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Original Research Article

Response of Mothbean (*Vigna acontifolia*) to Different Levels of Fertilizers and Organic Manures in Shallow Black Soils of Northern Dry Zone, Karnataka

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A B S T R A C T

A field experiment entitled "Response of mothbean (*Vigna acontifolia*) to different levels of fertilizers and organic manures in shallow black soils of northern dry zone, Karnataka" was conducted at RARS, Vijayapur, University of Agricultural Sciences, Dharwad during *kharif*, 2018. The experiment was laid out in split plot design replicated thrice with four main plots consisted of organic manures *viz*., M_1- No organics (Control); M_2 - Vermicompost 0.5 t ha^{-1}; M_3- Vermicompost 1.0 t ha^{-1} and M_4 - FYM 2.5 t ha^{-1} and five sub plots consisted of different levels of fertilizers *viz*., S_1- No inorganics (Control); S_2-7.5:15:0 N: P_2O_5: K_2O kg ha^{-1}; S_3-10:20:0 N: P_2O_5: K_2O kg ha^{-1}; S_4-12.5:25:0 N: P_2O_5: K_2O kg ha^{-1}; S_5-15:30:0 N: P_2O_5: K_2O kg ha^{-1}. Combined application of vermicompost @ 1.0 t ha^{-1} and supply of fertilizer @ 12.5:25:0 N: P_2O_5: K_2O kg ha^{-1} (M_3S_4) recorded highest plant height, dry matter accumulation, pod numbers per plant, test weight, grain yield and straw yield. Further, highest gross returns was recorded with same said treatment (M_3S_4) but maximum net returns and B:C was recorded with combined application of FYM 2.5 t ha^{-1} + 12.5:25:0 N: P_2O_5: K_2O kg ha^{-1} (M_4S_5) which was on par with vermicompost @ 1.0 t ha^{-1} + fertilizer @ 12.5:25:0 N: P_2O_5: K_2O kg ha^{-1} (M_3S_4)

Keywords

FYM, Vermicompost, Fertilizer

Introduction

Mothbean [*Vigna aconitifolia* (Jacq.) Marechal] is an important pulse crop of the desert region and is remarkably well suited to arid and semi-arid areas of India and some other countries of Asia. In India, it is grown on an area of 13.19 lakh ha, mostly confined to Rajasthan, Gujarat, Maharashtra, Karnataka, Uttar Pradesh and Haryana with a production of 1,753 lakh t and productivity of 133 kg ha^{-1} (Rajendra Prasad, 2013). It can very well stand drought conditions and is probably the most drought resistant crop among the grain legumes. The crop has spreading growth habit forming a mat like covering on the soil surface. It thus helps greatly in the conservation of soil, water and serves as a very efficient and suitable cover crop for checking soil erosion. The lower productivity of this crop is attributed to several factors *viz*., growing the crop under

moisture stress, marginal lands with very low inputs, without proper nutrient management and other agronomical practices, without pest and disease management, non-availability of high yielding varieties and late sowing. This clearly shows that it is necessary to overcome these constraints to get higher yields. Yield is a complex character resulting from the interplay of nutrient management with the environmental variables and other factors.

Balanced fertilization is necessary to increase the productivity of pulses. Regular and judicious use of fertilizers not only helps in raising good crop yield, but also can help farmers to gain consistently higher profit. But even today, a great number of farmers are not smearing recommended dose of fertilizers. As a consequence of technological dissemination farmers have realised importance of use nitrogen, phosphorus, secondary or trace elements and organic manures. Price escalation of fertilizers has also been a factor that prevents the farmers from using optimum quantities of fertilizers.

With the increasing demand of pulses, there is an urgent need to increase their productivity, so combined use of fertilizers and organic manure not only give the great promise in crop production but also control the emergence of multiple nutrient deficiencies and maintain good soil health. Keeping this in view, an effort was made to investigate the Influence of different levels of fertilizers and manures on soil fertility, growth and yield of moth bean (*Vigna aconifolia*) in shallow black soils of Northern Dry Zone, Karnataka

Materials and Methods

The field experiment was conducted at Regional Agricultural Research Station, Vijayapur in Northern dry zone of Karnataka (at latitude 160 491 N, longitude 750 431 E and altitude of 593 m above MSL) during *kharif* 2018. Experiment was laid out in split plot design with four main plot (Organic manures) *viz*., no organics(M_1); vermicompost @ 0.5 t ha^{-1}(M_2); vermicompost @ 1.0 t ha^{-1} (M_3)and FYM @ 2.5 t ha^{-1} (M_4) and five sub plots (Fertilizer levels) *viz*., no inorganics(S_1) ; 7.5:15:0 N: P_2O_5 : K_2O kg ha^{-1} (S_2); 10:20:0 N: P_2O_5 : K_2O kg ha^{-1}(S_3); 12.5:25:0 N: P_2O_5 : K_2O kg ha^{-1}(S_4); 15:30:0 N: P_2O_5 : K_2O kg ha^{-1}(S_5) and replicated three times. The seed rate of 12 kg ha^{-1} was used for sowing. Organic manures and fertilizers were applied as per treatments at the time of sowing. The biometric observations were recorded at regular time intervals during crop period and data were subjected to standard statistical analysis. The soil of the experimental site was shallow black clay loam having pH of 8.34 recorded by using potentiometric method, low in available nitrogen (175.00 kg ha^{-1}), medium in available phosphorous (33.0 kg ha^{-1}) and high in potassium (335.0 kg ha^{-1}).

Results and Discussion

Influence of different levels of fertilizer and manures on growth and yield of mothbean

Effect of organics

Significant differences were noticed on growth, seed yield and yield attributing characters of mothbean. Significantly higher plant height at 60 DAS and at harvest (35.8 and 43.1 cm respectively, Table 1) was recorded with the incorporation of vermicompost @ 1.0 t ha^{-1}. Significantly higher dry matter accumulation at 60 DAS and at harvest was recorded with incorporation of vermicompost @ 1.0 t ha^{-1} (8.36 and 18.86 g ha^{-1}). This increment in growth parameters might be due to application of vermicompost which produced vigorous seedling as vermicompost contains

the growth hormones and enzymes, essential nutrients and organic matter which favours rapid cell elongation and division and favours better growth and development and gave higher germination of mothbean as contrast to the control. Similar finding has reported by Netwal (2003) in cowpea Rajkhowa *et al.,* (2003) and Watisenla and Lanunola (2016) in green gram.

Significantly higher pod numbers (54.6), pod length (8.0 cm) and test weight (1.82 g) were reported with incorporation of vermicompost @ 1.0 t ha^{-1} as compared to control. This increment was attributed to increased photosynthetic rate and increased translocation of photosynthate to sink and also due to slow nutrient releasing pattern of vermicompost benefiting crop during entire growth period this may resulted in enhancement of growth parameters (plant height and DMA) which may attribute to maximization in yield attributes. These findings are in concordant with Netwal (2003) in cowpea, Vadgave (2010) and Kumawat *et al.,* (2006) in geengram and Raghawendra and Kedar (2008) in chickpea.

Significantly higher grain yield (572.73 kg ha^{-1}) and straw yield (2124.87 kg ha^{-1}) was reported with incorporation of vermicompost @ 1.0 t ha^{-1}.This increment attributed to the amplified growth probably as a consequence of effective use of nutrients absorbed through ramified root system and productive shoot growth due to amended nourishment through organic fertilization and it also might be due to application of organics which improved the physicochemical and biotic properties of soil which in turn benefited plant by providing balanced nutrition to crop as and when needed which helped in production of a greater number of yield parameters (pod length, pod numbers per plant and test weight) and ultimately increased the mothbean yield. Rajkhowa *et al.,* (2003) also opined that incorporation of vermicompost @ 2.5 t ha^{-1} noticed the supreme grain and stover yield of mungbean. These results are in line with the reports of Krishna Jagadish (2002) in blackgram, Vadgave (2010) in green gram, Netwal (2003) in cowpea Sadashivanagowda *et al.,* (2017 a) in mothbean.

Effect of fertilizer levels

Among different levels of fertilizers application of fertilizer @ 12.5:25:0 N: P_2O_5: K_2O kg ha^{-1} has recorded significantly higher plant height (33.0 and 40.2 cm) and dry matter accumulation (7.33 and 17.56 g) at 60 DAS and at harvest respectively. This increment in plant height and DMA was due to improved consumption of readily available form of nutrients which play a main role in growth and development of crop by developing ramified roots which resulted in maximum withdrawal of essential nutrients from soil depth. Thereby increasing the supply of essential nutrients to developing portions of plant subsequently increased area of photosynthesis and DMA. Similar finding has reported by Sing and Pareek (2003) in green gram and Suneetha *et al.,* (2004) and Namakkha (2017) in cowpea.

Among different fertilizer levels, the higher grain yield (536.67 kg ha^{-1}) and straw yield (1982 kg ha^{-1}) was noticed with the supply of fertilizer @ 12.5:25:0 N: P_2O_5: K_2O kg ha^{-1}which remained 18.47 and 18.43 % superior as contrast to control. This may attribute due to enhancement in yield attributes like pod numbers per plant, length of pod and test weight which remained 14.5, 20.0 and 7.95 %, respectively superior over control. This increment was attributed due to supply of nitrogen and phosphorus, resulted in amplified photosynthetic activity and helps to develop a ramified root system and thus empowers the plant to withdraw extra water

and nutrient from deeper layers, resulted in better growth and yield attributes. Present results are in concordant with the finding of Saraswathy *et al.,* (2004) in green gram, Indoria and Majumdar (2007) in cowpea and Trivedi (1996) in black gram.

Interaction effect

Among interactions substantially higher plant height (M_3S_4, 39.2 and 45.0 cm, respectively) and dry matter accumulation (M_3S_4, 9.48 and 20.43, respectively) was recorded with combined application vermicompost @ 1.0 t ha^{-1} + fertilizer @ 12.5:25:0 N: P_2O_5: K_2O kg ha^{-1}. Grain yield (625.00 kg ha^{-1}) and straw yield (2340.00 kg ha^{-1}) was substantially higher in combination of vermicompost @ 1.0 t ha^{-1} + supply of fertilizer @ 12.5:25:0 N: P_2O_5: K_2O kg ha^{-1} than other combinations. This increment was attributed due to favourable influence of combined application of manures and fertilizers on sink component resulted to improved development of the plants in relations of yield attributes (pod length, pod numbers per plant and test weight) and growth attributes (plant height and DMA) on account of balanced nutrition and synergistic influence of combined incorporation as contrast to control. Present findings were in accordance with the study conducted by Raghwendra and Kedar (2008) in chickpea, Vadgave (2010) and Rajkhowa *et al.,* (2003) in green gram.

Influence of different levels of fertilizers and manures on economics of mothbean production

Effect of organics

Significantly higher gross returns (Table 2) were noticed with incorporation of VC @ 1.0 t ha^{-1} alternatively maximum net realization and benefit cost ratio was recognized with incorporation of FYM @ 2.5 t ha^{-1} followed by VC @ 1.0 t ha^{-1}. This was because of lower cost of FYM and higher cost of vermicompost. However, both the treatments were comparable with each other. These outcomes were in line with the reports of Raj Singh (2008) and Sadashivanagowda *et al.,* (2017 b) in mothbean.

Effect of inorganics

Significantly maximum gross returns, net returns and benefit cost ratio was reported with supply of fertilizer @ 12.5:25:0 N: P_2O_5: K_2O kg ha^{-1}. It was equivalent with supply of fertilizer @ 15:30:0 N: P_2O_5: K_2O kg ha^{-1} as the higher grain yield and straw yield of mothbean was recognized with said treatment. The present results are in concordant with the reports of Kokani *et al.,* (2014) and Himani *et al.,* (2017).

Interaction effect

Significantly higher gross returns were noticed with combined application vermicompost @ 1.0 t ha^{-1} + fertilizer @ 12.5:25:0 N: P_2O_5: K_2O kg ha^{-1} (M_3S_4) and being comparable with FYM @ 2.5 t per ha + 12.5:25:0 N: P_2O_5: K_2O kg ha^{-1} (M_4S_4) as contrast to control. However maximum net returns and benefit cost ratio was noticed with FYM @ 2.5 t per ha + 12.5 :25:0 N: P_2O_5: K_2O kg ha^{-1} (M_4S_4) followed by VC @ 1.0 t ha^{-1} + 12.5:25:0 N: P_2O_5: K_2O kg ha^{-1} (M_3S_4) as contrast to control. This was because of higher cost incurred for vermicompost than FYM. These outcomes are in concordant with the reports of Subbarayappa *et al.,* (2009) in green gram and Sutaria *et al.,* (2010) in cowpea.

Table.1 Influence of different levels of fertilizers and organic manures on growth and yield attributes of mothbean

Treatments	Plant height (cm)		Dry matter accumulation (DMA)		Pod numbers	Pod length (cm)	100 seed weight (g)
	60 DAS	At harvest	60 DAS	At harvest			
Organics							
M_1	21.07	28.67	4.62	13.44	31.33	4.73	1.59
M_2	32.21	39.10	6.39	16.06	47.41	6.14	1.62
M_3	35.85	43.10	8.36	18.86	54.60	8.01	1.82
M_4	34.02	41.60	8.05	18.39	54.85	7.80	1.74
S.Em.±	0.41	0.54	0.14	0.28	0.67	0.09	0.02
C.D 5%	1.41	1.87	0.48	0.96	2.31	0.32	0.08
Fertilizer levels (S)							
S_1	27.46	34.42	6.04	15.65	42.97	5.80	1.62
S_2	29.88	37.46	6.72	16.18	45.38	6.36	1.68
S_3	31.48	38.79	6.88	16.85	46.84	6.84	1.68
S_4	33.09	40.21	7.33	17.56	50.31	7.25	1.76
S_5	32.04	39.71	7.31	17.19	49.75	7.09	1.73
S.Em.±	0.51	0.43	0.11	0.22	0.67	0.07	0.02
C.D 5%	1.46	1.25	0.32	0.64	1.94	0.19	0.05
Interaction (M×S)							
M_1S_1	16.00	22.00	3.70	13.18	27.60	4.04	1.57
M_1S_2	20.73	29.50	4.55	13.24	29.80	4.27	1.69
M_1S_3	22.10	29.83	4.43	13.37	31.40	4.97	1.50
M_1S_4	23.00	31.33	4.83	13.62	31.80	5.17	1.56
M_1S_5	23.53	30.67	5.58	13.80	36.07	5.21	1.60
M_2S_1	28.20	37.00	5.43	13.80	43.00	5.23	1.64
M_2S_2	31.50	38.83	6.26	15.20	45.80	6.15	1.65
M_2S_3	32.77	39.17	6.63	16.78	47.73	6.15	1.59
M_2S_4	33.63	40.50	6.63	17.21	48.47	6.53	1.65
M_2S_5	34.93	40.00	7.01	17.30	52.07	6.64	1.55
M_3S_1	34.53	40.50	7.72	17.83	50.27	7.03	1.68
M_3S_2	35.67	41.83	8.06	18.17	52.80	7.53	1.73
M_3S_3	35.74	43.50	8.24	18.74	54.00	8.37	1.85
M_3S_4	39.23	45.00	9.48	20.43	61.47	8.67	1.96
M_3S_5	34.07	44.67	8.30	19.10	54.47	8.47	1.90
M_4S_1	31.10	38.17	7.30	17.80	51.00	6.92	1.58
M_4S_2	31.60	39.67	8.02	18.09	53.13	7.49	1.64
M_4S_3	35.30	42.67	8.21	18.50	54.23	7.89	1.77
M_4S_4	36.50	44.00	8.37	18.99	59.50	8.63	1.87
M_4S_5	35.61	43.50	8.36	18.57	56.40	8.07	1.86
S.Em.±	1.00	0.95	0.24	0.48	1.38	0.15	0.04
C.D 5%	2.96	2.91	0.75	1.49	4.15	0.47	0.12

Table.2 Influence of different levels of fertilizers and organic manures on yield and economics of mothbean

Treatments	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Gross returns ₹ ha^{-1}	Net returns ₹ ha^{-1}	B:C
Organics					
M_1	391.00	1468.00	21752.00	7755.40	1.55
M_2	462.60	1718.40	25707.60	9320.20	1.57
M_3	572.73	2124.87	31823.97	13236.57	1.71
M_4	570.13	2081.13	31628.37	14940.97	1.89
S.Em.±	16.95	59.39	935.64	935.64	0.05
C.D 5%	58.66	205.52	3237.74	3237.74	0.17
Fertilizer levels (S)					
S_1	437.75	1632.50	24336.25	9110.75	1.58
S_2	484.92	1800.25	26946.21	10657.21	1.65
S_3	501.25	1828.83	27805.75	11235.75	1.67
S_4	536.67	1982.58	29807.21	12953.21	1.76
S_5	535.00	1996.33	29744.50	12609.50	1.73
S.Em.±	6.62	30.47	366.79	366.79	0.02
C.D 5%	19.06	87.77	1056.59	1056.59	0.06
Interaction (M×S)					
M_1S_1	296.33	1143.33	16531.67	4296.67	1.35
M_1S_2	413.33	1553.33	22996.67	8982.67	1.64
M_1S_3	414.33	1543.33	23031.67	8736.67	1.61
M_1S_4	416.00	1503.33	23055.00	8476.00	1.58
M_1S_5	415.00	1596.67	23145.00	8285.00	1.56
M_2S_1	431.33	1650.00	24041.67	8652.67	1.56
M_2S_2	452.00	1690.00	25135.00	8921.00	1.55
M_2S_3	460.00	1688.67	25533.00	9038.00	1.55
M_2S_4	485.33	1766.67	26916.67	10137.67	1.60
M_2S_5	484.33	1796.67	26911.67	9851.67	1.58
M_3S_1	513.33	1866.67	28466.67	10877.67	1.62
M_3S_2	537.67	2021.00	29914.83	11500.83	1.62
M_3S_3	566.00	2103.33	31455.00	12760.00	1.68
M_3S_4	625.00	2340.00	34760.00	15781.00	1.83
M_3S_5	621.67	2293.33	34523.33	15263.33	1.79
M_4S_1	510.00	1870.00	28305.00	12616.00	1.80
M_4S_2	536.67	1936.67	29738.33	13224.33	1.80
M_4S_3	564.67	1980.00	31203.33	14408.33	1.86
M_4S_4	620.33	2320.33	34497.17	17418.17	2.02
M_4S_5	619.00	2298.67	34398.00	17038.00	1.98
S.Em.±	20.68	80.61	1142.77	1142.77	0.06
C.D 5%	67.62	257.58	3736.09	3736.09	0.20

It can be concluded that combined incorporation of vermicompost @ 1.0 t ha^{-1} and supply of fertilizer @ 12.5:25:0 N: P_2O_5: K_2O kg ha^{-1} or FYM @ 2.5 t ha^{-1} + fertilizer @ 12.5:25:0 N: P_2O_5: K_2O kg ha^{-1} resulted in higher growth and yield attributes and higher net returns, gross returns and B:C.

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