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

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ABSTRACT

The factors attributed for low yields of pulses in India as compared to the world productivity are non-availability of quality seeds of improved and short duration varieties, growing of pulses under marginal and less fertile soil with low inputs and without pest and disease management, growing of pulses under moisture stress, unscientific post-harvest practices and storage under unfavorable conditions. Based on the fascts, the research on different organic and inorganic source of nutrients for cultivating the black gram was conducted to find out the effective nutrient input for black gram. The treatments comprised organic and inorganic input viz., vermicompost, farmyard manure, panchagavya, inorganic fertilizers alone and in combination with one another. Among the treatments, application recommended dose of fertilizer (RDF) 25:50:25 kg NPK ha^{-1} + Vermicompost @ 5 t ha^{-1} + Four spray of panchagavya @ 4% at 15, 25, 30 and 45 DAS was recorded the highest plant growth and yield in addition to maximum benefit cost ratio compared to recommended dose of fertilizer (RDF) 25:50:25 kg NPK ha^{-1}.

Keywords Black gram, Panchagavya, Vermicompost, Growth component, Economics.

INTRODUCTION

Black gram (*Vigna mungo* L.), is one of the important pulse crop, grown throughout the country. Black gram is widely considered as an excellent source of high quality protein with good digestibility and also contains water soluble vitamins and minerals of dietary significance. Pulses crop are the most important food crop after cereals refer to grain legumes, food legumes are commonly known as poor man meat because of their high protein content low price and aits wide spread access tothe poor. Food and agricultural organization was announced International Year of Pulses in 2016. India is the world's largest producer and consumer of a wide variety of pulses which is dominated by tropical and sub-tropical crops. The per capita requirement of pulses according to Indian

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Council of Medical Research (ICMR) is 150 g per capita per day and according to Food and Agriculture Organization (FAO), 140 g per capita per day. The decreasing per capita availability of pulses from 69 g in 1961 to 34.5 g in 2010 is due to lack production. They are rich source of proteins containing pulses like black gram for about 20 -30%. In India, pulses form is an integral part of diet as a source of protein and also rich in calcium and phosphorus. The Union Ministry of Agriculture in released on India's total pulses production at the rate of 176.7 kg ha^{-1} with119.1 million tonnes achieved in the year. India is the largest producer (25% of global production), consumer (27% of world consumption) and importer (14%) of pulses in the world. Pulses account for around 20% of the area under food grains and contribute around 7-10% of the total food grains production in the country.

The pulses are grown in both *kharif* and *rabi* seasons ; *rabi* pulses contribute more than 60% of the total production. Pulses are one of the second most important segments of Indian Agriculture after cereals as they rich in protein and play vital role in human diet. Pulses improve soil health by enriching nitrogen status, long-term fertility and sustainability of the cropping systems. It meets up to 80% of its nitrogen requirement from symbiotic nitrogen fixation from air. Vermicompost has been emerging as an important source in supplementing chemical fertilizer in agriculture in view of sustainable development after Rio Conference; vermicompost is a bio fertilizer enriched with all beneficial soil microbes and also contains all the essential plant nutrients like N, P and K. Since vermicompost helps in enhancing the activity of microorganisms in soil which further increase solubility of nutrients and their consequent availability to plants is known to be altered by microorganism by reducing soil pH at microsites, chelating action of organic acids produced by them and intraphyl mobility in the fungal filaments (Paul Sebastian and Christopher Lourdraj 2007). Selvakumar et al. (2012) reported that increased seed quality parameters with wider spacing may be attributed to butter source to sink relationship of the plants which resulted in better accumulation and assimilation of photosynthetic in to sink in black gram. Baloch et al. (2013) found that better availability of nutrients and moisture to the crop and less competition for natural resources as evident from the beneficial effects on the crop growth. Suresh Goyal et al. (2010) reported that application of 30 :60:30 kg of NPK along with 20 kg sulfur produced significantly higher value of growth components of chickpea. Kumpawat (2010) reported that increase in different parameters of growth and yield components, which ultimately resulted in higher yield in black gram. Meena and Baldev (2016) reported that number of pods per plant of crop was increased significantly and progressively with the increasing percentage of organic manure in a combination of inorganic source of nutrient in green gram.

The black gram haulm yield enhancement was due to the continuous supply of nutrients which in turn increased the leaf area and dry matter production resulting in higher haulm yield and higher nutrient uptake (Shanti et al. 2008). Sustaria et al. (2010) reported that the extensive root system development with organic in adequate amount would have assisted the efficient absorption and utilization of other nutrient. Since uptake of nutrients is a function of their content and yield, increase in seed and straw yield along higher content of nitrogen might have resulted in higher uptake of nitrogen in the crop. This may be attributed to availability of sufficient amount of nutrients throughout growth period resulting in better uptake and superior yield attributes. These results are similar to those reported by Shivakumar and Ahlawat (2008). Post-harvest soil nutrient status .Sheoran et al. (2010) stated that showed the maximum availability of nutrients in the soil, which might be ascribed to the addition of these nutrients in the soil which remained unutilized after crop harvest and thus improved the status of the soil.

REVIEW

Effect of organic and inorganic inputs on growth and yield of black gram

Farm yard manure

Application of farmyard manure in green gram @ 5 t ha^{-1} has significantly increased the growth parameters like plant height, no. of branches and yield (Kumar et al. 2011). This is likely due to balanced supply of nutrients to crop plants with farmyard manure appli-

cation besides, favorable effects of farmyard manure on physical, chemical and biological properties of soil. The highest yield and yield attributes gained due to chemical fertilizer in conjunction with farmyard manure and biofertilizers might have provided favorable soil environment and nourishment for better plant growth resulted in better vegetative growth in terms of plant height and total dry matter positive response in terms of yield and yield attributes to integrated nutrient management have also been reported by Mainul et al. (2016). Gable et al. (2008) reported that integrated nutrient management significantly influenced on yield components like number of pods per plant, number of seeds per pod. Integrated nutrient management system involving organics like farmyard manure and chemical fertilizer is a better way to achieve higher seed yield and yield components.

Vermicompost

Application of organic manure in the form of vermicompost releases the macro and micro nutrients during the course of microbial decomposition (Pattanayak et al. 2009). Earlier workers reported that application of vermicompost improve the physical, chemical and biological properties of the soil including supply of almost all the essential plant nutrient for growth and development of plant. Swati et al. (2014) reported that significant increase in seed yield was recorded with the application of vermicompost @ 2.5 tonnes ha^{-1} combined with phosphorus solubilizing bacteria inoculation is higher protein content was recorded with the higher level of phosphorus and combined treatment of vermicompost and phosphorus solubilizing bacteria inoculation.

Panchagavya

Yadava and Tripathi (2013) also reported that foliar spray of panchagavya @ 3% without chemical fertilizers was the most effective low cost technology in green gram. Foliar application of pulse wonder might have provided availability of iron, boron and plant growth hormones for black gram which in turn might have resulted in vigorous root, cell wall, plasma membrane, enhancement of cell division, tissue differentiation and metabolism of nucleic acid, carbohydrate and shoot initiation reflecting upon enhanced crop growth and establishment in terms of plant height. Similar inferences were documented by Kumar (2015). This may be due to the combination of nutrients and growth regulators present in pulse wonder. The nutrient and growth regulator present in the foliar spray play a major role in growth development and metabolism of black gram. This was in conformity with findings of Marimuthu and Surendran (2015). Nileema and Sreenivasa (2011) reported that, significant improvement in grain yield of green gram mainly attributed to significant improvement in yield parameters like test weight and number of pods per plant as compared to rest of treatments, the panchagavya is an efficient plant growth stimulant that enhanced the biological efficiency of crops. It is used to activate biological reactions and to protect the plants from disease incidence. Patil et al. (2012) found that application of panchagavya @ 3% at flower initiation and 15 days after first spray recorded significantly higher grain yield, haulm yield, number of pods per plant and 100 seed weight (20.91) compared to other treatment combination. Pandey and Gupta (2013) reported that increased yield might be due to enhanced yield attributes like number of pods per plant, number of seeds per pods and due to increased uptake of nutrients by effective translation of nutrients from sink to reproductive area of crop. Sarkar et al. (2014) stated that panchagavya found to be best in better utilization of leaf nitrogen and efficient photosynthesis activity improving the yield in black gram.

Economics

Ram et al. (2012) reported that the application of farmyard manure @ 5 t ha^{-1} could not statistically improve the net returns over without application of farmyard manure benefit cost ratio was significantly reduced due to application of farmyard manure @ 5 t ha^{-1} compared to without application of farmyard manure. Marimuthu and Surendran (2015) reported that application of 100% recommended dose of NPK + Tamil Nadu Agricultural University pulse wonder 5.0 kg ha^{-1} recorded higher number of pods $plant^{-1}$ (37.15), yield (1162 kg ha^{-1}) and benefit cost ratio (2.98) of black gram. Kulkarni et al. (2015) reported that the panchagavya spray produced higher yield, due to its high cost resulted in lower economics return and benefit cost ratio. Singh et al. (2016) reported that

gross monetary return, net monetary return and benefit cost ratio were significantly highest in recommended dose of fertilizer treatment.

MATERIALS AND METHODS

Field experiment was conducted at the Experimental Farm, Department of Agronomy, Annamalai University, during March to May 2017 to study the response of irrigated black gram to integrated nutrient management. The treatments were laid out in split plot design consisting three replications (as whole plot units) and six genotypes (as sub-plot units for two sasons). For each morphological trait, data were analyzed by Multi-year split plot design using SAS MIXED procedure (SAS Inst 2002-2008, SASV9.3). The details of the treatment was given below.

Treatment details

Treatments	Details
T_1	Recommended dose of fertilizer (RDF) 25 :50 : 25 kg NPK ha^{-1}
T_2	RDF 25:50:25 kg NPK ha^{-1} + FYM @ 12.5 t ha^{-1}
T_3	RDF 25:50:25 kg NPK ha^{-1} + Vermicompost @ 5t ha^{-1}
T_4	RDF 25:50:25 kg NPK ha^{-1} + Seed treatment of panchagavya @ 3-4 ml kg^{-1}
T_5	RDF 25:50:25 kg NPK ha^{-1} + FYM @ 12.5 t ha^{-1}+ Two spray of panchagavya @ 3% at 15 and 30 DAS
T_6	RDF 25:50:25 kg NPK ha^{-1} + FYM @ 12.5 t ha^{-1} + Three spray of panchagavya @ 3% at 15, 30 and 45 DAS
T_7	RDF 25:50:25 kg NPK ha^{-1} + FYM @ 12.5 t ha^{-1} + Four spray of panchagavya @ 4% at 15, 25, 30 and 45 DAS
T_8	RDF 25:50:25 kg NPK ha^{-1} + Vermicompost @ 5 t ha^{-1} + Two spray of panchagavya @ 3% at 15 and 30 DAS
T_9	RDF 25:50:25 kg NPK ha^{-1} + Vemicompost @ 5 t ha^{-1}+ Three spray of panchagavya @ 3% at 15,30 and 45 DAS
T_{10}	RDF 25:50:25 kg NPK ha^{-1} + Vermicompost @ 5 t ha^{-1} + Four spray of panchagavya @ 4% at 15,25, 30 and 45 DAS

Treatment application

Basal application : A fertilizer schedule of 25 kg nitrogen, 50 kg phosphorus and potassium 25 kg ha^{-1} was adopted. 100% of recommended NPK was applied as basal. Entire dose of nitrogen, phosphorus and potassium were supplied through urea, single superphosphate and muriate of potash, respectively.

Farmyard manure (FYM) : Farmyard manure was collected from the Experimental Farm, Department of Agronomy, Annamalai University and applied at the time of last ploughing to the experimental plot as per the treatment schedule.

Vermicompost : The vermicompost used in the study was obtained from Experimental Farm, Department of Agronomy, Annamalai University. The vermicompost was prepared using pressmud as raw material and by product from sugar factory. The earthworm *Eudrilus eugeniae* was used for the degradation of organic matter for obtaining vermicompost.

Panchagavya : The prepared panchagavya @ 3% was applied using hand sprayer with high pore size. Panchagavya at 15, 30 and 45 DAS.

Biometric observations

Five plants from each plot were chosen by simple random sampling method and were tagged. These tagged plants were used for recording all biometric observations at different stages of crop growth. The following biometric observations were recorded.

Plant height : Plant height was measured from the base of the plant to the tip of the last opened leaf at 30, 45 DAS and at harvest stage and expressed in cm.

Leaf area index (LAI) : Leaf area index was calculated at different growth stages viz., 30, 45 DAS and at harvest by using the following formula :

$$\text{Leaf area index} = L \times B \times K$$

Where, L = Legth of the leaf, B= Maximum breadth of the leaf, K= Constant factor (0.741).

From this, LAI was calculated using following formula :

$$LAI = \frac{\text{Leaf area per unit land area (sq cm)}}{\text{Unit land area (sq cm)}}$$

Dry matter production (DMP) : Five plants from each plot were collected from sample rows random at 30, 45 DAS and at harvest and air dried. The air dried samples were oven dried at 80 ± 5°C till a constant

weight was recorded. The dry matter production was computed and expressed in kg ha^{-1}.

Number of branches plant^{-1} : The number of branches plant^{-1} was counted at 30, 50 DAS and at harvest from five randomly selected plants in each plot.

Yield components : The following yield components were recorded from five sample plants and the mean was taken in each plot.

Number of pods plant^{-1} : The total number of pods in a plant was counted from the sample plants and the mean was taken as number of pods plant^{-1}.

Number of seeds pod^{-1} : The number of seeds pod^{-1} was recorded from ten pods selected at random in each plant. The mean number of seeds pod^{-1} was recorded.

Hundred seed weight (g) : Mean test weight of 100 seeds plot^{-1} was recorded at 14% moisture content and expressed in gram.

Seed yield : The seed yield from each plot was recorded at 14% moisture level and expressed in kg ha^{-1}.

Haulm yield : The dry weight of the sun dried haulm yield from each plot was recorded and expressed in kg ha^{-1}.

Harvest index : The proportion of seed yield to the total dry matter production plant^{-1} was calculated. The harvest index (HI) was calculated by using the formula and expressed as percentage.

$$\text{Harvest index} = \frac{\text{Economic yield}}{\text{Biological yield}} \times 100$$

RESULTS AND DISCUSSION

From the experimental results, it is evident that the integrated nutrient management practices significantly influenced the growth components viz., plant height, leaf area index, number of branches and dry matter production by application of farmyard manure, vermicompost and panchagavya spray treatment. Among the various treatments tested integrated nutrient management approach of application of recommended dose of fertilizer (RDF) 25:50:25 kg NPK ha^{-1} + Vermicompost @ 5t ha^{-1} + Four spray of panchagavya @ 4% at 15, 25, 30 and 45 DAS (T_{10}) significantly resulted in the highest plant height, leaf area index and dry matter production in black gram plant (Table 1).

Table 1. Effect of integrated nutrient management practices on growth components of irrigated black gram. Recommended dose of fertilizer (RDF) 25:50:25 kg NPK ha^{-1} (T_1) , RDF 25:50:25 kg NPK ha^{-1} + FYM @ 12.5 t ha^{-1} (T_2), RDF 25:50:25 kg NPK ha^{-1} + Vermicompost @ 5 t ha^{-1} (T_3), RDF 25:50:25 kg NPK ha^{-1} + Seed treatment of panchagavya @ 3–4 ml kg^{-1} (T_4), RDF 25:50:25 kg NPK ha^{-1} + FYM @ 12.5 t ha^{-1} + Two spray of panchagavya @ 3% at 15 and 30 DAS, (T_5), RDF 25:50:25 kg NPK ha^{-1} + FYM @ 12.5 t ha^{-1} + Three spray of panchagavya @ 3% at 15,30 and 45 DAS (T_6), RDF 25:50:25 kg NPK ha^{-1} + FYM @ 12.5 t ha^{-1} + Four spray of panchagavya @ 4% at 15, 25, 30 and 45 DAS (T_7), RDF 25:50:25 kg NPK ha^{-1} + Vermicompost @ 5 t ha^{-1} + Two spray of panchagavya @ 3% at 15 and 30 DAS (T_8), RDF 25:50:25 kg NPK ha^{-1} + Vermicompost @ 5 t ha^{-1} + Three spray of panchagavya @ 3% at 15,30 and 45 DAS (T_9), RDF 25:50:25 kg NPK ha^{-1} + Vermicompost @ 5 t ha^{-1} + Four spray of panchagavya @ 4% at 15,25, 30 and 45 DAS (T_{10}).

	Plant height (cm)					Dry matter production (kg ha^{-1})		
Treatments	30 DAS	45 DAS	At harvest	Leaf area index 50 DAS	Number of branches plant^{-1}	30 DAS	45 DAS	At harvest
T_1	18.21	32.32	34.28	1.76	2.45	907	1480	2329
T_2	19.65	34.13	36.43	2.14	3.36	1124	1720	2640
T_3	22.46	36.99	39.95	2.86	5.12	1489	2380	3100
T_4	21.67	36.06	38.86	2.68	4.65	1369	2220	2910
T_5	19.06	33.25	35.37	2.14	3.02	1004	1590	2560
T_6	20.18	35.21	37.52	2.32	4.07	1249	1940	2790
T_7	23.93	38.12	41.01	3.04	5.87	1614	2460	3210
T_8	24.72	39.17	42.15	3.22	6.23	1734	2520	3349
T_9	25.06	40.12	43.21	3.34	7.16	1854	2660	3622
T_{10}	26.05	41.05	44.03	3.52	7.88	1990	2820	3910
SEd	0.11	0.16	0.30	0.08	0.34	42.13	48.40	54.0
CD (p=0.05)	0.23	0.34	0.61	0.16	0.68	84.26	96.78	108.2

Table 2. Effect of integrated nutrient management practices on number of pods plant$_{-1}$, pod length, number of seeds pod^{-1} and hundred seed weight seed yield and haulm yield of irrigated black gram. Recommended dose of fertilizer (RDF) 25:50:25 kg NPK ha^{-1} (T_1), RDF 25:50:25 kg NPK ha^{-1} + FYM @ 12.5 t ha^{-1} (T_2), RDF 25 : 50 : 25 kg NPK ha^{-1} + Vermicompost @ 5 t ha^{-1} (T_3), RDF 25:50:25 kg NPK ha^{-1} + Seed treatment of panchagavya @ 3-4 ml kg^{-1} (T_4), RDF 25:50:25 kg NPK ha $^{-1}$+ FYM @ 12.5 t ha^{-1} + Two spray of panchagavya @ 3% at 15 and 30 DAS (T_5), RDF 25 : 50: 25 kg NPK ha^{-1} + FYM @ 12.5 t ha^{-1} + Three spray of panchagavya @ 3% at 15, 30 and 45 DAS (T_6), RDF 25 : 50 : 25 kg NPK ha^{-1}+ FYM @ 12.5 t ha^{-1} + Four spray of panchagavya @ 4% at 15, 25, 30 and 45 DAS (T_7), RDF 25 : 50: 25 kg NPK ha^{-1}+ Vermicompost @ 5 t ha^{-1} + Two spray of panchagavya @ 3% at 15 and 30 DAS (T_8), RDF 25:50: 25 kg NPK ha^{-1} + Vermicompost @ 5 t ha^{-1} + Three spray of Panchagavya @ 3% at15, 30 and 45 DAS (T_9) RDF 25:50:25 kg NPK ha^{-1} + Vermicompost @ 5t ha^{-1} + Four spray of panchagavya @ 4% at 15, 25, 30 and 45 DAS (T_{10}).

Treatments	Number of pods plant^{-1}	Pod length (cm)	Number of seeds pod^{-1}	Hundred seed weight (g)	Seed yield (kg/ha)	Haulm yield (kg/ha)	Harvest index
T_1	21.65	4.08	5.06	3.36	433	1416	23.41
T_2	23.01	4.42	5.46	3.56	565	1502	25.75
T_3	25.25	5.12	6.52	4.01	649	1646	28.27
T_4	24.40	4.91	6.16	3.89	626	1599	28.13
T_5	22.43	4.21	5.20	3.49	475	1460	24.54
T_6	23.65	4.66	5.88	3.67	601	1533	26.93
T_7	26.13	5.39	6.88	4.13	732	1693	30.18
T_8	27.00	5.69	7.26	4.22	775	1722	31.03
T_9	28.02	5.95	7.52	4.39	836	1795	31.77
T_{10}	28.97	6.20	7.89	4.52	895	1850	32.60
SEd	0.25	0.07	0.07	0.03	11.28	27.73	0.25
CD (p=0.05)	0.53	0.14	0.15	0.06	22.56	55.46	0.53

The higher dry matter production is ascribed to the vigorous and enhanced plant growth and also higher leaf area development that aided in the effective interception of light, thus leading to higher dry matter production. Better nutrient availability might have resulted in greater leaf area index . The overall improvement in the growth of black gram is due to addition of fertilizers were also reported by Hussain et al. (2011). Application of recommended dose of fertilizer (RDF) 25:50:25 kg NPK ha^{-1} (T_1) resulted in the least values of growth components. The higher values of leaf area index might be associated with increased availability of phosphorus due to phosphorus solubilizing bacteria treatment and balanced nutrition, which played an important role in rapid cell division and elongation in meristmatic plant tissues. Kumari et al. (2012) also reported more leaf area.

The yield components viz., number of pods per plant, pod length and number of seeds per pod were significantly influenced by application of recommended dose of fertilizer (RDF) 25:50:25 kg NPK ha^{-1} + Vermicompost @ 5 t ha^{-1} + Four spray of panchagavya @ 4% at 15, 25, 30 and 45 DAS (T_{10}) (Table 2). This might be due to better photosynthetic actively of the plant and more extensive root system and thus enabled the plant to extract nutrient from the soil there by resulting in better development of yield components. Application of recommended dose of fertilizer (RDF) 25 : 50:25 kg NPK ha^{-1} (T_1) resulted in the least values of yield components.The higher values of yield components might be associated with increased availability of nutrients due to balanced nutrition and phosphorus solubilizing bacteria which inturn played an important role in rapid cell division and elongation in meristematic tissues, root development and proliferation and enhancing flowering, pod setting and seed formation. Singh and Singh (2014) stated that the nutrients of organic sources are very essential for yield components of the crop.

Yield

Application of recommended dose of fertilizer (RDF) 25:50:25 kg NPK ha^{-1} + Vermicompost @ 5 t ha^{-1} + Four spray of panchagavya @ 4% at15, 25, 30 and 45 DAS (T_{10}) recorded the highest grain and haulm yield of black gram (Figs. 1 and 2). This might be due to adequate supply of nutrients at different growth stages of the crop which helped in better absorption and translocation into the plant system more efficiently to developing pods contributing to proper filling up of seeds thereby resulting in higher grain yield. The least grain yield recorded under (T_1) recommended

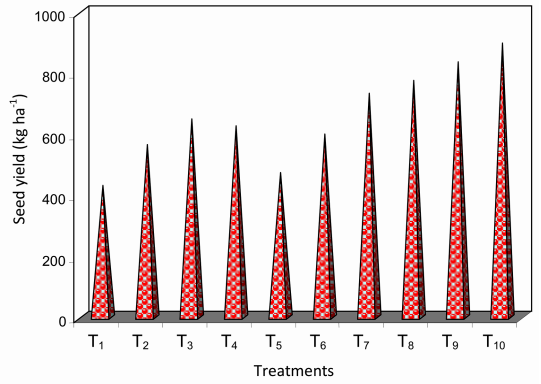

Fig. 1. Effect of integrated nutrient management practices on seed yield (kg ha^{-1}).

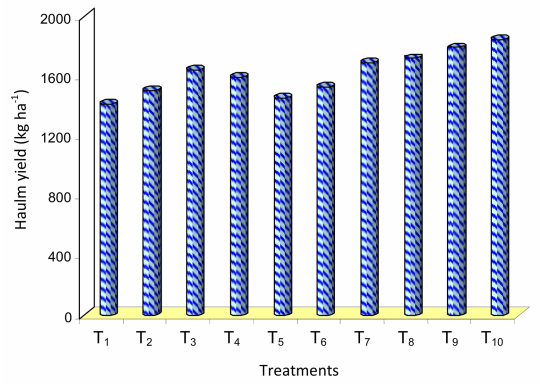

Fig. 2. Effect of integrated nutrient management practices on haulm yield (kg ha^{-1}).

dose of fertilizer (RDF) 25:50:25 kg NPK ha^{-1}. The highest grain and straw yield in this treatment was mainly due to the fact that under favorable soil condition, the plant accumulates and translocation of photosynthates from source to the sink more efficiently which inturn increased all the growth and yield components. Similar results were also reported by Jadhav et al. (2008). Kumpawat (2010) reported that increase in different parameters of growth and yield components which ultimately resulted in higher yield in black gram.

Economics

Among the treatments recommended dose of fertilizer (RDF) 25:50:25 NPK kg ha^{-1} +Vermicompost @ 5 t ha^{-1} + Four spray of panchagavya @ 4% at 15, 25, 30 and 45 DAS (T_{10}) recorded the highest net income (Table 3). Application of recommended dose of fertilizer (RDF) 25:50:25 kg of NPK ha^{-1} (T_1) recorded the lowest net income. The increased net return could be explained on the basis of increased yield under the influence of sources of inorganic nutrients in the present investigation. Further, the benefit cost ratio was decreased due to application of organic sources viz., farmyard manure and vermicompost because of the higher cost involved in applying the organic sources. Significantly increase net return and benefit cost ratio due to inorganic sources of nutrient under the present study are in close agreement with the findings of Basavarayappa Shashikumar et al. (2013).

CONCLUSION

Based on the basis of the above results, it may be concluded that application of recommended dose of

Table 3. Effect of integrated nutrient management practices on post-harvest nutrient status of soil (kg ha^{-1}). Recommended dose of fertilizer (RDF) 25:50:25 kg NPK ha^{-1} (T_1), RDF 25 : 50 : 25 kg NPK ha^{-1} + FYM @ 12.5 t ha^{-1} (T_2), RDF 25 : 50:25 kg NPK ha^{-1} + Vermicompost @ 5 t ha^{-1} (T_3), RDF 25:50:25 kg NPK ha^{-1} + Seed treatment of panchagavya @ 3–4 ml kg^{-1}. (T_4), RDF 25:50:25 kg NPK ha^{-1} + FYM @ 12.5 t ha^{-1} + Two spray of panchagavya @ 3% at 15, and 30 DAS (T_5), RDF 25:50:25 kg NPK ha^{-1} + FYM @ 12.5 t ha^{-1} + Three spray of panchagavya @ 3 % at 15, 30 and 45 DAS (T_6), RDF 25 : 50 :25 kg NPK ha^{-1} + FYM @ 12.5 t ha^{-1} + Four spray of panchagavya @ 4% 15, 25, 30 and 45 DAS (T_7), RDF 25:50:25 kg NPK ha^{-1} +Vermicompost @ 5 t ha^{-1} +Two spray of panchagavya @ 3% at 15 and 30 DAS (T_8), RDF 25: 50: 25 kg NPK ha^{-1}+ Vermicompost @ 5 t ha^{-1}+ Three spray of panchagavya @ 3% at 15, 30 and 45 DAS (T_9), RDF 25: 50 :25 kg NPK ha^{-1} + Vermicompost @ 5 t ha^{-1} + Four spray of panchagavya @ 4% at 15, 25, 30 and 45 DAS (T_{10}).

Treatments	Cost of cultivation (Rs ha^{-1})	Gross income (Rs ha^{-1})	Net income (Rs ha^{-1})	B : C ratio
T_1	20708	37472	16764	1.80
T_2	21220	48204	26984	2.27
T_3	22040	55212	33172	2.47
T_4	21750	53278	31528	2.44
T_5	20963	40920	19957	1.95
T_6	21500	51146	29646	2.37
T_7	22310	61946	39636	2.77
T_8	22600	65444	42844	2.89
T_9	22880	70470	47590	3.07
T_{10}	23150	75300	52150	3.25
SEd	–	–	–	–
CD (p=0.05)	–	–	–	–

fertilizer (RDF) 25:50:25 kg NPK ha^{-1} + Vermicompost @ 5 t ha^{-1} + Four spray of panchagavya @ four percent at 15, 25, 30 and 45 DAS had a remarkable effect on the growth, yield components, seed and haulm yield and nutrient uptake of black gram. It is an effective practice for augmenting higher yield in black gram. This organic practice for black gram was found to be agronomically good and economically viable, so it can be recommended to the irrigated black gram growers of Tamil Nadu for realizing better yield and net return and also to improve the soil fertility.

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