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Growth attributes and nutrient uptake of green gram as influenced by vermicompost and zinc in arid western Rajasthan

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ABSTRACT : A field experiment was conducted during *Kharif* season to find out the effect of vermicompost and zinc application on growth attributes of green gram [*Vigna radiata var. aureus* (L.) wilczek]. The treatments comprised of five organic manure (Control, FYM @ 10 t ha^{-1}, vermicompost @ 5 t ha^{-1}, vermicompost @ 7.5 t ha^{-1} and vermicompost @10 t ha^{-1}) and four spray of zinc sulphate (control, at initiation of branching, at initiation of flowering and at initiation of branching as well as flowering) were laid out in Randomized Block Design. Application of increasing levels of vermicompost from 5 to 7.5 t ha^{-1} significantly enhanced the plant height at harvest, dry matter accumulation at 30 , 45 and 60 DAS, dry weight of root nodules at 30 and 45 DAS, total chlorophyll content in fresh leaves at 30, 45 and 60 DAS, leaf area index at 30, 45, and 60 DAS, CGR during 30-45 and 45-60 DAS, RGR during 45-60 DAS, NAR during 45-60 DAS, total nitrogen, phosphorus, potassium and zinc uptake of green gram. Further an application of foliar spray of zinc at both branching and flowering stage in green gram significantly increased the plant height at harvest, dry matter accumulation at 45 and 60 DAS, dry weight of root nodules at 45 DAS, total chlorophyll content in fresh leaves at 30, 45 and 60 DAS, leaf area index (LAI) at 30, 45, and 60 DAS, CGR during 30-45 and 45-60 DAS, RGR during 30-45 and 45-60 DAS, NAR during 45-60 DAS, total nitrogen, phosphorus, potassium and zinc uptake, net return and B:C ratio of green gram.

Key Words : Green gram, Organic manure, Zinc, Growth attributes

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Green gram [*Vigna radiata* (L.) wilczek var. aureus] commonly known as "Moong" is an important pulse crop of India. Being a leguminous crop, green gram fixes 30-40 kg nitrogen ha^{-1}. After picking of pods, it may be used as green manure. It is a spreading type crop and helps in preventing soil erosion. The pulses are the chief sources of protein in a balanced diet in Indian conditions and contribute about 15 per cent of diet . The world's arable land resources are finite and there is not much scope for significantly expending the area of land under cultivation. Hence, most of the increase in agricultural production will have to be obtained through increased productivity from the existing agricultural land. Amongst various factors that limit the yield of green gram are poor soil fertility and its management has been recognized as one of the important constraint in green gram production. Since, the soils of North- Western Rajasthan are very low in organic matter as well as major and micro nutrients essential for healthy crop growth.

Vermicomposting or vermiculture revolution is a buzz word now days. Indian farmers had been using yhe FYM adages and its role in crop production and plant nutrition is well proved and documented. Vermicompost is dropping of earthworms after the intestinal digestion of organic matter; these dropping are high in nutritive value. Since vermicompost helps in enhancing the activity of micro-organisms in soils which further enhance solubility of nutrients and their consequent availability to plants is known to be altered by micro- organisms by reducing soil pH at micro sites, chelating action of organic acids producing by them and intraphyl mobility in fungal filaments (Chhonkar, 2002). Thus, in organic carbon deficient arid and semi arid soils, vermicompost would not only increase organic carbon status of soil but also increase the soil water holding capacity, soil flocculation and crop production sustainable one (Rajkhowa *et al*., 2000).

Further, zinc application in field crops is an important as that of major nutrients in present day agriculture. Increasing cultivation of higher fertilizer responsive genotypes, lack of use of organic manures and high cropping intensity have been affecting the zinc status in soils, therefore, zinc deficiency become one of the major constraints for crop productivity. Thereafter, the present investigation was undertaken to find out the effect of vermicompost and zinc on growth attributes of green gram.

RESEARCH PROCEDURE

The experiment was conducted at College of Agriculture, Bikaner during summer season. The soil was loamy sand and low in organic matter. The soil pH was 8.3. It was low in organic carbon (0.07 %), available nitrogen (65.48 kg ha^{-1}) and available phosphorus (9.56 kg ha^{-1}) and medium in potassium (160.22 kg ha^{-1}). The treatments comprised of five organic matter (Control, FYM @ 10 t ha^{-1}, vermicompost @ 5 t ha^{-1}, vermicompost @ 7.5 t ha^{-1} and vermicompost @10 t ha^{-1}) and four spray zinc sulphate (control, at initiation of branching, at initiation of flowering and at initiation of branching as well as flowering) were laid out in Randomized Block Design with three replications. Vermicompost and well decomposed FYM were applied as per treatment at the time of sowing and were thoroughly incorporated in soil with the help of spade. The calculated quantity of zinc sulphate spray was applied as per treatment at initiation of branching and flowering stage. Green gram variety RMG-62 was sown at 15 kg ha^{-1}in line spaced at 30 cm at a depth of 5 cm by "*Kera*" method in open furrow.

RESEARCH ANALYSIS AND REASONING

The results of the present study as well as relevant discussions have been presented under following sub heads:

Effect of organic manure :

Data (Table 1, 2 and 3) reveled that application of organic manure improved the growth parameter of the green gram as compared to control. Application of increasing levels of vermicompost from 5 to 7.5 t ha^{-1} significantly enhanced the plant height at harvest, dry matter accumulation at 30, 45 and 60 DAS, dry weight of root nodules at 30 and 45 DAS, total chlorophyll content in fresh leaves at 30, 45 and 60 DAS, leaf area index (LAI) at 30, 45, and 60 DAS, CGR during 30-45 and 45-60 DAS, RGR during 45-60 DAS, NAR during 45-60 DAS, total nitrogen, phosphorus, potassium and zinc uptake, net return and B:C ratio of green gram. Further increase of vermicompost up to 10 tha^{-1} the effect was found to be at par with vermicompost at 7.5 t ha^{-1}. The effect of FYM 10 t ha^{-1} at par with the vermicompost at 5 tha^{-1} was also significantly increased growth parameter as compared to control.

The magnitude of increase under vermicompost7.5 t ha^{-1} were 20.27, 6.65 and 6.16 per cent in plant height at harvest, 27.78 , 10.84 and 8.24 per cent in dry matter accumulation at 30 DAS, 31.49, 11.05 and 8.41 per cent in dry matter accumulation

Table 1: Effect of vermicompost and foliar spray of zinc on plant growth attributes and chlorophyll content of green gram

Treatments	Plant height (cm)		Dry matter accumulation (g $plant^{-1}$)			Dry weight of root nodules (mg $plant^{-1}$)		Total chlorophyll content in leaves (mg g^{-1} of fresh leave weight)		
	20 DAS	Harvest	30 DAS	45 DAS	60 DAS	30 DAS	45 DAS	30 DAS	45 DAS	60 DAS
Organic manure										
Control	8.80	25.21	0.72	4.51	6.49	15.81	24.08	1.28	1.42	1.33
FYM @ 10 tha^{-1}	9.10	28.43	0.83	5.34	8.17	19.15	29.18	1.36	1.55	1.42
Vermicompost @ 5 tha^{-1}	9.20	28.56	0.85	5.47	8.38	19.59	29.80	1.37	1.58	1.43
Vermicompost @ 7.5 tha^{-1}	9.28	30.32	0.92	5.93	9.32	21.12	32.15	1.43	1.64	1.50
Vermicompost @10 tha^{-1}	9.31	30.48	0.93	6.00	9.39	21.48	32.69	1.45	1.67	1.52
S.E.±	0.24	0.60	0.013	0.079	0.05	0.42	0.52	0.02	0.020	0.022
C.D. (P=0.05)	NS	1.73	0.039	0.22	0.43	1.20	1.51	0.058	0.059	0.065
Foliar spray of $ZnSo_4$ (0.5%)										
Control	8.80	26.27	0.85	5.20	6.98	19.43	28.70	1.31	1.50	1.22
At initiation of branching	9.30	28.63	0.86	5.67	8.39	19.40	30.40	1.44	1.63	1.44
At initiation of flowering	9.15	28.78	0.84	5.24	8.42	19.44	28.74	1.31	1.51	1.46
At initiation of branching + flowering	9.27	30.76	0.85	5.69	9.61	19.42	30.48	1.44	1.64	1.64
S.E.±	0.22	0.56	0.012	0.07	0.13	0.02	0.47	0.018	0.018	0.020
C.D. (P=0.05)	NS	1.55	NS	0.20	0.38	NS	1.35	0.052	0.053	0.058

NS=Non-significant

at 45 DAS, 43.61, 14.08 and 11.22 per cent in dry matter accumulation at 60 DAS, 33.59, 10.29 and 7.81 per cent in dry weight of root nodules at 30 DAS, 33.51, 10.18 and 7.89 per cent in dry weight of root nodules at 45 DAS, 11.72, 5.15 and 4.38 per cent in total chlorophyll content in fresh leaves at 30 DAS, 15.49, 5.81 and 3.80 per cent in total chlorophyll content in fresh leaves at 45 DAS, 12.78, 5.63 and 4.90 per cent in total chlorophyll content in fresh leaves at 60 DAS, 14.55, 5.00 and 3.28 per cent in leaf area index at 30 DAS, 25.25, 4.20 and2.48 per cent in leaf area index at 45 DAS, 38.16, 15.38 and 9.95 per cent in leaf area index at 60 DAS, 32.54, 11.33 and8.44 per cent in CGR during 30-45 DAS, 71.21, 20.21 and16.49 per cent in

Table 2: Effect of vermicompost and foliar spray of zinc on leaf area index, CGR, RGR and NAR of green gram

Treatments	Leaf area index (LAI)			CGR (g $day^{-1}plant^{-1}$)		RGR (mg g^{-1} day^{-1})		NAR (mg dm^{-2} day^{-1})	
	30 DAS	45 DAS	60 DAS	30-45 DAS	45-60 DAS	30-45 DAS	45-60 DAS	30-45 DAS	45-60 DAS
Organic manure									
Control	0.55	0.99	1.52	0.252	0.132	5.31	10.37	4.59	2.39
FYM@ $10tha^{-1}$	0.60	1.19	1.82	0.300	0.188	5.38	12.31	4.69	2.84
Vermicompost @ $5tha^{-1}$	0.61	1.21	1.91	0.308	0.194	5.39	12.35	4.78	3.01
Vermicompost @ $7.5tha^{-1}$	0.63	1.24	2.10	0.334	0.226	5.39	13.09	5.09	3.44
Vermicompost @$10tha^{-1}$	0.63	1.25	2.10	0.338	0.226	5.39	12.83	4.81	3.33
S.E.±	0.006	0.007	0.038	0.005	0.003	0.075	0.24	0.14	0.93
C.D. (P=0.05)	0.019	0.022	0.10	0.015	0.010	NS	0.70	NS	0.26
Foliar spray of $ZnSo_4$ (0.5%)									
Control	0.56	1.11	1.58	0.290	0.118	5.24	8.52	4.84	1.98
At initiation of branching	0.64	1.24	1.89	0.320	0.181	5.46	11.34	4.78	2.71
At initiation of flowering	0.56	1.10	1.91	0.293	0.212	5.30	13.73	4.89	3.53
At initiation of branching + flowering	0.65	1.25	2.17	0.322	0.261	5.50	15.17	4.76	3.85
S.E.±	0.006	0.006	0.034	0.004	0.003	0.067	0.22	0.12	0.85
C.D. (P=0.05)	0.017	0.02	0.098	0.014	0.009	0.19	0.63	NS	0.26

NS=Non-significant

Table 3: Effect of vermicompost and foliar spray of zinc on total nutrient uptake, net return and B: C Ratio of green gram

Treatments	Total nutrient uptake (kg ha^{-1})				Net return (Rs ha^{-1})	B:C ratio
	Nitrogen	Phosphorus	Potassium	Zinc		
Organic manure						
Control	31.04	3.75	19.96	25.87	5642	2.01
FYM@ $10tha^{-1}$	49.13	6.19	30.05	41.94	9675	2.07
Vermicompost @ $5tha^{-1}$	50.67	6.44	31.21	43.55	8545	1.81
Vermicompost @ $7.5tha^{-1}$	58.57	7.47	36.15	50.52	7570	1.58
Vermicompost @$10tha^{-1}$	59.58	7.70	36.95	51.68	5361	1.34
S.E.±	1.31	0.15	1.03	1.43	206	0.43
C.D. (P=0.05)	3.75	0.45	2.95	4.10	590	NS
Foliar spray of $ZnSo_4$ (0.5%)						
Control	33.70	4.06	21.12	28.08	1974	1.23
At initiation of branching	51.22	6.52	31.65	44.00	8420	1.85
At initiation of flowering	52.30	6.62	32.05	44.75	8575	1.87
At initiation of branching + flowering	61.97	8.07	38.62	53.95	10466	2.07
S.E.±	1.71	0.14	0.92	1.28	184	0.038
C.D. (P=0.05)	3.36	0.40	2.63	3.67	527	0.11

CGR during 45-60 DAS, 26.23, 6.34 and5.99 per cent in RGR during 45-60 DAS, 43.93, 21.13 and14.29 per cent in NAR during 45-60 DAS, 88.69, 19.21 and15.59 per cent in total nitrogen uptake, 99.20, 20.68 and15.99 per cent in total phosphorus uptake, 81.11, 20.30 and15.83 per cent in total potassium uptake, 95.28, 20.46 and16.00 per cent in total zinc uptake over control, FYM 10 tha^{-1} and vermicompost at 5 t ha^{-1}, respectively.

It is established fact that vermicompost improve the physical, chemical and biological properties of the soil including supply of almost all the essential plant nutrients for the growth and development of plant. Thus, balanced nutrition under favorable environment might have resulted in better root development and robust seedling growth. These results are in agreement with that of Reddy *et al.* (1998), Ranwa and Singh (1999) and Rajkhowa *et al.* (2000).

Effect of foliar spray of zinc :

Further an application of foliar spray of zinc at both branching and flowering stage in green gram significantly increased the plant height at harvest, dry matter accumulation at 45 and 60 DAS, dry weight of root nodules at 45 DAS, total chlorophyll content in fresh leaves at 30, 45 and 60 DAS, leaf area index at 30, 45 and 60 DAS, CGR during 30-45 and 45-60 DAS, RGR during 30-45 and 45-60 DAS, NAR during 45-60 DAS, total nitrogen, phosphorus, potassium and zinc uptake, net return and B:C ratio of green gram as compare to single application of foliar spray of zinc at branching as well as flowering and control. However, single application of foliar spray of zinc at branching as well as flowering also enhanced the growth attributes and nutrient uptake of green gram over control (Table 1,2 and 3).

The significant increase due to application of foliar spray of zinc at both branching + flowering, foliar spray of zinc at branching and foliar spray of zinc at flowering was 8.98, 9.55 and 17.09 per cent in plant height at harvest, 9.04, 0.77 and 9.42 per cent in dry matter accumulation at 45 DAS, 20.20, 20.63 and 37.68 per cent in dry matter accumulation at 60 DAS, 5.92, 0.14 and 6.20 per cent in dry weight of root nodules at 45 DAS, 9.92, 0.01 and 9.92 per cent in total chlorophyll content in fresh leaves at 30 DAS, 8.67, 0.67 and 9.33 per cent in total chlorophyll content in fresh leaves at 45 DAS, 18.03, 19.67 and 34.43 per cent in total chlorophyll content in fresh leaves at 60 DAS, 14.29, 0.00 and 16.07 per cent in leaf area index at 30 DAS,11.71, 0.00 and 12.61 per cent in leaf area index (LAI) at 45 DAS, 19.62, 20.89 and 37.34 per cent in leaf area index at 60 DAS, 10.34, 1.03 and 11.03 per cent in CGR during 30-45 DAS, 53.39, 79.66 and 121.19 per cent in CGR during 45-60 DAS, 4.20, 1.15 and 4.96 per cent in RGR during 30-45 DAS, 33.10, 61.15 and 78.05 per cent in RGR during 45-60 DAS, 36.87, 78.28 and 94.44 per cent in NAR during 45-60 DAS, 51.99, 55.19 and 83.89 per cent in total nitrogen, 60.59, 63.05 and 98.77 per cent in total phosphorus, 49.86, 51.75 and 82.86 per cent in total potassium, 56.70, 59.37 and 92.13 per cent in total zinc uptake, 326.55, 334.40 and 430.19 per cent in net return and 50.41, 52.03 and 68.29 per cent in B:C ratio of green gram, respectively, over control.

This might be due to quick supply of adequate amount available zinc to meet out the demand of growing plant as the DTPA extractable zinc content of the experimental soil was low (0.36 ppm). Zinc plays a vital role in plant nutrition, which is clear from its involment in process of photosynthesis and sugar translocation. This role of zinc might have resulted in a significant contribution in plant height, LAI, chlorophyll content and dry matter accumulation eventually led for significant increase in RGR, NAR and CGR of green gram. These results are in confermmity to those of Rizk and Abdo (2001).

Interaction effect of organic matter and foliar spray of zinc on net return :

The data presented in Table 4 clearly indicate that there are two aspects of analyzing interaction effect of organic manures and foliar spray of zinc on net return. A comparison of net return with the application of FYM at 10 t ha^{-1} and vermicompost at different doses reveled that at all foliar treatments of zinc, net return was higher with the application of FYM at 10 t ha^{-1}than any treatments of vermicompost. Further, evaluation of different treatment of vermicompost and their interaction with foliar spray of zinc revealed that application of vermicompost at 5 t ha^{-1} in combination with foliar spray of zinc at initiation of branching and flowering (Zn_{b+f}) increased the net return (Rs 12153 ha^{-1}) by Rs 1386 t ha^{-1} over the application of vermicompost at 7.5 ha^{-1} + Zn_{b+f} treatment (Rs 10766 ha^{-1}).

Table 4: Interaction effect of vermicompost and foliar spray of zinc on net return of green gram

Treatments	Net return (Rs ha^{-1})			
	Zn_0	Zn_b	Zn_f	Zn_{b+f}
Control	1513	6456	6575	8024
FYM @ 10 tha^{-1}	2595	11070	11274	13760
Vermicompost @ 5 tha^{-1}	2292	9777	9957	12153
Vermicompost @ 7.5 tha^{-1}	2031	8662	8822	10766
Vermicompost @10 tha^{-1}	1438	6135	6248	7626
S.E.±	412			
C.D. (P = 0.05)	1180			

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