Research Article

Micronutrient Foliar Spray on Growth Performance of Green Gram (*Vigna radiata* L.)

Smitanjali Nayak[1], Debabrata Nayak[2], Sagarika Parida[1]*

[1]School of Applied Sciences, Centurion University of Technology and Management, Odisha, INDIA.
[2]Department of Botany, Derabish College, Derabish, Kendrapara, Odisha, INDIA.

Submission Date: 05-07-2020; Revision Date: 25-08-2020; Accepted Date: 30-08-2020

ABSTRACT

Fertilizer application is an important source to increase the production in agricultural practices. Among various cultural practices, foliar nutrition is one of the important methods as the spray of micronutrients and fertilizers facilitate easy and quick utilization of nutrients. In this study the plant growth attributes like height, number of root nodules and the chlorophyll content was observed by foliar spraying of 1% Foliar feed spray, 1% Humic acid liquid fertilizer, 2% NPK (20:20:20) and 2% MAP (12:61:00) in three replicate pots containing soil as control and in variable concentration of soil and compost in 2:1, 2:2, 3:1 and 4:1 ratio. The highest plant growth was recorded in spraying of foliar feed spray and MAP (12:61:00). Humic liquid fertilizer and NPK (20:20:20) in control conditions was found to be effective. Highest nodulation was recorded in plants treated with the foliar feed spray and MAP (12:61:00) in different soil and compost ratios. Like that in case of chlorophyll estimation it has been observed that the highest chlorophyll a (0.13 mg/g) content was found in the plants grown in foliar application of NPK fertilizers applied in soil and compost (3:1 ratio) and the highest chlorophyll b (0.22 mg/g) was recorded in the plants grown both in NPK fertilizers and humic acid fertilizer foliar application and the highest carotenoid content (1.608 mg/g) was estimated in foliar application of humic liquid fertilizer in control pots.

Key words: Chlorophyll content, Fertilizer, Foliar spray, Micronutrients, Root nodules.

Correspondence:
Dr. Sagarika Parida
School of Applied Sciences, Centurion University of Technology and Management, Odisha, INDIA.

Phone no: +91 9437670320
Email: sagarika.parida@cutm.ac.in

INTRODUCTION

Green gram is one of the important pulse crop of India. It is one of the third prime pulse crop after chick pea and pigeon pea. It is a self-pollinated grain legume, rich in protein, iron and high fibre content. Root nodule is the characteristic features of green gram which contains nitrogen fixing bacteria *Rhizobium*. *Rhizobium* is known to improve soil fertility. Green gram is a dicotyledonous plant having a scientific name *Vigna radiata* L. R.Wilczek, commonly called as green gram belonging to the family Fabaceae. It is an annual herbaceous, short duration and drought tolerant crop and can grow well under varied conditions (irrigated and rain fed). Fertilizer application is an important source to increase the production in agricultural practices. Among various cultural practices for fertilizer application, foliar nutrition is one of the important methods as the spray of micronutrients and fertilizers facilitate easy and quick utilization of nutrients both by osmotic diffusion and penetration through stomata in to the leaf cells. Increase in productivity of yield is given more importance to fulfil the protein requirement of growing population of country. It is a warm season crop and requires low inputs and serves as good source of seed protein. Therefore high yielding varieties is being required. To enhance the productivity of the crops, the application of fertilizers in a balanced amount by appropriate methods and the management practices like irrigation, plant production are required. The green gram response to the fertilisers applied varies greatly in relation with the cultivated area and varieties along with other plant protection measures. Green gram can fix biological N_2 in root nodules and an important feature of green gram is that it can establish a symbiotic partnership with specific bacteria.[1,2] Nutrients are an

SCAN QR CODE TO VIEW ONLINE

www.ajbls.org

DOI : 10.5530/ajbls.2020.9.36

essential component required for plant growth and development. By the application of a small amount of plant growth substance can bring changes in the phenotypes by stimulating the natural growth regulatory system from seed germination to harvesting periods. Plant growth regulators improve the physiological efficiency including photosynthetic ability and helps in the emergence of flower, pod and seed development increasing productivity.[3] Foliar feeding of plants are very effective than soil application.[4] Green gram seeds contain about 25% protein which is almost three times that of cereals. It is consumed in the form of split pulse as well as whole pulse and is an essential supplement of cereal based diet. Nitrogen is essential for synthesis of amino acids, proteins, NADH, ATP, carbohydrates and proteins.[5] Chlorophyll content in leaf tissue plays an important role and also is the important index to manage chemical and fertilizer application.[6,7] Nitrogen, potassium and phosphorus play an important role in development of root, flower and pods. Uptake of these nutrients directly associated with the growth and yield of the crop.[8]

MATERIALS AND METHODS

Experimental Site

Pot experiment was conducted from November, 2019 to February, 2020 at Centurion University campus, Bhubaneswar. The pot experiments were conducted in different soil conditions for studying the influences of foliar spray of different micronutrients viz. Foliar feed spray, Humic liquid fertilizer, NPK (20:20:20) and MAP (12:61:00) and its impact on vegetative growth, chlorophyll content and nodulation of green gram.

Pot Preparation

Before sowing the seeds the pots were prepared by filling the pots with soil and farm yard compost in four replicates. 4 pots are filled with only soil and another 4 are filled with soil and compost in the ratio of 1:2, 2:2, 1:3 and 1:4.

Sowing of Seed

The seeds are pre- soaked overnight for better germination. Then the germinated seeds were shown in the soil in four replicates in variable proportion of soil and farm yard compost in 1:2, 2:2, 1:3 and 1:4 ratios along with control pot containing only soil. The seeds were sown in January 9, 2020.

Foliar Spray

Foliar spray is an important method for feeding the plants by applying liquid fertilizer directly to the leaves. Absorption of fertilizers takes place through the stomata and by the epidermis. Different micronutrients viz. Foliar feed spray, Humic liquid fertilizer, NPK (20:20:20) and MAP (12:61:00) were purchased from Amazon India. Micronutrient solution was prepared by taking 1 ml of foliar feed spray and organic humic liquid fertilizers separately in 250 ml of water and sprayed on seedlings grown on control pots containing only soil and also on seedlings grown on pots containing soil and compost in different ratio as shown in Table 1. Similarly spraying solution of NPK and MAP was prepared by taking 2 gm of NPK with 250 ml of water separately. Spraying was done with this micronutrient solution at various stages of vegetative crop growth in early morning or just after sunset as cited in Table 1. The fertilizers were sprayed to observe plant growth, to determine chlorophyll content and to study nodulation pattern in green gram. Observations were taken at regular interval. For each observation three replications were made.

Estimation of Chlorophyll Pigment

Chlorophyll content was estimated by following Arnon's method.[9] About 5 to 7 leaves was collected from each pot and total eight samples were collected at the pod formation stage to determine the chlorophyll contents using Arnon's method. Approximately 1 gm of leaf was was taken and homogenized in 5 ml of 80% acetone using mortar and pestle and transferred to centrifuge tubes. Then these were centrifuged at 5000 rpm for 10 min and a clear green coloured supernatant was collected in the test tubes and the absorbance was read at 663.2 and 646.8 and 470 nm on a spectrophotometer. The chlorophyll and carotenoid content was determined using the following equations:

Chlorophyll a = 12. 25 (A663.2) – 2.79 (A646.8) x V/1000 x W

Chlorophyll b = 21.50 (A646.8) – 5.10 (A663.2) x V/1000 x W

Carotenoid = 100(A470) – 1.82 chl a + 85.02 chl b x V/1000 x W

Where,

A663.2 = Absorbance at 663.2 nm

A646.8 = Absorbance at 646.8 nm

A470 = Absorbance at 470 nm

V = Total volume of the extract (ml)

W = Weight of the sample (g)

Number of Nodules

Nodules were collected randomly selected from 4 to 5 plants from each pot at pod formation stage. Few plants were excavated by digging and washed under running tap water and the number of nodules per plant was counted.

RESULTS

Plant Height

The Table 2 represents the effect of application of different micronutrients on shoot length of green gram at various stages of growth (25, 35 and 45 DAS). Minimum growth was noticed in plants subjected to foliar feed spray grown in only soil but maximum growth was observed in plants grown in soil and compost in 2:1 ratio. Like that minimum growth was noticed in foliar spraying in plants grown in soil in case of humic liquid fertilizer and maximum growth was observed in soil and compost in 2:2 ratios. In case of NPK fertilizers in both soil condition and in soil and compost 3:1 ratio medium growth was observed. Like that in case of MAP fertilizer in both soil and in soil and compost (4:1 ratio) medium growth was observed.

Impact on Nodulation

The application of fertilizer gave an inhibitory effect on the increase of number of nodules. In case of foliar feed spray, less number of nodules was formed in controlled condition but in soil and compost 2:1 condition maximum numbers of nodules were formed. Like that in case of humic liquid fertilizers in both only soil and in soil and compost in 2:2 ratio, less number of nodules were formed. In case of NPK fertilizers in both control and in soil and compost in 3:1 ratio, less numbers of nodules were formed. And in case of MAP fertilizers, less number of nodules were formed but in soil and compost in 4:1 ratio, maximum numbers of nodules were formed (Table 1; Figure 1).

Effect on Chlorophyll Content

Data depicted in Table 3 reflects the effect of micronutrients on chlorophyll and carotenoid content. The chlorophyll a, chlorophyll b and carotenoid content of green gram were found to be appreciably affected by the different micronutrient application. The chlorophyll a and b content of leaves collected from seedlings treated with foliar feed spray in control pots was 0.10 mg/g and 0.19 mg/g respectively and carotenoid content was estimated 1.20 mg/g and in soil and compost (2:1 ratio) the Chl a, Chl b was 0.11 mg/g and 0.21 mg/g respectively and carotenoid content was 1.601 mg/g. Humic acid liquid fertilizer in control condition the Chl a and Chl b content was estimated to be 0.11 mg/g and 0.22 mg/g respectively and carotenoid content was 1.608 mg/g, in soil and compost (2:2 ratio) Chl a and Chl b content was 0.11 mg/g and 0.21 mg/g respectively and carotenoid content was 1.603mg/g. Chl a and Chl b content was 0.11 mg/g and 0.22 mg/g respectively in control plants sprayed with NPK fertilizer and carotenoid content was 1.607 mg/g and in soil and compost ratio (3:1 ratio) the Chl a and Chl b content was 0.13 mg/g and 0.19 mg/g respectively and carotenoid content was 1.605mg/g.

Table 1: Effect of Foliar Nutrients on Nodulation of Plants.

Micronutrients	Nodules/Plant				
	Plants Grown on Soil (Control)		Plants Grown on Soil Mixed With Compost		
	Number of Nodules/ Plant (Minimum)	Number of Nodules/ Plant (Maximum)	Soil: Compost Ratio	Number of Nodules/Plant (Minimum)	Number of Nodules/ Plant (Maximum)
Foliar Feed Spray	3	5	2:1	13	17
Humic Acid Liquid Fertilizer	2	3	2:2	4	7
NPK 20:20:20	2	3	3:1	3	5
MAP 12:61:00	4	6	4:1	6	22

Table 2: Impact of Micronutrient Foliar Application on Growth.

Growth	Average Growth of Plants (Shoot Length in cm)							
	Foliar Feed Spray		Humic Acid Liquid Fertilizer		NPK 20:20:20		MAP 12:61:00	
	*Control	Soil:Compost (2:1)	Control	Soil:Compost (2:1)	Control	Soil:Compost (2:1)	Control	Soil:Compost (2:1)
25 **DAS	6	14.5	8	16.5	9	11	11.5	14
35 DAS	6.5	16.5	9.5	14.5	11.5	11.5	12	14.5
45 DAS	9	18	13	15.5	11.5	14	13	16

*Control: Soil; *DAS: Days after Sowing

Table 3: Effect of Micronutrients on Chlorophyll and Carotenoid Content.

Micronutrients	Chlorophyll Content (mg/g)						
	Plants Grown on Soil (Control)			Plants Grown on Soil Mixed With Compost			
	Chl a	Chl b	Carotenoid	Soil: Compost	Chl a	Chl b	Carotenoid
Foliar Feed Spray	0.10	0.19	1.20	2:1	0.11	0.21	1.601
Humic Acid Liquid Fertilizer	0.11	0.22	1.608	2:2	0.11	0.21	1.603
NPK 20:20:20	0.11	0.22	1.607	3:1	0.13	0.19	1.605
MAP 12:61:00	0.10	0.16	1.31	4:1	0.11	0.21	1.51

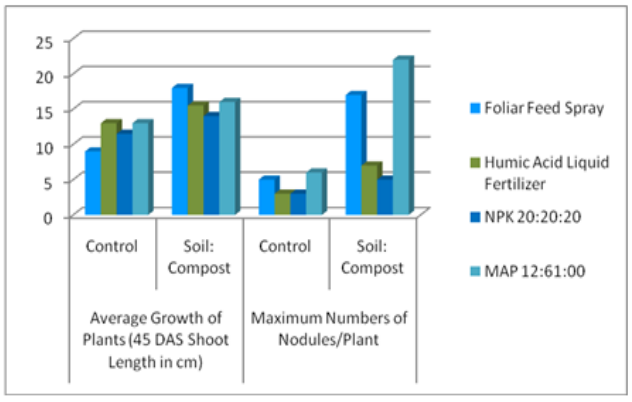

Figure 1: Shoot Length (45 DAS) and Maximum Number of Nodules/Plant.

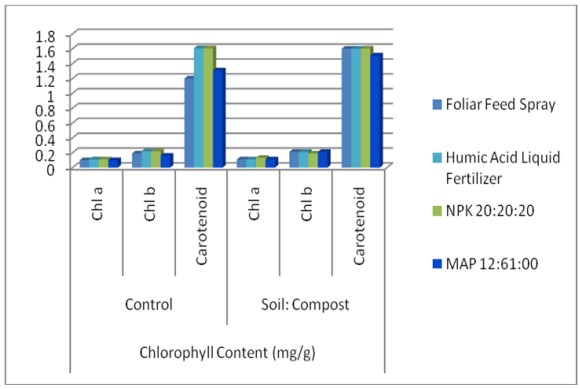

Figure 2: Estimation of Pigments in Response to Different Micronutrient Foliar Spray.

Chl a and Chl b content was 0.10 mg/g and 0.16 mg/g respectively in and carotenoid content was 1.31 mg/g in control seedlings when applied with MAP fertilizer foliar application. and in soil and compost (4:1 ratio) the Chl a and Chl b content was estimated to be 0.11 mg/g and 0.21 mg/g respectively and carotenoid content was 1.51 mg/g in MAP fertilizer spraying. Highest amount of Chl a was estimated from the leaf samples collected from the seedlings subjected to foliar spaying of NPK (20:20:20) and maximum amount of Chl b and carotenoid was estimated from the leaves collected from the plants sprayed with Humic Acid Liquid Fertilizer (Figure 2).

DISCUSSION

The present experiment showed the effective growth of green gram and increased number of nodules per plant by the foliar application of different micronutrients. Different micronutrients were applied by foliar application after 25 days of sowing of seeds. The spraying of fertilizers through the leaves was found to be very effective and significantly showed the acceleration in growth patterns. Initiation of flowering was noticed after 45 days of sowing and after 50 days of sowing pod formation started. Four different types of micronutrients was sprayed i.e. the foliar feed spray, humic liquid fertilizer, NPK 20:20:20 and MAP 12:61:00. Among them the foliar feed spray and the MAP 12:61:00 were proved to be the most effective for growth of green gram in different soil conditions. Humic liquid fertilizer and NPK 20:20:20 was proved to be effective in accelerating plant growth when applied to the soil. These micronutrients were also proved to be effective in nodule formation and increase in nodule number per plant. The fertilizers like the foliar feed spray and the MAP had shown effective in increasing the number of nodules per plant in different treated soil. Similarly in case of chlorophyll estimation it has been observed that the highest chlorophyll a (0.13 mg/g) content was found in the plants grown in NPK fertilizers applied in soil and compost 3:1 condition and the highest chlorophyll b (0.22 mg/g) was found in the plants grown in NPK fertilizers applied soil and the highest carotenoid content (1.608 mg/g) was estimated in the plants grown in humic liquid fertilizer applied soil. Literature data revealed that chlorophyll content was varied according to seasons[10] and enhanced yield of green gram was also observed in green gram (*Vigna radiata* L.).[11]

CONCLUSION

Foliar spray can be done according to the deficiency of the nutrients in the soil. From this study it was found that foliar fertilization was proved to be the effective technique in improving crop growth and yields. The efficiency of foliar application of fertilizer was higher than the conventional method. Atmospheric nitrogen fixation is triggered by root nodule bacteria and increase in root nodule in foliar treated plants enhanced the yield.

ACKNOWLEDGEMENT

The authors are thankful to the faculties of Department of Botany, Horticulturist Mr. Prasanna Kumar Sethi and the gardeners of Centurion University, Bhubaneswar Campus for their immense help during this work.

CONFLICT OF INTREST

The authors declare no conflict of interest.

ABBREVIATIONS

Chl: Chlorophyll; **DAS:** Days after Sowing; **MAP:** Monoammonium phosphate; **NPK:** Nitrogen, Phosphorus, Potassium.

REFERENCES

1. Mahmood A, Athar M. Cross inoculation studies: Response of *Vigna mungo* to inoculation with *Rhizobia* from tree legumes growing under arid Environment. Int J Environ Sci Technol. 2008;5(1):135-9.
2. Mandal S¸ Mandal M, Das A. Stimulation of indoleacetic acid production in a *Rhizobium* isolate of *Vigna mungo* by root nodule phenolic acids. Arch Microbiol. 2009;191(4):389-93.
3. Solamani A, Sivakumar C, Anbumani S, Suresh T, Arumugam K. Role of plant growth regulators on rice production: A review. Agric Rev. 2001;22(1):33-40.
4. Kazemi M. Effect of foliar application with SA and methyl jasmonate on growth, flowering, yield and fruit quality Tomato. Bull Env Pharmacol Life Sci 2013;3(2):154-8.
5. Ophardt CE. Virtual Chem Book. 2003. Retrieved from http:// www.elmhurst. edu/ ~chm/vchembook/index.html.
6. Haboudane D, Miller JR, Tremblay N, Zarco-Tejada PJ, Dextraze L. Integrated narrow-band vegetation indices for prediction of crop chlorophyll content for application to precision agriculture. Remote Sensing of Environment. 2002:81(2- 3):416-26.
7. Wu C, Niu Z, Tang Q, Huang W. Estimating chlorophyll content from hyperspectral vegetation indices: Modelling and validation. Agricultural and Forest Meteorology. 2008;148(8-9):1230-41.
8. Rathore AC, Raizad A, Jayaprakash J. Performance of Phalsa (*Grewia subinaequalis* Lin.) through intergrated nutrient and canopy management of saline soils of the Indo-Gangetic plains. Indian Journal of Soil Conservation. 2008;36(1):42-7.
9. Arnon D. Copper enzyme isolated chloroplasts, polyphenoloxidase in *Beta vulgaris*. Plant Physiology. 1949;24(1):1-15.
10. Chowdury MR, Kohri JK. Seasonal variations in chlorophyll content and chlorophyllase activity in Bangla and Mithra varieties of betelvine (*Piper bettle* L.) grown in different soil treatment. Plant Physiology. 2003;48:115.
11. Das A, Parida S. Integrated Plant Protection Measures and Micronutrient Foliar Spray on Growth and Yield of Green Gram (*Vigna radiata* L.). Indian Journal of Natural Sciences. 2020;10(59):18269-76.

Cite this article: Nayak S, Nayak D, Parida S. Micronutrient Foliar Spray on Growth Performance of Green Gram (*Vigna radiata* L.). Asian J Biol Life Sci. 2020;9(2):234-8.