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# Yield gap analysis of black gram (*Vigna mungo* L.) through front line demonstration under rainfed condition in Mahasamund district of Chhattisgarh

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**Abstract**
A Front Line Demonstration was conducted at farmers field in Mahasamund district of Chhattisgarh during *Kharif* season 2016 and 2017 to demonstrate the integrated nutrient management in Black gram (*Vigna mungo* L.). There were two treatments in which one was local check and second was cultivation of Black gram using INM technology. Data revealed that integrated use of organic manure, inorganic and biofertilizer had significant effect on yield and yield attributes of black gram over local check during both the years of experiment. The two years result revealed that local check given a yield of 5.16 q/ha. While Black gram cultivation with INM technology given a yield of 7.45 q/ha. Which shows that by adopting technology there were 44.15% increase in yield? The two year pooled data of plant height at harvest time recorded 27.50 cm. in local check against the39.67 cm. in demonstration field. Number of branch per plant recorded 6.5 in local check against the 8.37 in demonstration field. Seeds per pod recorded 4.72 in local check against the 5.99 in demonstration field. The two year pooled data of pods per plant recorded to 14.45 in local check against the 20.85 in demonstration field. Test weight per 1000 grains recorded 37.60 in local check against the 43.17 in demonstration field. Similarly net return was also calculated which shows that local check given a Net income of Rs. 13756 per ha. With a B:C ratio of 2.09 against a Net income of Rs. 23303 with B: C ratio of 2.58 in demonstration field.

**Keywords:** INM, Black gram, FLD, yield, extension gap, technology gap, technology index

## Introductions

Food security, nutritional security, maintenance of soil health, enhancement of productivity and leaving rightful heritage for future generation are the main focus of our agricultural development. From the current food production level of 210 Mt, Indiahas to step up food grain production to about 315 MT by the year 2025, to feed the burgeoning population (Sarkar, 2005) [10]. Since the possibility of horizontal expansion or putting more area under cultivation is remote, future augmentation in yield would have to be harnessed vertically through increase in productivity by judicious management of all input resources. India is the largest producer and consumer of pulses in the world accounting for 29 percent of world area and 19 percent of worlds production. At present the total area under pulses is 25.39 million hectares, with a production of 16.10 million tonnes (Anonymous, 2008) [1]. It is estimated that country population will reach nearly 1350 million by 2020 A. D. The country would then need 30.3 million tonnes of pulses to meet the requirement. In fact, there has been stagnation in the production and productivity of pulses over the past two decades. The per capita availability of pulses has declined from 64 g per capita per day (1951-56) toless than 35 g per capita per day (Asthana, 1998) [3], as against the FAO/WHO'S recommendation of 80 g.

The important grain legumes grown in India are chickpea, pigeon pea, green gram, black gram, cowpea, lentil and peas etc. Among these grain legumes, black gram (Vigna mungo (L), Hepper), an ancient and well known leguminous crop of Asia, is popular because of its nutritional quality (protein). (Rajeshwari, 2011) [8] Black gram (*Vigna Mungo* L.) is the third important pulse crop in India. It is the annual pulse crop and native to Central Asia. It is also extensively grown in West Indies, Japan and other tropical and subtropical countries. Blackgram seeds are highly nutritious containing 26.2 percent protein, 1.2 percent fat and 56.6 percent carbohydrate. It is rich in minerals having 185 mg calcium, 8.7 mg iron, and 345 mg of phosphorus.

It also contains 0.42 mg vitamin Bl, 0.37 mg vitamin B 2 and 2.0 mg niacin (Anonymous, 2006) [2]. The production of pulse crop in our country including black gram is not enough to meet the domestic demand of the population. There is scope to enhance the productivity of black gram by proper agronomic practices and fertilizers. In Chhattisgarh black gram is mostly grown in Raigarh, Jashpur, Jagdalpur, Mahasamund, Kanker and Korba districts which together account for about 76.91 percent area and 75.04 percent production. Higher productivity of black gram is obtained in Jashpur (410 kg/hectare) (Lahre *et al*. 2017) [7]. Average district yield of Black gram in Mahasamund district is 406 kg/ha. Which is very low due to imbalance nutrient management and non adoptio of INM with this crop?

Integrated Nutrient Management (INM) hold great promise in meeting the growing nutrient demands of intensive agriculture and maintaining the crop productivity at higher levels with overall improvement in the quality of resource base. In order to safeguard the environment from further degradation and to maintain the purity of air, water and food, we should opt for less use of chemicals and shift from chemical to ecological agriculture to fertilize our fields. Therefore to maintain production at high levels, recourse has to be made to the application of fertilizers and manures. Organic manures not only provide essential plant nutrients but also build up the organic carbon and improve soil physical conditions (Dhirendra, 2008) [5]. Over use of chemical fertilizers harm the biological power of soil, which must be prevented because all nutrient transfonnations are mediated by soil micro flora. Organic matter is the source of energy to the soil microflora and organic carbon content is considered to be the index of soil health. Integrated nutrient management is a flexible approach to minimize the use of chemical sources of nutrient along with maximization of their efficiency and farmer's profit. Fertilizers, organic minerals and biofertilizers are the main component of INM. No single source of plant nutrient canmeet the entire nutrient need of crops in modern agriculture rather they need to be used in a coherent manner following a management technology that is economically viable, socially acceptable and ecologically sound. The nutrient supply, the flows and the nutrient added should be managed properly in order to achieve as high yield as possible while, minimizing environmental pollution (Finck, 1998) [6]. Amongst the organic manures, FYM is one of the most traditional source, most readily available and widely used by the farmers since time immemorial Addition of organic material to the soil such as farm yard manure helps in maintaining soil fertility and productivity. It increases soil microbiological activities; plays keyrole in transformation, recycling and availability of nutrients to the crop (Collins *et al.*, 1992) [4]. It also improves the physical properties like soil structure, porosity, reduces compaction and crusting and increases water holding capacity of the soil. The availability of phosphorus and micronutrients from native source also increases with incorporation of organic matter which might be due to release of organic acids (Stevenson, 1982) [12]. Thus, sustainable agriculture in years to come should ideally be based on integrated plant nutrient supply (Tiwari, 2002) [13]. Biofertilizers are organic products containing a specific micro-organism (microbial inoculants) which is derived from the nodules of plant or from soil of root zone (*Rhizosphere*). They posses unique ability to fix atmospheric nitrogen either by living symbiotically or non symbiotically or to transform native soil nutrients such as phosphorus from the unavailable to available form through biological processes. The role of micro organism like *Rhizobium* and PSB (phosphate solubilizing bacteria) has been recognized since time immemorial. Inoculation of seeds with PSB plays a vital role in supplementing phosphorus requirements of crop. PSB brings out more amount of fixed or unavailable native phosphorus into soluble and available form (Dhirendra, 2008) [5].

Integrated nutrient management can be only option to mitigate this anomaly and it means that application of organic matter, biofertilizer and right quantity of fertilizers is suitable for crop growth and enhances the soil health also. The present investigation aimed to study the relationship between the nutrient supplied by organic and inorganic sources to develop a guideline to judicious use of INM for maximum production of Black gram. Keeping this fact to consideration, front line demonstration at village chhuhia under Baghbahara block of Mahasamud district has been designed and conducted to make cultivation of black gram, more remunerative, productive and sustainable.

**Material and Methods**

The on farm trail was conducted at farmers field of village Chhuhia, block Baghbahara, district Mahasamund, Chhattisgarh, India during *kharif* season 2017 and 2018, on integrated nutrient management in black gram, during these two years of study, an area of 4.8 ha. was coverd with plot size of 0.1 ha. Under front line demonstration with active participation of 12 farmers each years. Before conducting FLDs a list of farmers was prepared by group meeting and specific skill training was imparted to the farmers regarding different aspect of cultivation. Soil samples (0-15 cm. in depth) were collected, Soil was *Inceptisol* with sandy loam texture, dried and passed through 2 mm sieve and analyzed for physico-chemical properties, available nitrogen, available phosphorus and available potassium at soil testing laboratory of KVK Mahasamund. The economics in terms of benefit cost ratio was calculated on minimum support price, the potential yield, demonstration yield extension gap and technology index was also calculated. Pre sowing soil sample were analyzed at soil testing laboratory of KVK Mahasamund. Two treatments were taken one was local check and another was technology of interagated nutrient management. Farmyard manure (FYM) were applied @ 5 ton/ha, as per treatment applied 75% N:P:K-20:40:20 kg/ha. with seeds inoculated by *Rhizobium* and PSB @10g/kg of seed. Fertilizers were applied as per treatment as basal. The seeds were inoculated from proper method of seed inoculation. The crop was sown in first fortnight of July using genotype PU-31.Observation for plant height, no. of branch per plant; seeds per pod, pods per plant and test weight per 1000 grains were recorded.

The data on output of improved and local plots were recorded and studies were conducted on studying the potential yield, demonstration yield extension gap and Technology Index. These were studied by using the formula as suggested by Samui *et al.* (2000) [9].

$$\text{Percent Increase yield} = \frac{\text{Demonstration Yield} - \text{Farmers Yield}}{\text{Farmers Yield}}$$

Technology Gap = Potential Yield – Demonstration Yield

Extension Gap = Demonstration Yield- Yield under existing Practice

$$\text{Technology Index (\%)} = \frac{\text{Potential Yield} - \text{Demonstration Yield}}{\text{Potential Yield}} \times 100$$

## Result and Discussion
### Soil Characteristics
The soil was *Inceptisol* with sandy loam in texture and two years average soil nutrient status of twelve farmers was pH 5.9, electrical conductivity of the soil was 0.20 dS/m, organic carbon was 0.39%, low available nitrogen 200.99 kg/ha, low available phosphorus 11.98 kg/ha and medium available potash 240.38 kg/ha. (Table1). Through this soil are considered to low nitrogen and low phosphorus with low organic carbon and moderately supplied potassium.

**Table 1:** Average soil test value of farmers

| Average soil test value | | | | | | |
|---|---|---|---|---|---|---|
| **Year** | **pH** | **EC (dS/m)** | **OC (%)** | **Available N (kg/ha)** | **Available P (kg/ha)** | **Available K (kg/ha)** |
| 2016-17 | 5.8 | 0.19 | 0.37 | 199.83 | 12.71 | 236.14 |
| 2017-18 | 6.1 | 0.21 | 0.41 | 202.15 | 11.25 | 244.62 |
| Pooled Mean | 5.9 | 0.20 | 0.39 | 200.99 | 11.98 | 240.38 |

### Grain Yield
The result of front line demonstration revealed that maximum yield was recorded 7.96 q/ha during 2016-17 and minimum yield was recorded 6.94 q/ha in year 2017-18 under demonstrated plot and mean grain yield was recorded 7.45 q/ha in both years under demonstrated plots. Which was higher over local check 5.16 q/ha? On an average 44.15% yield increased under demonstration over local check. This clearly shows the positive impact of front line demonstration which is conducted with INM technology. And the results are in conformity with the finding of earlier investigation (Table 2).

**Table 2:** Yield and other technological attributes

| Year | Potential Yield | Average yield under FLD (q/ha) | Average yield local check (q/ha) | % increase over local check | Extension gap (q/ha) | Technology gap (q/ha) | Technology index (%) |
|---|---|---|---|---|---|---|---|
| 2016-17 | 12 | 7.96 | 5.47 | 45.52 | 2.49 | 4.04 | 33.66 |
| 2017-18 | 12 | 6.94 | 4.86 | 42.79 | 2.08 | 5.06 | 42.16 |
| Pooled Mean | 12 | 7.45 | 5.16 | 44.15 | 2.28 | 4.55 | 37.91 |

### Yield Parameters
Growth, yield attributes and yield of blackgram were significantly influenced due to integrated nutrient levels during both the years of study. The result of front line demonstration revealed that pooled mean of plant height was recorded 39.67 cm. under demonstrated plots, which was higher over local check of 27.50 cm. Number of branched per plant was recorded 8.37 under demonstrated plots, and 6.5 under local check. Seeds per pod was recorded 5.99under demonstrated plots, and 4.77 under local check. Pods per plant were recorded 20.85 under demonstrated plots, and 14.45 under local check. The pooled mean of Test weight per 1000 grains was recorded 43.17 under demonstrated plots, and 37.60 under local check. Integrated nutrient levels recorded significantly higher plant height, number of branch/plant, seeds/pod, pods/plant, test wt/1000g grains, as compared to local check which had the lowest value during both the years of study. So the result indicate that positive effect of FLD with INM technology over the existing local check toward enhancing the yield of Black gram in Mahasamund district of Chhattisgarh with its positive effect of yield attributes (Table 3).

**Table 3:** Yield attributes parameters

| Year | Yield attribute parameters | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Plant height At Harvest (cm) | | No. of branch/ plant | | Seeds/ pod | | Pods/ plant | | Testwt/ 1000 grains | |
| | Under FLD | Local check | Under FLD | Local check | Under FLD | Local check | Under FLD | Local check | Under FLD | Local check |
| 2016-17 | 42.39 | 29.13 | 9.22 | 6.87 | 6.51 | 5.14 | 22.28 | 15.31 | 44.08 | 38.06 |
| 2017-18 | 36.96 | 25.88 | 7.53 | 6.13 | 5.47 | 4.31 | 19.43 | 13.60 | 42.27 | 37.15 |
| Pooled Mean | 39.67 | 27.50 | 8.37 | 6.5 | 5.99 | 4.72 | 20.85 | 14.45 | 43.17 | 37.60 |

### Extension and technology gap
Table 2 revealed that there was 2.28 q/ha of extension gap which was emphasizes the need to improve the extension for educating the farmers for adopting improved agricultural production technologies to minimize the extension gap. The observed technology gap of 4.55 q/ha. May be attributed to erratic weather condition and insect-pest attack. Similar findings were recorded by Singh 2017 [11].

### Technology Index
The data of the technology index (Table 2) showed the feasibility of the evolved technology at the farmers field. The lowest values of technology index indicate the more feasibility of the technology. The technology index in this demonstration was found to be 37.91%. Some high value of technology index of the area might be due to erratic weather condition, insect-pest as well as wild animal attack.

### Economics
The two year data of the study was reported higher net return and B:C ratio in the demonstration due to INM technology as compared to farmers practices. The average net returns/ha from the demonstration was Rs. 23303/-while in farmers practices it was Rs.13756/- during the period of study (Table 4). The benefit cost ratio of demonstration and farmers practices were observed to be 2.58 and 2.09, respectively. While higher cost of cultivation involved in demonstration which was Rs. 14640/- as compared to the farmers practices which was Rs. 12556/-. The demonstration plot fetched high pooled mean gross return Rs. 37944 in demonstration as compared to the Rs. 26311/- of farmers practices (Table 4).

**Table 4:** Economic Impact of FLD with Traditional Package of Practice

| Year | Cost of cultivation (Rs/ha) | | Gross Return (Rs/ha) | | Net return (Rs./ha) | | B: C ratio | |
|---|---|---|---|---|---|---|---|---|
| | Local | Demo | Local | Demo | Local | Demo | Local | Demo |
| 2016-17 | 12519 | 14589 | 27350 | 39800 | 14831 | 25211 | 2.18 | 2.72 |
| 2017-18 | 12592 | 14692 | 25272 | 36088 | 12680 | 21396 | 2.00 | 2.45 |
| Pooled Mean | 12556 | 14640 | 26311 | 37944 | 13756 | 23303 | 2.09 | 2.58 |

## Conclusion

From the results narrated above it is concluded that use of improved variety, soil testing, application of 75% (N:P:K- 20:40:20 kg/ha.) and FYM @5 ton/ha with use of *Rhizobium* and PSB @10g/kg of seed, gave response in achieving higher yield and yield attributes of black gram grown in *inceptisol* of the Mahasamund district. This also suggests that integration of organic manure, inorganic fertilizers along with biofertilizer should be adopted by farmers to sustain soil heath and yield of blackgram. So there is a need to disseminate the technology among the farmers with effective extension methods like training and field demonstration. The farmers should be encourage to adopt the recommended INM technology on soil test basis for livelihoods well as getting maximum returns the of the farmers of this district.

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