Original Research Article

Response of maize (*zea mays* L.) to nitrogen levels, conventional and enriched organic manures on yield and major nutrient uptake in a Vertisol

Abstract: A field experiment was conducted during *kharif* 2015-16 at Mulmuthla village of Dharwad taluk in Dharwad district to study the effect of enriched FYM and vermicompost and nitrogen levels on yield and majornutrient uptake of maize (*Zeamays* L.) in a Vertisol. The experiment was conducted in Vertisolby split plot design with four replication and twelve treatment combinations. Application of nitrogen at 200 kg ha^{-1}+ Zn+Fe enriched vermicompost at 2.5 t ha^{-1} was found superior in terms of grain yield (79.93 q ha^{-1}), stover yield (88.77 q ha^{-1}) and test weight (100 seeds)(39.67 g) over other treatments. Similarly, the highest NPK uptake (232.33, 48.73 and 175.59 kg ha^{-1}) was recorded with the application of 200 kg N + Zn+Fe enriched vermicompost at 2.5 t ha^{-1}.

Key words: Enriched FYM, enriched vermicompost, nitrogen levels, maize, uptake, yield

Intruduction

Maize (*Zea mays* L.) is the most important cereal crop in the world after wheat and Rice, it is grown in all part of the world. It belongs to grass family Poacea, tribe Tryrasceae and genus Zea and characterized by monoceous flowers. Maize (*Zea mays* L.) is known as "Queen of cereals" because of its high production potential and wider adaptability. Globally maize occupies an area of 163.94 million hectares with the production of 832 million tones and productivity accounts for 5.08 t ha^{-1}. In Karnataka, maize occupies an area of 1.36 million hectares with the production of 4.09 million tones and average productivity is 3.02 t ha^{-1} (Anon., 2013).

Organics alone do not produce spectacular increase in the crop yields due to their low nutrient status and release-rates. Therefore, to maintain soil productivity on a sustainable basis, blending of organic and inorganic sources of nutrients need to be adopted. Thus, judicious combination of organics and chemical fertilizers help in higher availability of nutrients to the crop.

Still there is lot of scope to increase the present maize yields. The yield can be increased with many agronomic practices and adequate supply of nutrients to the maize. Since maize is a high exploiting crop, it requires high levels of various nutrients to attain its maximum yield levels. Hence efforts are need to be made towards assessing its yielding ability under different nutrient conditions. So the study of effect of different combinations of nutrients like nitrogen, enriched FYM, FYM, enriched vermicompost, vermicompost and their interactions over yielding ability of maize can help in developing a best source of nutrients for maize yield and uptake.

Materials and methods

A field experiment was conducted during *kharif* 2015-16 in a Vertisol in the farmer's field at Mulmuthla village in Dharwad taluk of Dharwad district, which is situated in the Northern dry zone (Zone-III) of Karnataka to study Effect of enriched FYM and vermicompost and nitrogen levels on yield and nutrient uptake of maize (*zea mays* L.) in a Vertisol. The experiment soil was clay in texture with alkaline in pH (7.33), low in EC (0.25dS/m), medium in organic carbon (4.47 g kg^{-1}), low in available nitrogen (218.6 kg/ha), medium in available P_2O_5 (19.70 kg/ha), high in available K_2O (258.28 kg/ha) and low in available sulphur (21.4 kg/ha). The soil had DTPA extractable Zn (0.57 mg/kg) and Fe (4.16 mg/kg) below their critical limits and available Mn (3.85 mg/kg) and Cu (1.46 mg/kg) were above the critical limit. The experiment was conducted with split plot design with replicated four as twelve treatments. Maize variety NK-4260 was sown. Organic manures like rock phosphate (RP) enriched FYM, FYM, vermicompost and Zn + Fe enriched vermicompost were applied as per the treatment at the time of sowing with three nitrogen levels.

Applied N, P_2O_5 and K_2O were in the form of urea, di ammonium phosphate and muriate of potash. Urea was used as a source of nitrogen as per the treatment and nitrogen application was made in three equal splits *viz.*, one third at the time of sowing and remaining two third at the time of 30 and 45 DAS in equal splits, except in the treatment RP enriched FYM, the entire dose of phosphorus was applied at the time of sowing as per the treatment through DAP. In case of enriched FYM treatment, phosphorus in the form of rock phosphate was used at the time of enrichment and remaining P_2O_5 was applied at the time of sowing in the form of DAP. Entire dose of 50 kg ha^{-1} K_2O was applied common to all the treatments through muriate of potash. Zinc sulphate was applied 10 kg ha^{-1}except for the Zn + Fe enriched vermicompost treatment.

Preparation of enriched FYM:The recommended quantity of the conventional FYM (6 t ha^{-1}) was enriched with the 10% of the recommended dose of P through rock phosphate. The material was inoculated with 50 gm of P solubilizing bacteria (*Agrobacterium radiobacter*) and thoroughly mixed and heaped. The above materials were mixed on floor and incubated for 60 days before sowing, bottom was sealed with cow dung and soil slurry. Turnings were made once in a week to maintain the aerobic condition by applying water gently, these mixed materials were done under shade to overcome from nutrient loss and the heap was covered with the polythene sheet. RP enriched FYM was applied on the day of sowing.

Preparation of enriched vermicompost:The recommended quantity (2.5 t ha^{-1}) of the vermicompost enriched with 25 kg each of $ZnSO_4$ and $FeSO_4$ thoroughly mixed and heaped separately. The above materials were mixed on floor and incubated for 30 days before sowing, bottom was sealed with cow dung and soil slurry. Turnings provided once in every week to maintain the aerobic condition by applying water gently, these mixed materials were done under shade to overcome from nutrient loss and the heap was covered with the polythene sheet.

While applying Zn + Fe enriched vermicompost to experimental plot these two $ZnSO_4$ and $FeSO_4$ enriched vermicompost were mixed and applied on the day of sowing.

Results and discussion

The yield parameters of maize as influenced by application of organics with or without enrichment and nitrogen levels are presented in the Table 2.

Test weight**:** Application of different nitrogen levels was not significantly influenced on test weight in maize (Table 2). However, higher test weight was recorded with the application of 200 kg N ha^{-1} (38.73 g). Among enriched organics, application of Zn + Fe enriched vermicompost recorded higher test weight (39.31 g) over other organics.

Application of different treatments was not significantly influenced on test weight in maize. However, the treatment with application of 200 kg N ha^{-1}+ Zn + Fe enriched vermicompost at 2.5 t ha^{-1} recorded numerically higher test weight (M_3S_4, 39.67 g) The lowest test weight of 37.47 g was recorded in the treatment M_1S_1which received 100 kg N ha^{-1}+ FYM at 2.5 t ha^{-1}.

Grain yield:Significantly higher grain yield was recorded at 200 kg N ha^{-1} (71.14 q ha^{-1}) over the other nitrogen levels (Table 2). The result was in agreement with the findings of Nimje and Seth (1998), Sanjeev and Bangarwa (1997) and Muhammad *et al.* (2003). The lowest grain yield of 54.37 q ha^{-1} was recorded in the treatment M_1S_1which received 100 kg N ha^{-1}+ FYM at 6 t ha^{-1}. Among organics, application of Zn + Fe enriched vermicompost at 2.5 t ha^{-1} recorded significantly higher grain yield (70.50 q ha^{-1}) over the other organic applications.

Grain yield was significantly influenced by the application of organic with or without enrichment and N levels. The highest grain yield of 79.93 q ha^{-1} was recorded in the treatment with the application of 200 kg N ha^{-1}+ Zn + Fe enriched vermicompost at 2.5 t ha^{-1} (M_3S_4) and followed by the treatment receiving 200 kg N ha^{-1} + RP enriched FYM at 6 t ha^{-1} (M_3S_2) (73.05 q ha^{-1}), 200 kg N ha^{-1}+ vermicompost at 2.5 t ha^{-1} (M_3S_3) (71.65 q ha^{-1}) and 150 kg N ha^{-1}+ Zn + Fe enriched vermicompost at 2.5 t ha^{-1} (M_2S_4) (68.84 q ha^{-1}) these were found on par with each other. Results might be due to proper translocation of sugar and starch in the grain by higher nitrogen application.

Stover yield:Significantly higher stover yield was recorded at 200 kg N ha^{-1} (83.40 q ha^{-1}) over the other nitrogen levels.This increase in all yield attributes may be attributed to higher availability of nitrogen leading to higher productivity and translocation of photosynthesis. Similar findings were reported by Singh *et al.* (2013). Among organic applications Zn + Fe enriched vermicompost recorded significantly higher stover yield (82.58 q ha^{-1}) over the rest of organics applications.

Among different treatments, higher stover yield was (88.77 q ha^{-1}) recorded in the treatment (M_3S_4) with the application of 200 kg N ha^{-1}+ Zn + Fe enriched vermicompost at 2.5 t ha^{-1} and followed by the treatment receiving 200 kg N ha^{-1} + RP enriched FYM at 6 t ha^{-1} (M_3S_2) (85.65 q ha^{-1}), 200 kg N ha^{-1}+ vermicompost at 2.5 t ha^{-1} (M_3S_3) (84.15 q ha^{-1}) and 150 kg N ha^{-1}+ Zn + Fe enriched vermicompost at 2.5 t ha^{-1} (M_2S_4) (82.62 q ha^{-1}) these were found on par with each other. However, lowest stover yield of 70.13 q ha^{-1} was recorded in the treatment M_1S_1which received 100 kg N ha^{-1}+ FYM at 2.5 t ha^{-1}.The reason might be due to enrichment of vermicompost with zinc regulates mineralization and prevents them from leaching and other losses besides mobilizing and supplying the native zinc. The results were accordance with the finding gets support from Sridevi *et al.* (2010).

Major nutrients uptake:Application of nitrogen levels and enriched FYM and vermicompost on the major nutrient uptake by maize at harvest and the data pertaining to this are presented in Table 6.

Nitrogen:Significantly higher total nitrogen uptake was recorded with 200 kg N ha^{-1} (232.33 kg ha^{-1}) over the other nitrogen levels. This attributed to higher grain and straw yield at 200 kg N ha^{-1} over the other levels of nitrogen. Fertilization with normal and enhanced doses of N levels significantly increased the N uptake as reported by Dahiya and Bhatiya (1982) and Mahmooda *et al.* (2014). Among organics applications, Zn + Fe enriched vermicompost recorded higher total nitrogen uptake (231.30 kg ha^{-1}) over the other organics.

Higher uptake of total nitrogen was recorded in the treatment (M_3S_4) with the application of 200 kg N ha^{-1}+ Zn + Fe enriched vermicompost at 2.5 t ha^{-1} (258.07 kg ha^{-1}) and it was significantly superior to rest of the treatment and followed by the treatment received 200 kg N ha^{-1}+RP enriched FYM at 6 t ha^{-1} (M_3S_2) (239.12 kg ha^{-1}), 200 kg N ha^{-1}+vermicompost at 2.5 t ha^{-1} (M_3S_3) (233.89 kg ha^{-1}) and 150 kg N ha^{-1}+ Zn + Fe enriched vermicompost at 2.5 t ha^{-1} (M_2S_4) (228.01 kg ha^{-1}) and these found to be on par with each other. The lowest total nitrogen uptake of 184.98 kg ha^{-1} was recorded in the treatment (M_1S_1) receiving 100 kg N ha^{-1}+ FYM at 6 t ha^{-1}. Results might be due to Zn + Fe enriched organics application could also be attributed to the priming effect causing higher crop growth to increase nutrients demand and thereby better nutrient uptake due to balance fertilization. The results were accordance with the finding gets support from Rathod *et al.* (2012) in poultry manure and bio gas slurry.

Phosphorus: Significantly higher total phosphorus uptake was recorded with the application 200 kg N ha^{-1} (48.73 kg ha^{-1}) over the other nitrogen levels. Among organics applications of Zn + Fe enriched vermicompost at 2.5 t ha^{-1} recorded higher total phosphorus uptake (49.16 kg ha^{-1}) over the other organics.

The total uptake of phosphorus ranged from 37.40 to 54.82 kg ha^{-1} due to various treatments and the highest uptake of 54.82 kg ha^{-1} was recorded in the treatment with 200 kg N ha^{-1}+ enriched FYM at 6 t ha^{-1}. This particular treatment was significantly superior to rest of the treatments and followed by the treatment (M_3S_2) which received 200 kg N ha^{-1}+ RP enriched FYM at 6 t ha^{-1} (50.65 kg ha^{-1}), 200 kg N ha^{-1}+ vermicompost at 2.5 t ha^{-1} (M_3S_3) (48.86 kg ha^{-1}) and 150 kg N ha^{-1}+ Zn + Fe enriched vermicompost at 2.5 t ha^{-1} (M_2S_4) (48.73 kg ha^{-1}). However, significantly lower total phosphorus uptake maize (37.40 kg ha^{-1}) was associated with the application of 100 kg N ha^{-1}+ FYM at 6 t ha^{-1} (M_1S_1). Results might be due to the fact that RP enriched FYM recorded higher P uptake because of higher availability of P and retention of N in enriched FYM (Debele *et al.*, 2001).

***Potassium*:** Significantly higher total potassium uptake was recorded with the application of 200 kg N ha^{-1} (175.59 kg ha^{-1}) over the other nitrogen levels. Among organics applications of Zn + Fe enriched vermicompost recorded higher potassium uptake (174.54 kg ha^{-1}) over the other organics.

The higher total potassium uptake of 194.69 kg ha^{-1} was recorded in the treatment (M_3S_4) receiving 200 kg N ha^{-1}+ Zn + Fe enriched vermicompost at 2.5 t ha^{-1} and it was significantly superior over the rest of the treatments and followed by 200 kg N ha^{-1}+ RP enriched FYM at 6 t ha^{-1} (M_3S_2, 182.39 kg ha^{-1}), 200 kg N ha^{-1}+ vermicompost at 2.5 t ha^{-1} (M_3S_3) (175.32 kg ha^{-1}) and 150 kg N ha^{-1}+ Zn + Fe enriched vermicompost at 2.5 t ha^{-1} (M_2S_4, 174.20 kg ha^{-1}) which found to be on par each other. The lowest total potassium uptake of 141.22 kg/ha was recorded in the treatment (M_1S_1) which receiving 100 kg N ha^{-1}+ FYM at 6 t ha^{-1}.

Sulphur:Significantly higher total sulphur uptake was recorded with the application of 200 kg N ha^{-1} (37.84 kg ha^{-1}) over the other nitrogen levels. Results might be due to the might be the fact that higher uptake of S was associated with higher uptake of N. In many of the cereals and oilseeds, N*S interaction was found to have synergetic effect. The nutrient uptake by the crop is determined by its nutrient contents and yield was a more vital deciding factor for the uptake of nutrients by the crop. Similar findings were also observed by Singh *et al.* (2013). Among organics applications of Zn + Fe enriched vermicompost recorded higher sulphur uptake (38.45 kg ha^{-1}) over the other organics.

Significantly higher total uptake of sulphur was recorded in the treatment (M_3S_4) which received 200 kg N ha^{-1}+ Zn + Fe enriched vermicompost at 2.5 t ha^{-1} (43.60 kg ha^{-1}) and followed by the treatment (M_2S_4) which received 150 kg N ha^{-1}+ Zn + Fe enriched vermicompost at 2.5 t ha^{-1} (38.94 kg ha^{-1}), 200 kg N ha^{-1}+ RP enriched FYM 6 t ha^{-1} (38.6 kg ha^{-1}) and 200 kg N ha^{-1} +vermicompost at 2.5 t ha^{-1} (M_3S_3, 37.77 kg ha^{-1}) these were found on par with each other. But the treatment (M_1S_1) received 100 kg N ha^{-1}+ FYM at 6 t ha^{-1} recorded significantly lower total sulphur uptake of 28.66 kg ha^{-1}.

Summary and conclusions

Application of 200 kg N ha^{-1} + Zn + Fe enriched vermicompost at 2.5 t ha^{-1} found superior with respect to grain and stover yield.Application of 200 kg N ha^{-1} + Zn + Fe enriched vermicompost at 2.5 t ha^{-1} showed higher nutrient uptake (N, P, K and S) by maize.Application of 200 kg N ha^{-1} + RP enriched FYM at 6 t ha^{-1} showed higher P_2O_5 status in soil at harvest of maize

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Table 1: Chemical properties and nutrient composition of organic manures (oven dry basis)

Particulars	FYM	Vermicompost	Enriched FYM	Enriched vermicompost
pH (1:2.5)	7.32	7.20	7.22	7.24

Major nutrient composition (%)				
Nitrogen	0.52	1.21	0.73	1.94
Phosphorus	0.21	0.84	1.43	0.79
Potassium	0.53	1.00	0.62	1.16
Sulphur	0.24	0.36	0.27	0.44
Micro nutrient composition (mg kg^{-1})				
Copper	30.2	45.0	37.56	48.56
Iron	856.0	1097	899.54	1578
Manganese	1680	245	1720	2586
Zinc	129.0	259	137	370

Table 2: 100 grain weight (g), grain yield (q ha^{-1}) and stover yield (q ha^{-1}) of maize as influenced by nitrogen levels and enriched FYM and vermicompost

Organics	100 grain weight (g)				Grain yield (q ha^{-1})				Stover yield (q ha^{-1})			
	----------Nitrogen levels----------											
	M_1	**M_2**	**M_3**	**Mean**	**M_1**	**M_2**	**M_3**	**Mean**	**M_1**	**M_2**	**M_3**	**Mean**
S_1	37.47	37.68	37.73	**37.63**	54.37	55.92	59.96	**56.75**	70.13	72.64	75.01	**72.59**
S_2	37.82	38.08	39.39	**38.33**	59.58	64.99	73.05	**65.87**	74.79	79.34	85.65	**79.93**
S_3	36.57	38.22	38.03	**37.61**	58.22	63.78	71.65	**64.55**	73.83	78.28	84.15	**78.75**
S_4	38.93	39.03	39.67	**39.31**	62.72	68.84	79.93	**70.50**	76.34	82.62	88.77	**82.58**
Mean	**37.70**	**38.33**	**38.73**		**58.72**	**63.38**	**71.14**		**73.77**	**78.22**	**83.40**	
	S	**M**	**S*M**		**S**	**M**	**S*M**		**S**	**M**	**S*M**	
S. Em.±	0.41	0.54	0.93		0.83	0.82	1.42		0.65	0.57	0.98	
CD (5 %)	NS	NS	NS		3.88	3.37	5.11		2.26	1.65	2.86	
C.V. %	8.34	8.85	7.90		5.17	6.40	6.48		7.33	8.51	8.07	

S_1=FYM 6 t ha^{-1} M_1= 100 kg N ha^{-1}
S_2= RP enriched FYM 6 t ha^{-1} M_2= 150 kg N ha^{-1}
S_3= Vermicompost 2.5 t ha^{-1} M_3= 200 kg N ha^{-1}
S_4= Zn+Fe enriched vermicompost 2.5 t ha^{-1} M_1S_1=FYM 6 t ha^{-1}+100 kg N ha^{-1} (Control)

Table 3: **Nitrogen uptake (kg ha^{-1}) by maize as influenced by nitrogen levels and enriched FYM and vermicompost at harvest**

Organics	Grain (kg ha^{-1})				Stover (kg ha^{-1})				Total uptake (kg ha^{-1})			
	←------Nitrogen levels------→											
	M_1	**M_2**	**M_3**	**Mean**	**M_1**	**M_2**	**M_3**	**Mean**	**M_1**	**M_2**	**M_3**	**Mean**
S_1	107.5 (1.940)	112.4 (1.943)	117.1 (1.954)	**112.0**	77.50 (0.343)	80.41 (0.344)	81.07 (0.345)	**80.09**	185.0	192.8	198.2	**192.0**
S_2	116.1 (1.949)	126.8 (1.951)	143.0 (1.958)	**128.6**	82.82 (0.350)	88.53 (0.351)	96.12 (0.356)	**89.16**	199.0	215.3	239.1	**217.8**
S_3	113.0 (1.941)	124.4 (1.951)	140.2 (1.957)	**125.9**	80.11 (0.343)	86.77 (0.348)	93.69 (0.349)	**86.85**	193.1	211.2	233.9	**212.7**
S_4	121.6 (1.942)	134.8 (1.958)	156.7 (1.961)	**137.7**	86.19 (0.356)	93.21 (0.355)	101.33 (0.358)	**93.57**	207.8	228.0	258.1	**231.3**
Mean	**114.6**	**124.6**	**139.3**		**81.65**	**86.83**	**93.05**		**196.2**	**211.3**	**232.3**	

	S	**M**	**S*M**	**S**	**M**	**S*M**	**S**	**M**	**S*M**
S. Em.±	3.76	3.63	4.55	1.17	1.42	2.17	5.93	4.04	7.01
CD (0.05)	7.27	10.98	11.41	3.53	4.43	4.32	10.80	15.41	15.73

S_1=FYM 6 t ha^{-1} S_2= RP enriched FYM 6 t ha^{-1} S_3= Vermicompost 2.5 t ha^{-1} S_4= Zn+Fe enriched vermicompost 2.5 t ha^{-1}

M_1= 100 kg N ha^{-1} M_2= 150 kg N ha^{-1} M_3= 200 kg N ha^{-1} M_1S_1=FYM 6 t ha^{-1}+100 kg N ha^{-1} (Control)

Note: Values in the parenthesis indicate concentration of nitrogen in per cent.

Table 4: **Phosphorus uptake (kg ha^{-1}) by maize as influenced by nitrogen levels and enriched FYM and vermicompost at harvest**

Organics	Grain (kg ha^{-1})				Stover (kg ha^{-1})				Total uptake (kg ha^{-1})			
	←----Nitrogen levels----→											
	M_1	**M_2**	**M_3**	**Mean**	**M_1**	**M_2**	**M_3**	**Mean**	**M_1**	**M_2**	**M_3**	**Mean**
S_1	21.59 (0.39)	22.31 (0.399)	24.04 (0.401)	**22.65**	15.81 (0.070)	16.01 (0.070)	16.52 (0.070)	**16.11**	37.40	38.32	40.57	**38.76**
S_2	23.83 (0.4)	26.65 (0.41)	30.39 (0.416)	**26.95**	17.40 (0.074)	19.16 (0.076)	20.27 (0.075)	**18.94**	41.23	45.81	50.65	**45.90**
S_3	23.00 (0.395)	25.57 (0.401)	29.52 (0.412)	**26.03**	16.42 (0.071)	18.21 (0.073)	19.35 (0.072)	**17.99**	39.42	43.79	48.86	**44.02**
S_4	25.46 (0.406)	28.78 (0.418)	33.41 (0.418)	**29.22**	18.45 (0.076)	19.95 (0.076)	21.41 (0.076)	**19.94**	43.92	48.73	54.82	**49.16**
Mean	**23.47**	**25.83**	**29.34**		**17.02**	**18.33**	**19.39**		**40.49**	**44.16**	**48.73**	
	S	**M**	**S*M**		**S**	**M**	**S*M**		**S**	**M**	**S*M**	
S. Em.±	0.72	0.64	1.10		0.35	0.27	0.46		1.37	1.01	1.74	
CD (0.05)	1.81	2.46	2.51		0.80	0.74	0.95		2.61	3.20	3.46	

S_1=FYM 6 t ha^{-1} S_2= RP enriched FYM 6 t ha^{-1} S_3= Vermicompost 2.5 t ha^{-1} S_4= Zn+Fe enriched vermicompost 2.5 t ha^{-1}

M_1= 100 kg N ha^{-1} M_2= 150 kg N ha^{-1} M_3= 200 kg N ha^{-1} M_1S_1=FYM 6 t ha^{-1}+100 kg N ha^{-1} (Control)

Note: Values in the parenthesis indicate concentration of phosphorus in Per cent.

Table 5: **Potassium uptake (kg ha^{-1}) by maize as influenced by nitrogen levels and enriched FYM and vermicompost at harvest**

Organics	**Grain (kg ha^{-1})**				**Stover (kg ha^{-1})**				**Total uptake (kg ha^{-1})**			
	←-----Nitrogen levels-----→											
	M$_1$	**M$_2$**	**M$_3$**	**Mean**	**M$_1$**	**M$_2$**	**M$_3$**	**Mean**	**M$_1$**	**M$_2$**	**M$_3$**	**Mean**
S$_1$	30.56 (0.552)	30.91 (0.553)	33.27 (0.555)	**31.58**	110.66 (0.490)	113.06 (0.495)	116.71 (0.497)	**113.47**	141.22	143.96	149.98	**145.05**
S$_2$	33.02 (0.554)	37.30 (0.574)	43.69 (0.598)	**38.00**	116.25 (0.491)	125.44 (0.497)	138.70 (0.513)	**126.79**	149.27	162.73	182.39	**164.80**
S$_3$	32.20 (0.553)	36.16 (0.567)	42.05 (0.587)	**36.80**	114.35 (0.490)	123.90 (0.498)	133.27 (0.497)	**123.84**	146.55	160.06	175.32	**160.64**
S$_4$	35.41 (0.565)	39.58 (0.575)	47.91 (0.599)	**40.97**	119.40 (0.494)	134.61 (0.513)	146.78 (0.518)	**133.60**	154.82	174.20	194.69	**174.57**
Mean	**32.80**	**35.99**	**41.73**		**115.16**	**124.25**	**133.86**		**147.96**	**160.24**	**175.59**	

	S	**M**	**S*M**	**S**	**M**	**S*M**	**S**	**M**	**S*M**
S. Em.±	1.42	0.95	1.64	3.26	2.02	3.50	3.17	3.96	4.12
CD (0.05)	2.37	4.02	3.50	5.44	6.73	6.70	7.82	10.75	10.21

S$_1$=FYM 6 t ha^{-1} S$_2$= RP enriched FYM 6 t ha^{-1} S$_3$= Vermicompost 2.5 t ha^{-1}S$_4$= Zn+Fe enriched vermicompost 2.5 t ha^{-1}

M$_1$= 100 kg N ha^{-1} M$_2$= 150 kg N ha^{-1} M$_3$= 200 kg N ha^{-1} M$_1$S$_1$=FYM 6 t ha^{-1}+100 kg N ha^{-1} (Control)

Note: Values in the parenthesis indicate concentration of potassium in Per cent.

Table 6: **Sulphur uptake (kg ha^{-1}) by maize as influenced by nitrogen levels and enriched FYM and vermicompost at harvest**

Organics	Grain (kg ha^{-1})				Stover (kg ha^{-1})				Total uptake (kg ha^{-1})			
	←Nitrogen levels→											
	M_1	M_2	M_3	Mean	M_1	M_2	M_3	Mean	M_1	M_2	M_3	Mean
S_1	17.31 (0.312)	17.49 (0.313)	18.94 (0.316)	**17.91**	11.35 (0.050)	11.94 (0.052)	12.43 (0.053)	**11.91**	28.66	29.43	31.37	**29.82**
S_2	18.69 (0.314)	20.44 (0.320)	24.03 (0.329)	**21.05**	12.45 (0.053)	14.08 (0.056)	14.59 (0.054)	**13.71**	31.14	34.51	38.62	**34.76**
S_3	18.20 (0.313)	20.01 (0.318)	23.01 (0.321)	**20.41**	12.07 (0.052)	13.76 (0.055)	14.76 (0.055)	**13.53**	30.28	33.77	37.77	**33.94**
S_4	19.68 (0.315)	23.61 (0.333)	26.70 (0.334)	**23.33**	13.12 (0.054)	15.33 (0.058)	16.90 (0.060)	**15.12**	32.79	38.94	43.60	**38.45**
Mean	**18.47**	**20.39**	**23.17**		**12.25**	**13.78**	**14.67**		**30.72**	**34.16**	**37.84**	

	S	M	S*M	S	M	S*M	S	M	S*M
S. Em.±	0.90	0.53	0.92	0.47	0.31	0.53	1.36	0.84	1.45
CD (0.05)	1.82	1.95	2.22	1.13	0.62	1.30	2.95	2.57	4.13

S_1=FYM 6 t ha^{-1} S_2= RP enriched FYM 6 t ha^{-1} S_3= Vermicompost 2.5 t ha^{-1} S_4= Zn+Fe enriched vermicompost 2.5 t ha^{-1}

M_1= 100 kg N ha^{-1} M_2= 150 kg N ha^{-1} M_3= 200 kg N ha^{-1} M_1S_1=FYM 6 t ha^{-1}+100 kg N ha^{-1} (Control)

Note: Values in the parenthesis indicate concentration of sulphur in Per cent.