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Effect of Organic and Inorganic Nutrient Combinations on Yield and Economics of Black Gram (*Vigna mungo* L.)

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A B S T R A C T

Effect of organic and inorganic nutrient combinations were evaluated in Mahamaya College of Agriculture Siyadehi, Dhamtari (Chhattisgarh) on yield and economics of black gram (*Vigna mungo* L.) under midland condition during summer season 2020. The result revealed that, application of 100% RDF with Zn+ Fe (N:P:K- 20:30:20 kg ha^{-1} + $ZnSO_4$ 5 kg ha^{-1} + $FeSO_4$ 5 kg ha^{-1}) performed well over rest of the treatments , and recorded significantly highest plant height (34.82 cm), dry matter (10.49 g $plant^{-1}$), LAI (2.34), number of pods (33.64 $plant^{-1}$), number of seeds pod^{-1} (6.79), seed yield kg ha^{-1} (857.24), straw yield kg ha^{-1} (1851.44), gross return (48005.25 ₹ ha^{-1}), net return (31205.25 ₹ ha^{-1}) and B:C ratio (2.86) respectively over rest of the treatments, The result suggested that, micro nutrients play major role to maximizing the yield of balck gram (*Vigna mungo* L.) by enhancing the rate of photosynthesis, dry matter accumulation and nutrient uptake.

Introduction

Blackgram (*Vigna mungo* L.) is one of the important pulse crops grown throughout India. It is rich source of protein (24%), fat (1.4%), carbohydrate (59.6%), calcium (154 mg), phosphorus (385 mg), iron (9.1 mg), beta carotene (38 mg), thiamine (0.4 mg), riboflavin (0.37 mg) and niacin (2 mg) per 100 g seeds (Aggarwal *et al.*, 2019). In India, Black gram is grown on 29 lakh ha area with total production of 15.9 lakh tones and productivity of 532 kg ha^{-1} (Anonymous, 2015). In Chhattisgarh, it occupies an area of 1.44 lakh ha with the productivity of 320 kg ha^{-1} (Anonymous, 2018). It is cultivated mostly on marginal lands in mono/ mixed cropping system without any fertilizers mostly under rainfed condition in India as well as in Chhattisgarh and this is the major fact behind low productivity of the black gram crop. Farmers of Chhattisgarh grow

blackgram without application of fertilizer or they use less than recommended dose of macro/major and micro/trace nutrients. This imbalanced nutrient supply adversely affects the grain yield of black gram (*Vigna mungo* L.), soil health, and population of microbes and also the profit of farmers.

By fixing atmospheric nitrogen it play an important role in maintaining soil health but an average yield of crop is far below even from the national average (532 kg /ha). The major constraints in maximization the productivity are weed, disease and improper fertilization. Nutrients play important role in exploiting the genetic potential of pulse crop. The significant response to phosphate nutrition by legume crops has been reported by several researchers (Singh and Yadav, 2008).

A large amount of P gets fixed and only 10-18% of applied is utilized by the standing crop (Subehia and Sharma 2002). Iron is most important for chlorophyll formation and photosynthesis and iron is also utilized by enzymes to regulate transpiration in plants (Jha *et al;* 2015). So micro nutrient iron and Zn play important role when applied with NPK and also helpful in maximize the grain yield of black gram crop. Stevenson, 1967 reported that, application of FYM and vermicompost supplies additional nutrient to the crop and also increase the availability of native nutrient of soil by release of organic acids and other microbial product during the decomposition.

Materials and Methods

A field experiment was carried out on black gram (var. *TAU-1*) by sowing of seed (10^{th} march 2020) in planting geometry of 30x5cm (RxP) by using the recommended dose of seed 25 kg ha^{-1} at instructional farm of Mahamaya College of Agriculture, Siyadehi, Dhamtari, Chhattisgarh, India during summer season 2018. Siyadehi lies at $20^{0}63'$ N latitude and $81^{0}65'$ E longitude with an altitude of 317 meter above mean sea level. The average annual rainfall of the area is 1084 mm and the amount of precipitation occurs between March to May 2018 is (70.2 mm) which is 6.47 % of the total annual precipitation. The average annual temperature is 23.45^{o}C. The soil of experimental site was *inceptisols* with 0.42 % organic matter, and pH of 6.7 and available N, P and K content in the soil was 195.7, 8.74 and 225.5 kg ha^{-1}, respectively.

The experiment was carried out in complete randomized block design (CRBD) with three replications, assigning 9 treatments viz; (control, 75% RDF, 100% RDF, 100% RDF + Zn + Fe, 50% RDF + 50% RDN through FYM, FYM 4 t ha^{-1}(Basal)' vermicompost 2 t ha^{-1} (Basal), FYM 2 t ha^{-1} (Basal) + vermicompost 1 tha^{-1} at 25 DAS and vermicompost 1 tha^{-1} (Basal) + vermicompost 1 t ha^{-1} at 25 DAS). The recommended doses of N, P_2O_5, K_2O, $ZnSO_4$, and $FeSO_4$ were 20, 30, 20, 5 and 5 kg ha^{-1}, respectively. Full dose of nitrogen, phosphorus, potassium, zinc and iron in the form of urea, DAP, MOP, $ZnSO_4$ and $FeSO_4$ were applied basal as per treatments. FYM and vermicompost were incorporated as per treatments. And all other cultural practices were adopted as per need of the crop.

Effect on growth parameter

The data on growth parameter of black gram (*Vigna mungo* L.) are presented in table 1. Various growth parameters of black gram were differ with the treatments imposed. The significantly maximum plant height (34.82 cm) at harvest was recorded with treatment 100% RDF+ Zn +Fe (N:P:K- 20:30:20 kg ha^{-1} + $ZnSO_4$ 5 kg ha^{-1} + $FeSO_4$ 5 kg ha^{-1}), which was at par with treatments 100 % RDF, 50%

RDF + 50% RDN through FYM, FYM 4 t ha^{-1} (basal) and vermincompost 2 t ha^{-1} (basal) and lowest (21.43cm) at harvest was recorded with treatment control. Similar trend was observed with plant dry matter and leaf area index. Similar trend was observed with test weight. Similar results were observed by Rathore *et al.,* (2010) and Jha *et al.,* (2015).

The data presented in table 1 revealed that, the significant maximum leaf area index (2.34) at harvest ware noticed with treatment 100% RDF+ Zn +Fe (N:P:K- 20:30:20 kg ha^{-1} + $ZnSO_4$ 5 kg ha^{-1} + $FeSO_4$ 5 kg ha^{-1}), which was at par with treatment FYM 4t ha^{-1} followed by treatment 50% RDF + 50 % RDN through FYM and lowest leaf area index (1.77) was observed in treatment control. Better availability of nutrient might have result in greater leaf area index which ultimately increase the yield of crop by increasing the rate of photosynthesis, dry matter accumulation, increasing energy transformation, root development and by symbiotic biological nitrogen fixation. The similar result observed by Hussain *et al.,* (2011).

Effect on yield and yield attributes

An analysis of data (Table 1 and 2) show that, yield and yield attributes increased significantly with the application of organic and inorganic sources of nutrients in blackgram over control. The maximum number of pods plant^{-1} (33.64) was significantly highest in treatment 100% RDF+ Zn + Fe (N:P:K- 20:30:20 kg ha^{-1} + $ZnSO_4$ 5 kg ha^{-1} + $FeSO_4$ 5 kg ha^{-1}), which was at par with treatment FYM 4 t ha^{-1} (basal) followed by treatment 100 % RDF and lowest pods plant^{-1} (18.87) was recorded in treatment control. Significantly the maximum number of seeds pod^{-1} (6.79) was observed in treatment-100% RDF+ Zn +Fe (N: P: K- 20:30:20 kg ha^{-1} + $ZnSO_4$ 5 kg ha^{-1} + $FeSO_4$ 5 kg ha^{-1}), which was at par with treatments FYM 4 t ha^{-1} (basal) and lowest seed pod^{-1} (4.80) was recorded in treatment control.

Table.1 Effect of organic and inorganic nutrient combination on growth and yield attributes of black gram

Treatments	Plant height (cm)	Dry matter (g)	Leaf area index (LAI)	Number of pods plant^{-1}	Number of seeds pod^{-1}	Test weight (g)
T_1 : Control	21.43	4.60	1.77	18.87	4.80	35.50
T_2 : 75 % RDF	30.34	6.79	2.07	24.48	5.67	36.17
T_3 : 100 % RDF	32.28	9.87	2.23	30.80	6.28	37.36
T_4 : 100% RDF +Zn +Fe	34.82	10.49	2.34	33.64	6.79	42.51
T_5: 50% RDF +50% RDN through FYM	31.51	7.80	2.25	29.73	6.35	39.17
T_6 : FYM 4 t ha^{-1} (Basal)	31.96	9.80	2.27	31.41	6.50	42.00
T_7: Vermicompost 2 t ha^{-1}(Basal)	31.47	7.05	2.20	24.67	5.37	36.83
T_8 : FYM 2 t ha^{-1}(Basal) + VC 1 t ha^{-1} at 25 DAS	29.43	8.56	2.01	28.48	6.01	37.04
T_9 : VC 1t ha-1 (Basal) +1 t ha^{-1} at 25 DAS	29.54	8.72	2.00	27.64	5.93	36.50
SEm (±)	**1.34**	**1.04**	**0.09**	**1.26**	**0.16**	**0.35**
CD (P= 0.05)	**4.08**	**3.16**	**0.27**	**3.83**	**0.49**	**1.06**

RDF = Recommended dose of fertilizer, DAS = Day after sowing, VC = Vermicompost

Table.2 Effect of organic and inorganic nutrient combination on yield and economics of black gram

Treatments	Yield (kg ha^{-1})			Harvest index (%)	Gross return (₹ ha^{-1})	Net return (₹ ha^{-1})	B:C ratio
	Seed	straw	biological				
T_1 : Control	427.96	1073.49	1501.45	28.51	23965.57	11925.57	1.99
T_2 : 75 % RDF	638.20	1556.86	2195.06	29.09	35739.01	19319.01	2.18
T_3 : 100 % RDF	796.97	1760.39	2557.35	31.16	44630.13	28243.47	2.72
T_4 : 100% RDF +Zn +Fe	857.24	1851.44	2708.68	31.65	48005.25	31205.25	2.86
T_5: 50% RDF +50% RDN through FYM	752.32	1733.00	2485.32	30.25	42129.73	26036.40	2.62
T_6 : FYM 4 t ha^{-1} (Basal)	842.70	1831.34	2674.05	31.49	47191.39	30541.39	2.83
T_7: Vermicompost 2 t ha^{-1}(Basal)	710.51	1515.71	2226.22	31.91	39788.75	21888.75	2.22
T_8 : FYM 2 t ha^{-1}(Basal) + VC 1 t ha^{-1} at 25 DAS	745.14	1728.32	2473.46	30.11	41727.65	23527.65	2.29
T_9 : VC 1t ha-1 (Basal) +1 t ha^{-1} at 25 DAS	708.35	1509.71	2218.05	31.91	39667.41	21150.75	2.15
SEm (±)	**25.52**	**19.70**	**32.60**	**0.78**	**1429.29**	**1382.81**	**0.07**
CD (P= 0.05)	**77.17**	**59.57**	**98.58**	**NS**	**4321.90**	**4181.36**	**0.23**

RDF = Recommended dose of fertilizer, DAS = Day after sowing, VC = Vermicompost

Assessment of effect of split dose of vermicompost show that split application of vermicompost 1 t ha^{-1} at 25 DAS along with FYM 2 t ha^{-1} (Basal) recorded a significant increase yield attributes of black gram over vermicompost 1 t ha^{-1} (Basal)+vermicompost 1 t ha^{-1} at 25 DAS and control, respectively. Similarly significantly maximum grain yield (857.24 kg ha^{-1}), straw yield (1851.44 kg ha^{-1}) and biological yield (2708.68 kg ha^{-1}) recorded with the treatment 100% RDF+ Zn +Fe (N:P:K- 20:30:20 kg ha^{-1} + $ZnSO_4$ 5 kg ha^{-1} + $FeSO_4$ 5 kg ha^{-1}), which was at par with treatment FYM 4 t ha^{-1} (basal) followed by 100 % RDF. The maximum harvest index (31.91%) was recorded under treatment vermicompost 2t ha^{-1} (basal), it might be due to less vegetative growth of plants which ultimate produce lower biological yield which increase the percentage of harvest index.

Application of 100% RDF + Zn + Fe significantly enhance seed yield by 21.9 and 6.10 per cent over 75% RDF and 100% RDF, respectively. Further, assessment of effect of split dose of vermicompost show that split application of vermicompost 1 t ha^{-1} at 25 DAS along with FYM 2 t ha^{-1} as basal recorded a significant increase of 3.68 per cent in seed yield over vermicompost 1 t ha^{-1} (Basal) + vermicompost 1 t ha^{-1} at 25 DAS.

The combination of NPK+ Zn +Fe enhance the availability of macro and micro nutrients to black gram crop, which increase the early root development and cell multiplication ratio which enhance the absorption of other nutrients from the deeper layer of soil ultimately resulting the higher plant growth attributes, which increase the dry matter accumulation, finally which enhanced yield attributes and yield of crop which might be due to greater availability of nutrients which was easily absorbed by the crop which significantly increase the rate of photosynthesis. The translocation and

accumulation of photosynthates in the economic sinks resulted in increased seed, straw and biological yields. The incorporation of Zn and Fe with 100 % RDF significantly enhance the seed, straw and biological yield of black gram crop.

The absorption of Zn and Fe might be increase the rate of nitrogen metabolism, biosynthesis of hormones and rate of photosynthesis which ultimate increase the yield of crop. Similar findings are also reported by Athokpam *et al.,* (2009) and Jha *et al.,* (2015).

Economics of the treatments

The data presented in table 2 revealed that, significantly higher gross return (48005.25 ₹ ha^{-1}) was recorded in treatment 100% RDF+ Zn +Fe (N:P:K- 20:30:20 kg ha^{-1} + $ZnSO_4$ 5 kg ha^{-1} + $FeSO_4$ 5 kg ha^{-1}) which was at par with 100% RDF (44630.13 ₹ ha^{-1}) and FYM 4 t ha^{-1} (basal) (47191.39 ₹ ha^{-1}) over rest of the treatments and control.

The maximum net return (31205.25 ₹ ha^{-1}) which was at par with which was at par with 100% RDF (28243.47 ₹ ha^{-1}) and FYM 4 t ha^{-1}(basal) (30541.39 ₹ ha^{-1}) over rest of the treatments. The maximum B: C ratio (2.86) was recorded in treatment 100% RDF+ Zn +Fe (N: P: K- 20:30:20 kg ha^{-1} + $ZnSO_4$ 5 kg ha^{-1} + $FeSO_4$ 5 kg ha^{-1}) which was at par with FYM 4 t ha^{-1}(basal) (2.83) over rest of the treatments and control. on the other hand, application of 100% RDF + Zn + Fe (N:P:K- 20:30:20 kg ha^{-1} + $ZnSO_4$ 5 kg ha^{-1} + $FeSO_4$ 5 kg ha^{-1}) considerably enhanced the plant growth, higher dry matter production and nutrients uptake compared to control and resulted in significant increase in pods $plant^{-1}$, and seed yield of black gram (*Vigna mungo* L.) crop. Present study is closely related to findings of Jha *et al.,* (2015) and Kumawat *et al.,* (2013).

In conclusion, it is accomplished from that investigation the application of recommended dose of fertilizer (100% NPK of RDF) @ 20:30:20 and FYM @ 4 t ha^{-1} recorded better seed yield 796.97 and 842.70 kg ha^{-1} of black gram crop respectively. The maximum seed yield (857.24 kg ha^{-1}) and net return (31205.25 ₹ ha^{-1}) was obtained in the treatment consisting the basal application of Zn and Fe along with 100% nitrogen, phosphorus and potash (Recommended dose of fertilizer). The incorporation of $ZnSO_4$ and $FeSO_4$ as basal @ 5 kg ha^{-1} along with 100 % NPK of RDF prone superior to application of 100% NPK of RDF in terms of growth and yield parameters of black gram crop.

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