**Response of Plant Growth Regulators and Organic Manures on Growth and Yield of Okra (*Abelmoschus esculentus* L.)**

# Abstract

A field experiment was conducted at Research Farm, Mewar University Gangrar, Chittorgarh (Rajasthan) during Kharif season to check of PGR and organic manures on growth and yield of okra variety “Pusa Sawani ‟ was used in this study. The result revealed that the maximum growth parameters like plant height (71.33 and 74.51 cm), number of branches per plant (3.88 and 4.29), number of leaves per plant (20.42 and 21.54), days taken to 50% flowering (38.89 and 36.60 days), days taken to 100% flowering (43.17 and 41.18 days) and yield parameters like number of fruit per plant (20.44 and 22.62), fruit length (13.74 and 14.43 cm), girth of fruit (5.71 and 6.45 cm), fruit weight (12.73 and 13.22 g) and fruit yield (142.35 and 144.82 q/ha) was recorded with P3O3 (GA3 50 ppm + NAA 50 ppm + FYM 10 t/ha + Vermicompost 5 t/ha). On the basis of one year experimentation, it was concluded that treatment combination P3-GA3 50 ppm + NAA 50 ppm + O3-FYM 10 t/ha + Vermicompost 5 t/ha was found superior in growth and yield as compare to other treatments. So, it was concluded that the treatment P3O3 (GA3 50 ppm + NAA 50 ppm + FYM 10 t/ha + Vermicompost 5 t/ha) are better among all the treatments combination for higher yield.

**Key words: - Biofertilizer PGR, Okra, Foliar spray**

**1. Introduction**

Vegetable cultivation plays a vital role in Indian Agriculture; it is helpful to meet food and nutritional security and provide livelihood as well as income to rural areas. It also generates foreign trade meets export demand and raw material for processing industries. Total area under vegetables cultivation is 2855254 hectares with a production of 335245 million tons (Anonymous, 2024-25). Okra is one of the important vegetable crops of India. Okra (*Abelmoschus esculentus* (L.) is an annual vegetable crop of Malvaceae family. It grows quickly, tall and bears maximum number of fruits, which contributes to the maximum yield per unit area. In India total area under okra crop is 531000 hectares with the production of 646000 million tonnes and productivity of 11.84 tonnes per hectare (Anonymous, 2022). Yield enhancement is one of the most important objectives of any vegetable crop. It can be achieved by two ways. Primarily increase in yield through high yielding and resistant varieties, secondary through achieving higher productivity potential of variety by good seed quality, plant nutrient application and cultural practices and environmental conditions (Kusvuran, 2012). PGRs are now a days becomes an important contributor which influence the plant physiology and yield. It may apply at different stages. It stimulates or retards natural growth from germination to senescence (Das and Das, 1995). It can be applied in various ways *viz.* seed treatment, foliar application, shoot and root dipping, drenching, flower and stem injection (Khandaker *et al*., 2018). Plant growth regulators are the chemical substance, when applied in small amounts modify the growth of plants by stimulating or inhibiting part of the natural growth regulatory system. The growth regulators include both growth promoters and retardants, which have shown to modify the canopy structure and however, yield. The response of growth regulators depends upon the amount of particular compound absorbed by the plant and ability of the plant to respond to the stimulus of the chemical applied (Edwards *et al*., 2004). Growth regulators are considered to be a key factor in vegetative growth, flowering, pod setting and high yield in okra. Various PGRs were found effective in okra productivity like Gibberellins, IAA, NAA, Triacontanol and Salicylic acid etc. GA3 is a natural plant hormone. GA3 has many effects on plant growth such as enhance stem and internodes elongation, fruit setting and fruit growth and enzyme production during germination. The role of GA3 in cell elongation in plants has been well stabilizing which resulted in increasing the plant height. GA3 also enhance, early flowering in many plant species. Contrary to GA3, cycocel has been found to retard plant height by reducing internodes length and also simultaneously induces the formation of lateral shoots thereby plant possess a greater number of fruits bearing shoots. Organic manure has been identified as one of the potential processes in managing waste. Since it is a natural process, cost effective and required only for shorter duration. Organic manures are very cheap and easily available, apart from partially fulfilling the nutrient demand, improve soil structure, enhance fertility and promote biological activity. The organic manure gives better quality produce as compared to those grown with the inorganic source of fertilizer. But the release of nutrients from organic sources is much slower than chemical fertilizers, for which rapid demand of crop needs cannot be met through organic manures alone.

# 2. Materials and Methods

A field experiment was conducted during Kharif season of 2024-25 at research farm, Department of Agriculture (Horticulture), Faculty of Agriculture and Veterinary Sciences, Mewar University Gangrar, Chittorgarh (Rajasthan). Soil of the experimental field was sandy loam in texture, saline in reaction with a pH value of 7.6, poor in organic carbon (0.16%), deficient in available zinc (0.48 ppm) and iron (1.2 ppm) low in available nitrogen (176 kg/ha) and phosphorus (20.2 kg/ha) but medium in available potassium (320 kg/ha). The experiment was laid out in randomized block design with three replications – level-I: Control, GA3 50 ppm, NAA 50 ppm, GA3 50 ppm + NAA 50 ppm and level-II:- Control, FYM 10 t/ha, Vermicompost 5 t/ha, FYM 10 t/ha + Vermicompost 5 t/ha. Total treatment combination is 16 and three replications than total number of plots is 48.

**3. Results and Discussion**

The purpose of this study was to determine the extent of performance for growth and yield parameters.

# 3.1 Growth parameters

Significant differences were found of plant growth regulators were observed among the treatments for plant height at 30 and 60 DAS. The maximum plant height was recorded with P3-GA3 50 ppm + NAA 50 ppm (27.25 and 71.33 cm), it was found at par with P1-GA3 50 ppm (26.67 and 69.87 cm) and P2-NAA 50 ppm (26.34 and 69.00 cm). The minimum plant height was recorded with P0-Control (25.68 and 67.29 cm), respectively. Significant differences were found of organic manures were observed among the treatments for plant height at 30 and 60 DAS. The maximum plant height was recorded with O3-FYM 10 t/ha + Vermicompost 5 t/ha (28.44 and 74.51 cm), closely followed by treatments O2-Vermicompost 5 t/ha (26.83 and 70.22 cm). The minimum plant height was recorded with P0-Control (24.56 and 64.35 cm), respectively. Significant differences were found of plant growth regulators were observed among the treatments for number of branches per plant at 90 DAS. The maximum number of branches per plant was recorded with P3-GA3 50 ppm + NAA 50 ppm (3.88), closely followed by P1-GA3 50 ppm (3.63). The minimum number of branches per plant was recorded with P0-Control (3.42). Significant differences were found of organic manures were observed among the treatments for number of branches per plant at 90 DAS. The maximum number of branches per plant was recorded with O3-FYM 10 t/ha + Vermicompost 5 t/ha (4.29), closely followed by treatments O2-Vermicompost 5 t/ha (3.71). The minimum number of branches per plant was recorded with P0-Control (3.02). Significant differences were found of plant growth regulators were observed among the treatments for number of leaves per plant at 90 DAS. The maximum number of leaves per plant was recorded with P3-GA3 50 ppm + NAA 50 ppm (20.42), it was found at par with P1-GA3 50 ppm (19.82). The minimum number of leaves per plant was recorded with P0-Control (18.91). Significant differences were found of organic manures were observed among the treatments for number of leaves per plant at 90 DAS. The maximum number of leaves per plant was recorded with O3-FYM 10 t/ha + Vermicompost 5 t/ha (21.54), closely followed by treatments O2-Vermicompost 5 t/ha (19.86). The minimum number of leaves per plant was recorded with P0-Control (17.94). Significant differences were found of plant growth regulators were observed among the treatments for days required to 50% flowering. The minimum days required to 50% flowering was recorded with P3-GA3 50 ppm + NAA 50 ppm (38.89 days), it was found at par with P1-GA3 50 ppm and P2-NAA 50 ppm (39.18 and 39.46 days). The maximum days required to 50% flowering was recorded with P0-Control (39.98 days). Significant differences were found of organic manures were observed among the treatments for days required to 50% flowering. The minimum nu days required to 50% flowering was recorded with O3-FYM 10 t/ha + Vermicompost 5 t/ha (36.90 days), closely followed by treatments O2-Vermicompost 5 t/ha (39.42 days). The maximum days required to 50% flowering was recorded with P0-Control (41.19 days). Significant differences were found of plant growth regulators were observed among the treatments for days required to 100% flowering. The minimum days required to 100% flowering was recorded with P3-GA3 50 ppm + NAA 50 ppm (43.17 days), it was found at par with P1-GA3 50 ppm and P2-NAA 50 ppm (43.46 and 43.74 days). The maximum days required to 100% flowering was recorded with P0-Control (44.26 days). Significant differences were found of organic manures were observed among the treatments for days required to 100% flowering. The minimum nu days required to 100% flowering was recorded with O3-FYM 10 t/ha + Vermicompost 5 t/ha (41.18 days), closely followed by treatments O2-Vermicompost 5 t/ha (43.70 days). The maximum days required to 100% flowering was recorded with P0-Control (45.47 days). Similar result also reported by Kumari (2022), Choudhary *et al.* (2024), Abdullah *et al.* (2024), Yadav *et al.* (2023), Gupta *et al*. (2019), Meena *et al*. (2019) and Kumar *et al.* (2024).

* 1. **Yield attributes**

Significant differences were found of plant growth regulators were observed among the treatments for number of fruits per plant. The maximum number of fruits per plant was recorded with P3-GA3 50 ppm + NAA 50 ppm (20.44), closely followed by P1-GA3 50 ppm and P2-NAA 50 ppm (19.36 and 18.81). The minimum number of fruits per plant was recorded with P0-Control (17.96). Significant differences were found of organic manures were observed among the treatments for number of fruits per plant. The maximum number of fruits per plant was recorded with O3-FYM 10 t/ha + Vermicompost 5 t/ha (22.62), closely followed by treatments O2-Vermicompost 5 t/ha (19.58). The minimum number of fruits per plant was recorded with P0-Control (16.12). Significant differences were found of plant growth regulators were observed among the treatments for fruit length. The maximum fruit length was recorded with P3-GA3 50 ppm + NAA 50 ppm (13.74 cm), it was found at par with P1-GA3 50 ppm (13.22 cm). The minimum fruit length was recorded with P0-Control (12.50 cm). Significant differences were found of organic manures were observed among the treatments for fruit length. The maximum fruit length was recorded with O3-FYM 10 t/ha + Vermicompost 5 t/ha (14.43 cm), closely followed by treatments O2-Vermicompost 5 t/ha (13.49 cm). The minimum fruit length was recorded with P0-Control (11.54 cm). Significant differences were found of plant growth regulators were observed among the treatments for girth of fruit. The maximum girth of fruit was recorded with P3-GA3 50 ppm + NAA 50 ppm (5.71 cm), it was found at par with P1-GA3 50 ppm (5.85 cm). The minimum girth of fruit was recorded with P0-Control (5.56 cm). Significant differences were found of organic manures were observed among the treatments for girth of fruit. The maximum girth of fruit was recorded with O3-FYM 10 t/ha + Vermicompost 5 t/ha (6.45 cm), closely followed by treatments O2-Vermicompost 5 t/ha (6.04 cm). The minimum girth of fruit was recorded with P0-Control (5.04 cm). Significant differences were found of plant growth regulators were observed among the treatments for average fruit weight. The maximum average fruit weight was recorded with P3-GA3 50 ppm + NAA 50 ppm (12.73 g), it was found at par with P1-GA3 50 ppm and P2-NAA 50 ppm (12.45 and 12.32 g). The minimum average fruit weight was recorded with P0-Control (11.92 g). Significant differences were found of organic manures were observed among the treatments for average fruit weight. The maximum average fruit weight was recorded with O3-FYM 10 t/ha + Vermicompost 5 t/ha (13.22 g), closely followed by treatments O2-Vermicompost 5 t/ha (12.62 g). The minimum average fruit weight was recorded with P0-Control (11.32 g). Significant differences were found of plant growth regulators were observed among the treatments for fruit yield. The maximum fruit yield was recorded with P3-GA3 50 ppm + NAA 50 ppm (142.35 q/ha), it was found at par with P1-GA3 50 ppm and P2-NAA 50 ppm (141.09 and 139.48 q/ha). The minimum fruit yield was recorded with P0-Control (137.30 q/ha). Significant differences were found of organic manures were observed among the treatments for fruit yield. The maximum fruit yield was recorded with O3-FYM 10 t/ha + Vermicompost 5 t/ha (144.82 q/ha), it was found at par with O2-Vermicompost 5 t/ha (142.18 q/ha). The minimum fruit yield was recorded with P0-Control (132.92 q/ha). Similar findings also observed by Singh *et al.* (2017), Khandaker *et al.* (2018), Kushwaha *et al.* (2020), Gadade *et al.* (2021), Afrose *et al.* (2024) and Abdullah *et al.* (2024).

# Conclusion

On the basis of one year experimentation, it was concluded that treatment combination P3-GA3 50 ppm + NAA 50 ppm + O3-FYM 10 t/ha + Vermicompost 5 t/ha was found superior in growth and yield as compare to other treatments. So, it was concluded that the treatment P3O3 (GA3 50 ppm + NAA 50 ppm + FYM 10 t/ha + Vermicompost 5 t/ha) are better among all the treatments combination for higher yield.

**Table 1 Response of plant growth regulators and organic manures on growth parameters of okra**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Treatments** | **Plant height (cm)** | | **Number of branches per plant at 90 DAS** | **Number of leaves per plant at 90 DAS** | **Days required**  **50% flowering** | **Days required**  **100% flowering** |
| **30 DAS** | **60 DAS** |
| **Plant growth regulators** | |  |  |  |  |  |
| P0-Control | 25.68 | 67.29 | 3.42 | 18.91 | 39.98 | 44.26 |
| P1-GA3 50 ppm | 26.67 | 69.87 | 3.63 | 19.82 | 39.18 | 43.46 |
| P2-NAA 50 ppm | 26.34 | 69.00 | 3.53 | 19.55 | 39.46 | 43.74 |
| P3-GA3 50 ppm + NAA 50 ppm | 27.25 | 71.33 | 3.88 | 20.42 | 38.89 | 43.17 |
| S. Em. ± | 0.37 | 0.79 | 0.06 | 0.30 | 0.27 | 0.27 |
| CD% | 1.06 | 2.28 | 0.19 | 0.86 | 0.78 | 0.78 |
| **Organic manures** | | |  |  |  |  |
| O0-Control | 24.56 | 64.35 | 3.02 | 17.94 | 41.19 | 45.47 |
| O1-FYM 10 t/ha | 26.11 | 68.41 | 3.43 | 19.36 | 39.99 | 44.27 |
| O2-Vermicompost 5 t/ha | 26.83 | 70.22 | 3.71 | 19.86 | 39.42 | 43.70 |
| O3-FYM 10 t/ha + Vermicompost 5 t/ha | 28.44 | 74.51 | 4.29 | 21.54 | 36.90 | 41.18 |
| S. Em. ± | 0.37 | 0.79 | 0.06 | 0.30 | 0.27 | 0.27 |
| CD% | 1.06 | 2.28 | 0.19 | 0.86 | 0.78 | 0.78 |

**Table 2 Response of plant growth regulators and organic manures on yield parameters of okra**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Treatments** | **Number of fruits per plant** | **Fruit length (cm)** | **Girth of fruit (cm)** | **Average fruit weight (g)** | **Fruit yield (q/ha)** |
| **Plant growth regulators** | |  |  |  |  |
| P0-Control | 17.96 | 12.50 | 5.56 | 11.92 | 137.30 |
| P1-GA3 50 ppm | 19.36 | 13.22 | 5.85 | 12.45 | 141.09 |
| P2-NAA 50 ppm | 18.81 | 12.97 | 5.71 | 12.32 | 139.48 |
| P3-GA3 50 ppm + NAA 50 ppm | 20.44 | 13.74 | 6.09 | 12.73 | 142.35 |
| S. Em. ± | 0.30 | 0.22 | 0.10 | 0.15 | 1.23 |
| CD% | 0.85 | 0.63 | 0.30 | 0.44 | 3.56 |
| **Organic manures** | | |  |  |  |
| O0-Control | 16.12 | 11.54 | 5.04 | 11.32 | 132.92 |
| O1-FYM 10 t/ha | 18.26 | 12.97 | 5.68 | 12.26 | 140.30 |
| O2-Vermicompost 5 t/ha | 19.58 | 13.49 | 6.04 | 12.62 | 142.18 |
| O3-FYM 10 t/ha + Vermicompost 5 t/ha | 22.62 | 14.43 | 6.45 | 13.22 | 144.82 |
| S. Em. ± | 0.30 | 0.22 | 0.10 | 0.15 | 1.23 |
| CD% | 0.85 | 0.63 | 0.30 | 0.44 | 3.56 |

**References**

Abdullah, M., Anik, S. M., Nishi, N. J., Jahan, I., & Rahman, M. H. (2024). Application of GA3 and NAA improves yield and quality of Okra (*Abelmoschus esculentus* L.). <https://doi.org/10.21203/rs.3.rs-4294625/v1>].

Adeboye, O.C. and Oputa, C.O. 1996. Effects of galex on growth and fruit nutrient composition of okra (*Abelmoschus esculentus* L. Moench). *Life J. Agri*., **18**(1,2):1-9.

Afrose, S. N., Akand, M. H., Abira, Z., Haque, M. I., Manik, M. M. H., Islam, Z. & Syfullah, K. (2024). Effect of Potassium and Gibberellic Acid on Some Growth Parameters and Yield of Okra. *International Journal of Plant & Soil Science*, **36**(9), 712-722.

Anonymous, (2022). Indian Horticulture Database, published by National Horticulture Board.

Choudhary, S., Poonia, S., Moond, S. K., Raiger, P. R., Ram, M., & Kuri, R. (2024). Optimal Use of Plant Growth Regulators for Improved Growth, Yield, and Economic Returns of Winter Tomato (Solanum lycopersicum) in arid regions: Optimization of plant growth regulators use in tomato. *Annals of Arid Zone*, **63**(1), 107-112.

Das, B.C. and Das, T.K. 1995. Efficacy of GA3, NAA and ethrel on seed expression in pumpkin (*Cucurbita moschata*Poir.) cv. guamala local. *Orissa Journal of Horticulture*, **23**(1,2): 87-91.

Gadade, S.B., Kahate, N.S. and Magar, A.S. (2021). Effect of plant growth regulators on biochemical and quality aspects of lady’s finger (*Abelmoschus esculentus* L. Moench), *The Pharma Innovation Journal* **10**(6): 844-846.

Gemede, H.F., Ratta, N., Haki, G.D., Woldegiorgis, A.Z. and Beyene, F. 2015. Nutritional quality and health benefits of okra (*Abelmoschus esculentus*): A Review. *J. Food Process Technol*., **6**(6): 458.

Gupta, R., Swami, S. and Rai A.P. 2019. Impact of integrated application of vermicompost, farmyard manure and chemical fertilizers on okra (*Abelmoschus esculentus* L.) performance and soil biochemical properties. *International Journal of Chemical Studies*, 7: 1714-1718.

Khandaker, M.M., Azam, H.M., Rosnah, J., Tahir, D. and Nashriyah, M. 2018. The effects of application of exogenous IAA and GA3 on the physiological activities and quality of *Abelmoschus esculentus* (Okra) *var*. Singa 979. *Pertanika J. Trop. Agric. Sci*., **41**(1): 209-224.

Kumar, S., Chopra, S., Ayub, A., & Sharma, D. 2024. Enhancing nutrient utilization in eggplant (*Solanum melongena* L.) through integrated management approaches.

Kushwaha, R., Singh, V.K., Shukla, K.C. and Sahu, M.P. 2020. Effect of plant growth regulators on growth, yield and yield attributing characters of okra (Abelm*oschus esculentus* L.), *International Journal of Chemical Studies* **8**(5): 143-145.

Meena, D.C., Meena, M.L. and Kumar, S. 2019. Influence of organic manures and biofertilizers on growth, yield and quality of okra (*Abelmoschus esculentus* L. Moench). *Annals of Plant and Soil Research*, 21:130-134.

Singh, D., Vadodaria, J.R. and Morwal, B.R. 2017. Effect of GA3 and NAA on Yield and Quality of Okra (*Abelmoschus esculentus* L), *J Krishi Vigyan* **6**(1): 65-67.

Yadav, S. L., Topno, S. E., Bahadur, V., Prasad, V. M., & Kerketta, A. (2023). Effect of Different Organic Manure and Inorganic Fertilizer on Growth, Yield and Quality of Okra (*Abelmoschus esculentus* L.). *International Journal of Environment and Climate Change*, **13**(8), 1990-1997.