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Effect of Bioregulators and Chemical on Seed Germination and Seedling Growth in Papaya (*Carica papaya* L.) cv. Pusa Nanha under Valley Condition of Garhwal Himalaya

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ABSTRACT

An experiment entitled "Effect of Bio-regulators and Chemical on Seed Germination and Seedling Growth in Papaya (Carica papaya L.) cv. Pusa Nanha" was conducted at Horticultural Research Centre and Department of Horticulture, Chauras Campus, H.N.B. Garhwal University, Srinagar (Garhwal), Uttarakhand, India during the year 2015-16. The treatments comprised of Thirteen levels of bio-regulators and chemicals viz., T_1(GA_3 100ppm), T_2 (GA_3 150ppm), T_3 (GA_3 200ppm),T_4 (GA_3 250ppm), T_5 (NAA 100ppm), T_6 (NAA 200ppm), T_7 (NAA 300ppm), T_8 (NAA 400ppm), T_9(Thiourea 1000ppm), T_{10}(Thiourea 1500ppm),T_{11} (Thiourea 2000ppm), T_{12}(Thiourea 2500ppm), T_{13}(Control). The experiment was laid out in Randomized Complete Block Design (RBD) with thirteen treatments and replicated thrice. The seeds treated with 400 ppm NAA showed the minimum number of days required for first germination (12.00 days), maximum germination percentage (77.78%), height of seedling (19.90cm), number of leaves per seedling (18), fresh weight of seedling (7.71g), number of roots per seedling (28.00), dry weight of seedling (1.68g). On the basis of result achieved in the present study, it can be concluded that among the bio-regulators and chemical, NAA @ 400 ppm may be suggested for seed germination and seedling growth of papaya cv. Pusa Nanha under valley condition of Gharwal Himalaya.

Key words: *Bio-regulators, Growth, Seedling, Germination.*

INTRODUCTION

Papaya plant is also called as *"Melon tree"* since the various parts of the crop are used either for human consumption or for animals or as raw materials for many agro-based industries. Papaya is botanically known as *Carica papaya* L. belongs to the family Caricaceae, of the 48 species known in Caricaceae, *Carica papaya* is only species grown for edible fruits. There is wide diversity of biological types of cultivated papaya, which may be dioecious, monoecious and hermaphrodite.

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Presently, the papaya is one of the most important fruit crops of Hawaii, Malaysia, Burma, Sri Lanka, India, Queens Land, South Africa, and other tropical and sub-tropical countries of the world. In India, it is successfully grown all over the country and is available round the year. Gibberellins effect in papaya internodes to stretch in relation to light intensity. Less is the light intensity more will be internode length and vice versa. Stimulate stem growth through cell elongation and cell division.GA_3 is used to break the seed dormancy of freshly harvested seeds of papaya. Auxins (NAA) applied on papaya seed for stimulate root growth and development. It induces parthenocarpy i.e., formation of seedless fruits without fertilization. Formation of an abscission layer at the base of petiole or pedicel results in shedding of leaves, flowers or fruits. It inhibits abscission, as they prevent the formation of abscission layer. Formation of an abscission layer at the base of petiole or pedicel results in shedding of leaves, flowers or fruits. Thiourea increases the growth attributes like plant height, fresh weight, no. of leaves per plant, etc. It is dormancy breaking bioregulator. It favoured larger green photosynthetic surface but it might have also favored the activity of starch synthetase and hence the effective period of filling seeds[4]. Papaya is mainly propagated through seeds. The seeds are covered with sarcotesta, a whitish succulent and translucent material which has been reported to delay germination. The freshly extracted seeds exhibit dormancy when sown immediately and the dormancy can be broken by after ripening by storage for a short period, but prolonged storage also results in poor germinability. Treatment of seeds with growth regulators and certain chemicals has been found to break dormancy and improve the germination.

MATERIAL AND METHODS

The experiment on "Effect of Plant Bio Regulators on Seed Germination and Seedling Growth in Papaya (*Carica papaya* L.) cv Pusa Nanha Under Valley Condition of Garhwal Himalaya" was conducted from April to June 2016. The papaya seed of the variety Pusa Nanha was procured from Head, Division of Fruits and Post Harvest Technology, IARI New Delhi. The test weight of the seed was taken by before initiation of the experiment by counting 100 seeds each in three replications. These were weighed on a digital balanced to compute test weight. The treatments comprised of Thirteen levels of bio-regulators and chemicals viz., T_1(GA_3 100ppm), T_2 (GA_3 150ppm), T_3 (GA_3 200ppm),T_4 (GA_3 250ppm), T_5 (NAA 100ppm), T_6 (NAA 200ppm), T_7 (NAA 300ppm), T_8 (NAA 400ppm), T_9(Thiourea 1000ppm), T_{10}(Thiourea 1500ppm),T_{11} (Thiourea 2000ppm), T_{12}(Thiourea 2500ppm), T_{13}(Control). The experiment was laid out in Randomized Complete Block Design (RBD) with thirteen treatments and replicated thrice. The solution of bio-regulators used i.e. GA_3 (100ppm, 150ppm,200ppm and 250ppm) and NAA(100ppm,200ppm,300ppm and 400ppm) was prepared by weighing (100mg, 150mg,200mg and 250mg) GA_3 and (100mg,200mg 300mg and 400mg) NAA with the help of digital balance. This was dissolved in small volume amount of N/10 NaOH and made up to per treatment 950ml with distilled water. p^H of this solution was adjusted to 6.5 +0.5 by N/10 H_2SO_4 with the help of digital pH meter and then final by made up to one liter volume. The solution of chemicals used i.e. thiourea (1000ppm, 1500ppm,2000ppm and 2500ppm) was prepared by weighing (100mg, 150mg,200mg and 250mg) with the help of digital balance. This was dissolved in each 100ml of distilled water. Seeds were treated with the bio-regulators i.e. gibberellic acid, NAA and chemical thiourea under each treatment for 12 hours and control with

distilled water. For preparing the rooting media, the sandy soil and farm yard manure (FYM) in ratio 2:1 were mixed thoroughly. The mixture was filled in polythene bags (1 kg capacity) tightly leaving one inch space at the top (head space). All the treated seeds were sown in the poly bag (1 kg capacity) in the evening hours of 28th April, 2016. The seeds are sown in each treatment (18 seeds) and irrigated immediately. Optimum moisture of media was maintained during the period of seed germination.

RESULTS AND DISCUSSION

The mean data on the germination and seedling growth related parameters as influenced by different bio-regulators and chemicals were recorded accordingly during the experimentation and presented as under.

Germination attributes

The days taken to first germination was recorded on the basis of emergence of the seedling from the seed and its being visible just above the surface of sowing media. The results pertaining to number of days required for first germination were significantly influenced by different treatment (Table 1). The treatment T_8 (NAA 400ppm) significantly took the minimum days for germination initiation and remained at par with rest of the treatments. It might be due to retention of more water and air which helped in quick and early enzymatic action for synthesis of metabolites for cell multiplication and also enhanced the breakdown of the seed coat resulting in the transformation of embryo into a seedling early enough Singh *et al.*[3], While, T_{12} (Thiourea 2500ppm) and T_{13} (control) noted the maximum days for first germination.The number of days taken to seed germination as influenced by the various treatments has been presented in Table 1. Seed germination was recorded at five day intervals from the date of emergence of seedling and continued up to 30 days after sowing (DAS). Treatment T_8 (NAA 400ppm) have significantly maximum number of seed germination at 40 days after sowing. The highest germination percentage in NAA (400 ppm) might be due to fact that the synthesis of amino acids in palnt is accerelated, which is indirectly exhibited enhanced by growth of papaya plant and its various parts. The optimum germination of papaya seed were also obtained by Vyas *et al.*[6], Singh *et al*[3]. The least number of seed germinated were recorded in treatment T_{13} (Control). The coefficient of velocity (Table 1), which shows the speed of germination, was found to have increased in all the treatments over control. However, treatment T_{12} where seeds was sown after treatment with (Thiourea 2500ppm), the coefficient of velocity was lower than the control. The coefficient of velocity was found to be non-significantly maximum T_8 (NAA 400ppm). This was followed by treatment T_{13} (Control). The similar results found by Singh *et al.*[3], and Tripathi *et al.*[5] in walnut.

Growth attributes

The results pertaining to height of seedling 45 DAS were significantly influenced by different treatment at all the respective periods. The treatment T_8 (NAA 400ppm) significantly recorded the highest length of seedling at 45 DAS as compared to rest of the treatments. The increased plant height with NAA may be due to removal of sarcotesta which induced seed dormancy and reduces the nutrient and water uptake so, minimize the overall growth of plant. The results are also accordance with the results of, Meshram *et al.*[2], Kadam *et al.*[1] in kazagi lime. While, minimum height of seedling at 45 DAS, respectively was recorded in treatment T_{13} (control).The number of leaves per seedling was increased with increase in days. The treatment T_8(NAA 400ppm) recorded significantly the maximum number of leaves at 45 DAS as compared to rest of the

treatments. Increase in number of leaves NAA (400ppm) might be due to maximum height of seedling under this treatment. This also helps in invigoration of physiological process of plant and stimulatory effect of chemicals to form new leaves at faster rate at suggested by Meshram *et al*.[2], Kadam *et al.*[1], in kazagi lime. While, minimum number of leaves at 45 DAS, respectively were noted in T_{13} (control).An appraisal of results pertaining to fresh weight of seedling was significantly affected by different treatment. The treatment T_8 (NAA 400ppm) exhibited its superiority and recorded significantly the maximum fresh weight of seedling at 45 DAS, respectively as compared to rest of the treatment. Whereas, the minimum fresh weight of seedling at 45 DAS, respectively were recorded in T_{13} (control). The effect of higher concentration of NAA was more pronounced to the fresh and dry weight of roots. The favourable effect of NAA might be due to increased auxin level in roots which stimulated more root initiation, more nutrient uptake and root cell elongation, thus resulting into increased tap root and no. of roots in return increased the fresh and dry weight of roots. The present study are accordance with findings of Kadam *et al.*[1] in kagzi lime, Meshram *et al*[2]. The results pertaining to number of roots per seedling at 45 DAS were significantly influenced by the treatment T_8 (NAA 400ppm) recorded significantly maximum number of roots per seedling at 45 DAS, respectively as compared to rest of the treatment. NAA promotes root initiation, more nutrient uptake and root cell elongation. These results are conformity with Vyas *et al*[6]., Kadam *et al.*[1],On the other hand the minimum number of roots at 45 DAS, respectively were noted in treatment T_{13} (control)The result clearly showed that there was a significantly maximum length of tap root was found in the treatment T_7 (NAA 300ppm) as compared to rest of the treatment. The more length of tap root in NAA might be due to restorer of apical dominance which promotes root initiation, more nutrient uptake and root cell elongation as suggested by Kadam *et al.*[1], While, minimum length of tap root was found in treatment T_{13} (Control). An appraisal of results pertaining to dry weight of seedling was non-significantly affected by different treatment. The treatment T_8 (NAA 400ppm) - non-significantly the maximum dry weight of seedling at 45 DAS, respectively and proved its superiority over rest of the treatment. Whereas, the minimum dry weight of seedling 45 DAS, respectively were noted with the treatment T_{13} (control). The effect of higher concentration of NAA was more pronounced to the fresh and dry weight of roots. The favourable effect of NAA might be due to increased auxin level in roots which stimulated more root initiation, more nutrient uptake and root cell elongation, thus resulting into increased tap root and no. of roots in return increased the fresh and dry weight of roots. The present study are accordance with findings of Kadam *et al.*[1] in kagzi lime, Meshram *et al*.[2]. The root: shoot ratio (weight wise) was significantly influenced by different treatment at all the respective periods. The treatment T_1 (GA_3 100ppm) and T_2 (GA_3 150ppm) recorded the significantly maximum root: shoot ratio at 45 DAS, respectively as compared to rest of the treatment. More root: shoot ratio was found in GA_3 better due to the effect of mobilization of water and nutrients transport at higher rate which might have presented more production of photosynthetic product and translocated then to various plant part which might have resulted in better growth of the seedling and hence were fresh and dry weight as suggested by Kadam *et al.*[1], in kagzi lime, Meshram *et al*.[2]**,** While, treatment T_{13} (control) recorded the minimum root: shoot ratio at 45 DAS, respectively.

Table 1: Effect of Bio Regulators and Chemical on Germination Attributes in Papaya (*Carica papaya* L.) cv. Pusa Nanha

Treatments	Days required for first germination	Percentage of seed germination days after sowing						Coefficient of velocity
		12DAS	17DAS	22DAS	27DAS	32DAS	37DAS	
T_1(GA_3 100ppm)	17.00	5.56	11.11	27.78	38.89	50.00	72.22	3.60
T_2 (GA_3 150ppm)	17.00	5.56	16.67	22.22	38.89	50.00	66.67	3.68
T_3 (GA_3 200ppm)	22.00	0.00	5.56	11.11	22.22	33.33	38.89	3.60
T_4 (GA_3 250ppm)	20.33	5.56	11.11	16.67	22.22	27.78	44.44	3.60
T_5 (NAA 100ppm)	22.00	5.56	5.56	11.11	16.67	22.22	50.00	3.51
T_6 (NAA 200ppm)	15.33	5.56	16.67	27.78	38.89	55.56	72.22	3.71
T_7 (NAA 300ppm)	18.67	0.00	11.11	22.22	27.78	38.89	55.56	3.63
T_8 (NAA 400ppm)	12.00	22.22	27.78	38.89	44.44	55.56	77.78	4.08
T_9 (Thiourea 1000ppm)	17.00	5.56	11.11	22.22	33.33	44.44	66.67	3.57
T_{10} (Thiourea 1500ppm)	15.33	5.56	16.67	22.22	38.89	50.00	66.67	3.72
T_{11} (Thiourea 2000ppm)	15.33	0.00	5.56	16.67	22.22	27.78	50.00	3.38
T_{12}(Thiourea 2500ppm)	25.33	0.00	0.00	11.11	11.11	22.22	38.89	3.31
T_{13}(Control)	25.33	0.00	5.56	11.11	11.11	11.11	27.78	3.99
S. Em±	2.44	4.45	5.54	5.98	5.26	6.61	7.52	0.34
C. D. at 5 %	7.11	NS	NS	NS	15.36	19.30	21.96	NS
C. V. %	22.59	163.89	86.32	51.60	32.32	30.45	23.27	15.97

Table 2: Effect of Bio Regulators and Chemical on Growth Attributes in Papaya (*Carica papaya* L.) cv. Pusa Nanha

Treatments	Seedling Height (cm)	Number of Leaves	Fresh Weight of Seedling (gm)	Number of Primary roots	Length of Tap Root (cm)	Dry Weight of Seedling (gm)	Root: Shoot Ratio
T_1(GA_3 100ppm)	13.80	14.67	2.92	12.67	20.27	0.55	0.33
T_2 (GA_3 150ppm)	12.10	13.00	2.82	18.33	21.70	0.35	0.31
T_3 (GA_3 200ppm)	9.73	12.00	2.52	12.67	17.70	0.74	0.33
T_4 (GA_3 250ppm)	11.50	17.67	2.97	14.00	22.03	0.99	0.18
T_5 (NAA 100ppm)	7.37	12.67	3.12	18.00	20.53	0.22	0.27
T_6 (NAA 200ppm)	15.33	13.00	4.20	15.33	22.00	0.76	0.22
T_7 (NAA 300ppm)	10.93	13.67	2.88	20.00	30.20	0.65	0.26
T_8 (NAA 400ppm)	19.90	18.00	7.71	28.00	28.27	1.68	0.16
T_9 (Thiourea 1000ppm)	13.27	16.00	5.67	19.67	25.50	1.51	0.16
T_{10} (Thiourea 1500ppm)	13.07	14.67	5.56	15.00	25.90	0.95	0.19
T_{11} (Thiourea 2000ppm)	8.80	12.67	3.27	10.33	24.50	0.47	0.26
T_{12}(Thiourea 2500ppm)	9.37	12.00	2.88	11.33	23.43	0.83	0.24
T_{13}(Control)	8.33	10.33	2.36	6.67	19.53	0.25	0.12
S. Em±	1.16	1.33	0.47	1.88	2.20	0.30	0.05
C. D. at 5 %	3.38	3.89	1.38	5.48	6.41	NS	0.13
C. V. %	16.98	16.63	21.82	20.92	16.39	68.68	33.69

CONCLUSION

On the basis of result achieved in the present study, it can be concluded that among the chemical and bio-regulators, NAA @ 400 ppm was found superior for early and higher germination percentage, better coefficient of velocity and shoot growth, tap root, root production of seedlings. So, NAA @ 400 ppm may be suggested for seed germination and seedling growth of papaya cv. Pusa Nanha under valley condition of Gharwal Himalaya.

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