International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(4): 3204-3207

Received: 01-05-2019
Accepted: 03-06-2019

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Effect of growth regulators and chemicals on germination of avocado seeds

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Abstract
Experiment on effect of growth regulators and chemicals on germination of avocado seeds was carried out in the college of Horticulture Mysuru during the year 2018-19. The experiment was done with completely randomized design having eight treatments with three replications. Among the different treatment seeds treated with GA_3 500 ppm (T_4) took minimum number of days for early germination (18 days), fifty per cent germination (29 days) and complete germination (38 days). Maximum germination percentage (96.60 %) was obtained in control.

Keywords: Growth regulators, chemicals, germination, avocado seeds

Introduction
Avocado botanically known as *Persea americana*, Mill belongs to the family Lauraceae (Samson, 1980). It is native to central and South America (Rice *et al.*, 1987) [16]. It is grown in most of the tropical and subtropical countries. It was introduced to south and west coast of India from Ceylon (Srilanka) about 50-100 years ago. The world's major producing countries are Mexico, U. S. A., Dominican Republic and Brazil. In India, it is mainly grown as a backyard tree and is found in small pockets on hill slopes of Tamil Nadu, Kerala, Coorg and in selected regions of Karnataka and Maharashtra (Bose, 1990) [1].

It is a nutritious and healthy fruit containing all the elements like carbohydrates (5.10 g/100g), proteins (1.70 g /100g), fats (26.4 g / 100g) and also wide spectrum of vitamins (A, B complex and C) and minerals (K, P, Mg, S, Cl, Ca, and Fe). Since it is a rich source of fat, it generates 245 calories of energy (per 100g). Hence Rainey *et al.* (1994) [15] consider it as a nutrient dense food. Dawnson (1942) [2] stated that fruit is used as a yardstick to measure the foods, which is used as a yardstick to build and repair the body.

It possess lot of medicinal properties, regular consumption of fruit has been associated with reduction of degenerative, cardiovascular and circulatory diseases. This is due to presence of phenolic compounds such as flavonoids, especially in fruit peels, which have antioxidant properties. Even though it is a rich source of fat, sugar content is very low (< 1%) and easily digestible, hence it is recommended for diabetic patients (Scharamm and German, 1998) [20]. Avocado oil possess medicinal property, fruit peel contains compound that helps in preventing lipid oxidation and also possess significant amount of minerals. Leaves and peels are consumed as a medicinal food due to these properties (Lu *et al*., 2005). Rotta *et al*. (2016) [10, 17] tried avocado tea from dry peel since it is a rich source of phenol and flavonoids content compared to apple tea and also possess good antioxidant property and acceptable by the sensory analysis as a promising product.

Over the years, nurseries have experienced a problems in avocado propagation due to variable germination period of seeds, which results in extending the propagation period as they wait for late germinating seedlings to achieve graftable size (Sauls and Campbell, 1980) [5]. Hence considering the demand for avocado in both local and international markets, it is important to explore measures that can enhance the rate of seed germination of avocado, thus increase in seedling uniformity helps to facilitate mass propagation. Since the seeds exhibit slow and less germination, pre-germination treatments may help in enhancing the germination potential of avocado seeds. Hence the study was carried out to increase the germination potential of the seedlings with different chemicals and growth regulators.

Materials and Methods

The present investigation was carried out in the college of Horticulture Mysuru during 2018-19. The experiment was laid out with completely randomized design having eight treatments with three replications viz. Control (T_1), Water soaking (T_2), GA_3 250 ppm (T_3), GA_3 500 ppm (T_4), Thiourea 1 % (T_5), KNO_3 1 % (T_6), Cow urine 10% (T_7), Vermiwash 10 % (T_8) for 12 hours.

Seeds were sown during second week of August, 2018 in polybags of size 5×8" inches of 300 gauge thickness using soil, sand and farm yard manure in 1:1:1 proportion as a media. The germination of the seeds was studied under partially shaded nursery condition.

Observation like number of days taken for initiation of germination, fifty percent germination, complete germination and per cent germination, seedling growth characters like seedling height, number of leaves and stem girth were recorded.

Results and Discussion

Germination behaviour

Among the different treatments, seeds soaked in GA_3 500 ppm (T_4) for 12 hours took minimum number of days for initiation of germination, fifty per cent germination and complete germination (18, 29 and 38 days, respectively) while it took maximum number of days in 10 % cow urine (T_7) for initiation of germination and fifty per cent germination (29 and 43 days, respectively) and 56 days for complete germination in 1% KNO_3 (T_6) were presented in the table 1.

This might be due to enhancement of seed germination by growth regulators in increasing the transcription and translation during protein synthesis. The mobilization of protein and lipid storage bodies upon specific enzymes, which is most essential for growth and emergence of the embryo, as reported by Khatana *et al*. (2012) [8] in Kagzi lime. Similar findings were obtained by Zahang *et al*. (2015) [25] in litchi and also by Patil *et al*. (2018) [14]. Gibberellic acid induces synthesis of proteolytic enzymes like α-Amylase and ribonuclease and these amylases in turn hydrolase starch in the endosperm, provides essential sugars for the initiation of growth processes. Similar results were reported by Shaban (2010) [21] in mango and Lay *et al*. (2013) [9] in papaya.

Per cent germination

Per cent germination was maximum (96.60 %) in control (T_1). Whereas, it was minimum in seeds treated with 10 % cow urine 43.30 % were depicted in the table 1.

There was a reduction in germination percentage in water soaking of seeds for 12 hours and it may be due to accumulation of toxic chemicals and leaching of cellular constituents that might stimulate fungal or bacterial attack and causes anoxia. Indeed, water was gradually turned turbid and brown as reported by Woodstock (1988) [23]. Similar findings were obtained by Zhao *et al*. (2005) [26] in dragon fruit. The present study is in confirmation with these findings.

Julian *et al*. (1980) [5] in "Waldin" avocado, observed differences in the seedling height and number of leaves in seeds treated with GA_3 during the initial days of the experiment but there is no difference afterwards. Hence, use of growth regulators in increasing total germination percentage of avocado has no practical importance.

Seedling vigour index

Highest seedling vigour index-I (1073) was recorded in the seeds treated with 10 % cow urine (T_7), whereas highest seedling vigour index-II (2086) was recorded in control (T_1) were presented in table 2. Highest vigour index-I may be due to the role of cow urine in increasing the seedling height, number of leaves and length of primary roots as reported by Shinde and Malshe (2015) [22] in khirni. Similar, results were obtained by Desai *et al*. (2017) [3] in papaya and Yadav *et al*. (2018) [24] in papaya cv madhubindhu and custard apple, respectively. Whereas, highest vigour index-II was recorded in control, it might be due to the lack of dormancy and better growth.

Seedling growth parameters

Seedling height

Seedling height shows non-significant variation among the treatments. However, seeds treated with GA3 250 ppm (T_3) showed maximum values for seedling height at 30 and 60 days after sowing i.e., 9.90 and 14.90 cm, respectively. Whereas seeds treated with 10 % vermiwash (T_8) and 10 % cow urine (T_7) recorded maximum seedling height at 90 and 120 days after sowing i.e., 27.00 and 34.50 cm, respectively (Table 3).

The increased seedling height with GA_3 treatment was due to the fact that there may be increased osmotic uptake of nutrients, results in cell multiplication and cell elongation in the cambium tissue of the internodal region and thus increased height of the seedling, as reported by Patil *et al*. (2018) [14] in jamun. The results are also in accordance with results of Meena and Jain (2012) [12] in papaya and Harshavardhan and Rajasekhar (2012) [6] in jackfruit. The increased seedling height with vermiwash and cow urine treatment at 90 and 120 days after sowing might be due to the fact that these hormones helps in increasing the seedling height at later stages may be due to increased width of the cortical zone and the vascular cambion zone. These finding are supported by Elumalai *et al*. (2015) [4] in bhendi and Desai *et a*l. (2017) [3] in papaya, respectively.

Number of leaves

Number of leaves shows non-significant variation among the treatments. However, seeds treated with 10 % vermiwash (T_8) showed maximum values for number of leaves at 30, 90 and 120 days after sowing i.e., 3.60, 12.00 and 17.30, respectively. While 60 days after sowing maximum number of leaves (6.80) were recorded in the seeds treated with GA_3 250 ppm (T_3) were presented in the Table 3.

Higher number of leaves were noticed in seeds treated with GA_3 250 ppm at 60 days after sowing. Increase in number of leaves with GA_3 250 ppm might be due to maximum seedlings height under this treatment. This also helps in increasing physiological process of plant and stimulatory effect of chemicals to develop new leaves at faster rate. Activity of GA_3 at the apical meristematic region resulting in more synthesis of nucleoprotein responsible for increasing leaf initiation and area and highest number of leaves using 10 % vermiwash might be also due to the fact that vermiwash induces vigorous growth by more number of branches which in turn facilitates better harvest of sunshine by the plants to produce more number of leaves as reported by Patil *et al*. (2018) [14] in jamun. This is in line with the results of Kadam *et al*. (2010) [7] in Kagzi lime and Palepad *et al*. (2017) [13] in custard apple.

Seedling girth

Seedling girth shows non-significant variation among the treatments. However, seeds treated with 10 % vermiwash (T_8)

during 30 days after sowing showed maximum stem girth (4.23 mm). While at 60, 90 and 120 days after sowing maximum seedling girth was recorded in seeds treated with 10 % cow urine (T_7) i.e., 5.00, 7.20 and 10.40, respectively (Table 3).

Maximum girth of the seedling recorded in thiourea during early days after sowing and cow urine during the later period. Increased stem girth might be due to the presence of growth promoting substances like auxins and nutrients in cow urine as reported by Shinde and Malshe (2015) [22] in khirni. These findings are also supported by Desai *et al*. (2017) [3] in papaya and Yadav *et al*. (2018) [24] in custard apple. Increasing stem girth due to 1 per cent thiourea was in agreement with the results of Mane *et al*. (2018) [11] in custard apple.

Conclusion

Seeds which were treated with GA_3 500 ppm results in reducing number of days taken for initiation, 50 % and complete germination. While highest germination percentage was recorded in the control and seedling height, number of leaves and stem girth shows non-significant variation among treatments.

Table 1: Effect of growth regulators and chemicals on germination characters of avocado seeds

Treatments	Days taken for			Germination percentage
	Initiation of germination	Fifty per cent germination	Complete germination	
T_1 (Control)	23	38	49	96.60 (79.45)*
T_2 (Water soaking)	27	42	53	66.60 (54.69)
T_3 (GA_3 250 ppm)	20	34	46	80.00 (63.43)
T_4 (GA_3 500 ppm)	18	29	38	60.00 (50.76)
T_5 (Thiourea 1 %)	24	37	48	76.6 (61.07)
T_6 (KNO_3 1 %)	26	41	56	70.00 (56.79)
T_7 (Cow urine 10%)	29	43	51	73.30 (58.89)
T_8 (Vermiwash 10 %)	25	39	54	43.30 (41.14)
S.Em ±	1.32	1.28	1.27	01.32
C.D @ 5%	3.96	3.83	3.82	3.96

*****Germination percentage values in parenthesis are arc sin transformation data

Table 2: Effect of growth regulators and chemicals on seedling vigour index of avocado seeds

Treatments	Vigour index-I	Vigour index-II
T_1 (Control)	0949	2086
T_2 (Water soaking)	0490	1518
T_3 (GA_3 250 ppm)	0769	1672
T_4 (GA_3 500 ppm)	0720	1104
T_5 (Thiourea 1 %)	0840	0911
T_6 (KNO_3 1 %)	0646	1253
T_7 (Cow urine 10%)	1073	0686
T_8 (Vermiwash 10 %)	0698	0770
S.Em ±	1.15	1.15
C.D @ 5%	3.46	3.46

Table 3: Effect of growth regulators and chemicals on plant height, stem girth and number of leaves

Treatments	Seedling height (cm)		Number of leaves		Seedling girth (mm)	
	90 DAS	120 DAS	90 DAS	120 DAS	90 DAS	120 DAS
T_1 (Control)	21.03	33.20	10.50	16.10	6.70	08.50
T_2 (Water soaking)	21.10	30.50	11.20	14.40	6.80	08.23
T_3 (GA_3 250 ppm)	25.60	33.93	10.70	16.30	6.40	09.50
T_4 (GA_3 500 ppm)	25.20	29.20	11.20	15.53	6.80	09.90
T_5 (Thiourea 1 %)	16.80	24.00	09.00	12.40	5.90	08.70
T_6 (KNO_3 1 %)	21.60	26.40	09.70	15.90	5.70	08.20
T_7 (Cow urine 10%)	25.20	34.50	09.80	16.90	7.20	10.40
T_8 (Vermiwash 10 %)	27.00	33.10	12.00	17.30	7.17	10.40
S.Em ±	1.21	1.17	1.09	1.19	1.19	01.03
C.D @ 5%	3.63	3.52	NS	NS	NS	NS

DAS*- Days after sowing

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