

Original Research Article

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Effect of Plant Growth Regulators and Chemicals on Seed Germination, Vigour Index and Mortality of Avocado (*Persea americana* Mill.)

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Study on effect of plant growth regulators and chemicals on seed germination of avocado (*Persea americana* Mill.) was carried out in college of Horticulture, Mudigere, during the year 2019-2020, under Complete Randomized Design with thirteen treatments and replicated thrice. Seeds were soaked in different solutions of plant growth regulators and chemicals. Among all treatments seeds soaked in GA₃ 400 ppm recorded early germination (13.00 days), 50 per cent germination (19.33 days), highest germination percentage (95.22), maximum shoot length (75.67 cm) and seedling vigour index-I and II (9878.54 and 806.60, respectively). Among all the treatments, GA₃ 400 ppm was superior to the other treatments, followed by GA₃ 600 ppm for the enhancement of germination traits.

Introduction

Avocado (*Persea americana* Mill.) belong to family Lauraceae and it is native to the Central America and Southern Mexico, presently one of the most sought after food sources worldwide. Avocado is also called as Butter fruit for its buttery taste of pulp and gained importance over year as one of the most nutritive fruit. This fruit is also known by the name 'Alligator Pear' and 'fruit of new world (Radha and Mathew 2007). Butter fruit is rich in fat (26.4 g) and flesh of some varieties has twice the energy value of

bananas. Fat is low in sugar content and easily digestible, hence it is a recommended fruit for diabetic patients. It contains one to two times more protein (1.70 g) than any other fruit, is rich in minerals such as manganese (35.00 mg), phosphorous (38.00 mg), iron (0.60 mg) and potassium (368.00 mg) but low in sodium (3.00 mg). Also contains the vitamins niacin (1.01 mg) vitamin E, vitamin C, β -carotene (0.17 g), thiamine (0.06 mg), riboflavin (0.13 mg), nicotinic acid, folate, total carbohydrates (5.10 g) and energy value of 245.00 calories (Rainey *et al.*, 1994). The commercial avocado production is based on grafting of

cultivars onto rootstocks mainly on the Mexican and Guatemalan races. In subtropical climates, the Guatemalan genotypes represent the dominant horticultural race. Avocado was brought to India during the first decade of the nineteenth century by an American missionary, residing in Bangalore between the years 1906 and 1914. In India it is growing in tropical and subtropical regions like Tamil Nadu, Sikkim, Kerala, Maharashtra and Karnataka. In India, avocado is generally propagated through seeds. The viability of seeds of avocado is quite short (2 to 3 weeks) but this can be improved by storage the seed in dry peat or sand at 50°C. Removal of seed coat before sowing, use of plant growth regulators and chemicals improves seed germination. In India, most of the trees grown are seedlings in origin. The seeds taken from ripe fruits are sown directly in the nursery or in polyethylene bags, then 8-12 months old, the seedlings are ready for transplanting. The seedling trees have long juvenile phase, yield and fruit quality is highly variable due to heterozygous nature, it is impossible to obtain genetically uniform plant as needed for the formation of commercial orchards. Avocado is vegetatively propagating through various methods like softwood stem cuttings taken from young avocado seedlings, hardwood and semi-hardwood cuttings, layering, grafting and budding and there is a great demand for production of rootstock (Tripathi and Kuranakaran, 2013). Hence, the current study was undertaken to find out the effect of plant growth regulators and chemicals on seed germination of avocado.

Materials and Methods

The experiment was carried out at College of Horticulture, Mudigere during the year 2019-2020. It was laid out in Complete Randomized Design (CRD) thirteen treatments with three repetitions viz. water

soaking as control (T₁), GA₃ 200 ppm (T₂), GA₃ 400 ppm (T₃), GA₃ 600 ppm (T₄), ethrel 10 ppm (T₅), ethrel 20 ppm (T₆), ethrel 30 ppm (T₇), KNO₃ 1.0 per cent (T₈), KNO₃ 1.5 per cent (T₉), KNO₃ 2.0 per cent (T₁₀), thiourea 1.0 per cent (T₁₁), thiourea 1.5 per cent (T₁₂) and thiourea 2.0 per cent. (T₁₃). For experiment purpose fresh and disease free seeds of avocado are collected and extracted and seeds soaked in different concentrations of GA₃, ethrel, KNO₃ and thiourea for 8 hours and seeds sown in polybags under the polytunnel. Polybags having a length of 15 cm and diameter of 10 cm with 200 gauge thickness were used and filled with soil + sand + FYM in the ratio of 1:1:1, respectively. Treated seeds of avocado were sown in polybags of 20 X 10 cm size filled in different mixture and its combinations on 28/09/2020. One seed per poly bag was sown at 5-10 mm depth. Watering was done regularly to maintain the uniform moisture. Necessary plant protection measures were taken. Five representative plants from each treatment were selected and observed for different germination parameters, growth characters and biochemical parameter. The experimental data recorded on various parameters during the investigation were analyzed statistically using the method of analysis of variance (ANOVA) for Complete Randomized Design (CRD) by Fisher and Yates (1963). Whenever 'F' test was found significant for comparing the means of two treatments, the critical difference (C.D. at 5%) was worked out.

Results and Discussion

The data presented in Table 1 clearly shows that plant growth regulators and chemicals had significant influence on germination characters of avocado. Among the different treatments the earliest germination (13.00 days) was recorded significantly when seeds treated with GA₃ 400 (T₃) and maximum days taken for initiation of germination (20.67

days) was recorded in control (T_1). The increase in germination due to involvement of gibberellic acid in the activation of

cytological enzymes along with increase in cell wall plasticity and better water absorption.

Table.1 Effect plant growth regulators and chemicals on seed germination of avocado

Tr. No.	Treatments	Days taken for initiation of germination	Days taken for 50 per cent germination	Germination percentage at 45 DAS	Shoot length (cm)	Mortality percentage at 90 DAS
T_1	Water soaking (control)	20.67	36.00	65.00	41.48	28.57
T_2	GA ₃ @ 200 ppm	15.33	23.67	85.22	58.20	7.14
T_3	GA ₃ @ 400 ppm	13.00	19.33	95.22	75.67	2.38
T_4	GA ₃ @ 600 ppm	13.33	20.33	91.17	68.83	4.76
T_5	Ethrel @ 10 ppm	15.33	27.00	81.00	57.89	11.90
T_6	Ethrel @ 20 ppm	15.00	23.33	90.00	58.70	9.52
T_7	Ethrel @ 30 ppm	14.33	23.00	90.33	63.43	4.76
T_8	KNO ₃ @ 1.0%	15.33	28.00	80.26	56.18	14.28
T_9	KNO ₃ @ 1.5%	16.67	30.67	76.28	53.98	19.04
T_{10}	KNO ₃ @ 2.0%	17.67	31.33	74.26	45.81	14.25
T_{11}	Thiourea @ 1.0%	15.67	29.67	78.00	55.42	16.66
T_{12}	Thiourea @ 1.5%	17.00	31.00	75.00	52.76	23.80
T_{13}	Thiourea @ 2.0%	19.33	34.00	73.00	43.81	26.19
S. Em \pm		0.77	0.90	2.73	3.75	1.30
C.D. @ 5%		2.24	2.61	7.95	10.90	3.79

Table.2 Effect of plant growth regulators and chemicals on seedling vigour index I and II of avocado at 90 days after sowing

Tr. No.	Treatments	Seedling index-I	Seedling index-II
T_1	Water soaking (control)	3802.50	229.38
T_2	GA ₃ @ 200 ppm	6834.64	459.61
T_3	GA ₃ @ 400 ppm	9878.54	806.60
T_4	GA ₃ @ 600 ppm	8677.36	569.25
T_5	Ethrel @ 10 ppm	6394.77	429.91
T_6	Ethrel @ 20 ppm	7276.00	504.83
T_7	Ethrel @ 30 ppm	7970.11	522.54
T_8	KNO ₃ @ 1.0%	6182.69	405.58
T_9	KNO ₃ @ 1.5%	5569.29	340.52
T_{10}	KNO ₃ @ 2.0%	4698.18	310.59
T_{11}	Thiourea @ 1.0%	5941.87	367.72
T_{12}	Thiourea @ 1.5%	5325.00	317.34
T_{13}	Thiourea @ 2.0%	4470.03	282.60
S. Em \pm		331.74	28.85
C.D. @ 5%		964.36	83.87

It may be due to the fact that, GA₃ impacts on initial enzyme stimulation and activation of reserve food mobilization intern improves germination. These findings are supported by Gupta (1989) in citrus, Ratan and Reddy (2004) in custard apple, Babu *et al.*, (2010) in papaya and Satya *et al.*, (2018) in jamun.

The minimum days to 50 per cent germination (19.33 days) was observed significantly with GA₃ 400 ppm (T₃) while, the maximum days taken to 50 per cent germination was observed in control (T₁). GA₃ helps in synthesis of α - amylase which converts the starch into simple sugars. These sugars provide energy that is required for various metabolic and physiological activities. Similar result was reported by Meena *et al.*, (2003) in papaya. The findings of Venkatrao and Reddy (2005) in mango and Kumar *et al.*, (2008) in mango, Satya *et al.*, (2018) in jamun are close to the conformity of the findings.

The maximum germination percentage (95.22 %) was noted significantly when seed soaked in GA₃ 400 ppm (T₃) whereas, the minimum germination percentage (65 %) was noted in control (T₁). The promotive effect of GA₃ on seed germination might be due to enzyme α -amylase is activated which converts starch into simple carbohydrate and chemical energy is released which intern activates embryo. Also might be due to, the production of amino acids in plants is enhanced, which is indirectly exhibited by improved growth of whole plant. The current findings is supported by Reddy and Khan (2001) in khirni, Jadhav (2003) in Rangpur lime, Sulabha and Kherdekar (2003) in Kagzi lime, Singh *et al.*, (2011) in manila tamarind and Satya *et al.*, (2018) in jamun.

The data in Table 1 shows that ethrel at concentrations of 20 and 30 ppm *i.e.* T₆ and T₇ (90.00 and 90.33 %, respectively) also had significant effect on germination percentage

of avocado after 45 days of sowing. Increased germination per cent with ethrel for 8 hours soaking period might be due to fact that ethrel being ethylene releasing compound, the localized production of ethylene is responsible for the initiation, formation and maintenance of either the plume arch, hypocotyl hook, depends on mode of germination. Ethylene is insoluble in water but soluble in lipids, therefore.it associated with lipid fraction of cell membrane and affects membrane structure permeability.

Significantly, the highest shoot length (75.67 cm) of avocado seedlings was observed when seeds soaked in GA₃ 400 ppm (T₃) which was statistically on par with T₄ *i.e.* GA₃ 600 ppm. Whereas, the lowest shoot length (41.48 cm) was noted in control (T₁). This variation might be due to additional GA₃, activated α -amylase which digested the available carbohydrate into simple sugar so that energy and nutrition were easily available to faster growing seedlings. The increase in plant height due to GA₃ has also been reported by Babu *et al.*, (2010) in papaya. The similar, results was reported by Wanyama *et al.*, (2006) in Cape gooseberry, Kumar *et al.*, (2008) in mango, Mishra *et al.*, (2017) in papaya and Satya *et al.*, (2018) in jamun.

The data presented in Table 1 clearly indicates that growth regulators and chemicals had significant influence of mortality percentage of avocado seedlings at 90 days after sowing. Among the different treatments the least mortality percentage of seedling (2.38 %) was recorded significantly with GA₃ 400 ppm (T₃), which was statistically on par with (T₄ and T₇) and maximum mortality of seedling (28.57 %) was noted in control (T₁). This could be attributed to softening of seed for exchange of gaseous and moisture and availability of food material required for early and better germination in this treatment. Early germination might have resulted in faster and

stronger root development, which might have supported for better development of stem and leaves in these seedlings, that might have resulted in increased in survival of seedlings. This might be also due to availability of favorable amount of light, temperature and humidity under poly-house or shade net condition, which makes the plants harder and able to withstand against adverse climatic conditions. The result has been supported by Ramteke *et al.*, (2015) in papaya and Chiranjeevi *et al.*, (2017) in aonla.

A perusal of data presented in Table 2 shows that plant growth regulators and chemicals shown significant influence of seedling vigour index I and II of avocado at 90 days after sowing. The maximum SVI-I (9878.54) was recorded significantly with GA₃ 400 ppm (T₃) and the minimum SVI-I (3802.50) was recorded in control (T₁). Enzymes as well as physical and nutritional condition increased the physiological activities of plant. These finding are supported by Kumar *et al.*, (2011) in papaya, Padma *et al.*, (2013) in papaya, Gurung *et al.*, (2014) in passion fruit and Satya *et al.*, (2018) in jamun.

The maximum SVI-II (806.60) was noted in (T₁) i.e. GA₃ 400 ppm while, the minimum SVI-II was recorded in control (T₁). The maximum seedling vigour in GA₃ treated seeds is an account of increased rate of metabolic activities like respiration, movement of photosynthates etc., (Earlplus and Lambeth, 1974), which leads to increase in root length, shoot size and seedling dry weight, in turn increase in seedling vigour. The results of Kumar *et al.*, (2011) in papaya, Padma *et al.*, (2013) in papaya, Gurung *et al.*, (2014) in passion fruit and Satya *et al.*, (2018) in jamun follow same trend.

In conclusion form the present investigation it is concluded that GA₃ 400 ppm (T₃) enhanced the germination parameters, survival of

seedling and increased the seedling vigour index of avocado followed by GA₃ 600 (T₄).

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