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Effect of GA_3 and nitrobenzene on flowering parameters in different germplasm of Brinjal (*Solanum melongena L.*)

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Abstract
Brinjal is one of the most common, popular and principal vegetable crops grown in India and other parts of the world. Heterostyled feature of its flower causes low fruit set which resulted in poor production. A field experiment was conducted with 20 different germplasm of brinjal to investigate the effect of Gibberellic acid (50ppm) in combination of nitrobenzene (150ppm) on Days taken to 50% flowering; number of flower per plant and number of flower attained the fruit. The experiment was laid out in Randomized Block Design (RBD) with 1 treatment and three replications for two consecutive years. The treated germplasm with combination of GA_3 and Nitrobenzene shows a significant difference when compared with control where no PGRs were used. An average of 5.4 days earliness in 50% flowering, 5.66 more number of flower and 3.61more flower attained the fruit in all the 20 germplasm during 2020-21. GA_3 and Nitrobenzene proved to be effective in all the flowering parameters of brinjal.

Keywords: genotypes, gibberellic, nitrobenzene, flowering

Introduction
Brinjal (*Solanum melongena* L.), or eggplant is one of the most common, popular and principal vegetable crops grown in India and other parts of the world. The brinjal is grown extensively in India and other Asian countries like Bangladesh, Pakistan and Philippines'. Major Brinjal producing countries are China, Turkey, Japan, Egypt, Indonesia, Iraq, Italy, Syria and Spain. The cultivated brinjal of Indian origin has been in cultivation for long time (Thompson and Kelly, 1957) [11]. India ranks second after China in its production and area. Major Brinjal producing states are Orissa, Bihar, Karnataka, Tamil Nadu, West Bengal, Andhra Pradesh, Maharashtra and Uttar Pradesh. Brinjal fruits are fairly good source of Ca, P, Fe, and vitamins particularly 'B' group. Brinjal is also valued for its medicinal properties and role of brinjal in treatment of liver disease, cough due to allergy, rheumatism, leucorrhea and intestinal worms has been mentioned. Like other vegetables, it provides dietary fiber, minerals, vitamins, carbohydrate and protein.

It is one of the most common vegetable crops grown throughout the country except higher altitudes in India. It is a perennial but grown commercially as an annual crop. The maximum potential yield of brinjal is not achieved due to its poor physiological efficiency; poor fruit setting, poor plant architecture and none synchronize maturity (Kropi *et al.* 2020) [5]. Application of plant growth regulators (PGRs) may play an important role in proper flowering, fruit setting, synchronize maturity, ripening and thereby increase in the physiochemical efficiency and yield of the crops. One of the major problem associated with brinjal are flower and fruit drop resulting in poor fruit yield. The market demand and consumer preference of brinjal depends upon fruit colour, shape, size and stage of maturity. Use of PGRs may increase the productivity of brinjal in terms of quantity and quality, and thereby increase the market price and profitability. Since brinjal is a popular vegetable in India, therefore yield and quality improvement of the crop is of considerable importance. Considering the above fact the present research was carried out to investigate the response of 20 different germplasm of Brinjal to GA_3 and Nitrobenzene.

Material and Methods
The present study on Effect of GA_3 and Nitrobenzene on parameters of flowering in different germplasm of Brinjal (*Solanum melongena L.*) was carried out during Rabi season for two

consecutive years; 2020-2021 and 2021-2022 in the Department of Horticulture, College of Agriculture, Sardar Vallabhbhai Patel University of Agriculture and Technology Meerut. The experiment was laid out in Randomized Block Design (RBD) with three replications. Twenty Brinjal genotype obtained from the Department of Horticulture was selected for the study. The details of experiment design and the treatment details are given below:-

Table 1: Experimental details

Design	Randomized Block Design
Germplasm	20
Replication	3
Spacing	60×60 cm
Season	Rabi (2020-21 and 2021-22)

Treatment details

The experiment site was first cleaned and a throw weeding was done to remove noxious weeds and diseased plants which are collateral host for the pathogens. During summers deep ploughing was done to expose the insect eggs and weed seed to the surface. During October before planting the seedlings the field was ploughed three times and brought to a fine tilth. The field was thrown into ridges of 60 cm distance. The seedlings were transplanted at 42 days after sowing on the ridges at a spacing of 60 x 60cm; Entire field was applied with recommended dose of inorganic fertilizers. As basal dressing 100:50: 50 kg/ha NPK was given in the form of urea, super phosphate and muriate of potash, applied in the soil. Another 50 kg nitrogen was given as top dressing on 40 days after transplanting. The growth regulators were applied in two stages. First spray was given on 25th day after transplanting and second spray was given on 40th day after transplanting. The sticking agent 'Teepol' was added to the spray solution at 0.001 per cent. Spraying was done with sprayer during the early morning hours. Immediately after planting, one life irrigation was given on third day and subsequent irrigation were given as and when required to the crop. Weeding, hoeing and earthing up were done as and when required to the crop. Biometric observations like Days taken to 50% flowering, number of flower per plant and number of flower attained the fruit were recorded on four plants selected per plot at random, labeled and the mean was recorded. The data were statistically analyzed as applicable to Randomized Block Design (Panse and Sukhatme, 1967) [7]. Whenever the results were found significant, the critical differences were computed at 5 per cent level of probability to draw statistical conclusions.

Experimental Findings

The data for each observation was recorded from 4 randomly selected plants and there mean have been presented in terms of day to 50% flowering, number of flower per plant and the number of flower which attained the fruit: -

a) Day to 50% flowering

Effect of GA_3 (50ppm) + Nitrobenzene (150ppm) on different varieties of Brinjal was found significant in comparison of plant without any treatment. Early flowering in all the germplasm was observed for both the years of investigation. An average of 5.48 (2020-2021) and 5.06 (2021-2022) less days was taken by all the germplasm for 50% flowering in comparison of the control where no PGR was used.

Table 2: Days to 50% flowering

Sr. No.	Genotypes	2020-21		2021-22	
		Control	Treatments	Control	Treatments
1	SVT-9	61.75	55.42	59.00	54.75
2	Azad Kranti	56.58	50.92	56.67	50.67
3	SVT-4	65.08	58.58	64.42	57.58
4	SVT-11	64.92	59.25	63.42	59.17
5	SVT-3	65.00	59.33	65.25	60.33
6	SVT-1	57.42	52.75	56.33	52.00
7	B-3-L	60.92	55.58	60.33	54.92
8	KS-224	74.58	67.25	73.58	64.42
9	SVT-6	76.83	70.17	76.17	72.58
10	ABH-1	50.33	46.00	50.33	46.42
11	EG-01-03-02	53.75	49.08	52.83	48.25
12	PR-5	55.25	50.25	54.83	47.42
13	Pant Samrat	69.58	62.58	69.08	62.58
14	Pusa Ankur	51.75	47.08	50.00	46.83
15	Swamani	57.42	52.08	55.42	51.75
16	Pusa Shyamla	57.08	52.75	57.25	53.92
17	SVT-2	72.25	66.92	70.67	66.50
18	SVT-12	53.75	49.75	50.75	47.67
19	Kashi Taru	56.25	50.92	54.92	50.00
20	Pant Rituraj	61.83	56.17	61.17	53.50
	Mean	61.12	55.64	60.12	55.06
	SE(m) ±	0.87	0.28	0.88	0.28
	C.D. at 5%	2.45	0.78	2.47	0.78

b) Number of flower per plant

Number of flower per plant varied significantly for the plant which was treated with PGRs. Observations for number of flower is presented in Table-2. Application of 50ppm GA_3 in combination of Nitrobenzene 150ppm leads to increase in flower numbers in every germplasm on an average 5.66 and 4.31 during 2020 and 2021 respectively.

Table 2: Number of flower per plant

Sr. No.	Genotypes	2020-21		2021-22	
		Control	GA_3 50ppm + Nitrobenzene 150ppm	Control	GA_3 50ppm + Nitrobenzene 150ppm
1	SVT-9	57.00	61.83	56.08	60.42
2	Azad Kranti	61.17	67.08	59.42	64.50
3	SVT-4	48.33	53.25	46.92	53.00
4	SVT-11	46.50	51.00	44.75	50.08
5	SVT-3	64.17	70.08	61.58	65.42
6	SVT-1	29.33	33.92	32.08	34.75
7	B-3-L	46.42	50.75	46.25	48.92
8	KS-224	41.83	46.83	41.83	46.17
9	SVT-6	43.67	49.17	43.33	48.00
10	ABH-1	57.33	61.92	56.00	58.83
11	EG-01-03-02	59.33	65.83	62.92	65.25
12	PR-5	30.00	36.75	31.42	36.58
13	Pant Samrat	41.83	47.33	44.08	48.08
14	Pusa Ankur	45.17	51.17	44.17	51.58
15	Swamani	33.00	39.25	34.75	38.58
16	Pusa Shyamla	54.75	60.67	54.33	59.33
17	SVT-2	34.75	41.67	36.83	40.83
18	SVT-12	34.25	41.91	35.83	40.42
19	Kashi Taru	43.58	49.08	46.08	49.17
20	Pant Rituraj	45.00	51.08	43.58	48.42
	Mean	45.87	51.53	46.11	50.42
	SE(m) ±	1.37	0.44	1.35	0.43
	C.D. at 5%	3.88	1.23	3.81	1.21

d) Number of flower attained the fruit

It is evidenced from the Table-3 GA_3 and NBZ significantly improve the fruit setting in brinjal. During 2020-2021 and 2021-2022 an average of 3.61 and 3.43 more number of flowers attained the fruit respectively when compared to the control where no PGR was applied.

Table 3: Number of flower attained the fruit

Sr. No.	Genotypes	2020-21		2021-22	
		Control	GA_3 50ppm + Nitrobenzene 150ppm	Control	GA_3 50ppm + Nitrobenzene 150ppm
1	SVT-9	26.50	29.58	29.42	28.00
2	Azad Kranti	29.50	33.08	32.42	31.21
3	SVT-4	20.92	24.08	24.42	22.83
4	SVT-11	23.50	27.00	26.83	24.88
5	SVT-3	30.58	34.17	33.75	31.88
6	SVT-1	14.17	17.50	19.75	17.88
7	B-3-L	20.67	24.42	24.75	23.25
8	KS-224	18.67	23.17	23.58	21.29
9	SVT-6	20.50	23.75	25.00	23.54
10	ABH-1	25.50	28.83	29.42	28.17
11	EG-01-03-02	29.33	32.92	32.08	30.00
12	PR-5	13.67	17.42	18.75	16.83
13	Pant Samrat	18.83	22.50	23.08	21.67
14	Pusa Ankur	18.83	22.42	23.17	21.88
15	Swamani	14.50	18.33	20.00	18.29
16	Pusa Shyamla	24.83	28.42	26.83	25.21
17	SVT-2	16.00	19.83	21.17	19.38
18	SVT-12	13.33	17.08	19.33	16.88
19	Kashi Taru	19.25	23.33	24.50	22.17
20	Pant Rituraj	19.42	22.92	23.00	21.71
	Mean	20.93	24.54	25.06	3.43
	SE(m) ±	0.75	0.24	0.72	0.23
	C.D. at 5%	2.12	0.67	2.02	0.64

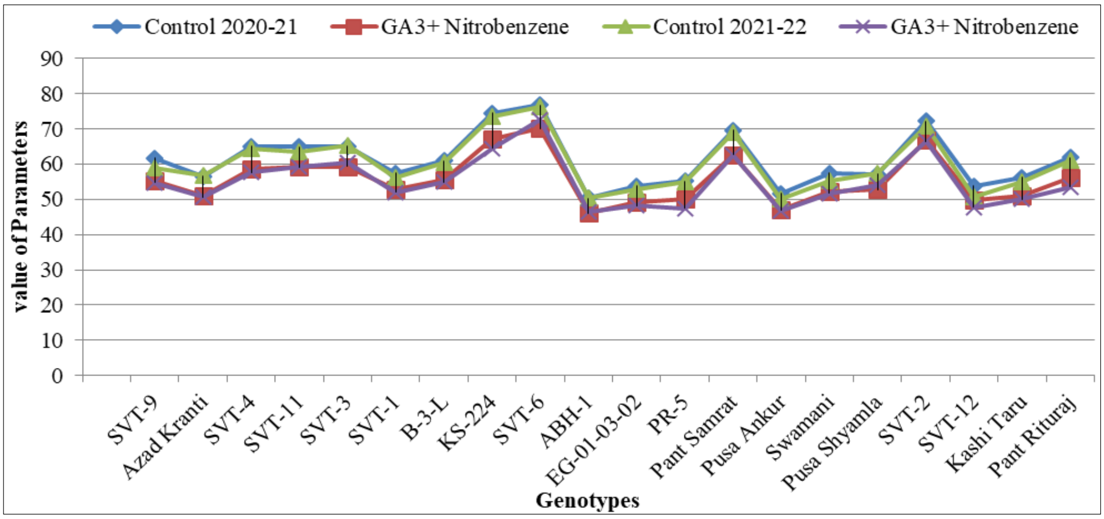

Fig 1: Days to 50% flowering

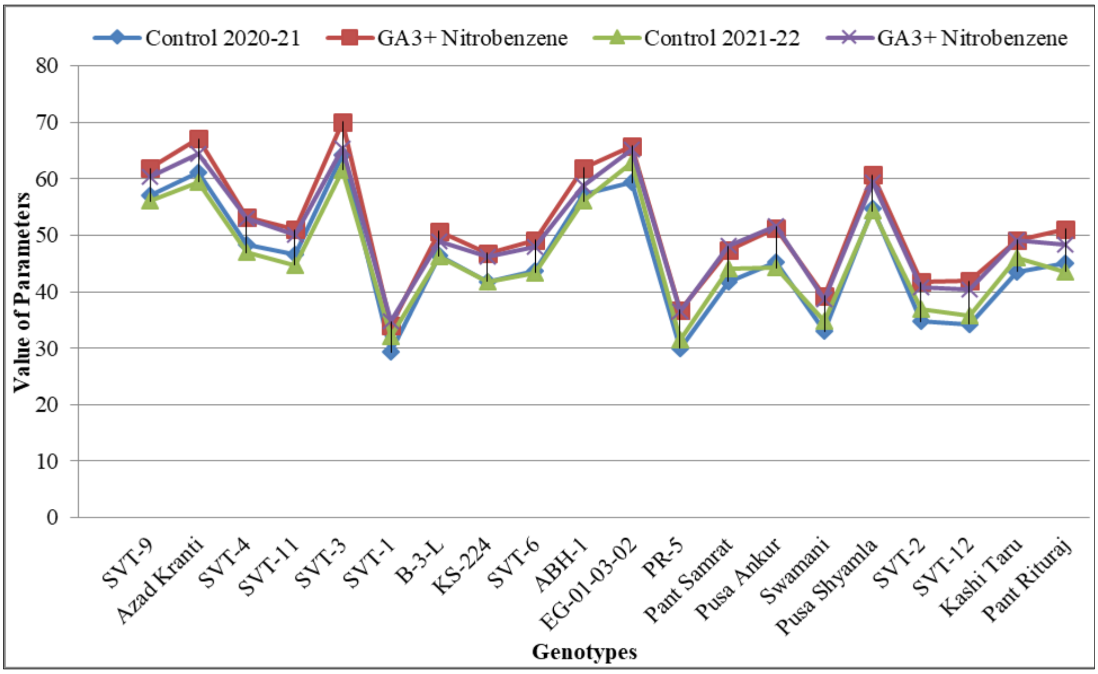

Fig 2: Number of flower per plant

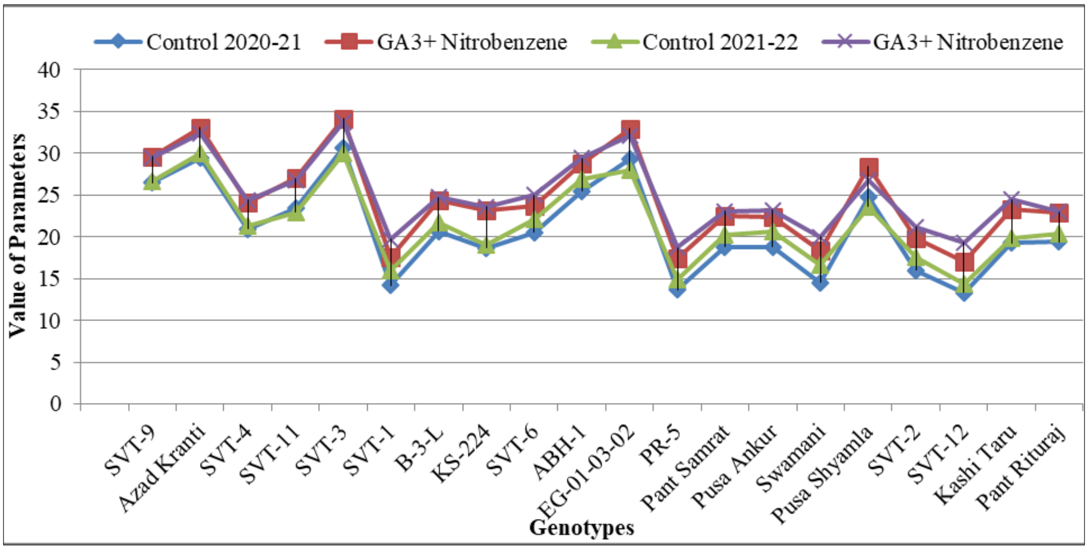

Fig 3: Number of flower attained the fruit

Discussion

Effect of GA_3 and nitrobenzene on flowering parameters of different germplasm of brinjal was evaluated. A significant different was observed in all the characters which was in accordance with the study of Mithila *et al*. 2012 who observed the capacity of Nitrobenzene in improving flowering as well as the fruit setting percentage. Furthermore, early fruit setting was observed by Nuruzzamani *et al*. (2015) [8] and observed the reduction in fruit drop. Griffiths (2006) [2], Hu (2008) [3], Rieu (2008) [10] Studied GA_3 regulatory effect in flowering of plants. Nester (1988) [7], Goto (1999) [1] examined the GA_3 deficiency responsible for sterility of flowers. Nester (1988) [7], Goto (1999) [1], Koornneef (1980) [4] observed the scarcity of GA_3 resulted in faulty development of sepals, petals and pistils and premature abortion also observed. The results obtained from the present study might be due to Nitrobenzene transport to the axillary buds would have resulted in a better sink for the mobilization of photo assimilates at a faster rate.

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Conflicts of Interest

All authors declare that they have no conflict of interest.

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