Bioved, **30**(1) : 29–33, 2019 http://biovedjournal.org/

Influence of chemicals on physiological indices and seedling vigour of custard apple (*Annona squamosa* L.)

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Received November 8, 2018 and Accepted January 19, 2019

ABSTRACT : The experiment comprised of 14 treatments, viz. T_1 (control/without water soaking), T_2 (Water soaking), Gibberellic acid concentrations -T_3 (200 ppm), T_4 (300 ppm), T_5 (400 ppm), and chemicals viz.T_6 (Thiourea 0.5%), T_7 (Thiourea 0.75%), T_8 (Thiourea 1.00%), T_9 (KNO_3 0.5%), T_{10} (KNO_3 0.75%), T_{11} (KNO_3 1.00%), T_{12} (Sodium thiosulphate-150 ppm), T_{13} (Sodium thiosulphate-200ppm), T_{14} (Sodium thiosulphate-250 ppm) was conducted to study the effect of chemicals and plant growth regulators on germination, vigour of seedling and survivability of custard apple. Among the various treatments, GA_3, concentration at 400ppm (T_5) was proved superior in respect to physiological indices and seedling vigour of custard apple.

Key Words : Custard apple (*Annona squamosa* L.), seedling vigour indices, chemicals, leaf area index (LAI), leaf area duration (LAD), plant growth regulators (PGR), light transmission ratio (LTR), energy interception (EI), germination, survival.

Custard Apple (*Annona squamosa* L.) belongs to the family Annonaceae and is one of the finest fruits introduced in India from tropical America. It is also found in wild form in many parts of India. In India, custard apple occupies an area of 29.87 thousand ha with production of 228.37 MT (Anonymous, 2015). It is found growing almost in all the tropical and sub tropical regions mostly in wild form. Andhra Pradesh is the major custard apple growing state along with Tamil Nadu, Orissa, Assam, U.P., M.P., Bihar and Rajasthan. Setten and Koek-Noorman (1992) observed that Annonaceae seeds undergoing dispersal have a small embryo that is considered underdeveloped and immature.

Seed germination of custard apple is uneven and irregular making sexual propagation difficult. Much experimental evidences support the concepts that specific endogenous growth promoting and inhibiting compounds are involved directly in the control of seed development, dormancy and germination (Black, 1980). Custard apple requires 35-50 days for potential germination (Hernandez, 1983). Irregular germination, in custard apple seeds may be due to dormancy or due to hard seed coat. Very limited work has been carried out on this aspect in India and in different parts of the world indicating, the utility of GA_3 from 150-500ppm and chemicals for getting better germination of custard apple seeds (Banker, 1987; Stino *et al.*, 1996; Pawshe *et al.*, 1997; Ratan and Reddy, 2004). Therefore, pre treatment of custard apple seed with water, different organics and chemicals is very important to improve germination. Considering the above problem the investigation was conducted to find out effect of water soaking, plant growth regulator (PGR) and chemicals on seed germination, seedling vigour and survivability of custard apple.

Materials and Methods

The investigation was conducted at Horticulture Farm Maharajpur, Department of Horticulture, College of Agriculture, JNKVV, Jabalpur (M.P.) during 2014-15 under polyhouse condition in Randomized Block Design with three replication. The seeds were treated with chemicals and PGR as per treatments. The experiment comprised of 14 treatments viz. Without water soaking (control) -T_1, Water soaking- T_2, GA_3 -200 ppm- T_3, GA_3 -300 ppm- T_4, GA_3 -400 ppm- T_5, Thiourea -0.5 % - T_6, Thiourea -0.75 % - T_7, Thiourea -1.00 % - T_8, KNO_3 - 0.5 % - T_9, KNO_3 -0.75 % - T_{10}, KNO_3-1.00 % - T_{11}, Sodium Thiosulphate -150 ppm- T_{12}, Sodium Thiosulphate -200 ppm - T_{13}, Sodium Thiosulphate- 250 ppm- T_{14}. The seeds were soaked in water and as well as in GA_3 and different chemical solutions for 24 hours and grown in polybags under the polyhouse. One seed per poly bag was sown at 2-2.5 cm depth. The growth parameters were recorded at 30, 60, 90, 120 and 150 days after sowing. Five plants were randomly selected for observations and mean value was computed. The data were analyzed using standard statistical methods (Panse and Sukhatme, 1985). The length was measured with metre scale, width was with verniere calipers and weight with electronic weighing machine. The germination in each treatment was recorded at 60 days after sowing. Number of seedlings were counted and expressed as germination per-

centage.

$$\text{Germination (\%)} = \frac{\text{Total no. of seeds germinated}}{\text{Total no of seeds sown}}$$

Seedling vigour index-I (cm)

(Abdulbaki and Anderson, 1973)

Seedling vigour index-I

= Germination percentage x [root length (cm) + shoot length (cm)].

Seedling vigour index-II (g)

Seedling vigour index-II

= dry wt. of seedlings (g) × germination percentage

Results and Discussion

Leaf Area Index (LAI) and Leaf Area Duration (LAD)

The data revealed that all the treatments significantly affected the Leaf Area Index (LAI) over T_1 at interval of 120 and 150 days after sowing. Maximum Leaf Area Index (1.75) was recorded at interval 120 and 150 days after sowing under T_5 (GA_3 400ppm) having at par value with T_{11} (1.70) whereas, minimum Leaf Area Index (1.09) was recorded under T_1.

The data revealed that almost all treatments significantly affected the Leaf Area Duration over T_1 (control) at an interval of 120 and 150 days after sowing. The maximum Leaf Area Duration (LAD) (15209.69 cm^2 × days) was recorded under T_5 and was found statistically at par with T_{11} (14749.01). The minimum Leaf Area Duration (LAD) (9452.34 cm^2.day) was noted under T_1. This was higher ascribed to higher magnitude increases in parameter associated with the LA. The finding was supported by Munde and Gajbhiye (2010).

Light Transmission Ratio (LTR)

The data revealed that the various treatments significantly reduced the Light Transmission Ratio (LTR). The minimum Light Transmission Ratio (LTR) (25.81) was recorded under T_5, which was found statistically at par with T_{11} (26.64), T_{10} (28.78) and T_{12} (29.09), whereas, maximum Light Transmission Ratio (LTR) (39.90) was recorded under T_1. The GA_3 showed significant effect on Light Transmission Ratio. The findings are supported by Thakur and Kaur (2001).

Energy Interception (EI)

The data revealed that almost all the treatments significantly increased the Energy Interception (EI) over T_1 (control). The maximum Energy Interception (0.75) was recorded under T_5 (GA_3 400 ppm), statistically at par with T_{11} (0.70). The minimum Energy Interception (0.43) was recorded under T_1 (control). In the present study, the treatments gibberellic acid concentration showed significant effect on the experiment concern**.** The probable reason may be that Interception of light by a crop canopy is strongly related to total leaf area. A crop will thus intercept more PAR and hence grow faster if it develops leaf area rapidly. Similar findings were reported by Maddonni and Otegui (1996).

Seedling vigour index-I (cm)

The data revealed that all the treatments significantly increased the seedling vigour (cm) over T_1 (control). The maximum seedling vigour index-I (5547.00 cm) was recorded under T_5 and minimum seedling vigour index-I (2919.50 cm) was in T_1 at 150 days after seed sowing. Enzymes as well as physical and nutritional condition increased the physiological activities of plant. The result is in agreement with the findings of Shanmugavelu (1968) in jackfruit, Gupta (1989) in citrus, and Babu *et al*. (2004) in papaya. Plant growth regulators and some chemicals are widely used in increasing vigour of seedlings. Similar findings were reported by Parmar *et al*. (2016).

Seedling vigour index-II (g)

The data revealed that different treatments significantly increased the seedling vigour index-II (g) over T_1 (control). Data indicated that the maximum seedling vigour index-II (168.60 g) was noted under T_5, which was found statistically at par with T_{11} (161.78 g), T_{10} (155.70 g), T_{12} (143.83 g), T_4 (140.12 g) and T_3 (133.98 g) whereas, minimum seedling vigour index-II (89.75 g) was recorded under T_1 at 150 days after seed sowing. The seedling vigor significantly differed due to invigoration of seeds. The highest seedling vigour in GA_3 was attributed to enlarged embryos, higher rate of metabolic activity and respiration, better utilization and mobilization of metabolites to growth points and higher activity of enzymes. Enzymatic and hormonal mechanism stimulate metabolic process such as sugar mobilization, protein hydrolysis, oxidation etc. (Evans, 1970), which leads to increase in root length, shoot length and seedling dry weight, in turn increase in seedling vigour. The present results are in conformity with the results of Dhoran and Gudadhe (2012) and Thakur (2015).

1. The maximum Leaf Area Index (1.75), Leaf Area Duration (LAD) (15209.69 cm^2×day), Energy Interception (0.75) and minimum Light Transmission Ratio (LTR) (25.81), were recorded at interval between

Table-1: Effect of seed treatment on Leaf Area Index (LAI), Leaf Area Duration (LAD), Light Transmission Ratio (LTR) and Energy Interception (EI) at interval of 120 and 150 days after sowing.

Treatments		Leaf area index	Leaf area duration	Light transmission ratio (%)	Energy interception (cal.cm^{-2} Mn^{-1})
Control	T_1	1.09	9452.34	39.90	0.43
Water soaking	T_2	1.23	10641.30	33.42	0.45
GA_3 -200 ppm	T_3	1.38	12000.29	31.79	0.57
GA_3 -300 ppm	T_4	1.45	12581.21	30.67	0.61
GA_3 -400 ppm	T_5	1.75	15209.69	25.81	0.75
Thiourea -0.5%	T_6	1.37	11886.03	30.20	0.55
Thiourea -0.75%	T_7	1.36	11776.87	30.21	0.54
Thiourea -1.00%	T_8	1.28	11075.68	31.93	0.51
KNO_3 -0.5%	T_9	1.35	11741.67	31.03	0.53
KNO_3 -0.75%	T_{10}	1.49	12955.71	28.78	0.64
KNO_3-1.00%	T_{11}	1.70	14749.01	26.34	0.70
Sodium Thiosulphate -150 ppm	T_{12}	1.55	13478.98	29.09	0.67
Sodium Thiosulphate -200 ppm	T_{13}	1.26	10959.77	32.78	0.48
SodiumThiosulphate -250 ppm	T_{14}	1.24	10785.59	33.35	0.45
S.Em ±		0.05	419.22	1.64	0.02
C.D 5% level		0.14	1218.67	4.76	0.06

Table-2 : Effect of seed treatment on seedling vigour index-I (cm) and seedling vigour index-II (gm) at 150 days after sowing.

Treatments		Seedling vigour index-I (cm)	Seedling vigour index-II (gm)
Control	T_1	2919.50	89.75
Water soaking	T_2	3275.00	97.28
GA_3 -200 ppm	T_3	4046.73	133.98
GA_3 -300 ppm	T_4	4241.80	140.12
GA_3 -400 ppm	T_5	5547.00	168.60
Thiourea -0.5 %	T_6	3986.67	126.12
Thiourea -0.75 %	T_7	3916.13	121.73
Thiourea -1.00 %	T_8	3656.80	109.07
KNO_3 -0.5 %	T_9	3796.42	118.72
KNO_3 -0.75 %	T_{10}	4692.02	155.70
KNO_3-1.00 %	T_{11}	4754.54	161.78
Sodium Thiosulphate -150 ppm	T_{12}	4303.44	143.83
Sodium Thiosulphate -200 ppm	T_{13}	3637.93	107.33
Sodium Thiosulphate-250 ppm	T_{14}	3418.95	104.47
S.Em ±		124.95	12.23
C.D 5% level		363.23	35.54

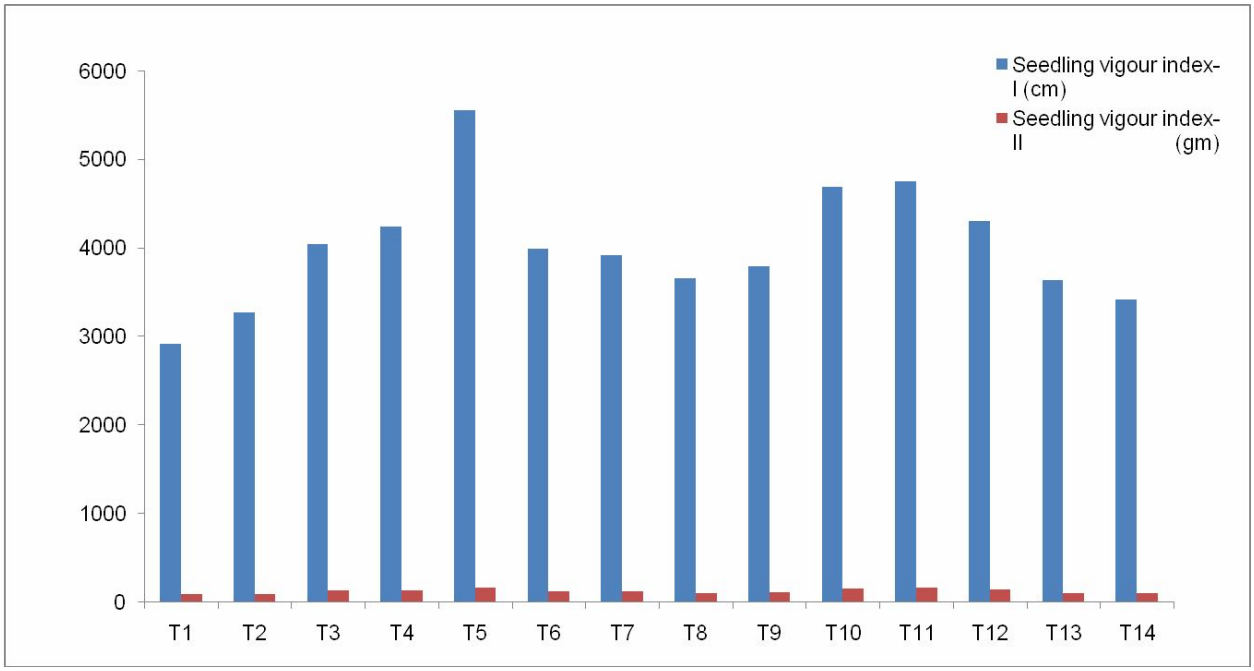

Fig. : Effect of seed treatment on seedling vigour index-I (cm) and seedling vigour index-II (gm) at 150 days after sowing

120 - 150 days after sowing under T_5 (GA_3 400ppm) having at par value with T_{11} (KNO_3-1.00%).

2. The maximum seedling vigour index-I (5547.00 cm) was recorded under T_5 as well as maximum seedling vigour index-II (168.60 g) was noted under T_5, with statistically at par with T_{11} (161.78 g), T_{10} (155.70 g) , T_{12} (143.83 g), T_4 (140.12 g) and T_3 (133.98 g) at 150 days after seed sowing.

Based on the present investigation, it is concluded that GA_3, concentration at 400 ppm (T_5) was proved superior in respect to physiological indices and seedling vigour of custard apple seedling.

Acknowledgement

Authors are thankful to Jawaharlal Nehru Krishi Vishwa Vidyalaya, JNKVV, Jabalpur, MP- 482004

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