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Effect of GA3, NAA and biofertilizers on seedling growth of custard apple (*Annona squamosa* L.) cv. local

HM Raut and AV Kotecha

Abstract
The research experiment was carried out on "Effect of GA3, NAA and biofertilizers on seedling growth of custard apple (*Annona squamosa* L.) cv. Local" at Horticultural Research Farm, Department of Horticulture, B. A. College of Agriculture, Anand Agricultural University, Anand during Kharif-Rabi season of the year 2018-19. The experiment was laid out in Completely Randomized Design (CRD) having ten treatment combinations, comprising of three levels of growth regulators viz., GA3 @ 50, 75 and 100 mg/l, NAA @ 50, 75 and 100 mg/l, and biofertilizers viz., *Azatobactor, Azospirillum* and Bio NPK consortia each of 5 ml/l of water as a seed soaking for 24 hours before sowing. The treatments were repeated thrice. Among all the treatments, GA3 @ 100 mg/l treatment recorded significantly maximum height of seedling, diameter of seedling, number of leaves per seedling, leaf area, chlorophyll content, seedling length, fresh weight of seedling and dry weight of seedling.

Keywords: GA3, NAA, biofertilizers and seedling growth

Introduction
Custard apple being a hardy in nature and it is successfully cultivated in wide range of soil and climatic conditions. It is being cultivated since long back and occupies an important place among indigenous fruits of India. Germination is the first stage or transitional stage of plant development; it corresponds to the passage of inert seed to seedling. But, in natural ecosystems, seed germination may be limited by intrinsic factors such as the seed dormancy or extrinsic one such as climate changes, predation or infestation of seeds by pathogens. Seed-coat dormancy is widespread in the dry tropical zones and in most cases due to the impermeability of the coats. Indeed, a seed can germinate if the embryo has the opportunity to soak, but the presence of impermeable cell layers prevents the progress of the critical process of imbibition.

These seeds with impermeable seed-coats are called hard seeds. However, there are several ways to lower coat inhibitions. In the environment, the infestation of seeds and the involvement of soil microorganisms without damage to the embryo may increase the permeability of the seed-coat to water and thus promote the germination of hard seeds. Due to hard and thick seed coat of custard apple seed, it requires about 35-40 days for germination. To get higher and proper germination, seed needs pre sowing treatments which helps in promotion of early and higher percentage of seed germination with healthy vigorous seedling. Seed priming is a seed treatment in which seeds are hydrated with bioactive chemical to initiate the pre-germinative metabolism in embryo, which accelerate the rapid germination and growth rate of seedling. Primed seed usually emerge from soil is faster and seedling is more uniform than non-primed seed. Nurserymen are often encountered with problem of slow growth of seedling. Treating seeds with GA3 and NAA also helps enhancing their growth (Chadha, 2010) [1]. The old seeds lose their germination ability with the passing of time. However it is possible to extend seed germination ability by using some germination promoters. Biofertilizers are also used for breaking seed dormancy and promote seed germination.

Materials and Methods
The experiment was conducted on "Effect of GA3, NAA and biofertilizers on seedling growth of custard apple (*Annona squamosa* L.) cv. Local" at Horticultural Research Farm, Department of Horticulture, B. A. College of Agriculture, Anand Agricultural University, Anand during

Kharif-Rabi season of the year 2018-19. The experiment was laid out in Completely Randomized Design (CRD). Ten different treatments were imposed including control. Fifty seeds were used for each treatment, which was replicated thrice. The treatments as follows T1-Control, T2 - GA3 @ 50 mg/l, T3 - GA3 @ 75 mg/l, T4 - GA3 @ 100 mg/l, T5 - NAA @ 50 mg/l, T6 - NAA @ 75 mg/l, T7 - NAA @ 100 mg/l, T8 - *Azatobactor* (5 ml/l of water), T9 - *Azospirillum* (5 ml/l of water) and T10 - Bio NPK consortia (5 ml/l of water). Before sowing seeds were soaked in GA3 and NAA solution for 24 hour. In biofertilizer treatment seeds were properly mix with biofertilizer liquid formulation for half an hour before sowing. The seeds were sown in polythene bag containing media 1: 1 (soil, vermicompost) and kept in 75% green shade net house. The polythene bags were watered daily till final data were recorded. The data collected from the five labelled seedlings in each treatment.

Results and Discussion

The results obtained from the research experiment on effect of GA3, NAA and biofertilizers on seed germination of custard apple are presented in Table 1 to 8.

There were significant effect of GA3, NAA and biofertilizers on growth parameter *viz.*, height of seedling, diameter of seedling, number of leaves per seedling, leaf area, chlorophyll content, seedling length, fresh weight of seedling and dry weight of seedling. Among all the treatment, GA3 @ 100 mg/l treatment recorded significantly maximum height of seedling (16.19, 30.18 and 45.60 cm), diameter of seedling (0.33, 0.49 and 0.61 cm) at 60, 90 and 120 DAS, respectively and seedling length (59.40 cm) at 120 DAS it might be due to GA3 increased osmotic uptake of nutrients, causing cell elongation and thus increasing height, diameter and length of the seedling was also increased due to greater cell division and elongation (Sen *et al.*, 1990). Similar results were also found by Hore and Sen (1985) [3] in bael, Singh *et al.* (2002) [14] and Prajapati *et al.* (2014) [12] in jackfruit, Meena and Jian (2005) [7] in papaya, Kumar *et al.* (2008) [6] and Naguri Ashiya (2013) [8] in mango and Nimbalkar *et al.* (2012) [9] in karonda.

Table 1: Effect of GA3, NAA and biofertilizers on seedling height of custard apple cv. Local

Sr. No.	Treatments	Height of seedling (cm)		
		60 DAS	90 DAS	120 DAS
T1	Control	12.42	23.92	31.33
T2	GA3 @ 50 mg/l	15.42	28.80	43.26
T3	GA3 @ 75 mg/l	15.03	27.44	41.26
T4	GA3 @ 100 mg/l	16.19	30.18	45.60
T5	NAA @ 50 mg/l	14.02	27.19	37.73
T6	NAA @ 75 mg/l	14.07	27.13	37.93
T7	NAA @ 100 mg/l	14.40	27.67	39.46
T8	*Azatobactor*(5 ml/l of water)	13.57	25.72	38.80
T9	*Azospirillum*(5 ml/l of water)	13.68	25.64	37.56
T10	Bio NPK consortia(5 ml/l of water)	14.23	26.86	40.54
	S.Em±	0.36	0.64	0.83
	C.D. at 5%	1.06	1.91	2.47
	CV%	4.38	4.15	3.68

Table 2: Effect of GA3, NAA and biofertilizers on seedling diameter of custard apple cv. Local

Sr. No.	Treatments	Diameter of seedling (cm)		
		60 DAS	90 DAS	120 DAS
T1	Control	0.20	0.32	0.41
T2	GA3 @ 50 mg/l	0.32	0.47	0.57
T3	GA3 @ 75 mg/l	0.30	0.43	0.54
T4	GA3 @ 100 mg/l	0.33	0.49	0.61
T5	NAA @ 50 mg/l	0.26	0.41	0.55
T6	NAA @ 75 mg/l	0.26	0.39	0.54
T7	NAA @ 100 mg/l	0.27	0.42	0.55
T8	*Azatobactor*(5 ml/l of water)	0.26	0.37	0.53
T9	*Azospirillum*(5 ml/l of water)	0.25	0.37	0.51
T10	Bio NPK consortia(5 ml/l of water)	0.27	0.40	0.55
	S.Em±	0.007	0.011	0.016
	C.D. at 5%	0.020	0.033	0.046
	CV%	4.37	4.65	5.01

Table 3: Effect of GA3, NAA and biofertilizers on seedling length of custard apple cv. Local

Sr. No.	Treatments	Seedling length (cm) at 120 DAS
T1	Control	38.79
T2	GA3 @ 50 mg/l	53.59
T3	GA3 @ 75 mg/l	55.84
T4	GA3 @ 100 mg/l	59.40
T5	NAA @ 50 mg/l	49.92
T6	NAA @ 75 mg/l	49.77
T7	NAA @ 100 mg/l	51.46
T8	*Azatobactor* (5 ml/l of water)	50.27
T9	*Azospirillum* (5 ml/l of water)	49.79

T10	Bio NPK consortia(5 ml/l of water)	51.82
	S.Em±	1.10
	C.D. at 5%	3.24
	CV%	3.73

The maximum number of leaves at 60, 90 and 120 DAS (6.83, 11.40 and 15.33, respectively) were recorded when the seeds of custard apple were treated with GA3 @ 100 mg/l it might be due to higher growth of seedlings and also due to activity of GA3 at the apical meristem resulting in more synthesis of nucleoprotein responsible for increasing leaf initiation (Sen and Ghunti, 1976) [13]. Similar results were also reported by Meena and Jian (2005) [7] in papaya, Kumar *et al.* (2008) [6] and Naguri Ashiya (2013) [8] in mango, Nimbalkar *et al*. (2012) [9] in karonda and Prajapati *et al.* (2014) [12] in jackfruit.

Table 4: Effect of GA3, NAA and biofertilizers on number of leaves per seedling of custard apple cv. Local

Sr. No.	Treatments	Number of leaves per seedling		
		60 DAS	90 DAS	120 DAS
T1	Control	4.00	7.20	9.73
T2	GA3 @ 50 mg/l	6.40	10.60	15.06
T3	GA3 @ 75 mg/l	6.13	10.33	14.33
T4	GA3 @ 100 mg/l	6.83	11.40	15.33
T5	NAA @ 50 mg/l	5.86	10.43	14.00
T6	NAA @ 75 mg/l	5.83	10.33	13.66
T7	NAA @ 100 mg/l	6.06	10.36	13.33
T8	*Azatobactor* (5 ml/l of water)	5.00	9.50	13.40
T9	*Azospirillum* (5 ml/l of water)	5.10	9.40	13.20
T10	Bio NPK consortia (5 ml/l of water)	5.36	10.26	14.06
	S.Em±	0.15	0.28	0.28
	C.D. at 5%	0.44	0.84	0.82
	CV%	4.64	4.96	3.57

The maximum leaf area at 60, 90 and 120 DAS (35.14, 48.00 and 59.67cm2, respectively) was recorded when the seeds of custard apple were treated with GA3 @ 100 mg/l it might be due to GA3 increase in leaf length and width, which ultimately increased in leaf area due to greater cell division and elongation. Similar results were also reported by Meena and Jian (2005) [7] in papaya and Prajapati *et al.* (2014) [12] in jackfruit.

Table 5: Effect of GA3, NAA and biofertilizers on leaf area of custard apple cv. Local

Sr. No.	Treatments		Leaf area (cm2)	
		60 DAS	90 DAS	120 DAS
T1	Control	16.95	19.91	22.68
T2	GA3 @ 50 mg/l	28.17	32.12	35.05
T3	GA3 @ 75 mg/l	28.04	37.22	45.80
T4	GA3 @ 100 mg/l	35.14	48.00	59.67
T5	NAA @ 50 mg/l	31.95	37.04	45.71
T6	NAA @ 75 mg/l	31.19	40.40	55.33
T7	NAA @ 100 mg/l	32.53	39.16	55.34
T8	*Azatobactor* (5 ml/l of water)	28.70	37.50	43.12
T9	*Azospirillum* (5 ml/l of water)	26.84	36.75	46.13
T10	Bio NPK consortia (5 ml/l of water)	27.94	40.25	53.27
	S.Em±	0.76	0.86	1.12
	C.D. at 5%	2.25	2.53	3.30
	CV%	4.60	4.04	4.19

The maximum chlorophyll content at 60, 90 and 120 DAS (32.93, 35.06 and 40.00, respectively) was recorded when the seeds of custard apple were treated with GA3 @ 100 mg/l it might be due toincreased chlorophyll content of leaves of GA3 treated plants may be indication of increased rate of photosynthesis (Kanjilal and Singh, 1998) [5] and decreased chlorophyll degradation and increased chlorophyll synthesis and the increase in total chlorophyll content can also be attributed to involvement of growth regulators in promoting the synthesis of chlorophyll as well as development of chloroplast (Fetcher and Mc Cullagh, 1971) [2]. These results were in accordance with (Kanjilaland Singh, 1998) [5] who explained that application gibberlic acid increased chlorophyll content in chamomile. Similar results were also reported by Hota *et al.* (2018) [4] in Jamun.

Table 6: Effect of GA3, NAA and biofertilizers on chlorophyll content of custard apple cv. Local

Sr. No.	Treatments	Chlorophyll content (SPAD value)		
		60 DAS	90 DAS	120 DAS
T1	Control	28.63	30.00	34.93
T2	GA3 @ 50 mg/l	30.90	32.76	37.63
T3	GA3 @ 75 mg/l	31.00	32.60	37.46
T4	GA3 @ 100 mg/l	32.93	35.06	40.00
T5	NAA @ 50 mg/l	30.20	31.86	37.06
T6	NAA @ 75 mg/l	30.46	31.66	36.90
T7	NAA @ 100 mg/l	30.16	32.03	36.33
T8	*Azatobactor* (5 ml/l of water)	28.90	30.83	37.10
T9	*Azospirillum* (5 ml/l of water)	29.60	30.56	35.23
T10	Bio NPK consortia (5 ml/l of water)	30.73	31.23	36.06
	S.Em±	0.70	0.83	0.88
	C.D. at 5%	2.08	2.46	2.60
	CV%	4.03	4.54	4.15

The maximum fresh weight of seedling at 60, 90 and 120 DAS (1.67, 4.54 and 7.52g, respectively) was recorded when the seeds were dipped in GA3 @ 100 mg/l it might be due to overall growth of the seedling and increased rate of photosynthesis that lead to the overall assimilation and redistribution of photosynthates within the seedling and hence, resulted in higher fresh weight. Thus, increased growth is a consequence of increased dry matter accumulation. Similar results were also obtained by Palepad *et al*. (2017) [11] in custard apple, Meena and Jian (2005) [7] in papaya, Naguri Ashiya (2013) [8] in mango and Prajapati *et al.* (2014) [12] in jackfruit.

Table 7: Effect of GA3, NAA and biofertilizers on fresh weight of custard apple seedling cv. Local

Sr. No.	Treatments	Fresh weight of seedling (g)		
		60 DAS	90 DAS	120 DAS
T1	Control	1.05	2.04	4.22
T2	GA3 @ 50 mg/l	1.60	4.38	7.32
T3	GA3 @ 75 mg/l	1.59	4.37	7.34
T4	GA3 @ 100 mg/l	1.67	4.54	7.52
T5	NAA @ 50 mg/l	1.39	3.73	6.67
T6	NAA @ 75 mg/l	1.40	3.90	6.80
T7	NAA @ 100 mg/l	1.42	3.91	6.84
T8	*Azatobactor* (5 ml/l of water)	1.21	3.01	5.84
T9	*Azospirillum* (5 ml/l of water)	1.20	2.90	5.99
T10	Bio NPK consortia (5 ml/l of water)	1.23	3.05	6.58
	S.Em±	0.02	0.08	0.11
	C.D. at 5%	0.08	0.25	0.33
	CV%	3.60	4.09	3.05

The maximum dry weight of seedling at 60, 90 and 120 DAS (0.65, 2.23 and 3.83g, respectively) was recorded when the seeds were dipped in GA3 @ 100 mg/l it might be due to overall growth of the seedling and increased rate of photosynthesis that lead to the overall assimilation and redistribution of photosynthates within the seedling and hence, resulted in higher dry weight. Thus, increased growth is a consequence of increased dry matter accumulation. Similar results were also obtained by Palepad *et al*. (2017) [11] in custard apple, Palanisamy and Ramamoorthy (1987) [10], Meena and Jian (2005) [7] in papaya, Naguri Ashiya (2013) [8] in mango and Prajapati *et al.* (2014) [12] in jackfruit.

Table 8: Effect of GA3, NAA and biofertilizers on dry weight of custard apple seedling cv. Local

Sr. No.	Treatments	Dry weight of seedling (g)		
		60 DAS	90 DAS	120 DAS
T1	Control	0.31	1.01	2.06
T2	GA3 @ 50 mg/l	0.62	2.18	3.69
T3	GA3 @ 75 mg/l	0.61	2.17	3.70
T4	GA3 @ 100 mg/l	0.65	2.23	3.83
T5	NAA @ 50 mg/l	0.44	1.88	3.42
T6	NAA @ 75 mg/l	0.45	1.90	3.45
T7	NAA @ 100 mg/l	0.48	1.89	3.47
T8	*Azatobactor* (5 ml/l of water)	0.38	1.54	2.89
T9	*Azospirillum* (5 ml/l of water)	0.37	1.49	2.98
T10	Bio NPK consortia (5 ml/l of water)	0.41	1.53	3.32
	S.Em±	0.01	0.03	0.05
	C.D. at 5%	0.03	0.09	0.16
	CV%	4.47	3.11	2.95

Conclusion

The result obtained from research experiment, it can be concluded that GA3 @ 100 mg/las a seed soaking treatment to custard apple seeds for 24 hrs. was recorded maximum maximum height of seedling, diameter of seedling, number of leaves per seedling, leaf area, chlorophyll content, seedling length, fresh weight of seedling and dry weight of seedling.

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