I (R^2 = 0.87& 0.76) and vigour index-II (R^2 = 0.93 % 0.85) respectively. The pre-sowing treatments had direct significant influence on germination and growth of mango seedlings, which in turn led to maximum vigour.

Key words: Germination, Mango stones, Pre sowing treatments, Regression analysis, Vigour determination.

Mango stones are usually available during the drier parts of the year (April-May) because of which the germination percentage and vigour are very low (Kolekar et al., 2017). The viability of mango stones is also low since the stones are recalcitrant in nature. Germination percentage of mango stones is only 12 to 50 per cent when sown within a month of extraction. To meet the ever rising market demand and to evolve the best technology for producing quality planting material within a short time, pre-sowing treatments are important. This will also regulate growth and vigour of the rootstock.

Pre-sowing treatments with water and chemicals *viz.,* gibberellic acid (GA_3) and potassium nitrate (KNO_3) can make a perceptible difference in enhancing germination, boosting growth and vigour, and reducing mortality (Rao and Reddy, 2005; Kumar et al., 2008; Shaban, 2010). Pre sowing treatments also protect seeds from biotic and abiotic stresses during the critical phase of seedling establishment. Synchronization and rapid seedling emergence are the commonly reported benefits of pre-sowing treatments on germination. Soaking seeds in aqueous solutions of growth chemicals for 12-36 hours has been found to induce early germination, enhance germination percentage and promote seedling growth in many fruit crops.

Results of well organized research work on these lines in mango is not available and hence, the present experiment was designed to elucidate the relationship between germination parameters and vigour of mango as influenced by various pre-sowing treatments. Fruits of 'KotookonamVarikka' variety of mango were selected for stone extraction. The treatments consisted of soaking mango stones for 24 hours prior to sowing in aqueous solutions

*Author for Correspondence: Phone: 91-9567583102, Email: reshmaraveendran566@gmail.com

of GA_3- 100 ppm, GA_3- 200 ppm, KNO_3 -1 ppm, KNO_3 - 2 ppm, cowdung slurry, and water, along with the untreated stones. They were then sown in nursery beds (soil: sand: FYM- 2:1:1). Each treatment was replicated thrice. The germination of stones started 15 days after sowing and continued up to 55 days. Observations were recorded daily for germination parameters, and vegetative parameters like seedling length, dry weight and seedling vigour index I & II were recorded four months after sowing.

The experiment was laid out in Completely Randomized Design (CRD). The data were pooled and analysed as per standard procedures by calculating critical differences from ANOVA as suggested by Panse and Sukhatme (1967). Treatment means were separated using F test values at 5 per cent level of significance. The relationship between germination parameters and vigour of mango as influenced by various pre-sowing treatments was plotted by regression method.

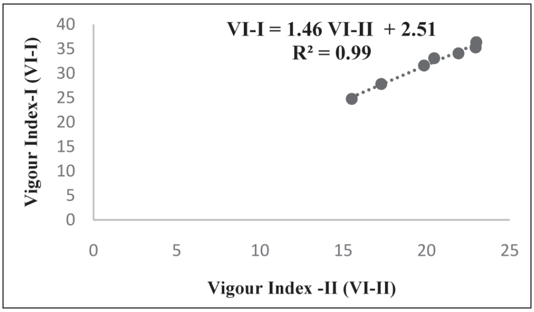

Figure 1. Relationship between vigour index-I and vigour index-II as influenced by various pre sowing treatments.

The vigour index-I showed positive relation with vigour index-II (V-I = 1.46 V-II + 2.51, $R^2 = 0.99$) (Fig. 1). Vigour Index-I (VI-I) and Vigour Index-II (SVI- II) both were found to be maximum when mango stones were soaked in 100 ppm GA_3, whereas minimum was noticed in control (Table1). These results are in agreement with the earlier reports by Abdul- Baki and Anderson (1973) and Patil et al. (2012).

The stones pre-treated with 200 ppm GA_3, required minimum number of days for initiation of germination (22.62 days) followed by GA_3, 100 pm (23.89 days). The days taken for initiation of germination showed significant but negative relation with Vigour Index-I (VI-I = -1.40, days

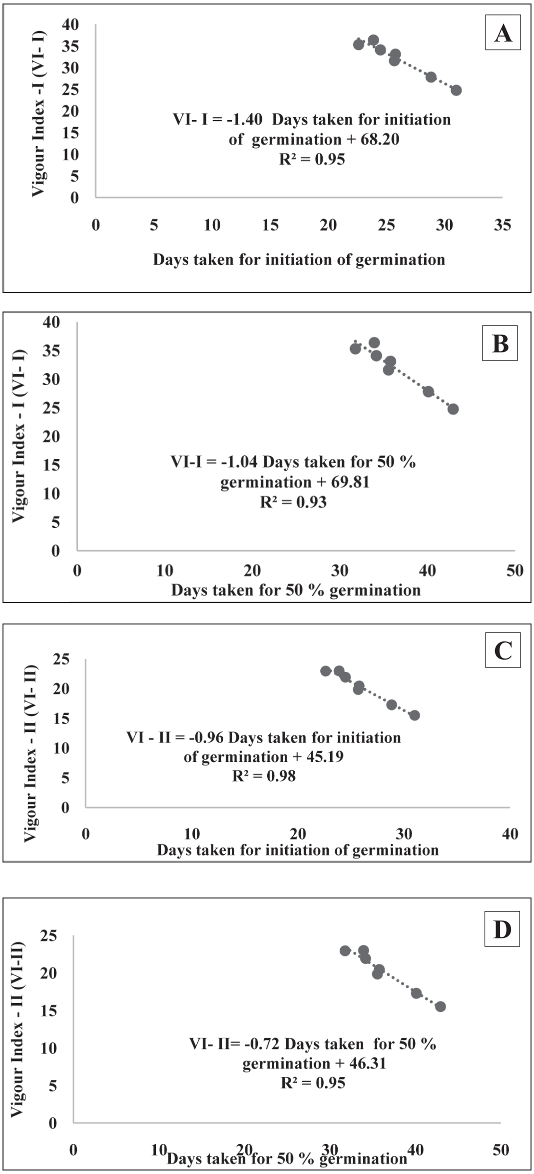

Figure 2. Relationship between germination parameters and vigour indices as influenced by various pre-sowing treatments, (A) Days taken for initiation of germination vs Vigour Index-I, (B) Days taken for initiation of germination vs Vigour Index-II, (C)Days taken for 50 % germination vs Vigour Index-I and (D) Days taken for 50 % germination vs Vigour Index-II.

taken for initiation of germination + 68.20, R^2= 0.95). But days taken for initiation of germination showed non-significant and negative correlation with VI-II (g) (VI- II = -0.96, days taken for initiation of germination +45.19, R^2=0.98) as influenced by various pre- sowing treatments (Fig.2). The stones treated with GA_3, 200 ppm (31.78 days) required minimum number of days for 50 per cent germination followed by GA_3, 100 ppm (33.94 days). The days taken for 50 per cent germination showed significant and negative correlation with VI-I and VI-II (VI- I = -1.04, days taken for 50 per cent germination + 69.81, R^2 = 0.93; VI- II = - 0.72, days taken for 50 per cent germination + 46.31, R^2 = 0.95) (Fig.2). Early stone germination in GA_3, 200 ppm treatment might be due to increased endogenous auxin content. The variation with respect to the number of days required for potential germination might be due to stimulative effect of these chemicals on emergence of seedling and the rate of different growth processes like cell elongation, cell division and cell multiplication (Patel et al., 2016).

Positive linear relationship was observed between germination percentage and rate of germination with vigour indices-I and II (Fig.3). The results pertaining to germination behaviour showed almost similar trends and were statistically significant among seven pre-soaking treatments (VI-I = 0.49, germination percentage + 7.17, R^2 = 0.95 and VI-II = 0.32, germination percentage + 3.82, R^2 = 0.89) (Fig. 3). The stones pre-soaked with GA_3, 100 ppm recorded the highest percentage of germination (62.59 %). The pre-soaking treatment of GA_3 might have affected and altered the enzymatic reaction, protein synthesis and conversion of starch to sugars involved in the germination process (Paleg, 1960). Gibberellic acid induces *de novo* synthesis of proteolytic enzymes like α-Amylase and ribonuclease. Amylases in turn hydrolyse starch in the endosperm, providing essential sugars for the initiation of growth processes and liberate chemical energy which is used in the activation of embryo as well as suppression of inhibition along with synthesis of RNA which results in higher germination (Copeland and Mc Donald, 1995).

The highest rate of germination was observed in the treatment GA_3, 200 ppm (0.47) followed by

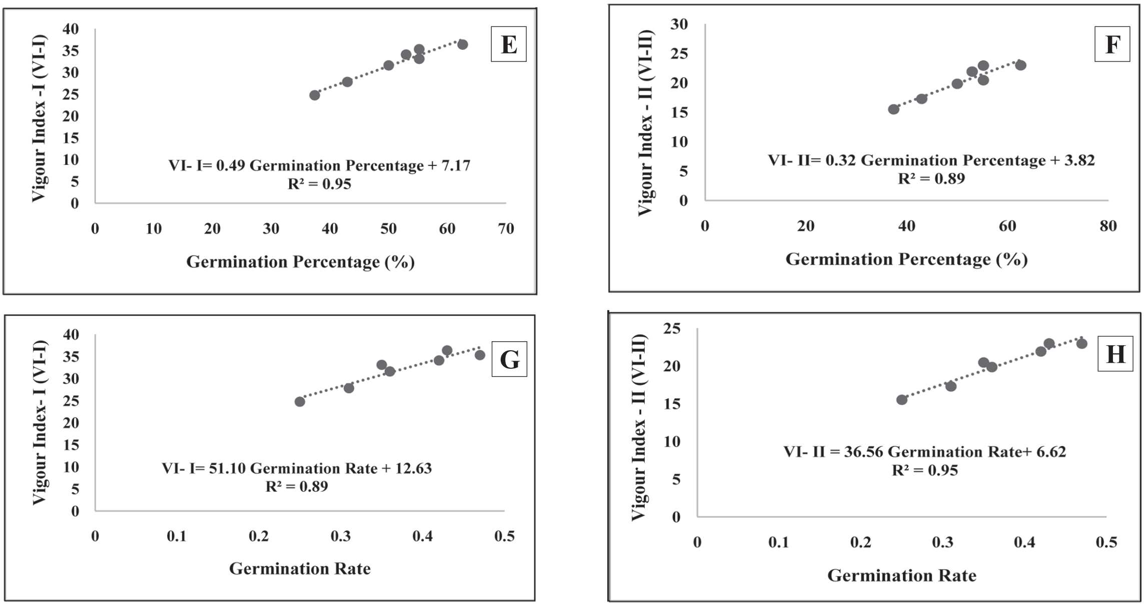

Figure 3. Relationship between germination parameters and vigour indices as influenced by various pre-sowing treatments, (E) Germination percentage vs Vigour Index-I, (F) Germination percentage vs Vigour Index-II, (G) Germination rate vs Vigour Index-I and (H) Germination rate vs Vigour Index-II.

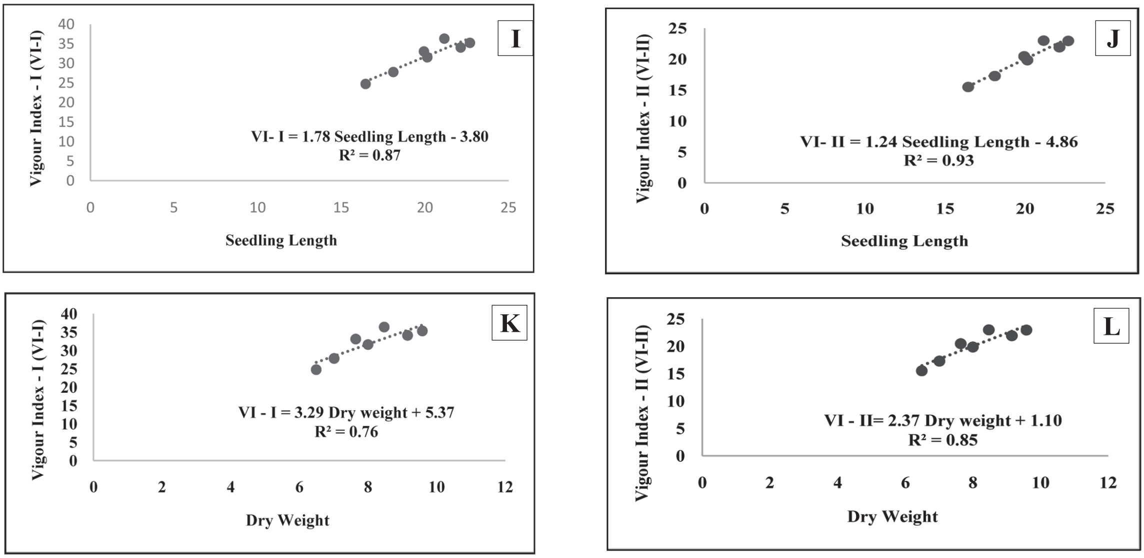

Figure 4. Relationship between growth parameters and vigour indices as influenced by various pre-sowing treatments, (I) Seedling length vs Vigour Index-I (J) Seedling length vs Vigour Index-II (K) Dry weight vs Vigour Index-I and (L) Dry weight vs Vigour Index- II.

GA_3, 100 ppm (0.43) and KNO_3, 1 ppm (0.42), and the lowest in control (0.25). Vigour index-I and vigour index-II had linear positive relationship with germination rate (VI-I = 51.10, germination rate + 12.63, R^2 = 0.89 and VI-II = 36.56, germination rate + 6.62, R^2 = 0.95) (Fig. 3). It is clearly evident that germination percentage and rate of germination had very high degree of association with vigour index-I (R^2 = 0.95 & 0.89) and vigour index-II (R^2 = 0.89 & 0.95) respectively (Fig. 3). The difference in rate of germination may be attributed to the differential ability of the pre-sowing treatment of these chemicals to reduce the time taken for germination and to remove the obstruction in embryo growth (Muralidhara et al., 2015).

Among the various treatments, the maximum seedling length and dry weight were recorded in GA_3, 200 ppm (22.69 cm & 9.58 g respectively) followed by KNO_3, 1 % (22.14 cm &9.15 g respectively). The seedling length showed significant positive linear relationship with vigour index-I and vigour index- II (VI-I = 1.78, seedling length – 3.80, R^2 = 0.87 and VI-II = 1.24, seedling length – 4.86, R^2 = 0.93). The seedling length had very high degree of association with vigour index-I (R^2 = 0.87) and vigour index-II (R^2 = 0.93) (Fig. 4). The seedling dry weight showed significant positive linear relationship with vigour index-I and vigour index- II (VI-I = 3.29 Dry weight + 5.37, R^2 = 0.76 and VI-II = 2.37 Dry weight + 1.10 R^2 = 0.85) and in the same way the seedling dry weight had high degree of association with vigour index-I (R^2 = 0.76) and vigour index-II (R^2 = 0.85) (Fig. 4). This might be due to the fact that the GA_3 stimulates vegetative growth by increased osmotic uptake of nutrients, cell multiplication and cell elongation which might have reflected in the maximum height of seedlings in this treatment. These results are in accordance with results obtained by Shalini et al. (1999) and Kumar et al. (2008). The regulation of growth by gibberellins and KNO_3 relates almost extensively to its stem elongation properties. The increased weight of seedling was mainly attributed to enhanced germination, early seedling emergence and better seedling growth.

It is evident from the present study that the cumulative effect of rapid seedling emergence, higher germination percentage, reduced mortality rate, greatest seedling length and dry weight as influenced by various pre- sowing treatments

Table 1. Germination characters of mango as influenced by different pre-sowing treatments

Pre sowing treatments	Germination Parameters							
	Days taken for initiation of germination	Days taken for 50 per cent germination	Germination (%)	Rate of germination	Seedling length (cm)	Dry weight of seedling (g)	Seedling vigour index -I	Seedling vigour index- II
GA_3 - 100 ppm	23.89	33.94	62.59	0.43	21.16	8.47	36.37* (1322.78)	22.99* (528.54)
GA_3 - 200 ppm	22.62	31.78	55.19	0.47	22.69	9.58	35.30* (1246.09)	22.95* (526.70)
KNO_3 - 1 ppm	24.49	34.17	52.96	0.42	22.14	9.15	34.09*(1162.13)	21.92* (480.49)
KNO_3 - 2 ppm	25.69	35.56	50.00	0.36	20.14	8.00	31.60* (998.56)	19.85* (394.02)
Cow dung slurry	25.78	35.78	55.19	0.35	19.94	7.64	33.10*(1095.61)	20.46* (418.61)
Water	28.84	40.11	42.96	0.31	18.11	7.01	27.81* (773.40)	17.28* (298.60)
Control (no treatment)	31.01	42.94	37.40	0.25	16.45	6.49	24.76* (613.06)	15.51* (240.56)
SE(m)	0.087	0.310	1.291	0.003	0.101	0.049	0.424	0.267
CD (0.05)	0.244	0.872	3.630	0.008	0.285	0.137	1.192	0.751

*Square root transformed values   Values in parantheses are original values

resulted in highest seedling vigour in mango.

Acknowledgements

The authors are thankful to Dr. Babu Mathew, former Professor and Head of the Instructional Farm, College of Agriculture, Vellayani for providing the necessary facilities for the research programme and Dr. Vijayaraghava Kumar, Professor and Head, Department of Agricultural Statistics for data analysis and technical assistance.

References

Abdul- Baki, A. A. and Anderson, J. D. 1973. Vigour determination of soybean seed by multiple criteria. Crop Sci., 13: 630-633.

Copeland, L. O. and McDonald, M. B. 1995. Principles of Seed Science and Technology, III Edition- Chapman and Hall Publications, New York, 127-146.

Kolekar, S. N., Kadam, A. S., and Gend, D. G. 2017. Effect of different organics and chemicals treatments on germination, growth and success of softwood grafting in mango during nursery stage. Int. J. Chem. Stud.,5: 880-884.

Kumar, H. S., Swamy, G. S. K., Patil, C. P., Kanmadi, V. C., and Kumar, P. 2008. Effect of pre-soaking treatments on the success of softwood grafting and growth of mango grafts. Karnataka J. Agric. Sci., 21:471-472.

Muralidhara, B. M., Reddy, Y. T. N., Akshita, H. J., and Srilatha, V. 2015. Effect of presowing treatments on germination, growth and vigour of polyembryonic mango seedlings. Environ. Ecol., 33(3): 1014-1018.

Paleg, L. G.1960. Physiological effects of gibberellic acid II. Plant Physiol., 35: 902-906.

Panse, V.G. and Sukhatme, P.V. 1967. Statistical Methods for Agricultural Workers. ICAR, New Delhi.

Patel, R. J., Ahlawat, T. R., Singh, A., Momin, S. K., and Gavri, C. 2016. Effect of pre- sowing treatments on stone germination and shoot growth of mango (*Mangifera indica* L.) seedlings. Int. J. Agric. Sci., 8(52): 2437-2440.

Patil, S. R., Sonkamble, A.M., and Khobragade, H. M. 2012. Influence of some growth regulators on germination and growth of Rangpur lime (*Citrus limonia* O.) seeds. Green Farming, 3(6): 690-693.

Rao, V. and Reddy, Y. T. N. 2005. Effect of osmopriming on germination seedling growth and vigour of mango stones. Karnataka J. Hortic., 1(4): 29-35.

Shaban, A. E. A. 2010. Improving seed germination and seedling growth of some mango rootstocks. Am. Eurasian J. Agric. Environ. Sci., 7(5): 535-541.

Shalini, P., Bagde, T. R., and Bhati, B. 1999. Growth of mango (*Mangifera indica* L.) seedlings as influenced by stone treatment. J Soils Crops, 9(2): 227-230.