Published with Open Access at Journal BiNET
Vol. 22, Issue 02: 1840-1844
Journal of Bioscience and Agriculture Research
Journal Home: www.journalbinet.com/jbar-journal.html

Foliar application of Spirulina and Oscillatoria on growth and yield of okra as bio-fertilizer

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Article Received: 13.09.19; Revised: 30.09.19; Published online: 30 October 2019.

ABSTRACT

An experiment was conducted at horticulture farm, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh during April-July 2019 to evaluate the spirulina and oscillatoria as bio-fertilizer for okra production. The experiment conducted with four treatments viz. Control (T_0), Oscillatoria (T_{0s}), Spirulina (T_{Sp}) and Spirulina + Oscillatoria (T_{Sp+os}) following Randomized Complete Block Design (RCBD) with three replications. The both application of oscillatoria and spirulina treatment exhibit significant differences with other studied treatments and influenced to increase the yield (25.5%) over control. However, individual application of oscillatoria and spirulina were related to the best bio-fertilizer of okra production and increased yield (19.3% and 21.4% respectively) as compared to control. So, the effectiveness of all the treatment, individual use of oscillatoria and spirulina will be the prominent bio-fertilizer for safe and organic crops production and, both use of oscillatoria and spirulina is recommended.

Key Words: *Bio-fertilizer, bio-stimulator, spirulina, oscillatoria and cyanobacteria*

Cite Article: Jamal Uddin, A. F. M., Rakibuzzaman, M., Wasin, E. W., Husna, M. A. and Mahato, A. K. (2019). Foliar application of Spirulina and Oscillatoria on growth and yield of okra as bio-fertilizer. Journal of Bioscience and Agriculture Research, 22(02), 1840-1844.
Crossref: https://doi.org/10.18801/jbar.220219.227

I. Introduction

Soil fertility is decreasing due to continuous cultivation, soil erosion, nutrient loss and un-balanced nutrient compensation. The use of fertilizers is therefore prominent factor to enhance root growth, nutrient availability and plant resistance to pest and disease attack through agriculture yield (Huang et al, 2014). Chemical fertilizer provides essential plant nutrients which are easily available to plants improve crop yield; on the other excessive use increase production cost as well as harmful effects on environment (Adesemoye et al., 2009). Basically, residual chemicals reach to water bodies through rainwater and cause eutrophication in water bodies. It can also reduce water holding capacity, soil fertility and disparity in soil nutrients, which could further led to unfavorable condition for living microorganisms in soil (Youssef and Eissa, 2014). Bio-fertilizer is an alternative source of supply of nutrients for plant growth and provides an alternative to chemical fertilizers. It helps in waste recycling, increases in soil and plant nutrient level, improvement of animal and human life and also

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ensures an environmental friendly and low cost method of improving soil fertility and structure (Al-Shakankery et al., 2014; Aggani, 2013). The bio-fertilizer, organic manuring and bio-control of agricultural have emerged as a promising component of integrating nutrient supply system in agriculture. Microbiological fertilizers are important to environment friendly stainable agricultural practices (Bloemberg et al., 2000). Cyanobacteria is efficient biofertilizer instead of chemical fertiliozers which is beneficial for plant growth as well as crop production with enhance the ssoil quality through using organic matter to the soil (Maqubela et al., 2009). Furthermore, micro algal biomass is a rich source of metabolites in agriculture (Nirmal et al., 2018). In this concern, spirulina and oscillatoria are the cyanobacteria which are prokaryotes, are also called "blue-green algae" have the capacity to fix the atmospheric nitrogen which play role to build the soil fertility (Venkataraman, 1981) and increase yield. Hence, the present attempt has been made to study the growth promoting effect of spirulina and oscillatoria as bio-fertilizer on okra production.

II. Materials and Methods

The experiment was conducted at horticulture farm, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh during April-July 2019 to evaluate the spirulina and oscillatoria as bio-fertilizer for okra production following Randomized Complete Block Design (RCBD) with three replications. BARI-1okra variety was used in this experiment. The experiment comprised with four treatments viz. Control (T_0), Oscillatoria (T_{os}), Spirulina (T_{Sp}) and Spirulina + Oscillatoria (T_{Sp+os}). Okra seed collected from local market and spirulina, oscillatoria collected from 2abiotech lab, Sher-e-Bangla Agricultural University. In considering the treatment, 1g added in 1 liter water and after stirring, foliar application was done three times from soil to upper leaf on okra plants in the field with 15 days interval. Data on plant height, number of leaves, number of branch, chlorophyll percentage (using SPAD-5 Chlorophyll meter), ist flowering (days), no. of pod/plant, pod length (cm), pod breadth (mm), single pod weight (g), yield/plant (kg), yield/ha (t) and yield increase over control (%) were recorded and arranged accordingly for analysis done by MSTAT-C computer program. Differences between varieties were evaluated by Least Significance Difference Test (LSD) at 5% level of significance (Gomez and Gomez, 1984).

III. Results and Discussion

Different treatment showed significant impact on plant height of okra. The tallest okra plant (124.9 cm) was attained from both application of spirulina and oscillatoria (T_{Sp+os}) whereas the shortest plant (109.5 cm) was recorded from control treatment. The study found that individual application of spirulina (T_{Sp}) and oscillatoria (T_{os}) showed impact on plant height (113.5 cm and 115.7 cm) respectively over control treatment (Figure 01). Grzzesik et al. (2017) observed that, application of cyanobacteria increased plants height of willow plants. Number of leaves expressed significant inequality in okra plants grown under different foliar application. Plants with T_{Sp+Ch} treatment showed maximum number of leaves (38.0) whereas the minimum (29.3) was found in control (T_0) treatment. Leaves number of okra plants (34.3) was found in T_{sp} treatment which was followed by T_{os} treatment and they were statistically similar (Table 01). Positive result was found by Omran et al. (2003) on grapevine leaf.

All the treatment gave significant improvement over control in chlorophyll content of okra leaves. In case of T_{Sp+os} treatment, chlorophyll content was found (53.9%) which was statistically similar with T_{os} (50.9%) and T_{Sp} (50.9%) (Table 01). Different foliar application significantly affected on producing the total number of branch. More effective treatment to produce maximum number of branch was found from T_{Sp+Os} (2.7) and minimum (1.3) from T_0 (Table 01). Foliar application of spirulina and oscillatoria was accompanied with stimulating growth characters significantly compared to control treatment (Eman et al., 2008).

Days to first flowering varied significantly with different treatment. Maximum days required for first flowering (43.0) in control treatment whereas minimum days (39.3) required in T_{Sp+os} treatment. In this case, the implementation of T_{os} and T_{Sp} treatment provide the better performance (41.7 and 41.3)

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over control treatment (Table 01). Number of pod/plant was significantly varied with different treatment. Plants bearing Maximum number (21.7) of pod found in T_{Sp+Os} (spirulina + oscillatoria) and minimum number of pod (14.3) observed in (T_0) control treatment. In case of individual application ofoscillatoria and spirulina number of pod/plant (17.0 and 17.3) was found respectively and was statistically similar (Table 01). Rakibuzzaman et al. (2019) observed that foliar application of bio-fertilizer increase fruit number of brinjal as compared to control treatment. Significant variation was found for pod length (cm) in case of different treatment. Minimum pod length (12.2 cm) was obtained in control treatment whereas maximum (15.6 cm) in both application of Oscillatoria and spirulina. In case of individual application of spirulina and oscillatoria application pod length was recorded (13.9 cm, 14.1 cm) respectively and was statistically similar (Table 02).

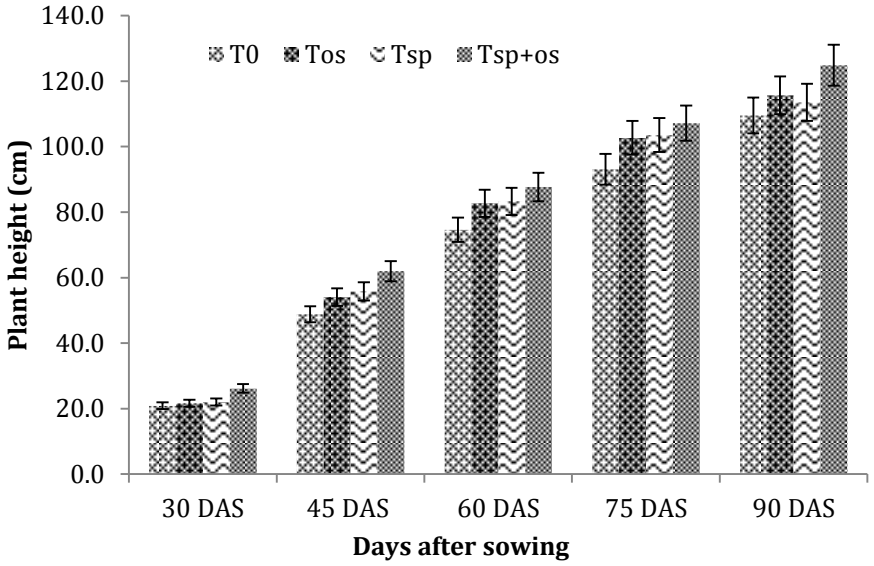

Figure 01. Influence of various treatment on plant height of Okra at different days after sowing
(Here, T_0: Control; T_{Os}: Oscillatoria; T_{Sp}: Spirulina and T_{Os+Sp}: Spirulina+ Oscillatoria)

The longest pod breadth of okra was 15.5 mm observed in (Spirulina+ Oscillatoria) application and differed with other treatments and control significantly (Table 02). The second and third highest pod breadth of okra 14.6 mm and 13.5 mm were obtained from the application of chlorella and spirulina application respectively (Table 02).

Table 01. Effect of spirulina and oscillatoria application on number of leaf, chlorophyll percentage, branch number, first flowering required days and number of pod/plant of okra

Treatment	Number of leaf	Chlorophyll (%)	Branch number	First flowering (Days)	Number of pod/ plant
T_0	29.3 c	42.4 b	1.3 b	43.0 a	14.3 c
T_{Ch}	33.7 b	50.3 a	2.0 ab	41.3 b	17.0 b
T_{Sp}	34.3 b	50.9 a	1.7 b	41.7 b	17.3 b
T_{Sp+Ch}	38.0 a	53.9 a	2.7 a	39.3 c	21.7 a
CV%	3.8	5.5	18.8	1.3	6.1
LSD	2.3	4.9	1.0	1.0	1.9

(Here, T_0: Control; T_{os}: oscillatoria; T_{Sp}: Spirulina and T_{os+Sp}: Spirulina+ oscillatoria)

The highest single pod weight (17.5g) of okra was related to (Spirulina + Oscillatoria) application and the lowest (15.9g) result revealed in control. In addition, individual application of oscillatoria and spirulina had higher single pod weight 16.8g and 16.6g respectively than control treatment (Table 02). Mahmoud (2001) observed the positive impact on wheat grain. The highest pod weight/plant (300.6g) of okra was recorded in T_{Sp+Os} treatment and the lowest (227.9g) result revealed in T_0. In addition, individual application of spirulina and oscillatoria had higher single pod weight/plant 285.7g and 288.7 respectively than control treatment (Table 02). Obioma et al. (2017) found similar result in okra.

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The maximum yield of okra (15.3t) was found from T_{Sp+Os} treatment and minimum (11.4t) was obtained from T_0 which was (25.5%) higher than control treatment. In addition, T_{Os} and T_{Sp} treatment had higher yield (14.1t and 14.5t), and yield increased (19.3% and 21.4%) over control treatment (Table 02). Similar result was found the in lettuce by Shaaban and Mobarak (2000).

Table 02. Effect of spirulina and oscillatoria application on pod length, pod breadth, pod wt., pod wt. /plant, yield/ha. and increased yield over control/ha. of okra

Treatment	Pod length (cm)	Pod breadth (mm)	Single pod wt. (g)	Pod wt./ plant (g)	Yield/ ha. (t)	Yield increased over control/ha (%)
T_0	12.2 c	12.6 d	15.9 c	227.9 c	11.4 d	_
T_{Ch}	14.1 b	14.6 b	16.8 b	285.7 b	14.1 c	19.3
T_{Sp}	13.9 b	13.5 c	16.6 b	288.7 ab	14.5 b	21.4
T_{Sp+Ch}	15.6 a	15.5 a	17.5 a	300.6 a	15.3 a	25.5
CV%	2.6	2.2	2.2	2.6	1.2	_
LSD	0.7	0.6	0.7	12.6	0.3	_

(Here, T_0: Control; T_{os}: oscillatoria; T_{Sp}: Spirulina and T_{os+Sp}: Spirulina+ oscillatoria)

IV. Conclusion

This study has shown that individual application of spirulina and oscillatoria is efficient bio-fertilizer and increased the productivity of okra. From the findings, farmers can easily apply oscillatoria and spirulina in okra field for increased the production. Furthermore, both application of spirulina and oscillatoria is more effective to increase the yield than individual application. In this concern, both application of oscillatoria and spirulina trigger more yield than individual application. So, it can be concluded that, both use of spirulina and oscillatoria is recommended for organic crop production.

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HOW TO CITE THIS ARTICLE?

Crossref: https://doi.org/10.18801/jbar.220219.227

MLA
Jamal Uddin, et al. "Foliar application of Spirulina and Oscillatoria on growth and yield of okra as bio-fertilizer". Journal of Bioscience and Agriculture Research, 22(02) (2019): 1840-1844.

APA
Jamal Uddin, A. F. M., Rakibuzzaman, M., Wasin, E. W., Husna, M. A. and Mahato, A. K. (2019). Foliar application of Spirulina and Oscillatoria on growth and yield of okra as bio-fertilizer. *Journal of Bioscience and Agriculture Research*, 22(02), 1840-1844.

Chicago
Jamal Uddin, A. F. M., Rakibuzzaman, M., Wasin, E. W., Husna, M. A. and Mahato, A. K. "Foliar application of Spirulina and Oscillatoria on growth and yield of okra as bio-fertilizer". Journal of Bioscience and Agriculture Research, 22(02) (2019): 1840-1844.

Harvard
Jamal Uddin, A. F. M., Rakibuzzaman, M., Wasin, E. W., Husna, M. A. and Mahato, A. K. 2019. Foliar application of Spirulina and Oscillatoria on growth and yield of okra as bio-fertilizer. Journal of Bioscience and Agriculture Research, 22(02), pp. 1840-1844.

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Jamal Uddin, AFM, Rakibuzzaman, M, Wasin, EW, Husna, MA and Mahato, AK. Foliar application of Spirulina and Oscillatoria on growth and yield of okra as bio-fertilizer. Journal of Bioscience and Agriculture. 2019 October 22(02): 1840-1844.

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