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Response of bottle gourd [*Lagenaria siceraria* (Mol.) Standl.] to pinching and NAA on flowering, sex expression and yield attributing traits

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Abstract

The experiment entitled "Response of bottle gourd [*Lagenaria siceraria* (Mol.) Standl.] to pinching and NAA on flowering, sex expression and yield attributing traits." was conducted at Instructional farm Jambuvadi, Department of Vegetable Science, College of Horticulture, JAU., Junagadh, Gujarat. during the year 2024. Total twelve treatment combinations comprising three level of pinching at different nodes *viz*., pinching at 2nd node (P_1), pinching at 4th node (P_2), pinching at 6th node (P_3) and four level of NAA concentration *viz*., 25 ppm (N_1), 50 ppm (N_2), 100 ppm (N_3) and 150 ppm (N_4) were allocated in randomized block design with factorial concept in three repetition. The result of experiment revealed that among the pinching at different nodes, pinching at 6th node (P_3) recorded more number of female flowers per vine (30.94), less number of male flowers per vine (102.78), narrow male: female ratio (3.43), maximum fruit set percentage (56.58%), maximum number of fruits per vine (17.17), maximum fruit yield per vine (11.43 kg). Among the NAA treatments, NAA at 100 ppm (N_3) recorded maximum number of female flowers per vine (29.48), narrow male: female ratio (3.77), maximum fruit set percentage (55%), maximum number of fruits per vine (16.67), maximum fruit yield per vine (10.41 kg). Whereas minimum number of male flowers were recorded in NAA 150 ppm (N_4). Furthermore, the interaction effect between pinching and NAA found significant with parameters like; number of female flowers per vine (34.41) in treatment combination pinching at 6th node + NAA 100 ppm. It was also recorded narrow male: female ratio (2.69), maximum number of fruits per vine (18.66), maximum fruit yield per vine (13.50 kg).

Keywords: Bottle gourd, pinching, nodes, NAA concentration

Introduction

Cucurbitaceous is one of the largest families in vegetable kingdom consisting of largest number of edible type species. Cucurbitaceous family is commonly known as the gourd, melon or pumpkin family. This family is composed of 118 genera and 825 species, which are widely distributed in the warmer regions of the world. Among gourds, bottle gourd [*Lagenaria siceraria* L. 2n = 2x = 22] commonly known as *lauki*, *kadu*, *ghiya* or *doodhi* is grown extensively in India, might have originated in Tropical Africa.

Bottle gourd also known as the 'calabash gourd' or the 'white flower gourd', may be the only gourd plant known in both the new and old world of early prehistoric times. It is a vegetable with a good source of carbohydrates, vitamin A, vitamin C and minerals.

Pinching is a form of pruning that encourages secondary and tertiary sprouts on plants there by enhancing the secondary branch number. It produces more female flowers during spring-summer under high temperature and long days. Pinching assists in maintaining a suitable balance between vegetative and reproductive growth of bottle gourd to maximize production. Pinching facilitates better vine spreading under open field condition by increasing the number of side shoots and boosts productivity.

The sex expression of calabash gourd is determined by environmental factors such as photoperiod, temperature and also influenced by plant growth regulators (PGRs). Exogenous application of growth regulators has shifted the sex expression towards femaleness by increasing the production of female flowers and suppressing male flowers of bitter gourd when applied at two or four leaf stage (Hossain, 2006) [11].

Normally the plant growth regulators produced in the leaves are transported through the phloem and reach the apical portion on lateral branches and causes transformation from vegetative primordial to floral primordial. The external application of plant growth regulators may regulate flowering in plants.

The global area under broader categories like pumpkins, squashes and gourds is 7.05 lakh hectares with production of 236.8 lakh metric tonnes and productivity of 40-50 t/ha (FAO., Statista 2023) [7]. The area under bottle gourd in India is 2.25 lakh hectares with a production of 38.11 lakh metric tonnes and productivity of 30-40 t/ha (Anon., 2024-2025a) [2]. Whereas in Gujarat, the area under bottle gourd is 0.20 lakh hectares with a total production of 3.16 lakh tonnes and productivity of 36.5 t/ha (Anon., 2024-2025b) [3].

Materials and Methods

The present investigation was conducted to know the "Response of bottle gourd [*Lagenaria siceraria* (Mol.) Standl.] to pinching and NAA on flowering, sex expression and yield attributing traits." was conducted at Instructional farm Jambuvadi, Department of Vegetable Science, College of Horticulture, Junagadh Agricultural University, Junagadh, Gujarat from February 2024 to July 2024. Bottle gourd seeds were collected from Vegetable Research Station, Junagadh Agricultural University, Junagadh. Total twelve treatment combinations comprising three level of pinching at different nodes *viz*., pinching at 2nd node (P_1), pinching at 4th node (P_2), pinching at 6th node (P_3) and four level of NAA concentration *viz*., 25 ppm (N_1), 50 ppm (N_2), 100 ppm (N_3) and 150 ppm (N_4) were allocated in randomized block design with factorial concept in three repetition. Main branch of bottle gourd vine was pinched out according to treatments. First treatment of pinching was given at 2nd node, second was at 4th node and third was at 6th node, respectively. Pinching treatment was done very carefully by gentle hand using thumb and forefinger. The NAA concentration were prepared by dissolving 0.250 g, 0.500 g, 1 g and 1.5 g of respective growth regulator in small quantity of ethyl alcohol and the volume was made up to 100 ml by adding distilled water. As per the treatment experimental dose of plant growth regulators solution were applied in two stages. First spray was done at 2nd true leaf (fully expanded) stage of seedlings and second spray was done at 4th true leaf (fully expanded) stage of seedling with the help of a hand sprayer during morning or evening hours, until both sides of the leaves completely become wet. The observations were recorded on six randomly selected plants in each treatment from each replication.

Results and Discussion

The minimum number of male flowers (102.78) were recorded in treatment pinching at 6th node (P_3). While, the maximum number of male flowers (117.67) were observed in treatment pinching at 2nd node (P_1). This might be due to reason that decrease in the production of male flower at 6th node pinching in bottle gourd may be related to higher C:N ratio due to pinching practice and release of hormones. These results are similar to the findings of Higashide *et al.* (2012) [10] in cucumber, Lakshmi *et al.* (2014) [14] in fenugreek. Further, with respect to NAA, the minimum number of male flowers (107.22) was recorded in NAA 150 ppm (N_4). Whereas, the maximum number of male flowers (118.84) were recorded in NAA 25 ppm (N_1) this is due to increase in the concentration of NAA leads to production of female flowers thereby supressing maleness. Similar study was found by Khatoon *et al.* (2019) [13] in bitter gourd. Interaction effect was found non-significant.

The maximum number of female flowers (30.94) were observed in treatment pinching at 6th node (P_3) While, the minimum number of female flowers (21.59) were recorded in treatment pinching at 2nd node (P_1). This might be due to reason that translocation of stored material towards the lateral branches lead to an increase in metabolic activity of bottle gourd plant due to pinching, thus producing more carbohydrates which leads to more number of female flowers reported by Muhammad *et al.* (2022) [17]. Higher rate of photosynthesis and accumulation of the photosynthates due to more number of leaves, leaf area and efficiencies lead to an increase in the number of female flower production. This is in conformity with the results reported by Singh and Mangal (1981) [21] in muskmelon. Further, with respect to NAA, the maximum number female flowers (29.48) were recorded in NAA 100 ppm (N_3). Whereas, the minimum number of female flowers (24.07) was recorded in NAA 25 ppm (N_1). It indicates that NAA 100 ppm was capable of producing maximum female flowers/plant. Growth regulators increased the female flowers in the present investigation, which might be due to increase in the mobilization of auxin substances in plants and also in reduction of sugar thereby bringing a change in membrane permeability. This collaborates the result of Dixit *et al.* (2001) [5]. Interaction effect shown that the treatment combination of pinching at 6th node and NAA 100 ppm (P_3N_3) recorded highest number of female flowers per vine (34.41). While the lowest number of female flowers per vine (15.66) was found in pinching at 2nd node and NAA 25 ppm (P_1N_1). This might be due to reason that pinching at upper nodes leads to focus on lateral branches development, which can lead to more female flowers, where lower nodes bear male flowers. In combination of NAA leads to higher floral differentiation. This is found similar to study of Rehan *et al.* (2022) [19] and Wamiq *et al.* (2020) [22] in bottle gourd.

The minimum male: female ratio (3.43) was observed in treatment pinching at 6th node (P_3). While, the maximum male: female ratio (5.39) was recorded in treatment pinching at 2nd node (P_1). Narrow sex ratio is due to pinching that result in higher number of pistillate flowers and lower number of staminate flowers. These findings are in conformity with the findings of Anand *et al.* (2014) [1] who analysed that pinching on secondary lateral at 6th node significantly narrowed the sex ratio in bottle gourd. Further, with respect to NAA, the minimum male: female ratio (3.77) was recorded in NAA 100 ppm (N_3). Whereas, the maximum male: female ratio (5.02) was recorded in NAA 25 ppm (N_1). This might be due to the reason that the sexual differentiation is controlled by endogenous levels of auxins (NAA at 2 to 4 leaf stage) which suppressed staminate flowers and promotes more number of pistillate flowers and thus registers lower sex ratio. Similar results found by Jiterwal (2010) [12] and Patel *et al.* (2017) [18]. Further, the results indicated that the treatment combination of pinching at 6th node and NAA 100 ppm (P_3N_3) found lowest male: female ratio (2.69), while the highest male: female ratio (6.72) was found in pinching at 2nd node and NAA 25 ppm (P_1N_1). This is due to more number of pistillate flowers found at 6th node pinching and NAA 100 ppm led to narrow male: female ratio. This is found similar to study of Rehan *et al.* (2022) [19] and Wamiq *et al.* (2020) [22] in bottle gourd.

The maximum fruit set percentage (56.58%) was observed in treatment pinching at 6th node (P_3). While, the minimum fruit set percentage (48.50%) was recorded in treatment pinching at 2nd node (P_1). This might be due to reason that optimized resource allocation by pinching can also help to balance the vegetative and reproductive growth of the plant, ensuring that resources are allocated more effectively towards fruit production rather than excessive vegetative growth. Similar findings were observed by Arora *et al.* (1982) [4] and Rehan *et al.* (2022) [19] in bottle gourd. Further, with respect to NAA, the maximum fruit set percentage (55%) was recorded in NAA 100 ppm (N_3). Whereas, the minimum fruit set percentage (49.11%) was recorded in NAA 25 ppm (N_1). This might be due to reason that NAA is used in chemical thinning and prevention of fruit drop or induction of flowering and increase fruit setting. The results are in close conformity with those cited by Wamiq *et al.* (2020) [22] in bottle gourd. The interaction effect of pinching and NAA on fruit set percentage was found non-significant at different levels of treatment.

The maximum number of fruits (17.17) were recorded in treatment pinching at 6th node (P_3). While, the minimum number of fruits (10.50) was recorded in treatment pinching at 2nd node (P_1). This might be due to reason that pinching is effective for better source-sink relationship which produced a greater number of female flowers and fruit set, thus increasing the number of fruits due to the diversion of photo assimilates towards the more primary branches. Similar studies found conformity with Sajjan *et al.* (2002) [20]. Further, with respect to NAA, the maximum number of fruits (16.67) were recorded in NAA 100 ppm (N_3). Whereas, the minimum number of fruits (12.44) were recorded in NAA 25 ppm (N_1). The increasing number of fruits per vine with NAA treatments might be due to the rapid and better nutrient translocation from roots to apical parts of the plant. These results are in accordance with Mozarkar *et al.* (1991) [16]. The results indicated that the treatment combination of pinching at 6th node and NAA 100 ppm (P_3N_3) shown highest number of fruits per vine (18.66). Whereas, the lowest number of fruits per vine (7.66) were found in pinching at 2nd node and NAA 25 ppm (P_1N_1). This might be due to reason that combination of pinching and applying Naphthalene acetic acid (NAA) can increase fruit production by promoting lateral growth and increasing the potential fruiting area. Pinching disrupts apical dominance, encouraging the development of more branches, while NAA can further enhance fruit set and development. This was found close conformity with findings of Rehan *et al.* (2022) [19] in bottle gourd.

The maximum fruit yield per vine (11.43 kg) was observed in treatment pinching at 6th node (P_3). While, the minimum fruit yield per vine (5.21 kg) was recorded in treatment pinching at 2nd node (P_1). This is due to better vegetative growth, increase in fruit set percent, number of fruits, weight of fruits. Similar findings were reported by Hartmann *et al.* (1969) [9], Fiedler and Leschke (1969) [8] in cucumber, Eccher and Zerbini (1970) [6] and Mangal and Pandita (1986) [15] in muskmelon. Further, with respect to NAA, the maximum fruit yield per vine (10.41 kg) was recorded in NAA 100 ppm (N_3). Whereas, the minimum fruit yield (7.62 kg) was recorded in NAA 25 ppm (N_1). The increase in yield was obviously due to consolidated effect of increased number of female flowers, fruit number, weight, fruit set caused by application of NAA and used in chemical thinning and prevention of fruit drop or induction of flowering, increasing fruit set, size and thus increasing yield. The results are in close conformity with those cited by Wamiq *et al.* (2020) [22] in bottle gourd. The results indicated that the treatment combination of pinching at 6th node and NAA 100 ppm (P_3N_3) was found highest fruit yield per vine (13.50 kg), while the lowest fruit yield per vine (3.53 kg) was found in pinching at 2nd node and NAA 25 ppm (P_1N_1). This is due to the combination of pinching and NAA can have a synergistic effect, leading to even greater increase in fruit yield compared to either treatment alone. Results are in close conformity with those cited by Rehan *et al.* (2022) [19] in bottle gourd.

Table 1: Effect of pinching and NAA on number of male flowers, female flowers, male: female ratio, fruit set%, number of fruits per vine and fruit yield per vine.

Treatment	No. of male flowers	No. of female flowers	Male: female ratio	Fruit set%	No. of fruits per vine	Fruit yield per vine (kg)
Level of pinching (P)						
P_1	117.67	21.59	5.39	48.50	10.50	5.21
P_2	115.45	27.72	4.14	50.67	14.83	9.51
P_3	102.78	30.94	3.43	56.58	17.17	11.43
S.Em.±	2.323	0.646	0.109	1.275	0.368	0.265
C.D. at 5%	6.81	1.90	0.32	3.74	1.08	0.80
Level of NAA (N)						
N_1	118.84	24.07	5.02	49.11	12.44	7.62
N_2	113.91	25.56	4.59	50.56	13.67	8.37
N_3	107.89	29.48	3.77	55.00	16.67	10.41
N_4	107.22	27.89	3.91	53.00	13.89	9.33
S.Em.±	2.683	0.746	0.126	1.472	0.425	0.319
C.D. at 5%	7.87	2.19	0.37	4.32	1.25	0.95
Interaction (P × N)						
S.Em.±	4.647	1.293	0.218	2.549	0.737	0.550
C.D. at 5%	NS	3.79	0.64	NS	2.16	1.66
C.V.%	7.19	8.37	8.73	8.50	9.01	10.53

Table 2: Interaction effect of pinching and NAA on flowering, sex expression and yield attributing traits of bottle gourd.

Treatment Combination		Number of female flowers per vine	Male: Female ratio	Number of fruits per vine	Fruit yield per vine (kg)
P_1N_1	Pinching at 2nd node + NAA 25 ppm	15.66	6.72	7.66	3.53
P_1N_2	Pinching at 2nd node + NAA 50 ppm	21.66	5.32	9.66	4.13
P_1N_3	Pinching at 2nd node + NAA 100 ppm	24.66	4.68	14.66	6.63
P_1N_4	Pinching at 2nd node + NAA 150 ppm	24.36	4.83	10.00	7.57
P_2N_1	Pinching at 4th node + NAA 25 ppm	26.55	4.49	14.00	9.23
P_2N_2	Pinching at 4th node + NAA 50 ppm	26.00	4.60	15.00	10.20
P_2N_3	Pinching at 4th node + NAA 100 ppm	29.36	3.92	16.66	11.00
P_2N_4	Pinching at 4th node + NAA 150 ppm	28.96	3.56	13.66	8.00
P_3N_1	Pinching at 6th node + NAA 25 ppm	30.00	3.83	15.66	10.00
P_3N_2	Pinching at 6th node + NAA 50 ppm	29.00	3.85	16.33	10.66
P_3N_3	Pinching at 6th node + NAA 100 ppm	34.41	2.69	18.66	13.50
P_3N_4	Pinching at 6th node + NAA 150 ppm	30.33	3.33	18.00	12.14
	S. Em.±	1.293	0.218	0.737	0.550
	C.D. at 5%	3.79	0.64	2.16	1.66
	C. V.%	8.37	8.73	9.01	10.53

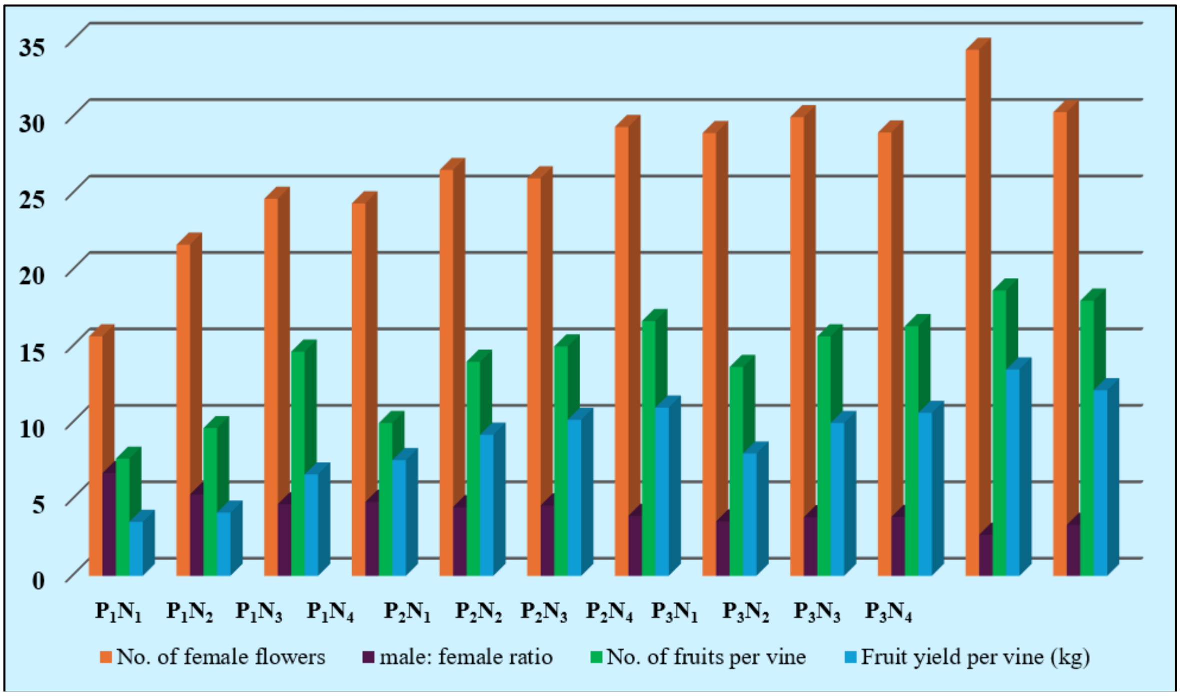

Fig 1: Effect of pinching and NAA on flowering, sex expression and yield attributing traits of bottle gourd.

Conclusion

It can be concluded that pinching and NAA concentration significantly influenced number of female flowers per vine, narrow male: female ratio, number of fruits per vine and fruit yield per vine (kg). The treatment combination of pinching at 6th node with NAA 100 ppm was found better for all the flowering, sex expression and yield attributing traits of bottle gourd.

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