www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.03
TPI 2020; 9(11): 349-352

www.thepharmajournal.com
Received: 26-08-2020
Accepted: 08-10-2020

Meenakhi Prusty
Regional Research and Technology Transfer Station, Dhenkanal, Odisha University of Agriculture & Technology, Bhubaneswar, Odisha, India

MA Alim
Regional Research and Technology Transfer Station, Dhenkanal, Odisha University of Agriculture & Technology, Bhubaneswar, Odisha, India

Debashish Swain
Regional Research and Technology Transfer Station, Dhenkanal, Odisha University of Agriculture & Technology, Bhubaneswar, Odisha, India

Monika Ray
Regional Research and Technology Transfer Station, Keonjhar, Odisha University of Agriculture & Technology, Bhubaneswar, Odisha, India

Corresponding Author:
Meenakhi Prusty
Regional Research and Technology Transfer Station, Dhenkanal, Odisha University of Agriculture & Technology, Bhubaneswar, Odisha, India

Effect of lime coating and molybdenum on the yield and nutrient uptake of green gram (*Vigna radiata* L.) under mid central table land zone of Odisha

Meenakhi Prusty, MA Alim, Debashish Swain and Monika Ray

DOI: https://doi.org/10.22271/tpi.2020.v9.i11f.5378

Abstract
The field experiment was carried out at Regional Research and Technology Transfer Station (OUAT), Mahisapat of Dhenkanal district during *kharif* season of 2017 and 2018 to study the response of lime coating and molybdenum influencing the yield and nutrient uptake of green gram under Mid Central Tale Land zone of Odisha. The experiment was laid out in a randomized block design with four replications comprising of six treatments. The detailed of the treatments are as follows. T_1-Soil Test Based Fertilizer Recommendation (STBFR), T_2- Soil Test Based Fertilizer Recommendation (STBFR) + Rhizobium inoculation@ 20gkg^{-1} of seed + PSB @4 kgha^{-1}, T_3- Soil Test Based Fertilizer Recommendation (STBFR) + Rhizobium inoculation@ 20gkg^{-1} of seed + PSB @4 kgha^{-1} + FYM @5 tha^{-1}, T_4- Soil Test Based Fertilizer Recommendation (STBFR) + Rhizobium inoculation@ 20g kg^{-1} of seed + PSB @4 kg ha^{-1} + FYM @5 t ha^{-1} +Lime 0.2 LR, T_5- Soil Test Based Fertilizer Recommendation (STBFR) + Rhizobium inoculation@ 20g kg^{-1} of seed + PSB @4 kgha^{-1} + FYM @5 tha^{-1} + seed coating with lime, T_6- Soil Test Based Fertilizer Recommendation (STBFR) + Rhizobium inoculation@ 20gkg^{-1} of seed + PSB @4 kgha^{-1} + FYM @5 tha^{-1} + Molybdenum(1g Ammonium Molybdate per 2.5 kg of seed as seed treatment) + seed coating with lime. It was revealed that T_6 recorded significantly higher seed yield (877.50 kg ha^{-1}), 1000 seed weight (37.93 g) and No. of seeds per pod (12.43) followed by $T_5$with seed yield (827.50 kg ha^{-1}), 1000 seed weight (37.58 g) and no. of seeds per pod (8.92). T_6 was superior over T_1 with the yield advantage of 34.5 % and B: C (1.76). The Concentration of nutrient N,P,K in the harvested seed was also found highest in T_6 i.e. 5.27 %, 0.51% and 1.53 % followed by T_5 having concentration of 5.07%,0.47 % and 1.47 % respectively. The same treatment T_6 recorded higher uptake of N, P and K with 35.35, 6.62 and 20.47 kg ha^{-1} in the harvested seed, respectively.

Keywords: Green gram, FYM, STBFR, molybdenum, PSB (Phosphorus solubilizing bacteria)

Introduction
Pulses are one of the important segments of Indian agriculture after cereals and oilseeds. They are the main source of protein particularly for vegetarians and contribute about 14 percent of the total protein of average Indian diet. Considering the importance of pulses, WHO recommends 80 g of pulse per adult per day in daily diet. The per capita availability of pulse in Odisha is improving gradually as a consequence of increase in cultivated area but not the productivity. Pulses are primarily used as human food and are also used as forage and partial green manure (Pattanayak *et al*., 2008) [8]. Besides the food pulses fix atmospheric Nitrogen ranging from 25-55 kg ha^{-1} annum^{-1} (Pattanayak *et al*., 2016) [11]. It improves soil organic matter content, soil fertility, limit soil degradation and conserve the soil. The pulse crops are soil recuperative crops, hence cultivated in many cropping situations as a pure crop, intercrop and mixed crop. India is the largest producer (18.5 million tons) as well as importers of pulses which imports around 3.5 million tons annually to meet its over increasing consumption need of around 22.0 million tons. India is contributing around 25 percent of total global consumption. Among pulses chick pea, pigeon pea, green gram and black gram are produced in India.

Green gram is the major pulse crop which ranks third next to gram and red gram and is the third important pulse crop of India, grown in nearly 8% of the total pulse area of the country (GOI, 2013). It has special importance in intensive crop production system of the country for its short growing period. India shares about 35-37% and 27% of the total area and production of pulses, respectively in the world. The calorific value of green gram is 334 calories per 100 g and its chemical composition is as follows: crude protein 24.0%, fat 1.3%, carbohydrate 56.6%, minerals 3.5%, lysine 0.43%, methionine 0.10% and tryptophan 0.04%

(Kachroo, 1970) [6]. In Odisha green gram is cultivated in an area of 8.33 lakh ha with a production of 0.396 million tones and productivity of 476 kg/ha. Out of which Rabi green gram is cultivated in area of 602230 ha with a production of 0.287 million tones and a productivity of 477 kg ha^{-1} (OAS, 2012-13). The low yields of green gram are due to imbalance application of fertilizers.

In Odisha more than seventy percent soil is acidic, out of which more than 25 % need immediate liming having pH < 5.5 (Pattanayak and Sarkar, 2016) [12]. In acidic soil crop productivity is constrained by Aluminum (Al) and Iron (Fe) toxicity, Phosphorus (P) deficiency, low base saturation, impaired biological activity and other acidity induced plant nutritional problems (Kumar *et al*., 2012) [7]. Soil acidity inhibits root elongation and nodule formation which reduce nitrogen fixation.

Rhizobium bio-fertilizer which is used for leguminous crops fixes nitrogen symbiotically. By use of bio-fertilizer the crop yield is increased by 20-30 % replacing chemical nitrogen and phosphatic fertilizer by 25 % and stimulate plant growth (Pattanayak and Rao, 2014) [10]. Liming is an old age practice in ameliorating acid soils. Liming practice improves the physical condition of soil by improving granulation of soil particles, favoring aeration. It also increases water holding capacity leading to better root growth. Lime application @0.2 LR for dicot and 0.1 LR for monocot have been recommended. These are to be side dressed or to be placed below the root zone, mixed with the FYM or any other organic sources to each crop grown in the soils having pH <5.5 instead of broadcasting and incorporation into the soil (Pattanayak *et al*., 2011) [9]. Molybdenum also plays an important role in structural interring of cell wall and cell membrane and synthesis of protein as well as nitrogen fixation. Molybdenum is required for the formation of the nitrate reductase enzyme and in legumes it plays an additional role in symbiotic nitrogen fixation (Janaki *et al*., 2018) [5].

Materials and methods

A field experiment was conducted at Regional Research and Technology Transfer Station situated at Mahisapat of Dhenkanal district in Mid Central Table Land Zone of Odisha under Odisha University of Agriculture and Technology during *kharif* season of 2017 & 2018. The farm is located in the geographical parallels between 20^0-3'and 21^0-16' North latitudes and 84^0 and 86^0-6' East longitude. The important soil groups of the zone are alluvial (Entisol), black (Vertisol), red-laterite (Alfisol) and lateritic (Oxisol). The soil of experimental site was red, sandy loam in texture & acidic in reaction (pH=5.58) with available N (240 kg ha^{-1}), available P_2O_5 (13.5 kg ha^{-1}) & available K_2O (170 kg ha^{-1}). The experiment was laid out in RBD with six treatments and four replications. The detailed of the treatments are as follows. T_1-Soil Test Based Fertilizer Recommendation (STBFR), T_2-Soil Test Based Fertilizer Recommendation (STBFR) +Rhizobium inoculation@ 20gkg^{-1}of seed +PSB @4 kgha^{-1}, T_3-Soil Test Based Fertilizer Recommendation (STBFR) + Rhizobium inoculation@ 20gkg^{-1}of seed +PSB @4 kgha^{-1} +FYM @5 tha^{-1}, T_4- Soil Test Based Fertilizer Recommendation (STBFR) + Rhizobium inoculation@ 20gkg^{-1}of seed +PSB @4 kgha^{-1} +FYM @5 tha^{-1} +Lime 0.2 LR, T_5- Soil Test Based Fertilizer Recommendation (STBFR) + Rhizobium inoculation@ 20gkg^{-1}of seed +PSB @4 kgha^{-1} +FYM @5 tha^{-1} +seed coating with lime, T_6- Soil Test Based Fertilizer Recommendation (STBFR) + Rhizobium inoculation@ 20gkg^{-1}of seed + PSB @4 kg ha^{-1} + FYM @5 t ha^{-1} + Molybdenum @ 1 g Ammonium Molybdate per 2.5 kg of seed as seed treatment + seed coating with lime. The green gram seed (cv. TARM-1) was sown with seed rate of 25 kg ha^{-1} with a row spacing of 30 cm. The intra-row spacing of 10 cm was maintained by thinning operation. As per the treatment specificity seeds are inoculated with Rhizobium @ 20 g kg^{-1} of seed. The inoculated seeds are again coated with lime using sago as sticker in the specific treatments. The water soaked sago was boiled in hot water to form jelly like sticking property and allowed for cooling. It was poured into a container containing Rhizobium inoculated green gram seeds and lime. Then it was rotated and shaken in a manner so that lime gets coated on each seed (25 kg seed required for one hectare land needs 4 kg lime for coating). Phosphorus Solubilizing Bacteria (PSB @ 4 kg $ha^{-1)}$) was applied to the soil as per the treatment. Molybdenum @ 1 g Ammonium Molybdate per 2.5 kg of seed as seed treatment was done as per the treatment. The thinning & weeding operations were carried out on 15 & 21 days after sowing. The soil test dose (25:50:20 N P_2O_5 K_2O kg ha^{-1}) was applied to the crop as per treatment. Full dose of P, K & ½ N in the form of DAP, MOP & Urea, respectively were applied as basal and rest ½ N after three weeks of sowing. The crop was harvested at physiological maturity. Data on growth parameters (No. of branches/plant and plant height) were taken just before harvesting and the yield parameters such as no. of pods/plant, no. of seeds /pod,1000 seed wt. (g),, gross yield (kg per plot) were recorded from the sample plants just after harvesting. Five plants were randomly selected for this purpose from each plot in such a way so that border effect could be avoided. Initial and post-harvest soil samples were collected following the procedure. The composite soil samples were collected treatment wise after harvest and analyzed as per the standard procedure. The plant samples were analyzed for the major nutrients by the standard methods (Chopra *et al*., 1978) [2]. The statistical analysis was done as per the procedure given by Gomez and Gomez, 1984 [4].

Results and Discussion

Table 1: Yield and yield attributing characters of green gram (cv.TARM-1) influenced by seed coating and lime application

S No	Treatments	Plant height (cm)	No. of branches/plant	No. of pods/plant	No. of seeds/pod	1000 seed wt. (g)	Yield (kg/ha)	% Increase in yield	B:C
1	Soil Test Based Fertilizer Recommendation (STBFR)	50.15	5.90	9.33	5.55	35.00	652.50	-	1.44
2	STBFR +Rhizobium inoculation@ 20gkg^{-1}of seed +PSB @4 kgha^{-1}	51.84	6.57	10.28	6.47	36.28	770.00	18.1	1.60
3	STBFR+Rhizobium inoculation@ 20gkg^{-1}of seed +PSB @4 kgha^{-1} +FYM @5 tha^{-1}	51.96	7.35	12.40	7.92	36.38	775.00	18.8	1.50
4	STBFR+ Rhizobium inoculation@ 20gkg^{-1}of seed +PSB @4 kgha^{-1} +FYM @5 tha^{-1} +Lime 0.2 LR	53.36	7.87	13.80	8.65	37.30	812.50	24.5	1.53

5	STBFR+ Rhizobium inoculation@ 20gkg^{-1}of seed +PSB @4 kgha^{-1} +FYM @5 tha^{-1} +seed coating with lime	53.72	8.50	16.28	8.92	37.58	827.50	26.8	1.66
6	STBFR+ Rhizobium inoculation@ 20gkg^{-1}of seed +PSB @4 kgha^{-1} +FYM @5 tha^{-1} +Molybdenum +seed coating with lime	54.33	8.87	17.18	12.43	37.93	877.50	34.5	1.76
S.E m (±)		0.11	0.12	0.14	0.13	NS	15.83	-	-
CD (P=0.05)		0.32	0.37	0.41	0.39	-	47.72	-	-

Growth and Yield Attributes

T_6 (STBFR+ Rhizobium inoculation@ 20 g kg^{-1} of seed + PSB @ 4 kg ha^{-1} + FYM @5 t ha^{-1} + Molybdenum(1g Ammonium Molybdate per 2.5 kg of seed as seed treatment) + seed coating with lime) recorded higher plant height (54.33 cm), number of branches per plant (8.87),number of pods per plant (17.18) and number of seeds per pod (12.43) followed by T_5(STBFR+ Rhizobium inoculation@ 20 g kg^{-1} of seed + PSB @ 4 kg ha^{-1} + FYM @5 t ha^{-1} + seed coating with lime) with 53.72 cm, 8.50 nos., 16.28 nos. and 8.92, respectively. The cumulative effect of bio-fertilizer, lime coating and Molybdenum in T_6 contributed towards better availability and uptake of plant nutrients by the crop reflected as increased plant height and other growth parameters (Table -1). This result has been in conformity with Janaki *et al*., 2018 [5].

Yield

T_6 (STBFR+ Rhizobium inoculation@ 20 g kg^{-1} of seed + PSB @ 4 kg ha^{-1} + FYM @5t ha^{-1} + Molybdenum(1g Ammonium Molybdate per 2.5 kg of seed as seed treatment) + seed coating with lime) recorded significantly higher seed yield (877.50 kg ha^{-1}) with a yield advantage of 34.5 % over T_1 (STBFR).The combined effect of (STBFR along with bio fertilizer, lime coating and Molybdenum performed better as compared to STBFR alone. Similarly T_6 was superior over the treatments with higher 1000 seed weight of 37.93 g. This treatment was followed by T_5 (STBFR+ Rhizobium inoculation@ 20 g kg^{-1}of seed + PSB @ 4 kg ha^{-1} + FYM @5 t ha^{-1} + seed coating with lime) having yield of 827.50 kg ha^{-1} and 1000 seed weight of 37.58 g. Rhizobium inoculation, Phosphorus application and seed treatment with Molybdenum enhance the yield of summer green gram (Bhattacharyya *et al*., 2001) [1].

Economics

The highest B:C (1.76) was obtained from T_6 (STBFR+ Rhizobium inoculation @ 20 g kg^{-1}of seed + PSB @ 4 kg ha^{-1} + FYM @5 t ha^{-1} + Molybdenum (1g Ammonium Molybdate per 2.5 kg of seed as seed treatment) + seed coating with lime) followed by T_5(STBFR+ Rhizobium inoculation @ 20 g kg^{-1}of seed + PSB @ 4 kg ha^{-1} + FYM @ 5 tha^{-1} + seed coating with lime) with B:C value of 1.66. However, the lowest B: C was indicated under the treatment only with STBFR (1.44).

Table 2: Concentration of Nutrients (%) in the Harvested Seed and Stover

Treatment	N Content (%)		P Content (%)		K Content (%)	
	Seed	Stover	Seed	Stover	Seed	Stover
T_1	3.47	1.64	0.27	0.13	1.22	1.20
T_2	4.22	1.82	0.31	0.22	1.31	1.38
T_3	4.55	2.06	0.35	0.31	1.38	1.46
T_4	4.92	2.18	0.41	0.37	1.44	1.51
T_5	5.07	2.22	0.47	0.39	1.47	1.61
T_6	5.27	2.34	0.51	0.43	1.53	1.66
S.Em(±)	0.12	0.03	0.01	0.01	0.01	0.03
CD (P=0.05)	0.37	0.10	0.04	0.04	0.04	0.09

The highest available nitrogen, phosphorus and potassium content in the seeds and stover were (5.27% & 2.34 %), (0.51% & 0.43%) and (1.53% & 1.66%) in T_6 followed by (5.07% & 2.22 %), (0.47% & 0.39%) and (1.47% & 1.61%) in T_5 (Table.2). The lowest NPK content was found in T_1 (STBFR). The highest NPK content in the seeds and Stover was found in T_6 due to higher assimilation of nutrients in that treatment (Pati *et al.*, 2016) [13].

Table 3: Uptake of Nutrients in the Harvested Seed and Stover

Treatment	N (kg/ha)		P (kg/ha)		K (kg/ha)	
	Seed	Stover	Seed	Stover	Seed	Stover
T_1	16.45	12.77	3.62	1.23	10.62	4.62
T_2	20.65	14.12	4.15	1.29	12.52	5.57
T_3	23.40	15.55	4.97	1.39	15.37	6.17
T_4	26.07	16.12	5.35	1.52	17.67	7.27
T_5	31.02	17. 52	6.10	1.57	19.12	7.97
T_6	35.35	18.12	6.62	1.70	20.47	8.75
S.E m(±)	0.28	0.21	0.17	0.03	0.32	0.26
CD (P=0.05)	0.84	0.64	0.50	0.08	0.94	0.77

Uptake of Nutrients in the Harvested Seed and Stover

Application of different sources like Molybdenum and seed coating with lime enhanced nutrient uptake by green gram crop (Table - 3). T_6 (STBFR+ Rhizobium inoculation @ 20 g kg^{-1}of seed + PSB @ 4 kg ha^{-1} + FYM @ 5 t ha^{-1} + Molybdenum(1g Ammonium Molybdate per 2.5 kg of seed as seed treatment) + seed coating with lime) recorded higher uptake of N, P and K both in seed and stover with (35.35

&18.12), (6.62 &1.70) and (20.47 & 8.75) kg ha-[1], respectively. The treatment T_5 (STBFR+ Rhizobium inoculation@ 20 g kg^{-1}of seed + PSB @ 4 kg ha^{-1} +FYM @ 5 t ha^{-1} + seed coating with lime) also recorded N, P, and K uptake both in seed and stover to the tune of (31.02&17.52), (6.10 & 1.57) and (19.12 &7.97) kg ha-[1], respectively (Pati *et al*., 2016) [13].

Nutrient status of post-harvest soil

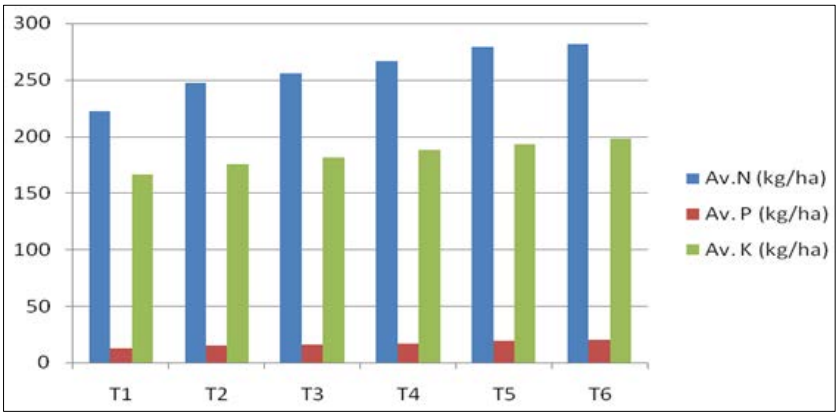

Fig. 1: Nutrient status (kg ha-[1]) of Post-harvest soil

The results revealed that management of micronutrients, lime and bio-fertilizers in the form of seed treatment with molybdenum and bio-fertilizers and seed coating with lime had prominent effect on availability of major nutrients in the soil. Presence of favourable soil environment and essential macro and micro nutrients might have promoted the nodule bacteria for nitrogen fixation as well as enhanced the availability of nitrogen, phosphorous and potassium in the soil. Srivastava and Varma (1995) [14] recorded increased nitrogen and phosphorus content of soil through addition of nitrogen, phosphorus and molybdenum in the cultivation practice.T_6 (STBFR + Rhizobium inoculation @ 20 g kg^{-1}of seed + PSB @ 4 kg ha^{-1} + FYM @ 5 t ha^{-1} + Molybdenum(1g Ammonium Molybdate per 2.5 kg of seed as seed treatment) + seed coating with lime) recorded higher N, P and K status in the post harvest soil having 281.75, 20.12 and 197.75 kg ha$^{-1,}$ respectively. This result confirmed with the result of Chatterjee *et al*., 2017 [3].

Conclusion

From the experimental finding it was concluded that STBFR+ Rhizobium inoculation @ 20 g kg^{-1}of seed + PSB @ 4 kg ha^{-1} + FYM @5 t ha^{-1} + Molybdenum(1g Ammonium Molybdate per 2.5 kg of seed as seed treatment) + seed coating with lime recorded the higher seed yield of 877.50 kg ha-$_1$ and B:C of 1.76 with yield advantage of 34.5 % over STBFR. The nutrient status of the post-harvest soil also improved in the same treatment. Seed coating with lime found to be more effective than that of soil lime application. The same treatment recorded higher uptake of N, P and K both in seed and stover with (35.35 &18.12), (6.62 &1.70) and (20.47 &8.75) kg ha-$_1$, respectively.

References

1. Bhattacharyya J, Pal AK. Effect of *Rhizobium* inoculation, phosphorus and molybdenum on the growth of summer green gram (*Vigna radiate* L. Wilezek). Journal of Interacademicia 2001;5(4):450-457.
2. Chopra SL, Kanwar JS. Analytical Agricultural Chemistry, Kalyani Publisher, Ludiana, 1978.
3. Chatterjeea R, Bandopadhaya S. Effect of boron, molybdenum and bio fertilizers ongrowth and yield of cowpea (*Vignaunguiculata*L. Walp.) In acid soil of eastern Himalayan region. Journal of the Saudi Society of Agricultural Sciences 2017;16:332-336.
4. Gomez KA, Gomez AA. Statistical Procedures for Agricultural Re-search (2nd Ed). John Wiley & Sons, New York, 1984, 28-192.
5. Janaki Movalia A, Parmar KB, Vekaria LC. Effect of boron and molybdenum on yield and yield attributes of summer green gram (*Vigna radiata* L.) under medium black calcareous soils. International Journal of Chemical Studies 2018;6(1):321-323.
6. Kachroo P. Pulse crops of India. ICAR, New Delhi, 1970, 148.
7. Kumar M, Hazarika S, Choudhury BU, Ramesh T. Liming and integrated nutrient management for enhancing maize productivity on acidic soils of north east India. Indian journal of Hill Farming 2012;28(1):35-37.
8. Pattanayak SK, Rao DLN. Bulletin of Bio fertilizers for Tropical vegetables. ANP on Bio fertilizers-OUAT, Bhubaneswar, 2008.
9. Pattanayak SK, Mishra UK, Sarkar AK. Integrated nutrient management of ground nut and residual gram on acid soils of Odisha. Better Crops, South Asia 2011;5(1):8-10.
10. Pattanayak SK, Rao DLN. Technical Bulletin on Bio fertilizers improve Tribal Livelihood in Odisha. ANP on Soil- Biodiversity –Bio fertilizers (ICAR), OUAT, Bhubaneswar, 2014, 1-27p.
11. Pattanayak SK, Sarkar A. Sustainable management of Acid soils: Technologies and their Transfer. Indian Journal of Fertilizers 2016;12(7):16-24 & 3.
12. Pattanayak SK. Biological Nitrogen fixation –Status Potential and Prospects in Supplementing Nitrogen needs of the crops. Indian Journal of Fertilizers 2016;12:94-103.
13. Pati S, Pattanayak SK. Encapsulation of green gram seed with lime influencing its productivity and quality. P.G thesis submitted to OUAT, Bhubaneswar, 2016.
14. Srivastava SNL, Varma SC. Effect of nitrogen, phosphorus and molybdenum fertilization on growth, nodulation and residual fertility in field pea. Indian J Agric. Res 1995;19(3):131-137.