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EFFECT OF GIBBERELLIC ACID AND MALEIC HYDRAZIDE ON PHENOLOGY AND YIELD OF OKRA (*ABELMOSCHUS ESCULENTUS*) CV. *VARSHA* UPHAR

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ABSTRACT: The experiment was carried out during *kharif* season of 2012-2013 at Sehore, Madhya Pradesh. The treatments consist of the three levels of maleic hydrazide, three GA_3 levels and one control. These treatments were applied in factorial randomized block design with three replications. Phenological characters *were* days to first flowering, days to 50 % flowering, days to first picking and days to maturity. Yield characters were number of fruits per plants, fruit length (cm), fruit girth (mm), fruit weight (g), fruit yield per plant (g), fruit yield per plant (kg) and fruit yield per ha (q/ha) was recorded. The significantly maximum days to first flowering (35 days), days to 50 % flowering (40 days), days to first picking (45 days), days to maturity (93.33 days), no of fruits per plants (21.30), fruit length (13.31 cm), fruit girth (17.01 mm), fruit weight (10.85 g), fruit yield per plant (226 g), fruit yield per plant (4.060 kg) and fruit yield per ha. (125.29 q/ha) was observed in the treatment, M_3G_3 100ppm MH + 60ppm GA_3 and minimum value in the same parameters (38.66 days, 46.00 days, 50.33 days, 89.00 days, 12.23, 10.42 cm, 14.35 mm, 7.20 g, 146.00, 2.620 kg and 80.85 q/ha.) was observed in control.

Keywords: *Okra, gibberellic acid, maleic hydrazide, phonological parameters*

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Okra, *Abelmoschus esculentus* (L.) Moench belong to the family Malvaceae and is a self pollinated crop. Tender green fruits are cooked in curry and soup, while crop has not adapted in India as leafy vegetable as in for East countries. Edible fresh and mature fruits contain 88% moisture and large number of chemical components including vitamin A 88 IU, B 63 IU and C 13 mg/100g. Unripe okra fruits contain 3100 calorie energy, 1.8g, protein, 90 mg calcium and 1.0 mg iron. In India, among fresh vegetables, 60 per cent share of export goes to okra. Okra is widely cultivated in plains of the India with acreage of 518.37 thousand hectare and production 6259.19 thousand mt. In Madhya Pradesh okra is grown in 23.59 thousand hectare area and 310.00 thousand mt productions with 13.14 tonnes productivity (NHB 2011-12).

The germination and vigour can be improved by pre sowing soaking treatments with different chemicals and growth regulators. So taking into consideration the vital role played by GA3 and NAA in modifying the growth behavior of plants resulting in increasing growth rate of shoot and root and finally increase yield, the present investigation has been undertaken to study the effect of seed treatment with GA3 on germination, growth and yield of okra, variety and yield of okra (Patil and Patel 2010).

MATERIAL AND METHODS

The experiment was carried out during *kharif* season of 2012-2013 at the Horticulture Research Farm, Department of Horticulture, R.A.K. College of Agriculture, Rajmata Vijayaraje Scindia Krishi Vishwavidyalaya, Sehore, Madhya Pradesh. The experimental material for the present investigation was comprised of three maleic hydrazide (MH) and three GA_3 treatments and one control. These treatments were applied in Factorial Randomized Block Design with three replications. The experiment consists of ten treatments of three GA_3 levels and three MH levels and one control. The information and details of the treatments are given below in the following: T_1- MH 60 ppm + GA 20, T_2- MH 60 ppm + GA 40, T_3- MH 60 ppm + GA 60, T_4- MH 80 ppm + GA 20, T_5- MH 80 ppm + GA 40, T_6- MH 80 ppm + GA 60, T_7- MH 100 ppm + GA 20, T_8- MH 100 ppm + GA 40, T_9- MH 100 ppm + GA 60 and T_{10}- Control.

RESULTS AND DISCUSSION

The earliest first flowering (35.00 days), days to 50% flowering (40.00 days), days to first picking (45.00 days) was recorded under treatment T_9 (M_3G_3 100ppm MH + 60ppm GA_3) which were at par with treatment T_8 (M_3G_2 100ppm MH + 40ppm GA_3), T_7 (M_3G_1 100ppm MH + 20ppm GA_3) and T_6 (M_2 G_3 80ppm MH + 60ppm GA_3). However, late first flowering (38.66 days), days to 50%

flowering (46.00 days), days to first picking (50.33 days) was noted in treatment T_{10} (control) as compare to other treatments. It is concluded that all the growth regulators treatment found beneficial in early first flowering, days to 50% flowering and days to first picking over control. These increase in early flowering and fruiting by application of GA_3 might be due to the enhanced cell division and cell enlargement which increased various growth attributes and resulted in improved flowering and flower production. Similar results have been reported by Singh *et al.* (1998), Patil and Patel (2010) reported that the GA_3 at 15 mg/l recorded the early flowering. Dhage *et al.* (2011) revealed that the significantly minimum number of days required for first flowering (39.67 days) and first harvesting (44.67 days) were recorded in treatment GA_3 at 150 ppm. The significantly maximum parentage of fruit set (74.79) and fruit yield per hectare were observed in same treatment.

The significantly maximum days (93.33 days) for maturity were recorded in treatment T_9 (M_3G_3 100ppm MH + 60ppm GA_3) followed by T_8 (M_3G_2 100ppm MH + 40ppm GA_3) (93.00 days), T_7 (M_3G_1 100ppm MH + 20ppm GA_3) (92.0 days) and which were at par with each other. However, the treatment T_{10} (control) was recorded lowest (89.00 days) to maturity as compared to other treatments. These findings are in agreement with the findings of Singh *et al.* (1999), Singh *et al.* (2004) reported that the gibberellic acid up to 150 ppm increased the number of pickings and duration of harvesting.

The maximum fruit per plant (21.30 fruits) was recorded in the treatment T_9 (M_3G_3 100ppm MH + 60ppm GA_3) which were at par with treatments T_8 (M_3G_2 100ppm MH + 40ppm GA_3), T_7 (M_3G_1 100ppm MH + 20ppm GA_3), T_6 (M_2G_3 80ppm MH + 60ppm GA_3) and T_5 (M_2G_2 80ppm MH + 40ppm GA_3). Therefore, the minimum fruits per plant (12.23 fruits) were recorded in the treatment T_{10} (control). These increase in early flowering and fruiting by application of GA3 might be due to the enhanced cell division and cell enlargement which increased various growth attributes and resulted in improved flowering and flower production. Similar results have been reported by Naruka and Paliwal (2000), Vijayaraghavan (2000), Pal and Hossain (2001), Hussaini and Babu (2004). Kumar and Sen (2004) revealed that the values of number of fruits per plant were higher with seed soaking in 50 ppm gibberellic acid. Singh *et al.* (2004) reported that the gibberellic acid up to 150 ppm increased the percent fruit set and number of fruits per plant. Kumar and Sen (2005) revealed that the seeds soaked in 50 ppm GA_3 had higher number of fruits per plant as compared to the control. Katung *et al.* (2007) reported that the 75 ppm of GA_3 increased fruit set by 22.9 and 45.5% in cv. White Velvet and 12.2 and 33.6% in cv. Ex-Borno. Patil and Patel (2010) reported that the GA_3 at 30 mg/l produced maximum number of fruits per plant. Ayyub *et al.* (2013) revealed that the increase in number of foliar application of GA_3 substantially improved the vegetative as well as reproductive growth of okra comparing to control plants. It was found that application at different growth stages of okra predominantly boosted the number of pods per plant.

Significantly maximum fruit length (13.31 cm), fruit girth (13.01 mm), fruit weight (10.85 g) were exhibited under the treatment of T_9 (M_3G_3 100ppm MH + 60ppm GA_3) which were at par with T_8 (M_3G_2 100ppm MH + 40ppm GA_3) and T_7 (M_3G_1 100ppm MH + 20ppm GA_3). While, lowest fruit length (10.42 cm), fruit girth (14.35 mm), fruit weight (7.20 g) were noted in treatment T_{10} (control). The reason for maximum fruit length, fruit girth, fruit weight may be due to better translocation of photosynthates. These findings are in agreement with the findings of Naruka and Paliwal (2000), Pal and Hossain (2001), Hussaini and Babu (2004) and Singh *et al.* (2004) reported that the gibberellic acid up to 150 ppm increased the length of fruit, diameter of fruit and mean fruit weight.

Significantly maximum fruit yield of per plant (226 g), fruit yield per plot (4.060 kg) and fruit yield per hectare (125.29 q/ha) were recorded under the treatment T_9 (M_3G_3 100ppm MH + 60ppm GA_3) which were at par with T_8 (M_3G_2 100ppm MH + 40ppm GA_3), T_7 (M_3G_1 100ppm MH + 20ppm GA_3) and T_6 (M_2G_3 80ppm MH + 60ppm GA_3. While the lowest fruit yield per plant (146 g), fruit yield per plot (2.620 kg) and fruit yield (80.85 q/ha) per hectare was obtained with the treatment T_{10} (control). The increased fruit yield per plant, fruit yield per plot and fruit yield per hectare may be attributed to corresponding increase in number of fruits per plant, fruit length, fruit girth and fruit weight. Similar results have been reported by Singh *et al.* (1999), Naruka and Paliwal (2000), Vijayaraghavan (2000), Pal and Hossain (2001), Hussaini and Babu (2004), Marie *et al.* (2007) reported that the foliar spraying with GA have actively increased the pods & seed yield per plant. Katung *et al.* (2007) reported that the 75 ppm of GA_3 increased fruit yield by 40.1% in cv. White Velvet and by 20.9% in cv. Ex-Borno in the dry season. Tyagi *et al.* (2008) revealed that GA_3 at 90 ppm concentration proved to be the best for all parameters of

growth and yield in okra. Patil and Patel (2010) reported that the GA_3 at 15 mg/l recorded the highest fruit yield per plant and fruit yield per hectare. Dhage *et al.* (2011) revealed that the significantly maximum parentage of fruit set (74.79) and fruit yield per hectare were observed in treatment GA_3 at 150 ppm.

Table 1: Phenological characters and yield characters as affected by different levels of gibberellic acid and maleic hydrazide on okra

Treatments	Days to first flowering	Days to 50% flowering	Days to first picking	Days to maturity	No. of fruits/ plant	Fruit length (cm)	Fruit girth (mm)	Fruit weight (g)	Fruit yield / plant (g)	Fruit yield per plot (kg)	Fruit yield per ha. (q)
T_1	38.00	43.66	48.00	89.66	13.93	10.87	14.74	8.02	152	2.750	84.86
T_2	37.33	43.33	47.66	90.00	15.26	10.95	14.86	8.44	162	2.900	89.49
T_3	37. 00	43.00	47.33	91.00	16.90	11.01	15.01	8.62	163	2.930	90.42
T_4	36.66	42.66	47.00	91.33	17.26	11.20	15.36	9.06	180	3.252	100.34
T_5	36.33	42.33	46.66	91.66	17.90	11.58	15.78	9.23	181	3.260	100.60
T_6	36.00	42.00	46.33	91.66	18.70	11.91	16.08	9.37	196	3.540	109.24
T_7	35.66	41.00	46.00	92.00	20.01	12.30	16.37	9.62	204	3.665	113.10
T_8	35.33	40.33	45.66	93.00	20.96	13.03	16.71	10.27	226	4.013	123.85
T_9	35.00	40.00	45.00	93.33	21.30	13.31	17.01	10.85	226	4.060	125.29
T_{10}	38.66	46.00	50.33	89.00	12.23	10.42	14.35	7.20	146	2.620	80.85
S.Em±	0.44	0.68	0.54	0.45	1.33	0.37	0.40	0.44	0.014	0.070	2.16
C.D. at 5%	1.32	2.04	1.64	1.36	4.01	1.12	1.20	1.32	0.042	0.211	6.49

Fig 1: Phenological characters as affected by different levels of gibberellic acid and maleic hydrazide on okra

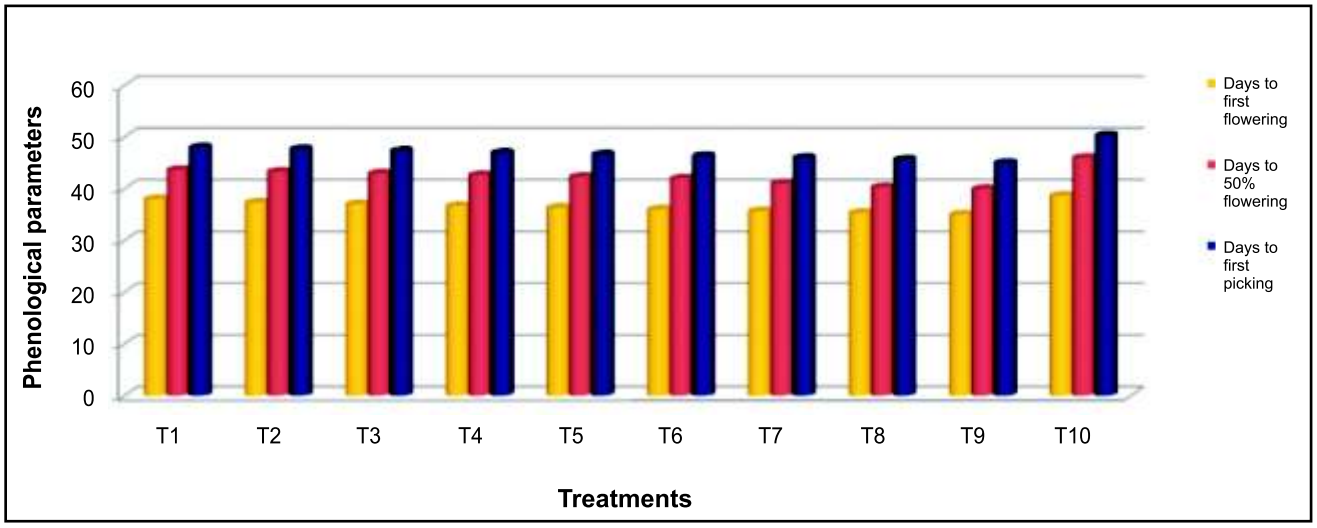


Fig 2: Yield characters as affected by different levels of gibberellic acid and maleic hydrazide on okra

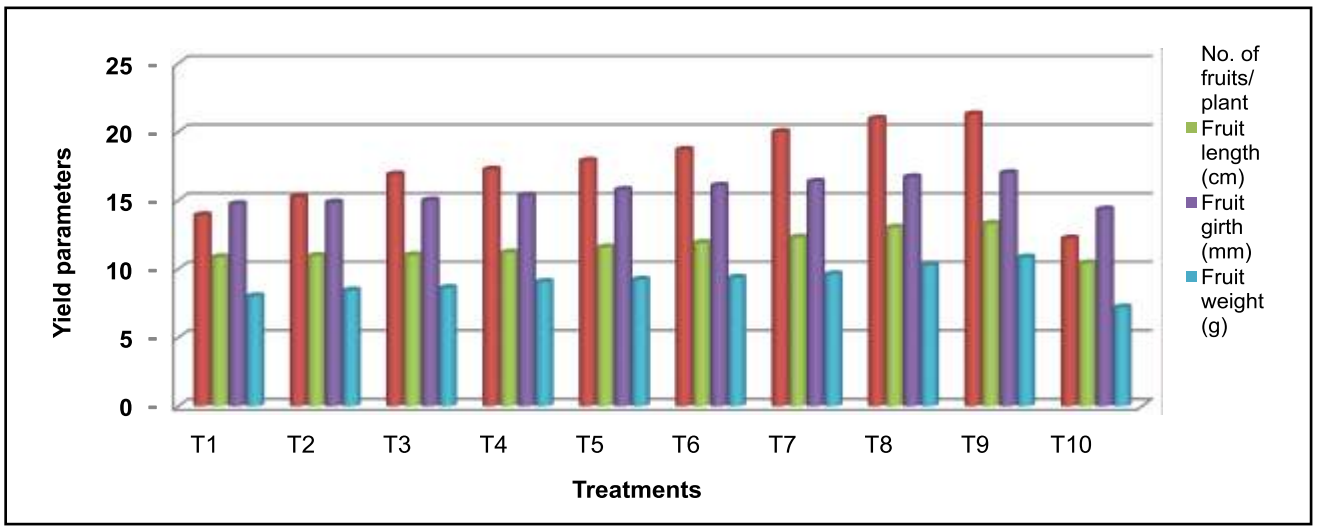
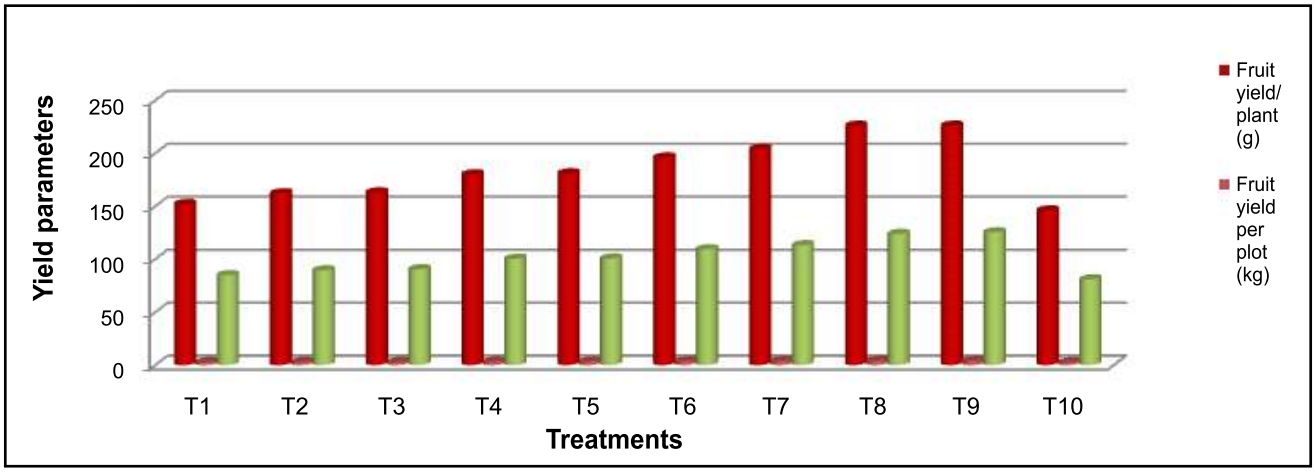


Fig 3: Yield characters as affected by different levels of gibberellic acid and maleic hydrazide on okra



CONCLUSION

It is concluded that the okra variety *varsha uphar* responded well in terms of phonological and yield attributing characters. Treatment, M_3G_3 100ppm MH + 60ppm GA_3 showed best response in phenological characters (days to first flowering, days to 50 % flowering, days to first picking and days to maturity) and yield characters (number of fruits per plants, fruit length, fruit girth, fruit weight, fruit yield per plant, fruit yield per plant and fruit yield per ha).

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