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Effect of plant growth regulators on functional leaf number and leaf area of lady's finger (*Abelmoschus esculentus* L. Moench)

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Abstract
The field experiment was conducted on field of Department of Agril. Botany, College of Agriculture, Parbhani, Maharashtra during *kharif*, 2015 for studying effects of plant groth regulators on functional leaf number and leaf area of Ladys Finger (*Abelmoschus esculentus* L.). The experiment was laid out in randomized block design with nine treatments and three replications. The treatments consisted of two growth regulators *viz*., gibberrellic acid (50,100,150 and 200 ppm) and naphthalene acetic acid (50,100,150 and 200 ppm). The number of leaves per plant differed significantly with maximum in GA (100 and 50 ppm) at 60 DAS and individually at 75-90 DAS Leaf area increased from 45 to 60 DAS. The experimental results revealed that application of plant growth regulators significantly increased number of leaves per plant as compared to control. The leaf area was found to be significantly higher in GA (100 ppm) at all the stages.

Keywords: PGR, functional leaf number, leaf area, ladys finger

Introduction
Okra is a tall growing, annual, semi woody and warm season crop. It is self- pollinated, but occasionally up to 20% cross pollination happens by insects. The okra flowers blossoms only one day. Okra pods are harvested when they reach the maximum size but still tender (may be 60-180 days from sowing) around 5-10 days after opening of flower depending on the cultivar grown [1].

Okra pods are considered nutritious, providing some human supplementary vitamins such as vitamin C, A, B- complex, calcium, potassium, iron and other minerals [2].

The application of plant growth regulators is known as one of the most important treatments used nowadays in agriculture. Some horticulture crop productions were increased by application of different growth regulators. Growth regulators mainly regulate the plant physiological and biochemical processes. There are some reports, which indicate that application of growth regulators improved the growth and yield of vegetables [3].

Plant growth regulators could manage vegetative and reproductive growth balance. PGRs are known as chemical messengers because they are produced in one part of plant and affect on another part. Exogenous of plant growth regulators improved the yield production and fruit quality of horticulture crops [4].

The overall objective of the experiments was to improve the productivity and quality of okra (*Abelmoschus esculentus*) which will benefit our local farms. Vegetables are high yielding and provide nutritional security, more employment, more cash and more foreign exchange.

West Bengal is the leading state of okra production cultivation in 75.5 thousand ha. area, 882.4 thousand MT production and 15 MT per ha productivity and sharing 18 percent of total production, Followed by Gujarat 73.08. thousand ha. area, 857.05 thousand MT production and 11 MT per ha productivity and sharing 14 percent of total okra production. In Maharashtra okra cultivation with 11.3 thousands ha area with annual production of 84.06 thousand MT and its productivity is of 14.9 MT per ha and sharing 5 percent of the total okra production.

The Area and Production of Maharashtra is low as compare to other leading Okra Producing States. About 60 per cent of okra is grown for the fresh fruit for market and the remaining is used for processing. (Indiastat.com 2015-16) With this background, the present investigation was aimed to find out the effect of plant growth regulators on biochemical and quality aspects in Ladys Finger (*Abelmoschus esculentus* L. Moench).

Materials and Methods

The experiment entitled "Effect of plant growth regulators on functional leaf number and leaf area of Lady's Finger (*Abelmoschus esculentus* L. Moench)" was conducted at Department of Agriculture Botany, VNMKV, Prabhani, Maharashtra, India during *kharif* 2015-2016. Okra variety 'Parbhani ok' was sown at 45cm × 30cm spacing with a net plot size of 2.6 m^2. The experiment was laid out in Randomized Block Design with three replications and eight treatments including plant growth regulators as GA3 (50, 100, 150, 200 ppm), NAA (50, 100, 150, 200 ppm) and one control (foliar spray).

Number of functional leaves on plant was recorded at 30, 45, 60, 75 and 90 DAS respectively. The leaf area per plant was counted 30, 45, 60, 75 and 90 DAS respectively with the help of automatic leaf area meter.

Statistical analysis: Fisher's method of analysis of variance was applied & analysis conducted as suggested by Panse and Sukhatme (1967) [19].

Result and Discussion

Mean number of functional leaves per plant

The table 1 data revealed that there was progressive increase the number of leaves per plant up to 75 DAS and their after it was slowly increased. The treatment differences significant at all growth stages except 30 DAS. The data revealed that the number of functional leaves per plant increased at all stages except 30 days after sowing. At 45 days number of functional leaves per plant was highest in treatment T_2 (GA 100 ppm) and treatment T_7 (NAA 150 ppm) and statistically significantly superior over the treatment T_9 (control) and at par with treatment T_1 (GA 50 ppm).

Table 1: Mean number of functional leaves per plant

Sr. No.	Treatments	30 DAS	45 DAS	60 DAS	75 DAS	90 DAS
T_1	GA 50 ppm	6.17	10.4	12.00	13.3	14.03
T_2	GA 100 ppm	5.80	12.16	13.03	14.63	15.90
T_3	GA 150 ppm	6.10	9.7	11.06	12.46	13.06
T_4	GA 200 ppm	4.83	8.9	10.90	12.03	12.70
T_5	NAA 50 ppm	5.03	8.4	10.46	11.76	13.40
T_6	NAA 100 ppm	5.43	9.8	11.03	12.43	12.93
T_7	NAA 150 ppm	4.40	12.2	13.03	14.63	15.50
T_8	NAA 200 ppm	5.30	7.8	10.30	11.80	13.06
T_9	Control	5.43	5.6	8.03	8.43	9.50
	S.E.±	0.36	0.30	0.50	0.29	0.29
	C.D.at 5%	N.S.	0.90	1.51	0.88	0.88

At 60 and 75 days treatment T_2 (GA 100 ppm) and treatment T_7 (NAA 150 ppm) was highest and statistically superior over treatment T_9 (Control) and at par with treatment T_1 (GA 50 ppm) and T_6 (NAA 100 ppm) respectively. At 90 days treatment T_2 (GA 100 ppm) and treatment T_7 (NAA 150 ppm) was highest and statistically superior over the treatment T_9 (control) and at par with treatment T_1 (GA 50 ppm).

Mean leaf area per plant (dm^2)

The table 2 data revealed that the leaf area per plant increased at all stages except 30 days. At 45 days leaf area per plant was highest in treatment T_2 (GA 100 ppm) and treatment T_7 (NAA 150 ppm) and statistically significantly superior over the treatment T_9 (control) and at par with treatment T_1 (GA 50ppm). At 60 days leaf area per plant was highest in treatment T_2 (GA 100 ppm) and treatment T_7 (NAA 150 ppm) and statistically significantly superior over the treatment T_9 (control) and at par with T_1 (GA 50 ppm).

Table 2: Mean leaf area per plant (dm^2)

Sr. No.	Treatments	30 DAS	45 DAS	60 DAS	75 DAS	90 DAS
T_1	GA 50 ppm	9.73	15.26	19.16	20.93	22.53
T_2	GA 100 ppm	10.70	16.36	22.33	23.23	24.13
T_3	GA 150 ppm	9.30	12.80	13.03	14.13	18.70
T_4	GA 200 ppm	9.40	9.83	17.46	20.83	20.20
T_5	NAA 50 ppm	9.33	9.36	16.00	21.16	22.73
T_6	NAA 100 ppm	9.53	9.50	14.26	19.53	20.26
T_7	NAA 150 ppm	10.20	16.13	21.40	22.53	23.53
T_8	NAA 200 ppm	8.73	9.26	14.86	18.63	19.5
T_9	Control	7.3	8.8	12.66	13.56	14.66
	S.E.±	0.89	0.19	0.61	0.33	0.25
	C.D.at 5%	N.S	0.57	1.84	1.01	0.76

At 75 and 90 days treatment T_2 (GA 100 ppm) and T_7 (NAA 150 ppm) was highest and statistically significant superior over the treatment T_9 (control) and at par with T_1 (GA 50ppm) and T_6 (NAA 50 ppm) respectively.

Increase in growth and yield attributes in the functions of plant growth regulators by foliar application which supports growth and developed in turn reflect in production of biomass. Each incremental application of GA and NAA had increased number of leaves per plant and leaf area per plant. Where as in case of number of leaves per plant and leaf area was also highest in treatment T2 (GA 100 ppm) and T7 (NAA 150 ppm) it might be GA promotes cell division and number of plant development mechanism and encourages numerous desirable effect such as number of leaves and leaf area per plant.

Same result regarding to GA and NAA in relation to different growth attributes were noted by the Rahman *et al*.(1984) [5], Singh *et al*. (1999) [6] Naruka and Paliwal (2000) [7] and Mandal *et al*. (2012) [8], Patil.*et al*.(2010) [9] and H. Mehraj, *et al* (2015) [10], Singh and Singh (1977) [11], Abdul *et al*. (1985) [12], Paliwal *et al* (1999) [14], Muhamm Shahid and *et al*.(2013) [15]. Devan Elumalai *et al* (2015) [16], H. Mehraj, *et al* (2015) [17] and YL Bhagure and Tambe (2015) [18] respectively.

Conclusion

In conclusion**,** the treatments, GA (100 ppm) showed significantly higher plant height at all the stages as compared to control thus the number of leaves per plant differed significantly with maximum in GA (100 and 50 ppm) at 60 DAS and individually at 75-90 DAS Leaf area increased from 45 to 60 DAS. The leaf area was found to be significantly higher in GA (100 ppm) at all the stages.

Conflict of Interest

The authors declare that there is no conflict of interest regarding publication of this paper**.**

Ethical standard

The experiment conducted complies with laws.

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