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RESEARCH ARTICLE

EFFECT OF GIBBERELLIC ACID (GA3) AND PLANT GROWTH PROMOTING BACTERIA (AZOTOBACTER AND AZOSPIRILLUM) ON PAPAYA (CARICA PAPAYA L. CV. RED LADY) UNDER DIFFERENT GROWING CONDITIONS

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ABSTRACT

The present investigation entitled "Effect of seed treatments using Gibberellic Acid (GA_3) and plant growth promoting bacteria under different growing conditions on germination and growth of papaya cultivar Red lady" was carried out using ten treatmentviz T1: control, T2: GA_3 @100 ppm, T3: GA_3 @ 150 ppm, T4: GA_3 @ 200 ppm , T5: GA_3 @100 ppm + Azotobacter, T6: GA_3 @ 150 ppm + Azotobacter, T7: GA_3 @ 200 ppm+Azotobacter , T8:GA_3 @100 ppm + Azospirillium, T9: GA_3 @ 150 ppm + Azospirillium , T10: GA_3 @ 200 ppm + Azospirillium under three growing conditions i.e. G1: Poly-house, G2: Net-house and G3: open field. The result revealed significant ($P \leq 0.01$) difference between treatments in all three selected growing conditions. Among all treatments,(T10: GA3 @ 200 ppm + Azospirillium) was found to be most superior for the germination and growth of papaya cultivar Red lady and poly – house condition favoured best palnt growth and germination followed by net house and open field. Therefore, the use of poly-house along with the pre-treated seed with the combination GA_3 @ 200 ppm + Azospirillium is beneficial for increasing germination and growth of papaya cv. Red lady.

INTRODUCTION

Papaya, (*Carica papaya* L.) belongs to Caricaceae family is short-lived, fast growing, succulent and delicious tropical and subtropical fruit (1),(2).It is the third most cultivated tropical crop worldwide (3). In India Papaya is mostly cultivated in the states of Andhra Pradesh, Gujarat, Karnataka, Orissa, West Bengal, Assam, Kerala, Madhya Pradesh and Maharashtra (4). It is rich source nutrients such as carbohydrates, Vitamin (carotene, thiamine, riboflavin, niacin, vitamin B6 and vitamin K) and ascorbic acid (5). It contains minerals, Phytochemicals-flavonoid, alkaloid, saponin and tannin (6), (7). Itsseed, fruit, leaf, bark, and latex, play a major role in the management of disease progression in human (8), (9),(10), (11). Papaya is traditionally propagated by means of seeds. Seedling vigor is affected by many factors like seed quality and seed treatments, type of substrate used, environmental factors etc. (12). The presence of gelatinous sarcotesta in papaya is also act as germinator inhibitor. Due to these factors papaya growers are facing slow, erratic and incomplete germination of papaya and sometime high initial seedling mortality. This motivated the researchers to study the effect of hormone, media, bacteria, etc. for increasing seed germination percentage and healthy seedlings (13),(14). The pre sowing treatment of papaya seeds resulted in significant impact on breaking dormancy, enhancing seed germination and growth development of seedling (15), (16).

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Therefore present study was done to investigate the effect of plant growth regulators as gibberellic acid (GA_3) and plant growth promoting bacteria as, *Azotobacter* sp. and *Azospirillum* sp. on seed germination and growth parameters of papaya cv. Red lady under different growing conditions.

MATERIALS AND METHODS

Current investigation was conducted at, Guru Kashi University, Talwandi Sabo, Bathinda, Punjab, India, during 2021-2022 with different dosage of Gibberellic acid (GA_3) and recommended dose of bio-fertilizer (*Azotobacter* and *Azospirillum*) using different growing conditions to observe the effect on germination and growth parameters of papaya cv. red lady. Seeds were soaked in the different concentration of GA_3 solution for 12 hours, washed and placed in petri plates with moist filter paper under laboratory condition. Total ten treatment along with control i.e. T1: control, T2: GA_3@100 ppm, T3: GA_3 @ 150 ppm, T4: GA_3 @ 200 ppm, T5: GA_3 @100 ppm + Azotobacter, T6: GA_3 @ 150 ppm + Azotobacter, T7: GA_3 @ 200 ppm + Azotobacter , T8: GA_3 @100 ppm + Azospirillium, T9: GA_3 @ 150 ppm + Azospirillium , T10: GA_3 @ 200 ppm + Azospirillium were finalized to perform under three growing conditions i.e. G1: Poly-house, G2: Net-house and G3: open field . These pre-treated seeds were grown in trays and further transplanted in separate poly-bags under different growing conditions. Split plot design (SPD) was used for the trail with three replications. The following parameters were observed Days to first emergences of seedling, Number of seeds germinated on the day of first seedling emergence, Days to 50 % germination, Number of seeds germinated on the date of 50% seed germination,

Germination percentage (%) at 30 days after sowing (DAS), Survival percentage (%), Plant height (cm) at 20 DAS and 45 DAS and Stem girth (cm) was recorded.ANOVA analysis was done using OPSTAT.

RESULTS AND DISCUSSION

Days to first emergences of seedling: The minimum days taken for first emergences of seedling was recorded in T10: GA_3 @ 200 ppm + Azospirillium at all selected growing (poly-house, net house and open field) conditions (2.33, 3.00 and 3.67 days), followed by T4: GA_3 @ 200 ppm (3.33, 4.00, 4.00 days). Whereas T1: control was taking 7.0 days at every growing condition for first emergences of seedling. The significant (P≤0.05) difference was recorded between treatments in all three selected growing conditions (Table I). The result also revealed that under G1: poly-house condition the minimum number of days were taken for first emergences in all selected treatments including control followed by G2: net house and G3: open field (TableI). Similar type of experiment conducted by Singh *et al*.(18) reported enhancement in germination percentage (83.3) within minimum days that is 15 days with pre-soaking of papaya cv. PusaNanha seeds for 24 hour prior to sowing, in 500 ppm GA_3.

Germination percentage (%) at 30 days after sowing (DAS): The maximum germination per cent at 30 days after sowing was recorded in T10: GA_3 @ 200 ppm + Azospirillium under all selected growing (poly-house, net house and open field) conditions (83.33, 81.00, 77.33 %), followed by T9: GA_3 @ 150 ppm + Azospirillium (80.0, 75.0, 72.0. Whereas minimum germination percentage at 30 days after sowing was recorded in T1: control (52.33, 50.67 and 50.67%). The significant (P≤0.05) difference was recorded between treatments in all three selected growing conditions (Table II).

The result also revealed that under G1: poly-house condition the maximum germination per cent at 30 days after sowing in all selected treatments including control followed by G2: net house and G3: open field (Table II). In similar type of study conducted by Babu *et al*. (19) reported the significant improvement in the germination of papaya seeds (66.17%) over the control (42.40%) by increasing the GA_3 concentration from 0 to 100 ppm. In 2013 Carrillo-Castañeda*et al*. (20) reported papaya seeds soaked in gibberellic acid solution followed by inoculation with a mixture of Azospirillumbrasilense cell suspension exhibited high seed germination (69 %) and plant emergence (47 %) than the control. Zhao Chun Xiang *et al*. (21) reported the 83.7% seed germination using 50 mg GA_3/litre.

Table 1. Days to first emergences of papaya cv. Red lady seedling treated with different treatments

Growing Conditions (G)	Treatments (T)										Mean (G)
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	
G1	7.00	6.00	6.00	3.33	6.33	5.00	4.00	6.00	4.00	2.33	5.00
G2	7.00	6.00	6.33	4.00	6.67	5.67	4.67	6.33	5.00	3.00	5.47
G3	7.00	6.00	7.00	4.00	7.00	6.00	5.33	6.67	5.33	3.67	5.80
Mean(T)	7.00	6.00	6.44	3.78	6.67	5.56	4.67	6.33	4.78	3.00	
CD (Treatments)										0.42	
CD (Growing conditions)										0.17	
CD (GXT)										0.56*	

*=P≤0.05

Table II. Germination percentage(%) at 30 days after sowing (DAS) in papaya cv. red lady treated with different treatments

Growing Condition (G)	Treatments (T)										Mean (G)
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	
G1	52.33	64.67	73.33	77.67	55.33	66.00	70.00	76.67	80.00	83.33	69.93
G2	50.67	63.00	70.33	75.33	54.33	64.00	67.00	73.00	75.00	81.00	67.37
G3	50.67	61.33	69.67	72.33	53.33	61.00	65.00	70.67	72.00	77.33	65.33
Mean (T)	51.22	63.00	71.11	75.11	54.33	63.67	67.33	73.44	75.67	80.56	
CD (Treatments)										1.30	
CD (Growing conditions)										0.68	
CD (G X T)										2.18*	

*=P≤0.05

Table III: Survival percentage (%) of papaya cv. Red lady treated with different treatments

Growing Conditions (G)	Treatments (T)										Mean(G)
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	
G1	43.00	64.33	68.00	72.33	55.33	57.33	64.33	70.67	71.67	76.00	64.30
G2	42.33	63.00	64.00	71.33	53.33	55.33	61.33	69.00	69.00	73.67	62.23
G3	40.67	60.33	61.67	70.00	49.00	50.33	59.67	64.33	65.00	72.00	59.30
Mean(T)	42.00	62.56	64.56	71.22	52.56	54.33	61.78	68.00	68.56	73.89	
CD (Treatments)										1.35	
CD (Growing conditions)										0.65	
CD (G X T)										2.09*	

*=P≤0.05

Table IV. Plant height (cm) at 20 DAS of papaya cv. Red lady treated with different treatments

Growing Conditions (G)	Treatments (T)										Mean (G)
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	
G1	4.63	6.00	6.13	6.70	5.23	5.90	6.00	6.23	6.57	7.03	6.04
G2	4.33	5.47	5.87	6.20	5.17	5.60	5.83	6.13	6.30	6.90	5.78
G3	4.20	5.83	5.80	5.50	5.07	5.57	5.73	5.91	6.10	6.67	5.64
Mean(T)	4.39	5.77	5.93	6.13	5.16	5.69	5.86	6.09	6.32	6.87	
CD (Treatments)										0.21	
CD (Growing conditions)										0.09	
CD (G X T)										0.29*	

*=P≤0.05

Table V. Plant height (cm) at 45 DAS of papaya cv. Red lady treated with different treatments

Growing Conditions (G)		Treatments (T)										Mean(G)
		T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	
	G1	16.10	22.77	24.3	26.87	21.23	22.23	23.43	23.93	24.63	27.73	23.33
	G2	15.50	21.77	22.83	26.47	18.50	18.60	22.23	23.00	24.27	26.87	22.03
	G3	14.53	20.77	21.37	24.27	17.17	17.93	21.37	21.63	24.33	26.60	20.97
Mean(T)		15.38	21.77	22.83	25.87	18.97	19.59	22.34	22.86	24.41	27.07	
CD (Treatments)											0.60	
CD (Growing conditions)											0.29	
CD (G X T)											0.94*	

*=P≤0.05

Table VI. Stem girth (cm) at 45 DAS of papaya cv. Red lady treated with different treatments

Growing Conditions (G)		Treatments (T)										Mean(G)
		T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	
	G1	4.10	5.93	5.13	5.57	4.27	5.03	5.23	4.60	6.30	6.73	5.29
	G2	4.03	5.70	5.07	5.50	4.07	5.00	5.13	4.47	6.27	6.53	5.18
	G3	4.10	5.67	5.03	5.43	4.03	4.90	5.03	4.33	6.17	6.23	5.09
Mean(T)		4.08	5.77	5.08	5.50	4.12	4.98	5.13	4.47	6.24	6.50	
CD (Treatments)											0.07	
CD (Growing conditions)											0.04	
CD (G X T)											0.12*	

*=P≤0.05

In year 2017 Parab *et al*. (22) reported significant effect and less number of days taken for plumule appearance (15.00) and completion of germination (35.00) in pre-soaking of seeds with GA_3 at 100 ppm.

Survival percentage (%): The maximum survival percentage (%) was recorded in T10: GA_3 @ 200 ppm + Azospirillium under all selected growing (poly-house, net house and open field) conditions (76.00, 73.67, 72.00 %), followed by T9: GA_3 @ 150 ppm + Azospirillium (71.67, 69.0, 65.00 %) respectively. Whereas in T1: control minimum survival percentage (43.00, 42.00 and 40. 67) was recorded. The significant (P≤0.05) difference was recorded between treatments in all three selected growing conditions (Table III). The result also revealed that under G1: poly-house condition the maximum survival percentage was recorded followed by G2: net house and G3: open field (TableIII).Choudhary*et al*. (23) reported the increase in survival percentage (86.42 percent) of papaya pre treated seed with 200 ppm $GA_3$when compared to control (77.33 percent).

Plant height (cm) at 20 DAS: The maximum plant height (cm) at 20 DAS was recorded in T10: GA_3 @ 200 ppm + Azospirillium under all selected growing (poly-house, net house and open field) conditions (7.03, 6.90, 6.67 cm), followed by T9: GA_3 @ 150 ppm + Azospirillium (6.57, 6.30, 6.10 cm) respectively. Whereas in T1: control minimum(4.63, 4.33 ,4.20 cm) plant height at 20 DAS was recorded (Table IV). The result also revealed that under G1: poly-house condition the maximum plant height (cm) at 20 DAS in all selected treatments including control followed by G2: net house and G3: open field (TableIV).

Plant height (cm) at 45 DAS: The maximum plant height (cm) at 45 DAS was recorded in T10: GA3 @ 200 ppm + Azospirillium under all selected growing (poly-house, net house and open field) conditions (27.73,26.87, 26.60 cm), followed by T4: GA3 @ 200 ppm (26.87, 26.47, 24.27 cm) respectively. Whereas in T1: control minimum plant height at 45 DAS (16.10, 15.50, 14.53 cm) was recorded (Table V). The result also revealed that under G1: poly-house condition the maximum plant height (cm) at 45 DAS in all selected treatments including control followed by G2: net house and G3: open field (TableV). In similar kind of study using GA_3Anjanawe*et al*. (24) reported increased in plant height (17.41 cm).

Stem girth(cm) at 45 DAS: The maximum stem girth at 45 DAS was recorded in T10: GA3 @ 200 ppm + Azospirillium under all selected growing (poly-house, net house and open field) conditions (6.73, 6.53, 6.23 cm), followed by T9: GA3 @ 150 ppm + Azospirillium (6.3, 6.27, 6.17 cm) respectively. Whereas in T1: control minimum stem girth was recorded at 45 DAS(4.1, 4.03, 4.1 cm). The significant (P≤0.05) difference was recorded between treatments in all three selected growing conditions (Table VI). The result also revealed that under G1: poly-house condition the maximum stem girth after 45 DAS recorded followed by G2: net house and G3: open field (Table VI). Similarly Anjanawe*et al*. (24) reported the maximum stem diameter(0.441cm) with 200ppm GA_3 treatment.

CONCLUSION

The present investigation showing positive significant effect of Gibberellic acid (GA3) and plant growth promoting bacteria (*Azotobacter* and *Azospirillum*) on Papaya (*Carica papaya L.*cv. Red lady)under poly-house condition followed by net house and open field.Therefore, the use of poly-house along with the pre-treated seed with the combination GA_3 @ 200 ppm + Azospirillium is beneficial for increasing germination and growth of papaya cv. Red lady.

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REFERENCES

1. Niklas K J, Marler T E. 2007. *Carica papaya* (Caricaceae): a case study into the effects of

domestication on plant vegetative growth and reproduction. *American Journal of Botany*, 94: 999-1002.
2. Santos C M, de Abreu C M P, Freire J M, Queiroz E D,Mendonca M M. 2014. Chemical characterization of the flour of peel and seed from two papaya cultivars. *Food Science and Technology, Campinas*, 34(2): 353-357.
3. Chávez-Pesqueira M,Núñez-Farfán J. 2017. Domestication and Genetics of Papaya: A Review. *Frontiers in Ecology and Evolution*, 5:155.
4. Das A C,Saha D. 2007. Effect of diazotrophs on the mineralization of organic nitrogen in the rhizosphere soils of rice (*Oryzasativa*). *Journal of Crop and Weed*, 3:69-74.
5. Nwofia GE, Ojimelukwe P,Eji C. 2012. Chemical composition of leaves, fruit pulp and seeds in some Carica papaya (L) morphotypes. *International Journal of Medicinal and Aromatic Plants*, 2 (1): 200-206.
6. Vyas SJ, Khatri TT, Ram VR, Dave PN, Joshi HS. 2014. Biochemical constituents in leaf of Carica papaya – ethnomedicinal plant of Kachchh region. *International Letters of Natural Sciences*, 12: 16-20.
7. Nwamarah JU, Adesanmi RA,Asogwa TJ. 2019. Nutrient Composition of CaricaPapaya Leaves Extracts. *Journal of Food Science and Nutrition Research*, 2 (3): 274-282.
8. Ayoola PB,Adeyeye A. 2010. Phytochemical and nutrient evaluation of Carica papaya (pawpaw) leaves. *InternationalJournal of Recent Research and Applied Studies*, 5 (3): 325-328.
9. Aravind G, Debjit B, Duraivel S, Harish G. 2013.Traditional and Medicinal Uses of Carica papaya. *Journal of Medicinal Plants Studies*, 1 (1): 7-15.
10. Gadhwal AK, Ankit BS, Chahar C, Tantia P, Sirohi P,Agrawal RPJ 2016. Effect of Carica papaya Leaf Extract Capsule on Platelet Count in Patients of Dengue Fever with Thrombocytopenia. *Assoc Physicians India*, 64(6):22-26.
11. Singh SP, Kumar S, Mathan SV, Tomar MS, Singh RK, Verma PK, Kumar A, Kumar S, Singh RP,Acharya AD. 2020 Therapeutic application of Carica papaya leaf extract in the management of human diseases. *DARU Journal of Pharmaceutical Sciences*, 28(2):735-744
12. Choudhary J, Wilson D. 2020. To Study the Effect of Different Growing Media on Papaya (Carica papaya) Seedling on Germination Percentage under Protected Condition cv. PusaNanha .*International Journal of Current Microbiology and Applied Sciences*, 9(12): 1035-1041.
13. Hafez M, Elbarbary T A, Ibrahim I, Abdel-Fatah Y. 2016. *Azotobactervinelandii* evaluation and optimization of Abu Tartur Egyptian phosphate ore dissolution. *Saudi Journal of Pathology and Microbiology*, 1: 80-93.
14. Desai A, Panchal B, Trivedi A,Prajapati D. 2017. Studies on seed germination and seedling growth of papaya (*Carica papaya* L.) CV. madhubindu as influenced by media, GA3 and cow urine under net house condition. *Journal of Pharmacognosy and Phytochemistry*, 6(4): 1448-1451.
16. Deb P, Das A, Gosh S.K, Suresh CP. 2010. Improvement of seed germination and seedling growth of papaya (Carica papaya L.) through different pre-sowing seed treatments. *AtcaHorticulturae*, 851:313-316.
17. Choudhary RC, Kanwar J, Chouhan GS, Sing P,Tanwar DR. 2018. Effect of GA_3 and growing media on seedling growth of papaya (Carica papaya L.) cv. PusaNanha. *International Journal of Chemical Studies*, 6(6): 1008-1012.
18. Singh M, Das AK,Palei S,Mahali B. 2017. Studies on the effect of different concentration of GA3 and KNO3 on germination of papaya seeds cv. PusaNanha. *Trends in Biosciences*,10 (38): 7979-7982.
19. Babu KD, Patel RK, Singh A, Yadav DS, Singh A, Yadav DS, De LC,Deka BC. (2010) Seed germination, seedling growth and vigour of papaya under North East Indian condition. *Acta Horticulture*, 851: 299-306.
20. Carrillo-Castañeda GM, Bautista-Calles F, Villegas-Monter A. 2013. Postharvest seed treatments to improve the papaya seed germination and seedlings development. *Tropical and Subtropical Agroecosystems*, 16: 133- 141.
21. Zhao ChunXiang, Huang XiuQing, Chen YingYi, Yong Y. 2004. Effects of plant growth regulators on the vitality of papaya seed germination and the growth vigour of seedlings. *South China Fruits*, 33: 36-37.
22. Parab A M, Mathad JC,Malshe KV. 2017. Effect of pre-soaking chemicals on germination and subsequent seedling growth of papaya (*Carica papaya* L.) cv. Solo. *International Journal of Chemical Studies*, 5(4): 1812-1816.
23. Choudhary RC, Kanwar J, Singh P. 2022. Effect of Gibberellic acid (GA3) and growing media on seedling growth parameters of papaya (Carica papaya L.) cv. PusaNanha. *The Pharma Innovation Journal*, 11(1): 247-251
24. Anjanawe SR, Kanpure RN, Kachouli BK,Mandloi DS. 2013. Effect of plant growth regulators and growth media on seed germination and growth vigour of papaya. *Annals of Plant and Soil Research*, 15(1): 31-34.

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