The Pharma Innovation Journal 2023; 12(7): 2681-2685

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(7): 2681-2685

www.thepharmajournal.com
Received: 08-05-2023
Accepted: 12-06-2023

Bhadarka Chandni R
Department of Fruit Science, College of Horticulture, Junagadh Agricultural University, Junagadh, Gujarat, India

Kanzaria DR
Department of Fruit Science, College of Horticulture, Junagadh Agricultural University, Junagadh, Gujarat, India

Prerna Prachi
Department of Fruit Science, College of Horticulture, Junagadh Agricultural University, Junagadh, Gujarat, India

Karmur NN
Department of Fruit Science, College of Horticulture, Junagadh Agricultural University, Junagadh, Gujarat, India

Shivani R Patel
Department of Fruit Science, College of Horticulture, Junagadh Agricultural University, Junagadh, Gujarat, India

Corresponding Author:
Bhadarka Chandni R
Department of Fruit Science, College of Horticulture, Junagadh Agricultural University, Junagadh, Gujarat, India

Influence of growth retardants on growth and flowering of papaya (*Carica papaya* L.) CV. GJP 1

Bhadarka Chandni R, Kanzaria DR, Prerna Prachi, Karmur NN and Shivani R Patel

Abstract
The investigation titled "Effect of growth retardants on dwarfism and flowering of papaya (*Carica papaya* L.) cv. GJP 1" was conducted at the Fruit Research Station, Lalbaug, Junagadh Agricultural University, Junagadh during the year 2022-23. The experiment followed a Randomized Block Design with three replications and included 10 treatments: T_1 (Control), T_2 (Ethrel 150 ppm), T_3 (Ethrel 250 ppm), T_4 (Ethrel 350 ppm), T_5 (Cycocel 750 ppm), T_6 (Cycocel 1500 ppm), T_7 (Cycocel 3000 ppm), T_8 (Paclobutrazol 250 ppm), T_9 (Paclobutrazol 500 ppm), and T_{10} (Paclobutrazol 1000 ppm). The results of the study showed that the treatment with Cycocel 3000 ppm resulted in the smallest plant height (142.44 cm), shortest average internodal length (2.87 cm), lowest bearing height (63.97 cm), height of the plant at the time of bearing (105.90 cm), leaf stalk length (46.51 cm), and shortest time to first flowering (61.83 days) and first fruit set (66.61 days). Additionally, this treatment exhibited a male-to-female ratio (plant) of 0.89 and the highest number of leaves (33.74).

Keywords: Growth retardants, growth, flowering, papaya *Carica papaya* L.

1. Introduction
Papaya (*Carica papaya* L.) is a highly prized and delectable fruit crop cultivated in tropical and subtropical regions across the globe, mainly between latitudes 32º N and S. Among the 48 species in the Caricaceae family, *Carica papaya* is the only one that is edible (Chadha, 1992). Originally from Mexico and tropical America, it was introduced to India from Malacca during the 1^{6th} century. Today, papaya is widely grown worldwide, with India being a leading producer of this fruit.

In India, papaya cultivation thrives in the southern peninsular regions, particularly in Tamil Nadu, Karnataka, Kerala, and Andhra Pradesh. The country has approximately 146,000 hectares of land dedicated to papaya cultivation, resulting in an annual production of 5,540,000 metric tons, with an average productivity of 37.94 metric tons per hectare (Anon., 2020). Among the Indian states, Andhra Pradesh holds the top position as the largest papaya producer, followed by Gujarat. In Gujarat, papaya is cultivated over an estimated area of 18,189 hectares, yielding a production of 1,107,880 metric tons, and boasting a productivity of 60.90 metric tons per hectare (Anon., 2020) [3].

Papaya plants are herbaceous and evergreen, characterized by a single straight trunk and trifoliate leaves with long petioles. They typically reach a height of 2.2 to 2.4 meters and can tolerate low temperatures at elevations up to 1500-2000 meters above sea level. Papaya exhibits three sex forms: monoecious, dioecious, and hermaphrodite (Arrilia *et al.*, 1980) [4]. Female plants produce shorter fruits compared to hermaphrodite plants. One remarkable aspect of papaya growth is that after flowering, both leaf and floral initiation and differentiation occur simultaneously, leading to continuous fruit production throughout the year. Due to its nutritional value and affordability, papaya is often referred to as the "poor man's fruit."

Papaya contains approximately 89.6% moisture, 0.5% protein, 0.1% fat, 9.5% carbohydrates, and trace amounts of calcium, phosphorus, and iron. It is also a rich source of various natural compounds such as alkaloids, pectins, volatile compounds, proteolytic enzymes, growth inhibitors, and the enzyme papain (Ram, 2005) [25]. The presence of papain is particularly noteworthy.

To regulate plant height and growth, growth retardants, which are organic chemicals, are utilized. These compounds slow down cell division and expansion in tissues without causing any formative effects. Among them, paclobutrazol has gained popularity in tree fruit crops.

Growth retardants often work by inhibiting the formation of growth-active gibberellins (GAs), which helps reduce unwanted shoot elongation (Singh, 2004; Mansuroglu *et al.*, 2009) [27, 19]. Besides controlling growth, these chemicals can also be employed in ornamental crops to enhance foliage color, strengthen flower stems, stimulate flowering, and improve resistance against environmental stresses (Kahar, 2008) [14].

2. Materials and Methods

The study titled "Effect of growth retardants on dwarfism and flowering of papaya (*Carica papaya* L.) cv. GJP 1" was conducted at the Fruit Research Station, Lalbaug, Junagadh Agricultural University, Junagadh, from January 2022 to December 2022. The experimental design employed was a Randomized Block Design (RBD) with 10 treatments, comprising T_1 (Control), T_2 (Ethrel 150 ppm), T_3 (Ethrel 250 ppm), T_4 (Ethrel 350 ppm), T_5 (Cycocel 750 ppm), T6 (Cycocel 1500 ppm), T_7 (Cycocel 3000 ppm), T_8 (Paclobutrazol 250 ppm), T_9 (Paclobutrazol 500 ppm), and T_{10} (Paclobutrazol 1000 ppm). Each treatment was replicated three times.

The main objective of the experiment was to investigate the effects of growth retardants on various growth and flowering parameters of the papaya plant. The parameters studied included plant height, average internodal length, bearing height, height of the plant at the time of bearing, leaf stalk length, days to first flowering, days to first fruit set, male: female ratio (plant), number of leaves, length of male flower stalk, and length of female flower bud. The data collected from the experiment underwent statistical analysis using the method proposed by Panse and Sukhatme (1985) [31]. The significance of each character was assessed using the "F" test. Additionally, the Standard Error of Mean (S. Em. ±) and Critical Difference (CD) were calculated at a 5% level of significance to evaluate the variation and significance among the different treatments

3. Result and Discussion

The data presented in Tables 1 and 2 clearly indicate that the growth retardants had a significant impact on the growth and flowering parameters of the papaya plants studied in this experiment.

3.1 Plant growth parameters

The investigation of the data clearly demonstrated that the application of various growth retardant treatments had a significant impact on several plant growth parameters in papaya. Notably, the treatment with Cycocel 3000 ppm (T_7) resulted in the lowest values for plant height (142.44 cm), average internodal length (2.87 cm), bearing height (63.97 cm), height of the plant at the time of bearing (105.90 cm), and leaf stalk length (46.51 cm). Additionally, this treatment led to the highest number of leaves (33.74).

The observed effects can be attributed to the nature of cycocel, which acts as a growth retardant by inhibiting the cyclization of geranyl pyrophosphate to copyallyl pyrophosphate in the gibberellin biosynthesis pathway. This inhibition hinders cell division and elongation, thereby arresting vegetative growth in the plant. These findings align with previous studies conducted on various other fruit crops, such as acid lime, phalsa, apple, strawberry, grape, and sapota, where similar effects of growth retardants on plant growth have been reported (Obadiya *et al*., 2018; Chundawat and Gupta, 1974; Guha, 1993; Kumra *et al.*, 2018; Kaur *et al*., 2022; Agrawal and Dikshit, 2008; Varu *et al.*, 2020; Mishra and Varu 2022; Bhadarka *et al.*, 2022; Jotava *et al.*, 2022 Parmar *et al.*, 2023; Parsana *et al.*, 2023) [22, 8, 10, 1, 29, 24, 5, 13, 23, 24]

3.2 Flowering parameters

The data analysis revealed that the application of different growth retardants had a significant impact on flowering parameters, specifically days to first flowering, days to first fruit set, and male: female ratio (plant). However, there was no significant effect on the length of the male flower stalk and the length of the female flower bud.

Plants treated with growth retardants exhibited early flowering, and the shortest time to first flowering (61.83 days) was observed in papaya plants treated with cycocel 3000 ppm (T_7). This treatment was comparable to T_5 and T_6 treatments (64.86 and 66.83 days, respectively) in terms of early flowering. Similarly, early fruit set was noted in plants treated with growth retardants, and the minimum time to first fruit set (66.61 days) was recorded in plants treated with cycocel 3000 ppm (T_7). This treatment was comparable to T_5 and T_6 treatments (71.53 and 69.60 days, respectively) in terms of early fruit set.

The male: female ratio (plant) was significantly lower (0.89) in papaya plants treated with cycocel 3000 ppm (T_7). This result was in line with T_5 and T_6 treatments (1.08 and 1.03, respectively), which also exhibited a lower male: female ratio. The reduction in the male: female ratio may be attributed to the action of cycocel, although the specific mechanism is not fully understood.

It is proposed that cycocel promotes the formation and translocation of flowering stimuli or hormones from the leaf to the axils of the leaves, leading to early flowering and subsequent early fruit set. These findings align with similar studies conducted on other fruit crops like papaya, strawberry, citrus, guava, and wood apple, where the effects of growth retardants on flowering and fruiting were reported (Hazarika *et al.*, 2016; Kumar *et al*., 2012; Salomon, 1981; Brahamchari *et al.*, 1996; Subrata *et al.*, 2019; Meera *et al.*, Makwana *et al.*, 2023; Vasava *et al.*, 2023) [11, 16, 26, 6, 28, 18, 30]. Additionally, the reduced male: female ratio in cycocel-treated papaya plants is consistent with previous research on papaya by Ghose and Sen (1975) [9].

Table 1: Effect of growth retardants on growth parameters of papaya (*Carica papaya* L.) cv. GJP 1

Treat. code	Treatments	Plant height (cm)	Average internodal length (cm)	Bearing height (cm)	Height of the plant at the time of bearing (cm)	Leaf stalk length (cm)	Number of leaves
T_1	Control	190.89	3.89	81.07	126.93	60.93	27.93
T_2	Ethrel 150 ppm	173.39	3.53	74.87	122.03	58.78	28.56
T_3	Ethrel 250 ppm	172.86	3.50	73.13	117.77	55.40	29.43
T_4	Ethrel 350 ppm	166.33	3.33	71.73	116.80	54.95	29.47
T_5	Cycocel 750 ppm	150.89	3.09	66.07	110.67	48.38	31.96
T_6	Cycocel 1500 ppm	142.78	3.05	65.83	107.80	47.95	32.53
T_7	Cycocel 3000 ppm	142.44	2.87	63.97	105.90	46.51	33.74
T_8	Paclobutrazol 250 ppm	162.72	3.33	71.34	114.73	53.61	29.83
T_9	Paclobutrazol 500 ppm	162.22	3.29	67.87	114.19	50.67	29.61
T_{10}	Paclobutrazol 1000 ppm	155.00	3.17	66.57	111.07	49.75	30.52
S. Em.±		8.568	0.156	2.768	3.677	2.189	1.057
C. D. at 5%		25.46	0.46	8.22	10.92	6.50	3.14
C. V. %		9.16	8.16	6.82	5.55	7.2	6.03

Table 2: Effect of growth retardants on flowering parameters of papaya (*Carica papaya* L.) cv. GJP 1

Treat. code	Treatments	Days to first flowering	Days to first fruit set	Male: Female ratio (plant)	Length of male flower stalk (cm)	Length of female flower bud (cm)
T_1	Control	85.83	92.03	1.45	24.53	3.82
T_2	Ethrel 150 ppm	79.03	84.69	1.38	22.28	4.50
T_3	Ethrel 250 ppm	77.89	83.32	1.37	21.06	4.95
T_4	Ethrel 350 ppm	76.00	81.63	1.31	20.45	4.48
T_5	Cycocel 750 ppm	66.83	71.53	1.08	19.06	4.26
T_6	Cycocel 1500 ppm	64.86	69.60	1.03	18.99	4.33
T_7	Cycocel 3000 ppm	61.83	66.61	0.89	17.82	4.41
T_8	Paclobutrazol 250 ppm	73.26	78.32	1.30	19.68	4.05
T_9	Paclobutrazol 500 ppm	73.01	78.08	1.28	19.94	4.19
T_{10}	Paclobutrazol 1000 ppm	71.00	76.53	1.19	20.65	4.21
S. Em.±		2.403	2.363	0.070	1.212	0.202
C. D. at 5%		7.14	7.02	0.21	NS	NS
C. V. %		5.71	5.23	9.89	10.27	8.12

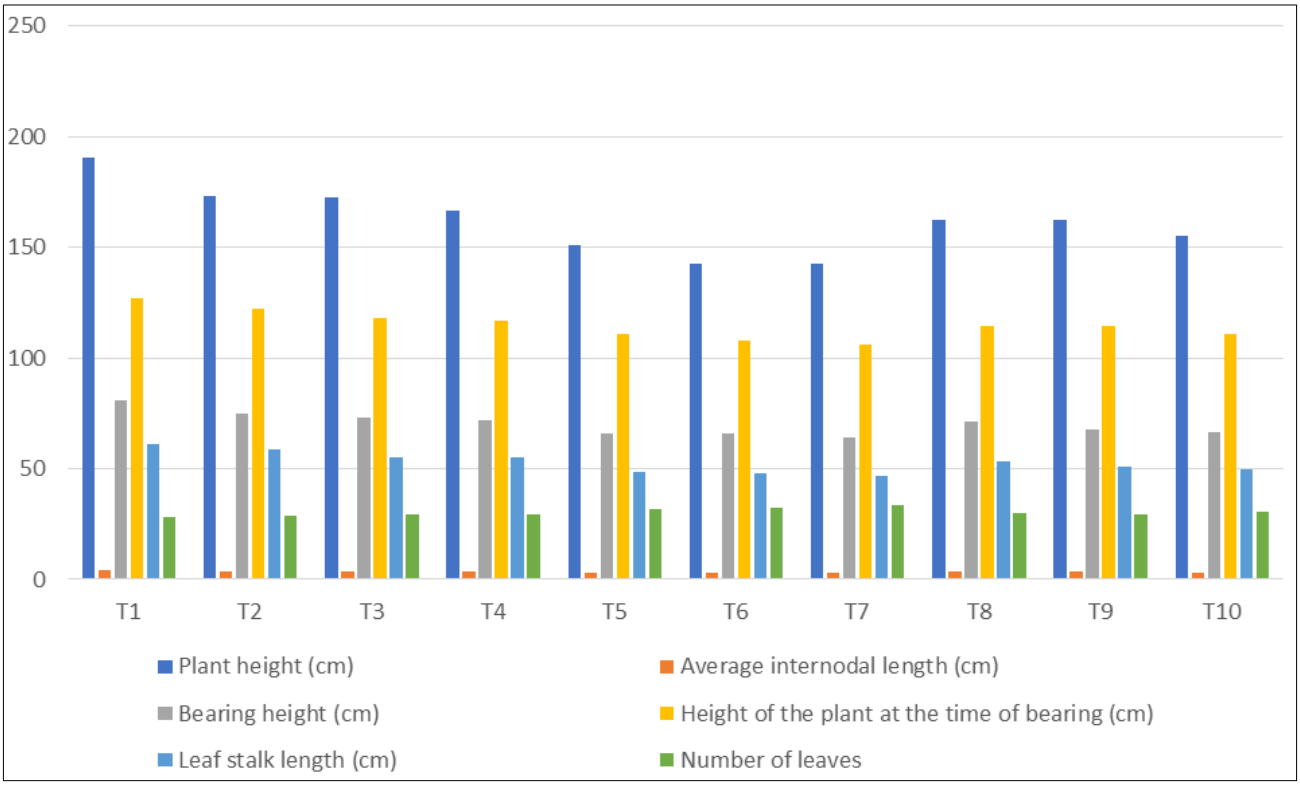

Fig 1: Effect of growth retardants on growth of papaya (*Carica papaya* L.) cv. GJP 1

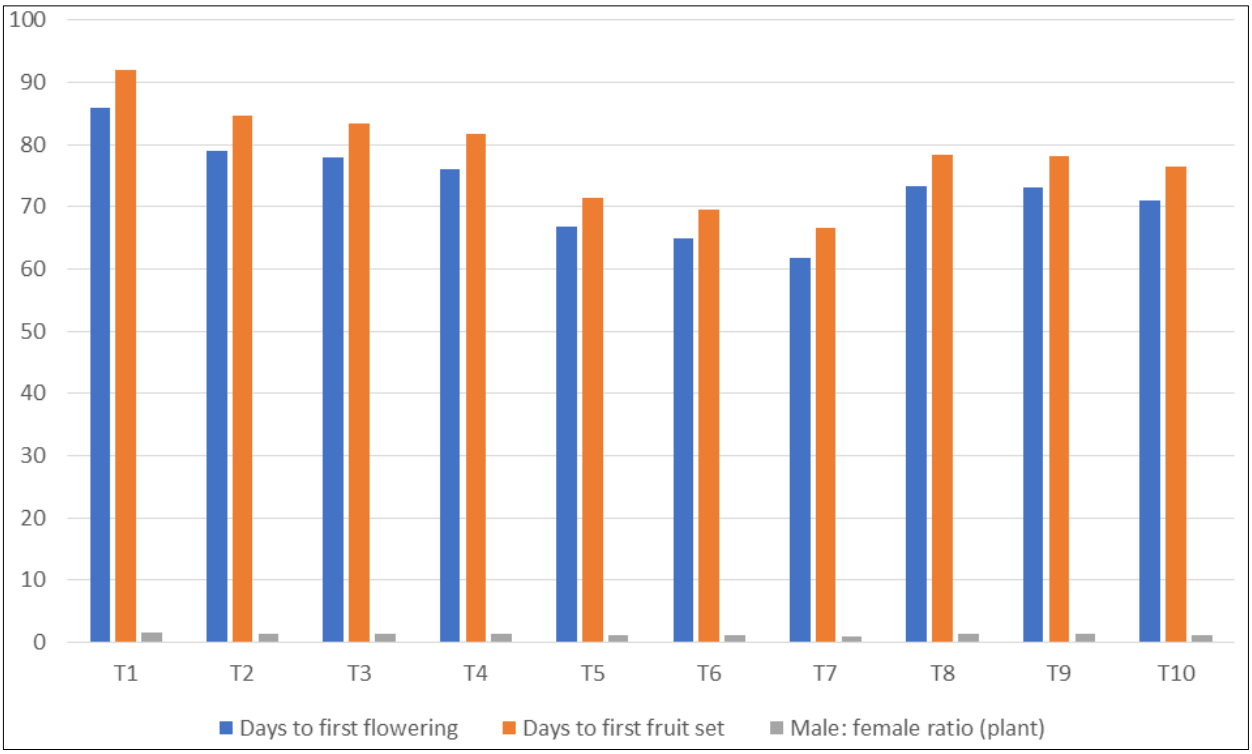

Fig 2: Effect of growth retardants on flowering of papaya (*Carica papaya* L.) cv. GJP 1

4. Conclusion

The findings from the investigation lead to the conclusion that applying a foliar spray of Cycocel (3000 ppm, *i.e.*, 3 ml/litre of water) on the 30th and 45th day after transplanting effectively suppresses vegetative growth, including parameters such as plant height, bearing height, internodal length, and leaf stalk length. Additionally, this treatment promotes early flowering and fruit set, resulting in a lower male: female ratio (plant), and an increase in the number of leaves.

5. References

1. Agrawal S, Dikshit SN. Studies on the effect of plant growth regulators on growth and yield of sapota (*Achras sapota* L.) cv. Cricket ball. Indian J Agric. Res. 2008;42(3):207-211.
2. Anonymous. Directorate of Horticulture. Agriculture, Farmers welfare and Cooperation Department, Government of Gujarat https://doh.gujarat.gov .in/horticuiturecensus.htm accessed on 2 May 2023.
3. Anonymous. National Horticulture Board. Ministry of Horticulture, 2020. New Delhi https://www.nhb.gov.in accessed on 2nd May 2023.
4. Arrilia MC, De JF, Mencha JF, Rolz CS. Tropical sub-tropical fruits. AVI. West part, connection, USA; c1980. p. 316-340.
5. Bhadarka Chandni, Kanzaria DR, Karmur NN, Muskan Sandh, Parsana JS, Patel HN, Parmar VM. Effect of sowing time on papaya seedlings. The Pharma Innovation Journal. 2022;11(8):1416-1420.
6. Brahamchari VS, Mandal AK, Kumar R, Rani R, Kumar R. Effect of growth substance on flowering and fruiting characters of 'sardar' guava (*Psidium guajava* L.). Hort. J 1996;9(1):1-7.
7. Chadha KL. Scenario of papaya production and utilization in India. Indian J. Hort. 1992;49(2):97-119.
8. Chundawat BS, Gupta OP. Effect of growth retardants (B-Nine and cycocel) on vegetative growth and yield of phalsa (*Grewia asiatica* L.). Haryana J. Hort. Sci. 1974;3:113-115.
9. Ghose SP, Sen SP. The modification of sex expression in papaya (*Carica papaya* L.). J Hortic. Sci. 1975;50(2):91-96.
10. Guha D. Regulation of tree growth and yield in golden delicious apple with cycocel and ethrel. South Indian J. Hort. 1993;41(6):333-340.
11. Hazarika TK, Balsri DS, Mandal D, Nautiyal BP, Shukla AC. Effect of plant growth regulators on growth, yield and quality of tissue cultured papaya (*Carica papaya* L.) cv. Red Lady. Indian J Hortic. Sci. 2016;86(3):404-408.
12. Heywood VH, Brummitt RK, Culham A, Seberg O. Flowering plant families of the world. Firefly Books. 2007. ISBN 9781554072064.
13. Jotava KS, Kanzaria DR, Mishra S. Effect of sarcotesta and time of sowing on seed germination and seedling growth of papaya cv. GJP 1. Scientist, 2022, 08903670.
14. Kahar SA. Effects of frequency and concentration of B-9 (Daminozide) on growth, flowering and flower quality of Reagan Sunny chrysanthemum (*Chrysanthemum morifolium* Ramat). Acta Hort. 2008;788:141-148.
15. Kaur J, Kaur G, Kaur K, Arora NK. Effect of Chloromequat Chloride application on vegetative growth and overall quality of grape cultivars under protected cultivation. Erwerbs-Obstbau; c2022. https://doi.org/10.1007/s10341-022-00781-9.
16. Kumar R, Sharma N, Jamwal M, Sharma RM, Singh DB. *et al*. Production and economic studies of PGRs treated strawberry (*Fragaria x ananassa* Duch.) cv. Sweet Charlie. American-Eurasian J Agriculture and Environment Sci. 2012;12:1543-1547.
17. Kumra R, Reena SS. Influence of plant growth regulators on strawberry: a review related paper. Int. J. Chem. Stud.

2018;6(1):1236-1239.
18. Makwana PC, Kanzaria DR, Chitroda RL, Kavad MH, Thumar KP. Effect of pre and post-harvest treatments on papaya and banana. Research matrix International Multidisciplinary Journal. 2023;3(6):51-55.
19. Mansuroglu S, Karaguzel O, Ortacesme V, Sayan MS. Effect of paclobutrazol on flowering, leaf and flower colour of *Consolida orientalis*. Pakistan J Bot. 2009;41:2323-2332.
20. Meera B, Solanki Kanzaria DR, Jignasa H, Rajatiya Farheen Halepotara H. Effect of GA_3 and different containers on seed germination and seedling growth of papaya (*Carica papaya* L.) cv. Madhubindu. Int. J of Chemical Studies.2018;6(5):535-538
21. Mishra PV, Varu DK. Effect of chemicals and agro-techniques on *Hast bahar* flowering of pomegranate. The Pharma Innovation Journal. 2022;11(7):1734-1736.
22. Obadiya R, Patil SN, Patil DR, Venkatshalu Mallikarjun A, Kiran KC. Effect of plant growth regulators and chemical on vegetative and reproductive parameters during hasta bahar in acid lime (*Citrus aurantifolia* Swingle). Int. J Curr. Microbiol. App. Sci., 2018;7(9):2640-2650.
23. Parmar VM, Bhadarka Chandni, Chitroda RL, Kanzaria, DR. Effect of various farming systems on papaya (*Carica papaya* L.). *Research matrix* International multidisciplinary Journal. 2023;3(6):77-81.
24. Parsana JS, Varu DK, Parmar VM, Shivani Patel, Kanzaria DR, Subhrajyoti Mishra. Influence of Pruning and integrated nutrient management on Custard Apple (*Annona squamosa* L.) Agricultural Mechanization in Asia, Africa and Latin America. 2023;54(04):12865-12874.
25. Ram M. Papaya. In: Introduction and production technology. Indian Council of Agricultural Research, New Delhi; c2005, p.2-89.
26. Salomon E. Effect of CCC on growth distribution and fruiting in citrus. Acta Hort. 1981;114:156-158.
27. Singh AK. Response of pot marigold (*Calendula officinalis*) to plant growth regulators. Indian J. Agric. Sci. 2004;74:130-132.
28. Subrata M, Subham G, Ghosh SN. Effect of CCC, KNO_3, $ZnSO_4$ and MAP on flowering and yield of wood apple (*Feronia limonia* Swingle). Int. J Chem. Stud. 2019;7(2):2069-2071.
29. Varu DK, Patel KD, Sandip Makhmale. Genotypic response on growth and yield in papaya. The Bioscan. 2020;15(3):385-389.
30. Vasava HV, Tejal M Chaudhari, Parasana JS, Varu DK, Shivani Patel, Subhrajyoti Mishra. Performance of different grafted variety and mulching in brinjal (*Solanum melongena* L). Agricultural Mechanization in Asia, Africa and Latin America. 2023;54(04):12981-12988.
31. Panse VG, Sukhatme PV. Statistical methods for agricultural research. ICAR, New Delhi. 1985;8:308-318.