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Effect of *rhizobium* and molybdenum inoculation on yield, economics, nodulation and nitrogen uptake in mungbean (*Vigna radiata* L.)

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Abstract
The study was carried out through front line demonstrations during *rabi* seasons of 2015-16 and 2016-17 to study the effect of *Rhizobium* and molybdenom inoculation on yield, economics, nodulation and nitrogen uptake in mungbean. The demonstration results showed that the improved practice of seed inoculation with *Rhizobium* and molybdenom recorded 41.6 % higher seed yield (9.82 q ha^{-1}), harvest index (29.74 %), production efficiency(15.11 kg ha^{-1} day^{-1}) and extension gap(2.89 q ha^{-1}) than farmer's practice. The same also produced higher plant height (47.0 cm), branches $plant^{-1}$(6.0), pods $plant^{-1}$(26.95), seeds pod^{-1}(9.47), nodules $plant^{-1}$ (13.06) and nodule dry weight (2.32 mg $plant^{-1}$) with a mean increase of nitrogen uptake 62.1% and 39.2 % by seed and stover respectively. The improved practice also recorded higher gross return of Rs.50070.75 ha^{-1}, B: C ratio (2.55), profitability (Rs.83.33 ha^{-1} day^{-1}) with additional net return of Rs.13102.63 ha^{-1} and can effectively replace the farmer's practice for higher yield, income, nodulation and nitrogen uptake in mungbean.

Keywords: molybdenom, mungbean, nitrogen uptake, nodulation, *rhizobium*, yield

Introduction
Green gram or mungbean (*Vigna radiata* L.) is the third most important food legumes grown and consumed in India including Odisha comparatively of shorter duration and is a good source of proteins and minerals and It is the major pulse crop of Odisha with a total coverage of 0.86 million hectare and the area under greengram crop in Angul district is 0.03 million hectare with a productivity of 0.42 t/ha which is much lower than the potential yield (Samant *et al*., 2013) [7]. Mungbean can be grown under wide range of soil types. It is grown usually as *rainfed* crop and can also be grown as pre-monsoon and late monsoon crop. Although, chemical fertilizers are playing a crucial role to meet nutrient requirement of the crop. Persistent nutrient depletion is posing a greater threat to the sustainable agriculture. Therefore, there is an urgent need to reduce the usage of chemical fertilizers and in turn increase in the usage of organics which needed to check the yield and quality levels. Use of organics alone does not result in spectacular increase in crop yields, due to their low nutrient status (Subba Rao and Tilak, 1977) [10]. Therefore, the aforesaid consequences have paved way to grow mungbean using organic and inorganic manures along with biofertilizers. *Rhizobium* spp. invades the root hairs of mungbean and result in formation of nodules, where free air nitrogen is fixed. These bacteria, although present in most of the soils vary in number, effectiveness in nodulation and N-fixation. It has been urged that usual native soil rhizobial populations are inadequate and are ineffective in biological nitrogen fixation. To ensure an optimum rhizobial population in rhizospere, seed inoculation of legumes with rhizobial strain is necessary. This helps improve nodulation. N_2-fixation solicits crop growth and yield of leguminous crops (Henzell, 1988) [3].

Although, mungbean crop is capable of fixing atmospheric nitrogen through *Rhizobium* species living in root nodules, however, under our agro ecological situations, the nodulation of the crop is poor and is major cause of lower yield. It was observed that inoculation of mungbean with *Rhizobium* spp. increased plant height, leaf area, photosynthetic rate and dry matter production (Thakur and Power, 1995) [11]. Unfavorable environmental conditions are major cause of poor stand establishment and low crop yield. However rapid germination of seedlings could emerge and produce deep root before the upper layers of the soil are dried and crusted, which may results better crop establishment and higher crop yield.

One way for achieving good crop stand, enhanced Biological Nitrogen fixation (BNF) capacity of legumes and getting more benefit from low fertile soils is seed priming which is a technique in which germination processes begin but radical emergence does not occur. Application of *Rhizobium* with seed priming significantly increased nodulation and nitrogenase activity, but had little effect on yield (Umair *et al.*, 2011) [13]. Therefore, Keeping in view such importance of priming for improved yield, nodulation and nitrogen uptake in mungbean, farmer's participatory field demonstrations were conducted to study the effect of seed inoculation on yield, economics, nodulation and nitrogen uptake in mungbean.

Materials and Methods

The study was carried out through front line demonstrations during *rabi* seasons of 2015-16 and 2016-17 in two villages *i.e. Ragudiapada and Baragaunia of* Angul district in mid central table land zone of Odisha with the active participation of farmers after different extension approaches to study the effect of *Rhizobium* and molybdenom inoculation on yield, economics, nodulation and nitrogen uptake in mungbean. The soil of the study area was slightly acidic in reaction (pH-5.42 to 6.18), loam in texture with medium organic carbon content(0.31 to 0.43 %), medium in nitrogen (189.6 to 290.6 kg ha^{-1}), low in phosphorus (10.3 to 12.7 kg ha^{-1}) and medium in potassium(182 to 278 kg ha^{-1}). Ten farmers were selected and they were supplied with inputs like *Rhizobium a*nd *Sodium molybdate*. The mungbean crop was grown with recommended package of practices in 0.1 ha by each farmer during both the year. The farmer's practices involved indiscrimate use of fertilizers. The improved practice included seed inoculation with *Rhizobium* and sodium molybdate. Mungbean *cv. OBGG 52* was sown 3rd week of December and harvested during 4th week of February in both the years of demonstrations. Observations on different yield parameters were taken and economic analysis was done by calculating cost of cultivation, gross return, net return and B: C ratio. Final crop yield (seed & stover) were recorded and the gross return were calculated on the basis of minimum support price, prevailing market price of the produce. Harvest index is the relationship between economic yield and biological yield (Gardner *et al.*, 1985) [1]. and it was calculated by using the Following formula:

$$\text{Harvest index (\%)} = \frac{\text{Economic yield}}{\textit{Biological yield}} \times 100$$

Production efficiency value was calculated with using formula by Tomar and Tiwari, (1990) [12]. Extension gap as calculated by the formula suggested by Samui, *et al*. (2000) [9].

Extension gap = Demonstration yield-Farmers yield.

Available soil nutrients and their uptake by seed and stover were determined following the standard procedures (Jackson, 1973) [4] at the end of each year. Tabular analysis involving simple statistical tools like mean was done by standard formula to analyses the data and draw conclusions and implications (Gomez and Gomez, 1984) [2].

Results and Discussion

Seed yield, stover yield and harvest index

Results of front line demonstrations (Table 1) indicated that the improved practice of seed inoculation with *Rhizobium* and molybdenum recorded seed yield 9.82 q ha^{-1} which was 41.6 % higher than that of farmer's practice. The improved practice also produced higher stover yield (23.21q ha^{-1}) and harvest index (29.74 %). The increase in seed and stover yield in mungbean might be attributed to high vegetative growth owing to availability of nitrogen in soil during vegetative growth period. This might be owing to enhanced germination, higher pod and grain production. Similar results were also obtained by Vitnor *et al*. (2015) [14].

Production efficiency and extension gap

The production efficiency (Table 1) was higher in improved practice (15.11 kg ha^{-1} day^{-1}) in comparison to local check due to more seed yield. Higher extension gap (3.96 q ha^{-1}) was found during 2015-16 and lower (1.81 q ha^{-1}) was during 2016-17. The new improved technologies might have a positive impact on farming community and will eventually lead to the farmers to discontinue the traditional method and to adopt new technology (Samant, 2014) [8].

Table 1: Effect of *Rhizobium* and molybdenum inoculation on yield, production efficiency and extension gap of mungbean

Year	Seed yield (q ha^{-1})		Stover yield (q ha^{-1})		Harvest index (%)		% of increase in seed yield over local check	Production efficiency (kg ha^{-1} day^{-1})		Extension gap(q ha^{-1})	
	IP	FP	IP	FP	IP	FP		IP	FP	IP	FP
2015-16	12.38	8.42	27.46	22.53	31.07	27.21	47.03	19.05	12.95	3.96	-
2016-17	7.26	5.45	18.95	12.54	27.7	30.3	33.21	11.17	8.38	1.81	-
Mean	9.82	6.394	23.21	17.54	29.74	28.34	41.60	15.11	10.67	2.89	-

* IP: Improved technology (Rhizobium and molybdenum inoculation in seed); FP: Farmer's practice (Indiscriminate use of chemical fertilisers)

Plant height, branches $plant^{-1}$, pods $plant^{-1}$, seeds pod^{-1}, nodules $plant^{-1}$ and nodules dry weight

The improved practice also produced (Table 2) higher plant height (47.0 cm), branches $plant^{-1}$(6.0), pods $plant^{-1}$ (26.95), seeds pod^{-1}(9.47), nodules $plant^{-1}$ (13.06) and nodule dry weight (2.32 mg $plant^{-1}$) in comparison to farmer's practice. The increase in nodules per plant due to application of *Rhizobium* inoculation in combination with sodium molybdate (Zammurad *et al*., 2006) [15]. These observations were also in agreement with findings of Patel *et al*. (2016) [6].

Table 2: Effect of *Rhizobium* and molybdenum inoculation on plant height, no of branches $plant^{-1}$, pods $plant^{-1}$, seeds pod^{-1}, nodules $plant^{-1}$ and nodule dry weight of mungbean

Year	Plant height		No of branches $plant^{-1}$		No of pods $plant^{-1}$		No of seeds pod^{-1}		No of nodules $plant^{-1}$		Nodules dry weight (mg $plant^{-1}$)	
	IP	FP	IP	FP	IP	FP	IP	FP	IP	FP	IP	FP
2015-16	45.7	38.5	6.3	5.4	26.5	15.3	9.2	6.4	12.5	7.3	2.28	1.38
2016-17	48.28	45.31	5.70	4.80	27.4	16.34	9.74	6.52	13.62	8.25	2.37	1.45
Mean	47.0	41.91	6.0	5.10	26.95	15.82	9.47	6.46	13.06	7.78	2.32	1.42

Nitrogen uptake by seed and stover

The improved practice of *Rhizobium* and molybdenum inoculation recorded higher nitrogen uptake by seed as well as stover than farmer's practice during both the years. Nitrogen uptake by improved practice (Figure 1) found 52.93 and 25.28 kg ha^{-1} which was 80.5 and 33.5% higher than farmer's practice during the year 2015-16 & 2016-17 respectively. Over all there was a mean increase of nitrogen uptake 62.1% observed in farmers practice during the study period. This might be due to better root system and nodulation which extracted proper moisture and nutrition for plant growth. Similar trend of nitrogen uptake by stover (Figure 2) was observed during both the year. Improved practice showed 42.7 and 33.6% higher nitrogen uptake as compared to farmer's practice during the year 2015-16 & 2016-17 respectively. The results obtained in this study were found in accordance with Umair *et al*. (2011) [13].

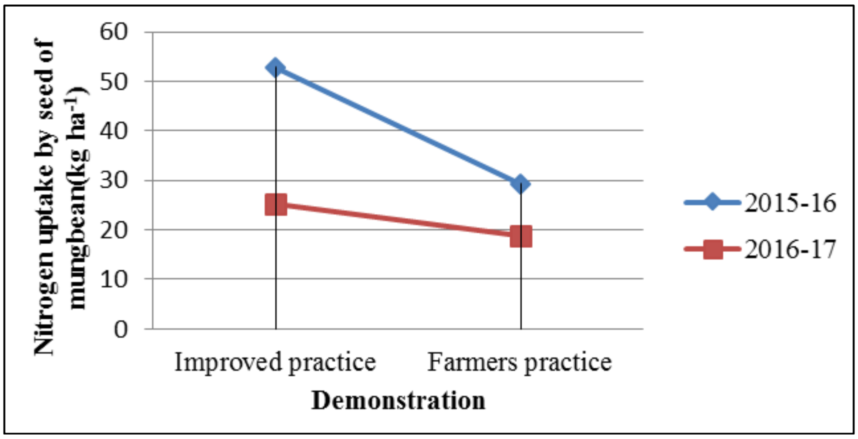

Fig 1: Effect of *Rhizobium* and molybdenum inoculation on nitrogen uptake by seed of mungbean

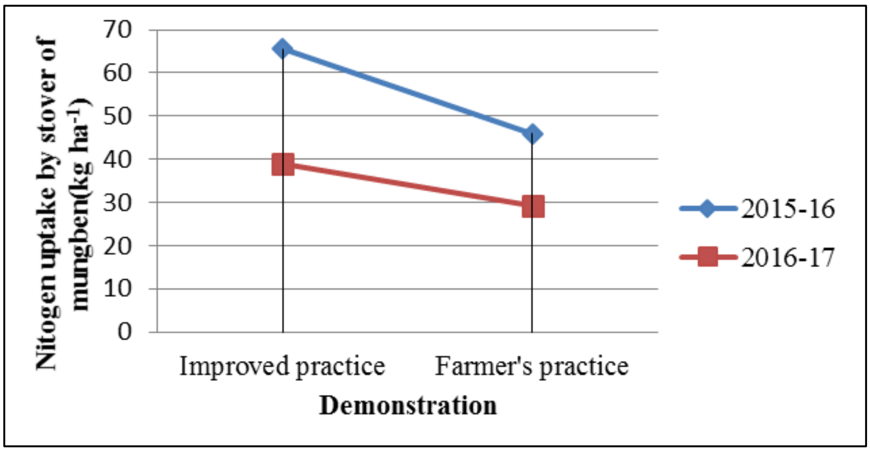

Fig 2: Effect of *Rhizobium* and molybdenum inoculation on nitrogen uptake by stover of mungbean

Economics

Improved practice recorded (Table 3) higher gross return of Rs.50070.75 ha^{-1} and profitability (Rs. 83.3 ha^{-1} day^{-1}) with additional net return of Rs. 13102.63 ha^{-1} over farmers practice. Higher B: C ratio (2.55) was found in improved practice due to higher net return as compared to local check (1.95) attributed to more seed production. The variation in net return and benefit-cost ratio may be attributed to the variation in the price of agri inputs and produce. Similar types of findings were also obtained by Patel *et al*. (2013) [5].

Table 3: Effect of *Rhizobium* and molybdenum inoculation on cost of cultivation, gross return, net return, B: C ratio and profitability of mungbean

Year	Improved practice (*Rhizobium* and molybdenum inoculation in seed)					Farmer's practice (indiscrimate use of chemical fertiliser)				
	Cost of cultivation (Rs ha^{-1})	Gross return (Rs ha^{-1})	Net Return (Rs ha^{-1})	B:C ratio	Profitability(Rs ha^{-1} day^{-1})	Cost of cultivation (Rs ha^{-1})	Gross return (Rs ha^{-1})	Net Return (Rs ha^{-1})	B:C ratio	Profitability (Rs ha^{-1} day^{-1})
2015-16	19250	60313	41063	3.13	112.50	17850	41406	23556	2.32	64.54
2016-17	20050	39828.50	19778.50	1.99	54.19	18650	29730.25	11080.25	1.59	30.36
Mean	19650	50070.75	30420.75	2.55	83.3	18250	35568.13	17318.13	1.95	47.45

*Sale price of mungbean seed Rs.4650/q and stover Rs.100/q for the year 2015-16; Sale price of mungbean seed Rs.5225/q and straw Rs.100/q for the year 2016-17

Conclusion

From the results obtained, it can be concluded that the existing farmer's practice can be effectively replaced by seed inoculation with *Rhizobium* and molybdenom in mungbean for higher yield, economics, nodulation and nitrogen uptake in the existing farming situation.

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References

1. Gardner FP, Pearce RB, Mistecell RI. Physiology of Crop Plants. Iowa State University. Press, Iowa. 1985, 6.
2. Gomez KA, Gomez AA. Statistical procedures for agricultural research. Johnwiley and Sons, New York, 1984.
3. Henzell EF. The role of biological nitrogen fixation research in solving problems in Tropical Agriculture. Plant Soil. 1988; 108:15-21.
4. Jackson ML. Soil chemical analysis. Prentice Hall of India Pvt. Ltd, New Delhi. 1973; 134-182.
5. Patel HR, Patel FH, Maheriya VD and Dodia IN. Response of kharif geengram *Vigna radiata* L. to sulphur and phosphorus with and without biofertiliser application. The Bioscan. 2013; 8(1): 149-52.
6. Patel SA, Chaudhary PP, Desai NH. Yield and economics of Greengram *Vigna radita* L. Cultivars as influenced by integrated nutrient management. Crop Research. 2016; 51(1): doi:10.4172/2454-1761.1000103
7. Samant TK, Panigrahi D, Dhir BC. Assessment of HYV greengram Durga (OBGG 52) in mid central table land zone of Odisha. Journal of Research. 2013; 31(1& 2):30-32.
8. Samant TK. Evaluation of growth and yield parameters of Greengram *Vigna radiata* L. Agriculture Update. 2014; 9(3):427-30.
9. Samui SK, Maitra S, Roy DK, Mondal AK, Saha D. Evaluation on front line demonstration on groundnut *Arachis hypogea* L. Journal of Indian Society Coastal Agricultural Research. 2000; 18:180-183.
10. Subba Rao, NS, Tilak KBR. Souvenir Bull. Directorate of Pulse Development, Govt. of India, 1977.
11. Thakur AK, Panwar JDS. Effect of Rhizobium VAM interaction on growth and yield in mungbean *Vigna radiata* L. under field conditions. Indian Journal of Plant Pathology. 1995; 38:62-65.
12. Tomar S, Tiwari AS. Production and economics of different crop sequences. Indian Journal of Agronomy. 1990; 35(1/2):30-35.
13. Umair A, Ali S, Hayat R, Ansar M, Tareen MJ. Evaluation of seed Priming in mung bean (*Vigna radiata*) for yield, nodulation and biological nitrogen fixation under rainfed conditions. African Journal of Biotechnology. 2011; 10(79):18122-18129.
14. Vitnor S, Lal EP and Rao KP. Studies on integrated nutrient management on seed yield and quality of greengram *Vigna radiata* L. International Journal of Resent Research in Life Sciences. 2015; 2(2):42-45.
15. Zammurad IA, Anjum MS, Rauf CA. Effect of Rhizobium inculation ongrowth and nodule formation of greengram. International Journal of Agriculture & Biology. 2006; 8(2):235-237.