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Impact of Foliar Application of Fertilizers on Growth and Seed Yield of *Vigna mungo* L.

*Sagarika Parida[1], Ananya Mishra[1], Aliva Das[2]

[1]Department of Botany, School of Applied Sciences, Centurion University of Technology and Management, Odisha, India

[2]Krishi Vigyan Kendra, Angul

***Corresponding author's e-mail:** sagarika.parida@cutm.ac.in

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, leaf area, number of root nodules, dry weight of nodules per plant, number of pods per plant and number of grains per plant, and seed yield of black gram was observed by foliar spraying of 1% of DAP, 1% of CaNO3, 2% of KCl and 2% of $ZnSO_3$ in the improved variety PU 35. Soil analysis was done prior to sowing to determine the elemental composition and soil fertility status of soil and thereby any deficiencies. All the growth attributes was found to be maximum in plants grown in the plot with recommended dose of fertilizer in soil along with foliar application of 1% $CaNO_3$ treated crops than in conventional method of cultivation.Highest nodulation was recorded in plants from the plot treated with both RDF and foliar application of 1% $CaNO_3$ followed by RDF with 2% of Di-ammonium phosphate (DAP), RDF with foliar application of 2% $ZnSO_3$ and RDF with Potassium chloride (2%) having 33.7, 32.6, 31.8 respectively.It was observed that foliar application of micronutrients resulted in maximum yield of 4.6 to 5.5 q/ha in improved variety PU 35 as well as the existing variety "Khuntibiri". But improved variety PU 35 showed higher yield over existing variety.

Keywords: Fertilizer, foliar spray, micronutrients, root nodules, soil Fertility, yield

Introduction

Many facets are there for interpreting sustainable development. Land is a limit resource to meet the earth's growing population. Therefore innovation in agriculture farming is the one of the useful practice to enhance the agricultural production. 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 stomatain to the leaf cells. This found to be a valuable method to increase the growth and yield of plant produce. Data stated that the amount of fertilizer in foliar application is reduced in comparison to conventional method through soil. Apart from that it resulted in crop yields. Time of nutritional uptake by the plant was also found to be reduced (Ahmed and Jabeen 2005). Since 1950's foliar fertilization in agricultural practices has been a well accepted practice by the farmers after knowing the effectiveness. It was also evident from the literature data that radioisotopes were used for foliar application to observe the path of foliar applied fertilizers and found that it was passed through the leaf cuticle into other cells (Brasher et al. 1953). Data revealed that application of a little amount of nutrients like nitrogen, potash or phosphates by foliar spraying enhances yield of crops significantly (Rauthan and Schnitzer, 1981, David et al. 1994, Asenjo et al. 2000). This technique is convenient for micronutrients and also can be practiced for major nutrients like nitrogen, phosphorous and potassium. Several applications at time interval are required to meet the nutritional requirement of the crop. Foliar application reduces the requirement of soil applied fertilizer and therefore leaching and run off of nutrients is reduced. Ahmed and Jabeen (2005) found that the foliar spray of mineral nutrients antagonistic to sodium was responsible to induce salt tolerance in plants growing under saline condition.This agricultural cultivation practice reduces the impact of fertilizers on the environment. Pulses constitute essential part of human diet and are the promising cheapest source of protein for human beings and are considered as "the meat of the poor" (Hamjah 2014).

Black gram (*Vigna mungo* L.) is an important crop of India and can be grown on variable soils from sandy loam to heavy cotton soils.This prefers well drained loam soil with a pH 6.5 to 7.8. The crop is resistant to unfavorable climatic conditions. This crop fixes atmospheric nitrogen

because of symbiotic association of Rhizobium and formation of root nodules and thereby the soil fertility is improved. It contains high amount of proteins, potassium, calcium, iron, niacin, thiamine and riboflavin. Because of improper management like use of old variety, sowing of seeds without seed treatment with fungicides to inhibit the growth of seed born fungi, heavy weed infestation, infection of crops due to insect, pest and disease infestation, delay or absence of plant protection measures resulted in low yield. Mir et al. (2010) reported the response of crops in relation to plant growth regulators and nutrients. Therefore this study was performed to study the impact of foliar fertilization of black gram to observe the impact on the growth and seed yield.

Materials and Methods

Experimental site

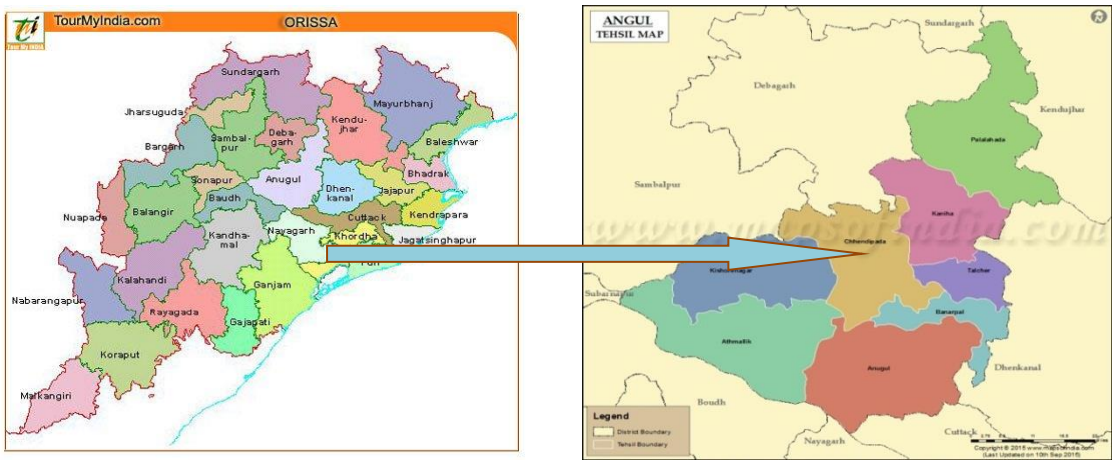
Field experiments were conducted at the farmer's field in Sankhapur village of Angul district, Odisha during 2018-2019 to determine the result of foliar micronutrients on growth and yield of black gram in *Rabi* crops.Black gram variety PU 35 was used by the farmers in the experimental area as it was provided by Krishi Vigyan Kendra, Panchamahala, Angul.

Land preparation and Experimental outline

Land preparation was done conventionally by cleaning the left over residues of the previous crops followed by ploughing using the rotavator. Randomized complete block design was done with three replications. The various treatments were performed in the plots measuring 8 m2 (4 mx 2m) within a block. Cow dung manure was added. Subplots were made for carrying different parameter testing. The plot was fertilized with basal doses of NPK at the rate of 60, 10, 15 kg per hectare respectively.

Soil testing

Soil testing was done to optimize crop production and to know the nutritional content of the soil and accordingly foliar application of nutrients was done to balance the nutritional requirement of black gram crops. Random soil samples were collected before the addition of manure from three different sites of the experimental plot up to the depth of 6 to 30 cm by cutting the land in 'V' shape. Chemical analysis of soil was done to know the properties of soil and its elemental composition.



(**Fig. 1.**Odisha map showing map of Angul district)

Treatment of seeds

Seed treatment was done with *Rhizobium* and phosphorus solubilizing bacteria (PSB) at the rate of 200gm and 250 gm per 10 kg of seeds. Seed treatment was done with mixture of 1 gm of carboxin with 1.5gm of thiramper kg of seeds to inhibit seed borne pathogen.

Sowing of seed

Sowing of seeds of black gram was done by broad casting method in mild winter as a *Rabi* crop. Sowing was done during mid September to first week of October.Seeds were treated with a mixture of 1 gm of carbendazim with 1.5 gm of Thiram per kg of seed before sowing to disinfect from the soil borne pathogenic fungi present on seed surface. The seeds were subjected to 200gm

of*Rhizobium* culture with 250 gm of phosphate solubilising bacteria (PSB) per kilogram of seeds. Row to row distance was kept nearly about 25 cm.

Foliar spray

The spraying of 2% Di-ammonium phosphate (DAP), 2% of potassium chloride, 1% $CaNO_3$and2% $ZnSO_3$was done during late afternoon hours when wind speed and intensity of sunshine period was minimum. Foliar feeding was done at vegetative stage before two weeks of flowering.

Results

Composition of soil

It was evident from table 1 total four soil samples were collected from Sankhapur village. These samples were tested to know the nutritional composition of the soil. Different parameters like pH, electrical conductivity (EC), organic carbon, available Nitrogen (N), Phosphorous (P), Potassium (K), Sulphur(S), Boron (B), Ferrous (Fe), and Zinc (Zn) were estimated and depicted in Table 1. It was observed in Table 1 that pH of the samples of Sankhapur village varied from 5.38 to 5.64. Percentage of organic carbon and available nitrogen content varied from 0.46 and 0.53. But Carbon, Potassium, Sulphur, Boron Ferrous and Zinc content was found to be maximum of 0.53%, 1.96 ppm, 4.86 ppm, 0.53 ppm, 4.25 ppm and 0.51 ppm respectively from the soil sample number 4. Soil fertility status of 1stsoil sample showed minimum organic carbon (0.46%), P (7.8), N (0.179) and K (1.58 ppm), Sulphur (3.14 ppm), Boron (0.35 ppm), Ferrous (0.34 ppm) and Zinc (0.45 ppm).It was observed that zinc was the most deficient nutrient.

Table 1. Initial soil status of experimental plot of Sankhapur village, Angul District

Sample no.	pH	EC (dSm^{-1})	Organic Carbon	Nitrogen (%)	Phosphorous (ppm)	Potassium (ppm)	Sulphur (ppm)	Boron (ppm)	Ferrous (ppm)	Zinc (ppm)

			(%)							
1	5.38	0.148	0.46	0.179	7.8	1.58	3.14	0.35	0.34	0.45
2	5.53	0.152	0.52	0.209	10.2	1.76	3.25	0.39	0.35	0.46
3	5.42	0.136	0.45	0.225	7.5	1.65	3.05	0.42	0.27	0.44
4	5.64	0.176	0.53	0.265	15.6	1.96	4.86	0.53	4.25	0.51

Table 2. Impact of different foliar application on growth and pod yield

Treatment no.	**Treatment**	**Average Plant height (cm)**	**Avg. Leaf area index**	**No. of pods/plant**	**No. of grains/pod**
1	Control	24.59	0.36	9.1	4.6
2	Recommended dose of fertilizer(RDF)	27.2	0. 41	11.2	5.8
3	RDF + Di-ammonium phosphate (DAP)	28.89	0.46	13.7	6.2
4	RDF + Potassium chloride (2%)	28.63	0.45	11.6	6.4
5	RDF + foliar application of 1% $CaNO_3$	30.23	0. 63	14.3	6.8
6	RDF + foliar application of 2% $ZnSO_3$	26.92	0 .54	14.2	6.7

The data depicted in Table 2 revealed that the height of the plant, average leaf area, number of pods per plant and number of grains per pod varied to a great extent by different fertilizer application through foliar spray. It was observed that maximum plant height was attended by plants treated with recommended dose of fertilizers with foliar application of 1% $CaNO_3$ followed by RDF and Di-ammonium phosphate (DAP) over conventional grown crops. Number

of grains also was more in mixture of RDF and foliar application of 1% $CaNO_3$ with 6.8 grains per pod over the control and RDF treated plots.

Impact on nodulation

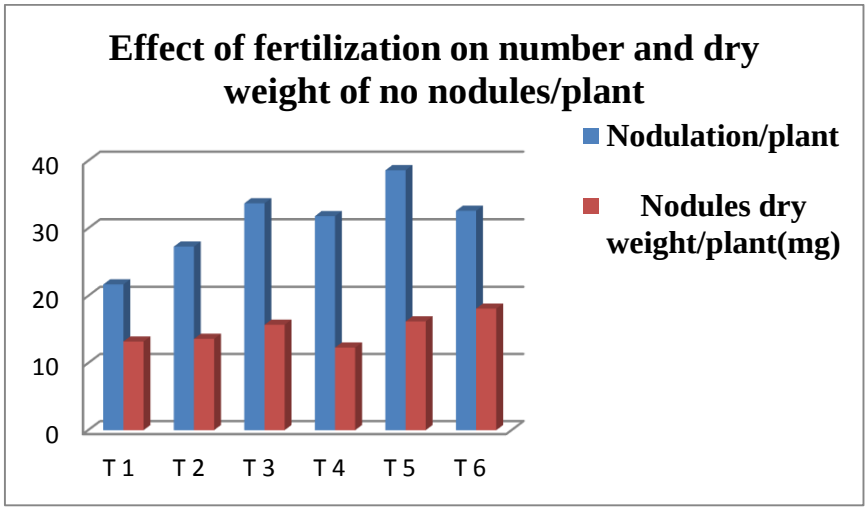
The number of nodules and dry weight of nodules per plant was differed in control and foliar treated crops. Maximum number of nodules of 31.33 per plant was recorded in foliar application of nutrients and dry weight of nodules was found to be 13.7 mg where as in conventional method of cultivation. 20.67 nodules per plant were recorded and the dry weight was found to be of 7.67 mg per plant.

Table 3. Effect of foliar nutrients on nodulation of plants

Treatment No.	Treatment	Nodulation/plant	Nodules dry weight/plant(mg)
T 1	Control	21.7	13.2
T 2	RDF	27.3	13.6
T 3	RDF + Di-ammonium phosphate (DAP)	33.7	15.7
T 4	RDF + Potassium chloride (2%)	31.8	12.3
T 5	RDF + foliar application of 1% $CaNO_3$	38.6	16.2
T 6	RDF + foliar application of 2% $ZnSO_3$	32.6	18.1

The number of nodules and dry weight of nodules per plant was differed in control and foliar treated crops. Maximum number of nodules of 38.6 per plant was recorded in plants withrecommended dose of fertilizer (RDF) with 1% $CaNO_3$foliar spray. Dry weight of nodules was also found to be high of16.2 mg in RDF with1% $CaNO_3$ foliar spray than in conventional method of cultivation. Lowest root nodules of 21.7 per plant were recorded in randomly

collected control plants. The dryweight of nodules was also low and was found to be of 13.2 mg per plant in control plants without any fertilizer application in soil. An increase in nodulation of 33.7 was observed from the plots subjected to RDF with DAP. Highest nodulation was recorded in plants from the plot treated with both RDF and foliar application of 1% $CaNO_3$followed by RDF with Di-ammonium phosphate (DAP), RDF with foliar application of 2% $ZnSO_3$ and RDF with Potassium chloride (2%) having 33.7, 32.6, 31.8 respectively (Fig. 1).



(**Fig. 1** Effect of fertilization on number and dry weight of no nodules/plant**)**

Table 4. Effect of foliar nutrients on yield of existing and improved variety

Yield Obtained (q/ha)	
Khunti biri	**Improved variety (PU-35)**
4.1	4.6 to 5.5

The data in Table 4 indicated the seed yield of existing black gram variety "khunti biri" and improved variety PU 35 after foliar fortification. Maximum yield of 4.6 to 5.5 q/ha was obtained from improved variety PU 35 than the existing variety "Khunti biri".

Discussions

Number of pods per plant was found to be highest in the plants grown in soil treated with RDF with foliar application of 1% $CaNO_3$. Mir et al. (2010) also reported that flower drop was reduced and pod formation was enhanced with seed setting percentage with foliar application of growth regulators like NAA. Root nodules were also found to be increased in the plants treated with foliar spraying of micronutrients. Increase in yield and nutrients composition in soya bean was also reported by Haq and Mallaniro (2000) when the crop was subjected to early season foliar application. It was also reported that micronutrient application as foliar spray of TNAU pulse significantly recorded higher yield by Hamayun (2011).

Conclusions

Soil testing is an important factor and 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. Further study has to be done on the composition of elements in the produce both under conventional and foliar application grown crops.

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Quality agricultural products are required in order to meet social needs and agriculture has direct impact on environment.

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