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Short Communication

Influence of integrated nutrient management on growth, yield, quality and economics of blackgram (*Vigna mungo* L.)

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Blackgram (*Vigna mungo* L.), popularly known as “urad bean”, is one of the most important pulse crop grown throughout the country. In Madhya Pradesh, it occupies the area up to 9.32 lakh hectares with production up to 515 million tonnes and productivity only 5534 kg ha^{-1}. The low yield of blackgram is due to the fact that it is generally grown under marginal and less fertile soils with low inputs and under moisture stress conditions. Moreover, the soils are going unproductive because the total removal of crop nutrients by the preceding crops is never replenished. Moreover, the use of chemical fertilizers alone for a longer period has resulted in deterioration of soil fertility and quality of produce. Integrated nutrient management approach is not only a reliable way of obtaining high productivity with substantial fertilizer economy, but also a concept of ecological soundness leading to sustainable agriculture by improving physico-chemical and biological properties of the soil. The basic concept of integrated plant nutrient system is maintenance and improvement of soil fertility for sustaining crop productivity on long term basis. Application of different organic-cum-inorganic sources of nutrients have been found very effective in realizing higher yield, better economy and improved fertility of the soil (Saket *et al.,* 2014, Sahu *et al.,* 2017). Encourageous results from additions of organic manures (FYM and vermicompost etc.) towards soil fertility and sustainable crop productivity have motivated to generate information on INM for the blackgram growers of this region. In view of the above facts, the present investigation was conducted during rainy season of 2018 using black gram as test crop.

A field experiment was conducted at the research farm, A.K.S. University, Satna (M.P.) The soil of the experimental field was silty clay-loam having pH 7.5, electrical conductivity 0.26 dSm^{-1}, organic carbon 4.8 g ha^{-1}, available N 186.6 kg ha^{-1}, P_2O_5 12.5 kg ha^{-1}, K_2O 200 kg ha^{-1} and available S 7.75 ppm. The total rainfall received during June to October, 2018 was 866.40 mm. The twelve integrated nutrient management (Table 1) were laid out in a randomized block design keeping three replications. Blackgram var. T-9 was sown in rows 30 cm apart on 16th July, 2018.Before sowing; the pertinent levels of FYM, vermicompost and leaf mould were applied as basal in open furrows. The N,P and K levels under 50,75 and 100% RDF ware applied similarly through urea, diammonium phosphate and muriate of potash, respectively. The crop was grown as per recommended package of practices and harvested on 15th October, 2018. The seed protein was determined by following the standard analytical procedure (A.O.A.C., 1997).

Amongst the INM treatments, 100% RDF ($N_{20}P_{40}K_{20}$) with 10 t FYM ha^{-1} + 30 kg S ha^{-1} (T_{12}) resulted in significantly higher plant height (37.0 cm), branches (7.86 $plant^{-1}$) and leaves (46.3 $plant^{-1}$). This was followed by T_8 (75% RDF + 5 t VC ha^{-1}). The increase in various parameters may be attributed to increased availability of nutrients over the long periods, which have positive effect on growth of the plants. The findings corroborate with those of Ghulam *et al.* (2011), Meena (2013), Singh and Singh (2014) and Tyagi and Singh (2019).The same INM treatment (T_{12}) also resulted in the maximum yield-attributes i.e. pods (18.0 $plant^{-1}$), pod length (7.95 cm), number of seeds (8.26 pod^{-1}), 1000-seed weight (45.53 g) and seed yield (8.60 g $plant^{-1}$). The maximum yield-attributes from 100% NPK level with or without FYM or VC may be owing to maximum increase in dry matter production and its effective partitioning to the economic sink. The increased supply of multi-nutrients might have increased multi-role activities in plant and soil which, in turn, resulted in greater accumulation of

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Table 1: Growth, yield-attributes, yield, quality and economics of black gram as influenced by different integrated nutrient management

Treatments	Plant height (cm) at harvest	Branches plant^{-1} at 60 DAS	Leaves plant^{-1} at 60 DAS	Pods plant^{-1}	Length of pod (cm)	Seeds pod^{-1}	1000-grain weight (g)	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Harvest index (%)	Seed protein (%)	Net income (Rs. ha^{-1})	B:C ratio
T_1 Control	30.6	2.35	30.6	9.8	3.70	4.56	40.40	4.88	15.66	23.7	20.4	9256	1.43
T_2 100% RDF ($N_{20}P_{40}K_{20}$)	35.5	5.43	44.6	17.4	7.60	7.43	44.73	12.41	32.34	28.3	22.8	53704	3.25
T_3 10 t FYM ha^{-1}	31.2	3.20	32.0	11.0	4.48	5.86	42.20	7.99	20.62	27.9	21.3	23412	1.88
T_4 5 t VC ha^{-1}	34.1	4.30	37.6	13.1	5.49	6.20	42.36	9.41	24.84	27.4	21.6	32354	2.22
T_5 10 t LM ha^{-1}	30.6	2.69	31.4	10.8	4.27	5.70	40.76	6.30	16.48	28.9	21.0	12758	1.48
T_6 75% RDF + 10 t FYM ha^{-1}	35.3	4.74	44.0	16.2	7.30	7.26	44.13	11.99	31.83	27.3	22.5	46808	2.65
T_7 50% RDF + 10 t FYM ha^{-1}	34.9	4.73	43.8	16.0	7.15	7.23	43.77	9.49	28.95	24.6	22.4	32095	2.16
T_8 75% RDF + 5 t VC ha^{-1}	36.2	7.23	45.6	17.6	7.86	7.53	45.36	12.74	29.89	29.8	23.3	51114	2.81
T_9 50% RDF + 5 t VC ha^{-1}	35.4	5.06	44.5	16.3	7.38	7.43	44.30	12.24	32.11	27.6	22.6	48911	2.76
T_{10} 5% RDF + 10 t LM ha^{-1}	34.2	4.73	43.7	15.4	6.93	6.97	43.23	9.16	25.67	26.3	22.4	29212	2.03
T_{11} 50% RDF + 10 t LM ha^{-1}	34.1	4.60	38.1	13.3	6.93	6.26	43.10	7.88	21.84	26.5	21.8	21702	1.78
T_{12} 100% RDF + 10 t FYM ha^{-1} +30 kg S ha^{-1}	37.0	7.86	46.3	18.0	7.95	8.26	45.53	14.82	30.50	32.7	23.9	61580	3.03
S.Em$\pm$	0.23	0.06	0.17	0.23	0.10	0.20	0.278	0.30	0.32	0.47	0.16	--	--
CD(P=0.05)	0.68	0.18	0.51	0.68	0.29	0.60	0.804	0.89	0.92	1.37	0.47	--	--

DAS= days after sowing, FYM = farmyard manure, VC= vermicompost, LM= leaf mould, RDF=recommended dose of fertilizers carbohydrates, protein and their translocation to the reproductive organs i.e. yield-attributes. The results are in close agreements with those of Ghulam *et al.* (2011), Chaya *et al.* (2014), Sahu *et al.* (2017) and Tyagi and Singh (2019).

Application of $N_{20}P_{40}K_{20}$ with 10 t FYM + 30 kg S ha^{-1}, recorded significantly higher grain yield (14.82 q ha^{-1}) over the remaining organic-cum-inorganic sources of nutrients. Whereas in control treatment the yield was only 4.88 q ha^{-1}. This might be owing to maximum growth parameters and higher rate of photosynthesis which is always associated with higher productivity (Sanwal *et al.,* 2007). It is apparent from the results that the higher amount of multi-nutrient application including sulphur through organic and inorganic sources (T_{12}, T_8 and T_2) proved better than all other INM treatments having less nutrient contents. The higher yield response under these treatments may be ascribed to improvement in physico-chemical and biological properties of the soil and nutrients use efficiency resulting in better supply of multi plant-nutrients led to good crop growth and yield-attributes. The significant variation in grain yield response due to different applied organic sources of nutrients (FYM or vermicompost) with or without NPK) might be due to variations in their nutrient composition, decomposition of organic residues, carbon: nitrogen ratio, nutrient release pattern, climate and soil characteristics Saket *et al.* (2014). The results are in accordance with findings of Saravana *et al.* (2013), Chhaya and Jain (2014), Sahu *et al.* (2017) and Tyagi and Singh (2019).

The maximum net income of Rs.61580 ha^{-1} with 3.03 B:C ratio was obtained from T_{12} ($N_{20}P_{40}K_{20}$ + 10 t FYM + 30 kg S ha^{-1}). This income was higher by Rs.52324 ha^{-1} over the control treatment. This was followed by T_2, T_8 and T_9 treatments having highest dose of NPK with or without FYM and vermicompost (Rs.53704, Rs.51114 and Rs.48911 ha^{-1}, respectively). The net income under different INM treatments was exactly in accordance with the increased grain yield which fetched higher market values. The protein content in grain in T_{12} was found highest (23.94%) as against 20.43% under control. This was followed by T_8 (23.32%), T_2 (22.80%) and T_9 (22.69%). The response of multi-nutrients in improving seed quality may be attributed to its significant role in regulating the photosynthesis, root-enlargement and better microbial activities (Marko *et al.,* 2013) and more synthesis of protein through amino acids as a result of N-metabolism (Dwivedi and Bapat, 1998).

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