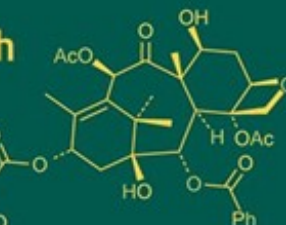


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Integrated use of biofertilizers and bio-stimulants for improved soil fertility in okra (*Abelmoschus esculentus* L.)

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ABSTRACT

A two-year field investigation was conducted during 2022–23 and 2023–24 at Gwalior, Madhya Pradesh, to evaluate “Integrated Use of Biofertilizers and Bio-stimulants for Improved Soil Fertility in Okra (*Abelmoschus esculentus* L.)”. The experiment consisted of 21 treatment combinations arranged in a randomized block design with three replications using *Pusa Bhindi-5* as the test variety. The treatments involved individual and combined applications of *Azotobacter*, phosphorus-solubilizing bacteria (PSB), potassium-solubilizing bacteria (KSB), seaweed extract and humic acid. Soil samples collected before and after crop harvest were analyzed for pH, electrical conductivity (EC), organic carbon and available N, P and K. The results demonstrated that the different biofertilizer and bio-stimulant combinations significantly modified the measured soil fertility parameters. The pooled analysis indicated that treatment T₂₁, consisting of *Azotobacter* + PSB + KSB + humic acid 4%, produced the most favourable response, with the highest values of organic carbon (0.81%), available nitrogen (147.33 kg ha⁻¹), available phosphorus (35.00 kg ha⁻¹) and available potassium (142.45 kg ha⁻¹), along with the lowest pH (7.02) and EC (0.18 dS m⁻¹). In contrast, the control treatment showed comparatively lower organic carbon and available nutrient concentrations and higher EC. The results suggest that combined application of compatible biofertilizers and bio-stimulants, particularly *Azotobacter* + PSB + KSB with 4% humic acid, can improve important soil fertility indicators under okra cultivation and contribute to better nutrient availability and soil quality.

Keywords: *Azotobacter*, PSB, KSB, Bio-stimulants, Soil fertility, Okra, Available nutrients

Introduction

Okra, scientifically identified as *Abelmoschus esculentus* (L.) Moench, is a vegetable plant from the Malvaceae family with a chromosome count of $2n = 130$. It is predominantly cultivated in tropical and subtropical areas globally. This yearly plant, also known as 'lady finger' or 'bhindi,' originated in Tropical Africa. Due to its nutritional value, delicious taste, medicinal properties, and industrial applications, Okra has become popular across diverse populations. The fibrous pods of Okra contain round seeds that are harvested when immature for consumption as a vegetable (Gaikwad *et al.*, 2021).

The extensive use of chemical fertilizers has negatively impacted soil structure and microbial populations in the soil. Moreover, the application of chemical fertilizers results in issues like nutrient loss through nitrogen leaching and phosphorus fixation. The high costs of chemical fertilizers pose a challenge for small-scale farmers to afford these costly inputs promptly. Overusing inorganic fertilizers has led to decreased nutrient absorption and a decline in vegetable quality (Tyagi *et al.*, 2016) [1].

Bio stimulants are increasingly recognized as beneficial modern farming methods used in agriculture worldwide. They contribute to improving crop quality, supporting crop health, and enhancing grower profitability. They provide effective solutions to tackle the challenges posed by the growing demand for food due to an expanding global population. The growth and yield of okra are influenced by various factors such as seed quality, nutrition, climatic conditions, and chemical substances like plant growth regulators that are used to induce changes in plants and impact growth by improving the natural growth regulation system from seed germination to aging. These substances help enhance the physiological efficiency of plants, including their photosynthetic capacity and the efficient distribution of assimilates by promoting the translocation of photo-assimilates. The use of growth promoters can scientifically boost the productivity of okra.

Biofertilizers typically contain microorganisms in either live or dormant forms that have diverse beneficial effects on plant growth. These microorganisms include nitrogen-fixing bacteria that convert atmospheric nitrogen into a usable form for plants, as well as microorganisms that solubilize phosphates and release potassium from insoluble sources (Nayak *et al.*, 2019) [2]. Biofertilizers contribute to maintaining soil fertility by

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releasing growth-promoting substances and vitamins. These substances not only enhance agricultural production but also aid in disease control by acting as antagonists and suppressing soil-borne plant pathogens (Sharma *et al.*, 2024) [3]. The presence of nitrogen-fixing, cellulolytic, and phosphate-mobilizing microorganisms in biofertilizers further enhances the diversity of plant nutrients in the soil (Singh *et al.*, 2018) [4].

Materials and methods

The materials and the methods adopted during the course of present investigation entitled “Effect of *biofertilizers* and *bio-stimulants* on soil parameters of okra (*Abelmoschus esculentus* L.) field” which was carried out during the year 2022-23 to 2023-24 under the climatic condition of Gwalior. The trial took place at the research farm of the College of Agriculture, R.V.S.K.V.V., Gwalior, located in Grid zone at a latitude of 26° 13'N and longitude 76° 10'E, at an elevation of 197 meters above mean sea level (MSL). The soil in the experimental area was alluvial, sandy clay loam in texture, categorized as typic us ochrepts at the subgroup level. The study was carried out on a 992.25 square meter area in consistently maintained plots, which had relatively even terrain with a slight incline and good drainage. The okra variety *Pusa Bhindi-5* was planted in the summer season, with a spacing of 45 cm between rows and 30 cm between plants within 21 plots, each replicated three times following a Randomized Block Design. All biofertilizers were administered via foliar spray at a rate of 2ml per liter of water after 25 days from sowing. Bio-stimulants, such as seaweed extract and humic acid, were applied via foliar spray at rates of 2% and 4% respectively after 30 days from sowing.

Table 1. Details of treatment

T ₁	Control
T ₂	<i>Azotobacter</i> + PSB
T ₃	<i>Azotobacter</i> + KSB
T ₄	PSB + KSB
T ₅	<i>Azotobacter</i> + PSB + KSB
T ₆	<i>Azotobacter</i> + PSB + Sea weed extract 2%
T ₇	<i>Azotobacter</i> + KSB + Sea weed extract 2%
T ₈	PSB + KSB + Sea weed extract 2%
T ₉	<i>Azotobacter</i> + PSB + KSB + Sea weed extract 2%
T ₁₀	<i>Azotobacter</i> + PSB + Sea weed extract 4%
T ₁₁	<i>Azotobacter</i> + KSB + Sea weed extract 4%
T ₁₂	PSB + KSB + Sea weed extract 4%
T ₁₃	<i>Azotobacter</i> + PSB + KSB + Sea weed extract 4%
T ₁₄	<i>Azotobacter</i> + PSB + Humic acid 2 %
T ₁₅	<i>Azotobacter</i> + KSB + Humic acid 2 %
T ₁₆	PSB + KSB + Humic acid 2 %

T ₁	Control
T ₁₇	<i>Azotobacter</i> + PSB + KSB + Humic acid 2 %
T ₁₈	<i>Azotobacter</i> + PSB + Humic acid 4 %
T ₁₉	<i>Azotobacter</i> + KSB + Humic acid 4 %
T ₂₀	PSB + KSB + Humic acid 4 %
T ₂₁	<i>Azotobacter</i> + PSB + KSB + Humic acid 4 %

Soil analysis (before and after experiment)

The soil samples were collected from the depth (0-15 cm) of soil profile with the help of screw and tube auger to study the impact of various fertility treatment on soil properties of experimental site. Soil samples were collected from each experimental plot before and after the crop harvest. The samples were air-dried, oven-dried, granulated using a wooden mortar and pestle and then passed through a 2 mm sieve.

Table 2. methods used for soil analysis

Soil analysis	Method	Reference
pH	pH meter	Richards (1954)
EC (dS m ⁻¹)	EC meter	Jackson (1974)
Organic carbon (%)	Walkley and Black (1965)	Walkley and Black (1965)
Available N (kg ha ⁻¹)	Alkaline KMnO ₄ method	Subbiah and Asija (1956)
Available P ₂ O ₅ (kg ha ⁻¹)	Olsen's method	Olsen <i>et al.</i> , (1954)
Available K ₂ O (kg ha ⁻¹)	Flame photometric method	Jackson (1974)

Results

An in-depth analysis of the information depicted in table 3 reveals that the lowest soil pH post-harvest was documented in treatment mixtures T₂₁ (*Azotobacter* + PSB + KSB + Humic acid 4%) and T₁₉ (*Azotobacter* + KSB + Humic acid 4%), specifically at 6.87, 7.17, and 7.02. In contrast, the highest soil pH post-harvest was registered in T₁ (control) at 7.50, 7.80, and 7.65 for the first year, second year, and overall data.

The data from table 3 indicates that the minimum soil EC (post-harvest) for the first and second years was noted in treatment combinations T₂₁ (*Azotobacter* + PSB + KSB + Humic acid 4%) and T₁₉ (*Azotobacter* + KSB + Humic acid 4%) at 0.20 and 0.17 (ds/m), respectively. Notably, T₂₁ (*Azotobacter* + PSB + KSB + Humic acid 4%) showed the lowest soil EC in the pooled data at 0.18 (ds/m). On the other hand, the maximum soil EC (post-harvest) was observed in T₁ (control) at 0.25, 0.22, and 0.23 for the first year, second year, and pooled data.

Table 3. Effect of biofertilizers and bio-stimulants on pH and EC (dS m⁻¹) after harvest

Treatments	pH (after harvest)			EC (dS m ⁻¹)		
	I st Year	II nd Year	Pooled	I st Year	II nd Year	Pooled
T ₁	7.50	7.80	7.65	0.25	0.22	0.23
T ₂	7.37	7.67	7.52	0.24	0.22	0.23
T ₃	7.27	7.57	7.42	0.23	0.20	0.21
T ₄	7.17	7.47	7.32	0.22	0.20	0.21
T ₅	7.23	7.53	7.38	0.23	0.21	0.22
T ₆	7.17	7.47	7.32	0.22	0.19	0.20
T ₇	7.07	7.37	7.22	0.21	0.19	0.20
T ₈	7.17	7.47	7.32	0.22	0.20	0.21
T ₉	7.07	7.37	7.22	0.21	0.18	0.19
T ₁₀	6.97	7.27	7.12	0.20	0.17	0.19

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Treatments	pH (after harvest)			EC (dS m ⁻¹)		
	I st Year	II nd Year	Pooled	I st Year	II nd Year	Pooled
T ₁₁	6.97	7.27	7.12	0.19	0.16	0.18
T ₁₂	7.03	7.33	7.18	0.20	0.17	0.19
T ₁₃	6.97	7.27	7.12	0.19	0.16	0.17
T ₁₄	7.17	7.47	7.32	0.25	0.22	0.23
T ₁₅	7.07	7.37	7.22	0.24	0.21	0.22
T ₁₆	7.07	7.37	7.22	0.23	0.21	0.22
T ₁₇	6.97	7.27	7.12	0.22	0.19	0.20
T ₁₈	6.93	7.23	7.08	0.21	0.18	0.19
T ₁₉	6.87	7.17	7.02	0.20	0.17	0.19
T ₂₀	6.97	7.27	7.12	0.21	0.18	0.19
T ₂₁	6.87	7.17	7.02	0.20	0.17	0.18
SEm ±	0.080	0.094	0.061	0.013	0.004	0.007
CD 5%	0.228	0.268	0.174	0.036	0.010	0.020

Upon examining the data presented in table 4, it was revealed that the highest percentage of organic carbon (after harvest) was found in treatment T₂₁ (Azotobacter + PSB + KSB + Humic acid 4 %) at 0.82, 0.80, and 0.81%. This was comparable to T₁₈, T₁₇, T₁₃, and T₁₁. Conversely, the lowest organic carbon levels (after harvest) were noted in T₁ (control) at 0.68, 0.66, and 0.67% across the first year, second year, and pooled data.

An in-depth analysis of the results in table 4 showed that the highest nitrogen levels (after harvest) were observed in treatment T₂₁ at 148.00, 146.67, and 147.33 kg/ha during the first year, second year, and pooled data. This was similar to T₁₈ and T₁₃ across the same periods. On the other hand, the lowest nitrogen content (after harvest)

was recorded in T₁ at 119.67, 117.67, and 118.67 kg/ha for the first year, second year, and pooled data.

By reviewing the data in table 5, it was determined that the maximum available Phosphorus levels (after harvest) were found in treatment T₂₁ at 36.00, 34.00, and 35.00 kg/ha, mirroring T₁₈, T₁₉, and T₁₀. In contrast, the minimum Phosphorus content was observed in T₁ at 25.00, 23.00, and 24.00 kg/ha for the first year, second year, and pooled data.

Examining the results in table 5, it was evident that the highest available Potassium levels (after harvest) were in treatment T₂₁ at 145.00, 139.90, and 142.45 kg/ha. Conversely, the lowest Potassium levels were reported in T₁ at 119.67, 114.57, and 117.12 kg/ha during the first year, second year, and pooled data.

Table 4. Effect of biofertilizers and bio-stimulants on organic carbon (%) and available Nitrogen (kg/ha) after harvest

Treatments	Organic carbon (%)			Nitrogen (kg/ha)		
	I st Year	II nd Year	Pooled	I st Year	II nd Year	Pooled
T ₁	0.68	0.66	0.67	119.7	117.7	118.7
T ₂	0.75	0.73	0.74	134.3	132.3	133.3
T ₃	0.72	0.70	0.71	130.0	128.0	129.0
T ₄	0.70	0.68	0.69	125.0	123.0	124.0
T ₅	0.76	0.74	0.75	142.3	140.3	141.3
T ₆	0.74	0.72	0.73	136.0	134.0	135.0
T ₇	0.72	0.70	0.71	132.3	130.3	131.3
T ₈	0.71	0.68	0.69	127.7	125.7	126.7
T ₉	0.75	0.73	0.74	138.7	136.7	137.7
T ₁₀	0.80	0.78	0.79	144.0	142.0	143.0
T ₁₁	0.78	0.76	0.77	142.7	140.7	141.7
T ₁₂	0.75	0.73	0.74	139.7	137.7	138.7
T ₁₃	0.80	0.78	0.79	147.7	145.7	146.7
T ₁₄	0.74	0.72	0.73	134.0	132.0	133.0
T ₁₅	0.72	0.70	0.71	131.7	129.7	130.7
T ₁₆	0.70	0.68	0.69	128.0	126.0	127.0
T ₁₇	0.76	0.74	0.75	138.0	136.0	137.0
T ₁₈	0.79	0.77	0.78	145.0	143.0	144.0
T ₁₉	0.75	0.73	0.74	143.3	141.3	142.3
T ₂₀	0.72	0.70	0.71	140.0	138.0	139.0
T ₂₁	0.82	0.80	0.81	148.0	146.7	147.3
SEm ±	0.021	0.013	0.014	1.39	1.55	1.22
CD 5%	0.061	0.036	0.039	3.97	4.44	3.48

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Table 5. Effect of biofertilizers and bio-stimulants on available Phosphorus (kg/ha) and available Potassium (kg/ha) after harvest

Treatments	Phosphorus (kg/ha)			Potassium (kg/ha)		
	I st Year	II nd Year	Pooled	I st Year	II nd Year	Pooled
T ₁	25.0	23.0	24.0	119.7	114.6	117.1
T ₂	30.0	28.0	29.0	134.7	129.6	132.1
T ₃	28.0	26.0	27.0	130.3	125.2	127.8
T ₄	26.0	24.0	25.0	125.0	119.9	122.5
T ₅	32.3	30.3	31.3	138.0	132.9	135.5
T ₆	29.0	27.0	28.0	132.0	126.9	129.5
T ₇	27.0	25.0	26.0	128.0	122.9	125.5
T ₈	26.0	24.0	25.0	126.0	120.9	123.5
T ₉	31.0	29.0	30.0	134.0	128.9	131.5
T ₁₀	33.0	31.0	32.0	140.3	135.2	137.8
T ₁₁	30.0	28.0	29.0	136.7	131.6	134.1
T ₁₂	28.0	26.0	27.0	127.0	121.9	124.5
T ₁₃	34.0	32.0	33.0	142.0	136.9	139.5
T ₁₄	29.0	27.0	28.0	129.7	124.6	127.1
T ₁₅	27.0	25.0	26.0	127.0	121.9	124.5
T ₁₆	25.0	23.0	24.0	125.0	120.2	122.6
T ₁₇	31.0	29.0	30.0	133.0	127.9	130.5
T ₁₈	35.0	33.0	34.0	143.0	137.9	140.5
T ₁₉	33.0	31.0	32.0	140.0	134.9	137.5
T ₂₀	30.0	28.0	29.0	136.0	130.9	133.5
T ₂₁	36.0	34.0	35.0	145.0	139.9	142.5
SEm ±	1.16	1.00	0.90	1.65	1.60	1.34
CD 5%	3.32	2.87	2.58	4.72	4.56	3.84

2. 2.

Discussion

According to the results, there has been an attempt to address a particular approach. It is evident from the data in tables 3 to 5 that the use of both biofertilizers and bio-stimulants had a considerable impact on various soil factors such as soil acidity, electrical conductivity, organic matter content, nitrogen availability, phosphorus levels, and potassium content.

The lowest soil pH after harvest was found in treatment combinations T₂₁ (Azotobacter + PSB + KSB + Humic acid 4 %) and T₁₉ (Azotobacter + KSB + Humic acid 4 %) at 6.87, 7.17, and 7.02, while the highest soil pH after harvest was documented in T₁ (control) at 7.50, 7.80, and 7.65 for the first year, second year, and overall data. The minimum soil EC post-harvest was noted in T₂₁ and T₁₉ at 0.20 and 0.17 (ds/m) for the first and second years, with T₂₁ recording the lowest soil EC in pooled data at 0.18 (ds/m). Conversely, the maximum soil EC after harvest was seen in T₁ at 0.25, 0.22, and 0.23 for the first year, second year, and pooled data. Treatment T₂₁ exhibited the highest organic carbon content at 0.82, 0.80, and 0.81 (%), while the lowest was observed in T₁ at 0.68, 0.66, and 0.67 (%). The maximum nitrogen content post-harvest was observed in T₂₁ at 148.00, 146.67, and 147.33 (kg/ha), whereas the minimum available nitrogen was found in T₁ at 119.67, 117.67, and 118.67 (kg/ha) for the first year, second year, and combined data. Maximum available Phosphorus was recorded in T₂₁ at 36.00, 34.00, and 35.00 (kg/ha), with the minimum in T₁ at 25.00, 23.00, and 24.00 (kg/ha). The highest available Potassium was observed in T₂₁ at 145.00, 139.90, and 142.45 (kg/ha), while the lowest was reported in T₁ at 119.67, 114.57, and 117.12 (kg/ha) for the first year, second year, and overall data.

It might be because Azotobacter plays an important role in the nitrogen cycle in nature, binding atmospheric nitrogen, which is inaccessible to plants, and releasing it in the form of ammonium ions into the soil. Azotobacter have a full range of enzymes needed to perform the nitrogen fixation: ferredoxin, hydrogenase and an important enzyme

nitrogenase. The introduction of efficient microbes (P solubilizers) in the rhizosphere has been found to increase the availability of phosphorus from both applied and native soil phosphorus. The microbial property of dissolving interlocked phosphates appears to have an important implication in agriculture. Humic acid comprises various components such as large molecules, water-repelling, water-attracting, and functional units. The water-attracting property of humic acid draws in hydrogen ions, enhancing the soil's ability to retain water. Humic acid present in organic matter, known as humus, like (HA), can greatly influence the soil's well-being and the growth of plants.

The results are in line with Katakai *et al.* (2023) [5] who conducted a research on the Arka Anamika Okra variety grown over two years in the summer season using nine different combinations of *Azospirillum* and PSB. The soil exhibited the highest quantities of accessible N, P, and K when treated with a mixture of *Azospirillum* and PSB (T₆) in conjunction with suitable compost. Soil health markers such as Microbial biomass carbon and the activities of enzymes (dehydrogenase and urease) significantly increased in soil treated with both *Azospirillum* and PSB together with optimal compost (T₆). Acid phosphatase activity was most notable in T₄ (PSB with optimal compost). Pawar *et al.* (2018) [6] conducted a study to investigate the impact of soil quality on Integrated Nutrient Management in Snowball-16 cauliflower variety. Azotobacter, Farm Yard Manure (10 t/ha), Recommended Dose of Fertilizers (120:80:40 NPK kg/ha), and *Azospirillum* (10 kg/ha) were all part of the experimental setup. According to the findings, the application of the highest INM dose—100% RDF + FYM + Azotobacter + *Azospirillum*—was linked to the highest levels of accessible nitrogen (265.66 kg/ha), available phosphorus (23.26 kg/ha), and available potassium (415.33 kg/ha). The treatment containing 75% RDF + FYM + Azotobacter + *Azospirillum* also displayed the highest organic carbon content (0.93%).

Conclusion

The present study demonstrates that soil fertility status under okra cultivation was influenced by the application of biofertilizers and bio-stimulants. Soil pH and electrical conductivity showed treatment-wise

variation, while organic carbon and the availability of nitrogen, phosphorus and potassium responded more favourably to integrated treatment combinations. Among the evaluated treatments, T₂₁ (Azotobacter + PSB + KSB + humic acid 4%) consistently recorded the most favourable values for the major soil fertility parameters. The pooled results showed higher pH (7.50), organic carbon (0.81%), available nitrogen (147.33 kg ha⁻¹), available phosphorus (35.00 kg ha⁻¹) and available potassium (142.45 kg ha⁻¹), along with lower electrical conductivity (0.18 dS m⁻¹), compared with the untreated control. Overall, the findings suggest that combined application of nitrogen-fixing and nutrient-solubilizing biofertilizers with humic acid can improve important indicators of soil fertility under okra cultivation. Therefore, integrated use of Azotobacter, PSB and KSB with 4% humic acid may be considered a promising soil-fertility management approach, although further evaluation under different soil types, locations and seasons would be useful for wider validation.

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Conflict of interest

The authors declare no conflicts of interest with any institutions or researchers involved in similar studies.

References

1. Tyagi SK, Shukla A, Mittoliya VK, Sharma ML, Khire AR, Jain YK. Effect of integrated nutrient management on growth, yield and economics of okra (*Abelmoschus esculentus* (L.) Moench) under Nimar Valley conditions of Madhya Pradesh. *International Journal of Tropical Agriculture*. 2016;34:415-419.
2. Nayak SH, Bara BM, Rai PK, Topno SE, Stella NB. Effect of organic, inorganic and bio fertilizers on growth, seed yield and quality traits of okra (*Abelmoschus esculentus* (L.) Moench). *The Pharma Innovation Journal*. 2019;8(7):468-473.
3. Sharma P, Pandey A, Bisarya SS. Impact of biofertilizers and nitrogen on growth parameters of okra (*Abelmoschus esculentus* L.). *EPRA International Journal of Agriculture and Rural Economic Research (ARER)- Peer-Reviewed Journal*. 2024;4(12):84-111.
4. Singh S, Ram RB. Effect of Organic, Inorganic and Bio-Fertilizers on Growth, Yield and Quality Traits of Okra [*Abelmoschus esculentus* (L.) Moench]. *International Journal of Current Microbiology and Applied Sciences*. 2018;7(04):2388-2392.
5. Kataki GB, Rajen P, Borah D, Mrinal NS. Fidelity of biofertilizer in okra. 2023;12:1975-1978.
6. Pawar R, Barkule S, Kirti S, Rasal D. Effect on soil health of cauliflower cultivation with Integrated nutrient management. *Journal of Applied and Natural Science*. 2018;10(3):1026-1031.
7. Jackson ML. Soil Chemical Analysis. *Journal of plant nutrition and soil science*. 1974;85(3):251-252.
8. Olsen SR, Cole CV, Watanabe FS, Dean LA. Estimation of available phosphorus in soil by extraction by sodium bi-carbonate. *USDA Circular No. 939*. 1954.
9. Richards LA. U.S.D.A. Hand Book No. 60. 1954:112 (34b).
10. Subbiah BV, Asija GL. A rapid procedure for the determination of available N in soils. *Current Science*. 1956;25(8):259-260.
11. Walkley A, Black IA. An examination of methods for determining organic carbon and nitrogen in soils. *Journal of Agricultural Science*. 1965;25(2):589-609.
12. Panse VS, Sukhatme PV. Statistical methods for Agricultural Workers. ICAR, New Delhi. 1969.
13. Gaikwad RA, Shinde SS, Shinde VS. Effect of different growth regulators on growth, flowering and quality of okra (*Abelmoschus esculentus* (L.) Moench). *Journal of Pharmacognosy and Phytochemistry*. 2001;10(1):1206-1210.

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