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Effect of Different Organics and Inorganics on Nutrient Uptake by Maize (*Zea mays* L.) Grown in a Vertisol

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ABSTRACT

A field experiment was undertaken during kharif 2016 in order to study the "Effect of different organics and inorganics on nutrient uptake by maize (Zea mays L.) grown in a Vertisol". The experiment was laid in a randomized block design with thirteen treatments and three replications. The results revealed that the total uptake of nutrients by maize increased significantly with the incorporation of organic manures along with RDF and the highest uptake of nitrogen (162.68 kg ha-1), phosphorus (59.22 kg ha-1), potassium (171.67 kg ha-1) and sulphur (32.80 kg ha-1) and micronutrients viz., zinc (381.53 g ha-1), iron (579.63 g ha-1), manganese (781.38 g ha-1) and copper (162.52 g ha-1) was recorded in the treatment with 100 per cent RDF + FYM (T1) which was significantly higher than the treatments receiving only RDF and organics alone.

Key words: *Maize, Manures, Primary and Micronutrients.*

INTRODUCTION

Maize (*Zea mays* L.) being a heavy feeder crop requires much more nutrients as compared to other cereals and in order to meet high nutritional requirements, the farmers are applying large quantities of inorganic fertilizers without understanding its negative impact on the fertility status of the soil as well as the concerned environment. On the other hand, organic source of fertilizers hold the key to the solution of current problems of fertilizers scarcity and expensiveness. Emphasis should be given on use of organic source of nutrients as continuous use of organics helps to build up soil humus and beneficial microbes besides, improving the soil physical properties and provides regulated supply of nutrients by releasing them slowly and thereby increases nutrient availability and use efficiency[9]. But, use of organic sources alone does not result in spectacular increase in crop yields due to their low nutrient status. Judicious combination of organic and inorganic fertilizers helps to maintain soil health, uptake of nutrients and crop productivity too[5].

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In this context, the approach for integrated nutrient management provides a better solution for conjunctive use of inorganic and organic sources of plant nutrients for crop nutrient uptake as well as sustaining soil health.

MATERIAL AND METHODS

The study was conducted in the long term maize experimental field at main agricultural research station (MARS), Dharwad, Karnataka during *kharif*, 2016. The soil of the experimental field was clay in texture, with slightly alkaline in reaction (pH 7.41) and EC were 0.21 dSm^{-1}. It was fertile, being medium in available organic carbon (7.5 g kg^{-1}) available nitrogen (360.15 kg ha^{-1}), phosphorus (40.16 kg ha^{-1}) high in available potassium (475.13 kg ha^{-1}) and sulphur (21.60 kg ha^{-1}) . The experiment was laid out in randomized complete block design with 13 treatments, replicated thrice. The treatments included, 100 per cent RDF+ FYM (T_1), 100 per cent RDF + Vermicompost (T_2), 100 per cent RDF + Poultry manure (T_3), 100 per cent RDF + Sheep manure (T_4), FYM alone (T_5), Vermicompost alone (T_6), Poultry manure alone (T_7), Sheep manure alone (T_8), 50 per cent RDF +FYM (T_9), 50 per cent RDF + Vermicompost (T_{10}), 50 per cent RDF + Poultry manure (T_{11}), 50 per cent RDF + Sheep manure (T_{12}) and RDF alone (T_{13}). The quantity of Farm yard manure (FYM), Vermicompost (VC), Poultry manure (PM) and Sheep manure (SM) applied was based on their N content to meet RDN in organic alone treatment and on equivalent basis of N in FYM in all other INM treatments. Recommended dose of nitrogen, phosphorous and potassium were applied in the form of urea, diammonium phosphate (DAP) and muriate of potash (MOP), respectively at the time of sowing of maize. After the harvest of crop, randomly tagged plants were sampled from each treatment at harvest for estimating concentration of nutrients and their uptake by grain and stover. Total nitrogen content was estimated by Kjeldahl digestion and distillation method as outlined by Piper [7], the phosphorus content was determined by vanadomolybdo-phosphoric acid yellow colour method using spectrophotometer[7], the potassium content was determined by flame photometer method[7], the sulphur estimated by turbidimetric method by[7], zinc, copper, iron and manganese contents were estimated by using atomic absorption spectrophotometer (AAS) as described by Piper[7].

The concentration of the nutrient was multiplied with the respective biomass yield at harvest to obtain nutrient uptake by the plant.

$$\text{Nutrient uptake} = \frac{\text{Nutrient concentration (\%) x Biomass yield (kg ha}^{-1}\text{)}}{100}$$

RESULTS AND DISCUSSION

The concentration (%) and uptake of N, P, K and S by grain and stover (kg ha^{-1}) is given in table 1, 2, 3 and 4.

Nitrogen

In grain, concentration of nitrogen was highest (1.44 %) in the treatment with application of 100 per cent RDF + FYM (T_1) and it was on par with all treatments. A significantly highest uptake of nitrogen by grain and stover (108.07 and 54.60 kg ha^{-1}, respectively) was recorded in INM treatment which received 100 per cent RDF + FYM (T_1) followed T_4, T_3, T_{13} and T_2. The N uptake by grain in the treatment with fertilizers alone (T_{13}) was 97.71 kg ha^{-1} and it was on par with 100 per cent RDF + vermicompost (T_2) and 100 per cent RDF + poultry manure (T_3). This might be due to the application of FYM at increasing rates enhanced the available nutrient status of soil and resulted in higher uptake by the plants. The constant release of nitrogen from FYM as a result of transformation process and increased mineralization of nitrogen resulted in higher uptake. Significantly higher uptake which could be attributed to the higher concentration of nutrients and higher biomass yield in these treatments[2].

Phosphorus

A Significantly highest concentration of phosphorus in grain and stover (0.55 and 0.23 %, respectively) was recorded in treatment having 100 per cent RDF + FYM (T_1) followed by similar INM treatments (T_2 to T_4) and RDF alone (T_{13}) treatment. Highest P uptake by grain (41.28 kg ha^{-1}) and stover (17.94 kg ha^{-1}) was recorded in 100 per cent RDF + FYM (T_1) and it was on par with 100 per cent RDF + sheep manure (T_4, 38.64 kg ha^{-1}). The P uptake in the treatment 100 per cent RDF alone (T_{13}, 35.96 kg ha^{-1}) was on par with T_2 and T_3. Pphosphorus uptake was higher due to reduced activity of phosphorus complexing agents, which leads to higher availability of phosphorus for uptake. The above findings also get support from the results of Tolessa Debele *et al.*[10], Kamalakumari and Singaram[4] and Yadav and Chipa[11].

Potassium

The concentration of potassium (K) in grain varied from 1.06 to 1.30 per cent. Significantly highest K concentration in grain (1.30 %) and stover (0.95 %) was noticed in treatment T_1 which received 100 per cent RDF + FYM and it was on par other all other. Significantly highest uptake of potassium (K) in grain and stover (97.57 kg ha^{-1} and 74.10 kg ha^{-1}, respectively) was recorded in the treatment receiving 100 per cent RDF + FYM (T_1) and it was significantly superior to all other treatments except T_3 (92.34 and 68.73 kg ha^{-1}, respectively) and T_4 (95.10 and 71.45 kg ha^{-1}, respectively). The higher uptake of potassium was probably due to constant release of potassium from total potassium in soil and also from FYM.

Sulphur

The treatment T_1 (100 % RDF + FYM) recorded significantly highest concentration of sulphur (S) in grain (0.25 %) and stover (0.18 %). Significantly highest sulphur uptake by grain and stover (18.76 and 14.04 kg ha^{-1}, respectively) was recorded in treatment T_1 which received 100 per cent RDF + FYM. The S uptake by grain and stover in the treatments T_3 and T_4 was on par with T_1. The S uptake by grain was higher than stover irrespective of the treatments. Total uptake of sulphur ranged from 6.65 to 32.80 kg ha^{-1}. higher uptake of sulphur when nutrients were applied through integrated application of 100 per cent RDF along with FYM who attributed it to more availability of these nutrients from the added fertilizers and also to the solubilizing action of organic acids produced during the decomposition of FYM, rendering more release of sulphur from the soil.Micronutrients concentration (mg kg^{-1}) and uptake by grain and stover (g ha^{1}) is given in table 5, 6, 7 and 8.

The uptake of micronutrients also followed a same trend as those of other nutrients *i.e.*, INM treatments accounting for higher uptake than organics alone. Significantly higher concentration of micronutrients such as Ze, Fe, Mn and Cu in grain and stover was recorded in treatment T1 which received 100 per cent RDF + FYM. At harvest, significantly highest total uptake of Zn, Fe, Mn and Cu (381.53, 579.63, 781.38 and 161.52 g ha^{-1}, respectively), by grain and stover was recorded in the treatment T_1 which received 100 per cent RDF + FYM and differed significantly from all other treatments. The treatment received 50 per cent RDF + organics accounted for on for values but significantly lower than 100 per cent RDF + organic treatments except T_1. Significantly lowest total uptake of Zn, Fe, Mn, and Cu was recorded in FYM alone treatment (78.99, 148.35, 191.27 and 37.65 g ha^{-1} , respectively). Application of organic manures have great influence on soil health and its sustainability as they enhance organic matter content resulting in increased micronutrient contents. The results obtained in this study are also in agreement with the findings of Math and Trivedi[6], Poongothai and Mathan[8] and Ghosh *et al.*[3].

Table 1: Effect of different organics and inorganics on nitrogen concentration in plant and uptake at harvest

Treatments	Concentration (%)		Uptake (kg ha^{-1})		Total uptake (kg ha^{-1})
	Grain	Stover	Grain	Stover	
T_1: 100 % RDF + FYM	1.44^{a}	0.70^{a}	108.07^{a}	54.60^{a}	162.67^{a}
T_2 : 100 % RDF + VC	1.40^{ab}	0.66^{a}	94.92^{b}	45.60^{c}	142.53^{c}
T_3: 100 % RDF + PM	1.42^{ab}	0.68^{a}	103.25^{ab}	50.25^{b}	153.50^{b}
T_4: 100 % RDF + SM	1.43^{ab}	0.68^{a}	106.25^{a}	51.68^{ab}	157.94^{ab}
T_5 : FYM alone	1.19^{c}	0.61^{a}	33.33^{f}	18.36^{g}	51.70^{i}
T_6: VC alone	1.24^{bc}	0.62^{a}	44.76^{e}	24.86^{f}	69.63^{h}
T_7 : PM alone	1.28^{a-c}	0.63^{a}	59.14^{d}	30.25^{e}	89.39^{g}
T_8 : SM alone	1.27^{a-c}	0.62^{a}	48.67^{e}	26.05^{f}	74.72^{h}
T_9 : 50 % RDF + FYM	1.33^{a-c}	0.67^{a}	79.27^{c}	42.49^{d}	121.75^{d}
T_{10} : 50 % RDF + VC	1.29^{a-c}	0.65^{a}	72.52^{c}	39.07^{d}	111.60^{f}
T_{11}: 50 % RDF + PM	1.32^{a-c}	0.67^{a}	77.09^{c}	41.54^{d}	118.63^{de}
T_{12}: 50 % RDF + SM	1.31^{a-c}	0.65^{a}	74.42^{c}	40.63^{d}	115.06^{ef}
T_{13} : 100 % RDF	1.41^{ab}	0.67^{a}	97.71^{b}	48.32^{bc}	146.03^{c}
LSD	0.16	NS	7.77	3.39	5.24

Means followed by same latter (s) within a column are not significantly different (DMRT P = 0.05)

Table 2: Effect of different organics and inorganics on phosphorus concentration in plant and uptake at harvest

Treatments	Concentration (%)		Uptake (kg ha^{-1})		Total uptake (kg ha^{-1})
	Grain	Stover	Grain	Stover	
T_1: 100 % RDF + FYM	0.55^{a}	0.23^{a}	41.28^{a}	17.94^{a}	59.22^{a}
T_2 : 100 % RDF + VC	0.48^{a-d}	0.20^{a-d}	32.54^{d}	13.82^{bc}	46.36^{c}
T_3: 100 % RDF + PM	0.51^{ab}	0.22^{ab}	37.08^{bc}	16.26^{ab}	53.34^{b}
T_4: 100 % RDF + SM	0.52^{a}	0.21^{abc}	38.64^{ab}	15.96^{ab}	54.60^{b}
T_5 : FYM alone	0.36^{e}	0.13^{f}	10.08^{i}	3.91^{g}	14.00^{h}
T_6: VC alone	0.40^{de}	0.16^{ef}	14.44^{h}	6.42^{fg}	20.86^{g}
T_7 : PM alone	0.44^{de}	0.16^{ef}	20.33^{g}	7.68^{ef}	28.01^{f}
T_8 : SM alone	0.41^{c-e}	0.16^{ef}	15.71^{h}	6.72^{fg}	22.43^{g}
T_9 : 50 % RDF + FYM	0.43^{c-e}	0.19^{b-e}	25.63^{e}	12.05 ^{cd}	37.68^{d}
T_{10} : 50 % RDF + VC	0.38^{e}	0.17^{de}	21.36^{fg}	10.22^{de}	31.58^{e}
T_{11}: 50 % RDF + PM	0.42^{c-e}	0.18^{c-e}	24.53^{ef}	11.16^{cd}	35.69^{d}
T_{12}: 50 % RDF + SM	0.40^{de}	0.19^{b-e}	22.72^{efg}	11.88^{cd}	34.60^{de}
T_{13} : 100 % RDF	0.49^{a-c}	0.20^{a-d}	35.96^{cd}	14.42^{bc}	48.38^{c}
LSD	0.07	0.03	3.11	3.24	3.50

Means followed by same latter (s) within a column are not significantly different (DMRT P = 0.05)

Table 3: Effect of different organics and inorganics on potassium concentration in plant and uptake at harvest

Treatments	Concentration (%)		Uptake (kg ha^{-1})		Total uptake (kg ha^{-1})
	Grain	Stover	Grain	Stover	
T_1: 100 % RDF + FYM	1.30^{a}	0.95^{a}	97.57^{a}	74.11^{a}	171.67^{a}
T_2 : 100 % RDF + VC	1.26^{ab}	0.91^{a}	85.43 ^{c}	62.88^{cd}	148.31^{d}
T_3: 100 % RDF + PM	1.27^{ab}	0.93^{a}	92.34^{a-c}	68.73^{a-c}	161.07^{bc}
T_4: 100 % RDF + SM	1.28^{a}	0.94^{a}	95.10^{ab}	71.45^{ab}	166.55^{ab}
T_5 : FYM alone	1.06^{d}	0.70^{b}	29.69^{g}	21.08^{h}	50.77^{g}
T_6: VC alone	1.13^{cd}	0.72^{b}	40.79^{f}	28.88^{g}	69.67^{h}
T_7 : PM alone	1.19^{a-c}	0.75^{b}	54.98^{e}	36.02^{f}	90.99^{g}
T_8 : SM alone	1.15^{b-d}	0.73^{b}	44.07^{f}	30.67^{fg}	74.74^{h}
T_9 : 50 % RDF + FYM	1.25^{a-c}	0.92^{a}	74.50^{d}	58.35^{de}	132.85^{e}
T_{10} : 50 % RDF + VC	1.22^{a-c}	0.88^{a}	68.59^{d}	52.90^{e}	121.49^{f}
T_{11}: 50 % RDF + PM	1.24^{a-c}	0.91^{a}	72.42^{d}	56.43^{de}	128.85^{ef}
T_{12}: 50 % RDF + SM	1.22^{a-c}	0.89^{a}	69.31^{d}	55.64^{e}	124.95^{ef}
T_{13} : 100 % RDF	1.27^{ab}	0.91^{a}	88.01^{bc}	65.63^{bc}	153.64 ^{cd}
LSD	0.10	0.08	7.57	6.17	9.67

Means followed by same latter (s) within a column are not significantly different (DMRT P = 0.05)

Table 4: Effect of different organics and inorganics on sulphur concentration in plant and uptake at harvest

Treatments	Concentration (%)		Uptake (kg ha^{-1})		Total uptake (kg ha^{-1})
	Grain	Stover	Grain	Stover	
T_1: 100 % RDF + FYM	0.25^{a}	0.18^{a}	18.76^{a}	14.04^{a}	32.80^{a}
T_2 : 100 % RDF + VC	0.20 $^{c-e}$	0.14^{dc}	13.56^{c-e}	9.67^{cd}	23.23^{c}
T_3: 100 % RDF + PM	0.22^{bc}	0.17^{ab}	16.00^{a-c}	12.56^{a-c}	28.56^{ab}
T_4: 100 % RDF + SM	0.24^{ab}	0.18^{a}	17.83^{ab}	13.68^{ab}	31.51^{a}
T_5 : FYM alone	0.13^{g}	0.10^{d}	3.64^{h}	3.01^{f}	6.65^{g}
T_6: VC alone	0.16^{f}	0.11^{cd}	5.78^{h}	4.41^{ef}	10.19^{fg}
T_7 : PM alone	0.20 $^{c-e}$	0.12^{cd}	9.24^{fg}	5.76^{ef}	15.00^{ef}
T_8 : SM alone	0.18^{ef}	0.11^{cd}	6.90^{gh}	4.62^{ef}	11.52^{fg}
T_9 : 50 % RDF + FYM	0.21^{cd}	0.17^{ab}	12.52^{d-f}	10.78^{a-d}	23.30^{c}
T_{10} : 50 % RDF + VC	0.18^{ef}	0.12^{cd}	10.12^{e-g}	7.21^{de}	17.33^{de}
T_{11}: 50 % RDF + PM	0.19^{de}	0.16^{ab}	11.10^{ef}	9.92^{cd}	21.02^{cd}
T_{12}: 50 % RDF + SM	0.18^{ef}	0.17^{ab}	10.23^{e-g}	10.75^{a-d}	20.85^{cd}
T_{13} : 100 % RDF	0.22^{bc}	0.14^{bc}	15.25^{b-d}	10.24^{b-d}	25.34^{bc}
LSD	0.03	0.03	3.19	3.24	4.65

Means followed by same latter (s) within a column are not significantly different (DMRT P = 0.05)

Table 5: Effect of different organics and inorganics on zinc concentration in plant and uptake at harvest

Treatments	Concentration (mg kg^{-1})		Uptake (g ha^{-1})		Total uptake (g ha^{-1})
	Grain	Stover	Grain	Stover	
T_1: 100 % RDF + FYM	40.01^{a}	10.33^{a}	300.95^{a}	80.58^{a}	381.53^{a}
T_2 : 100 % RDF + VC	35.02^{de}	8.00^{a}	237.44^{cd}	55.28^{cd}	292.72^{d}
T_3: 100 % RDF + PM	35.01^{bc}	8.50^{a}	254.52^{bc}	62.82^{b}	317.37^{c}
T_4: 100 % RDF + SM	37.01^{ab}	9.01^{b}	274.98^{b}	68.49^{b}	343.47^{b}
T_5 : FYM alone	22.02^{g}	5.75^{b}	61.61^{i}	17.31^{h}	78.99^{l}
T_6: VC alone	26.31^{f}	5.80^{b}	94.98^{h}	23.26^{g}	118.24^{j}
T_7 : PM alone	27.52^{ef}	5.90^{b}	127.14^{g}	28.33^{g}	155.47^{i}
T_8 : SM alone	26.41^{f}	5.85^{ab}	101.20^{h}	24.58^{g}	125.78^{k}
T_9 : 50 % RDF + FYM	36.52^{bc}	8.02^{ab}	216.47^{de}	50.86^{de}	267.33^{e}
T_{10} : 50 % RDF + VC	33.03^{cd}	7.01^{ab}	185.69^{f}	42.14^{f}	227.83^{h}
T_{11}: 50 % RDF + PM	35.12^{bc}	7.50^{ab}	205.10^{ef}	46.51^{ef}	251.61^{f}
T_{12}: 50 % RDF + SM	33.62^{bc}	7.23^{ab}	191.00^{f}	45.20^{f}	236.20^{g}
T_{13} : 100 % RDF	30.01^{de}	7.92^{ab}	207.97^{ef}	57.12^{c}	254.09^{e}
LSD	3.24	NS	23.24	4.90	3.50

Means followed by same latter (s) within a column are not significantly different (DMRT P = 0.05)

Table 6: Effect of different organics and inorganics on iron concentration and uptake at harvest

Treatments	Concentration (mg kg^{-1})		Uptake (g ha^{-1})		Total uptake (g ha^{-1})
	Grain	Stover	Grain	Stover	
T_1: 100 % RDF + FYM	45.01^{a}	31.00^{a}	337.80^{a}	241.80^{a}	579.63^{a}
T_2 : 100 % RDF + VC	36.02^{de}	28.00^{a-c}	244.22^{e}	193.48^{cd}	437.70^{e}
T_3: 100 % RDF + PM	41.01^{b}	30.00^{ab}	298.18^{c}	221.70^{abc}	519.88^{c}
T_4: 100 % RDF + SM	42.02^{ab}	30.08^{ab}	312.21^{b}	228.64^{ab}	540.85^{b}
T_5 : FYM alone	30.11^{f}	21.26^{d}	84.34^{l}	64.01^{g}	148.35^{l}
T_6: VC alone	31.32^{f}	23.00^{cd}	113.07^{k}	92.25^{fg}	205.32^{k}
T_7 : PM alone	33.01^{ef}	25.12^{b-d}	152.51^{i}	120.63^{f}	273.13^{j}
T_8 : SM alone	31.32^{f}	23.00^{cd}	120.02^{k}	96.65^{fg}	216.66^{k}
T_9 : 50 % RDF + FYM	40.01^{bc}	28.25^{a-c}	238.46^{f}	179.16^{de}	417.62^{f}
T_{10} : 50 % RDF + VC	37.01^{cd}	26.12^{a-d}	208.07^{h}	157.01^{e}	365.08^{i}
T_{11}: 50 % RDF + PM	39.23^{b-d}	28.00^{a-c}	229.82^{g}	173.63^{de}	402.73^{g}
T_{12}: 50 % RDF + SM	37.11^{cd}	25.95^{a-d}	210.82^{h}	162.24^{e}	373.06^{h}
T_{13} : 100 % RDF	36.52^{cd}	28.12^{a-c}	253.08^{d}	202.80^{b-d}	455.89^{d}
LSD	3.22	4.58	4.19	28.32	3.50

Means followed by same latter (s) within a column are not significantly different (DMRT P = 0.05)

Table 7: Effect of different organics and inorganics on manganese concentration and uptake at harvest

Treatments	Concentration (mg kg^{-1})		Uptake (g ha^{-1})		Total uptake (g ha^{-1})
	Grain	Stover	Grain	Stover	
T_1: 100 % RDF + FYM	75.01^{a}	28.00^{a}	562.95^{a}	218.43^{a}	781.38^{a}
T_2 : 100 % RDF + VC	65.02^{cd}	26.00^{a-c}	440.84^{b}	179.66^{d}	620.50^{e}
T_3: 100 % RDF + PM	73.01^{ab}	27.52^{ab}	530.73^{a}	203.37^{b}	734.23^{c}
T_4: 100 % RDF + SM	74.02^{a}	27.00^{ab}	549.86^{a}	205.22^{bc}	755.20^{b}
T_5 : FYM alone	50.01^{f}	17.00^{d}	140.08^{g}	51.19^{i}	191.27^{l}
T_6: VC alone	53.22^{f}	17.01^{d}	192.21^{fg}	68.23^{h}	260.35^{k}
T_7 : PM alone	60.02^{de}	17.52^{d}	277.29^{e}	71.48^{g}	361.42^{j}
T_8 : SM alone	53.23^{f}	17.01^{d}	203.98^{fg}	68.2^{lh}	260.45^{k}
T_9 : 50 % RDF + FYM	70.01^{abc}	25.75^{abc}	417.26^{bc}	163.31^{e}	580.57^{f}
T_{10} : 50 % RDF + VC	67.01^{bc}	23.56^{c}	376.73^{d}	142.16^{f}	517.89^{i}
T_{11}: 50 % RDF + PM	69.11^{abc}	24.75^{bc}	403.73^{cd}	153.47^{ef}	557.08^{g}
T_{12}: 50 % RDF + SM	67.24^{bc}	23.75^{c}	381.99^{cd}	148.49^{f}	530.48^{h}
T_{13} : 100 % RDF	65.11^{cd}	26.10^{a-c}	451.21^{b}	188.23^{cd}	639.45^{d}
LSD	5.91	2.46	34.50	12.48	8.74

Means followed by same latter (s) within a column are not significantly different (DMRT P = 0.05)

Table 8: Effect of different organics and inorganics on copper concentration and uptake at harvest

Treatments	Concentration (mg kg^{-1})		Uptake (g ha^{-1})		Total uptake (g ha^{-1})
	Grain	Stover	Grain	Stover	
T_1: 100 % RDF + FYM	15.21^{a}	6.20^{a}	114.15^{a}	48.37^{a}	161.52^{a}
T_2 : 100 % RDF + VC	13.01^{ab}	5.26^{b-d}	88.21^{c}	36.35^{c}	124.55^{c}
T_3: 100 % RDF + PM	14.21^{a}	6.20^{a}	103.32^{b}	45.82^{ab}	149.14^{b}
T_4: 100 % RDF + SM	14.11^{a}	6.21^{a}	104.84^{b}	47.20^{ab}	152.04^{b}
T_5 : FYM alone	8.52^{c}	4.58^{e}	23.86^{h}	13.79^{f}	37.65^{i}
T_6: VC alone	9.21^{bc}	4.78^{de}	33.25^{g}	19.17^{ef}	52.42^{h}
T_7 : PM alone	10.10^{bc}	5.00^{c-e}	46.66^{f}	24.01^{de}	70.67^{f}
T_8 : SM alone	9.71^{bc}	4.98^{cde}	37.21^{g}	20.93^{ef}	58.13^{g}
T_9 : 50 % RDF + FYM	13.10^{ab}	5.58^{b}	78.08^{d}	35.39^{c}	113.46^{d}
T_{10} : 50 % RDF + VC	12.21^{a-c}	5.20^{b-d}	68.64^{e}	31.26^{cd}	99.90^{e}
T_{11}: 50 % RDF + PM	13.12^{ab}	5.49^{bc}	77.15^{d}	34.04^{c}	111.19^{d}
T_{12}: 50 % RDF + SM	12.21^{a-c}	5.23^{b-d}	69.37^{e}	32.70^{cd}	102.06^{e}
T_{13} : 100 % RDF	12.90^{ab}	5.28^{b-d}	89.40^{c}	38.08^{bc}	127.48^{c}
LSD	3.39	0.48	5.37	8.58	5.25

Means followed by same latter (s) within a column are not significantly different (DMRT P = 0.05)

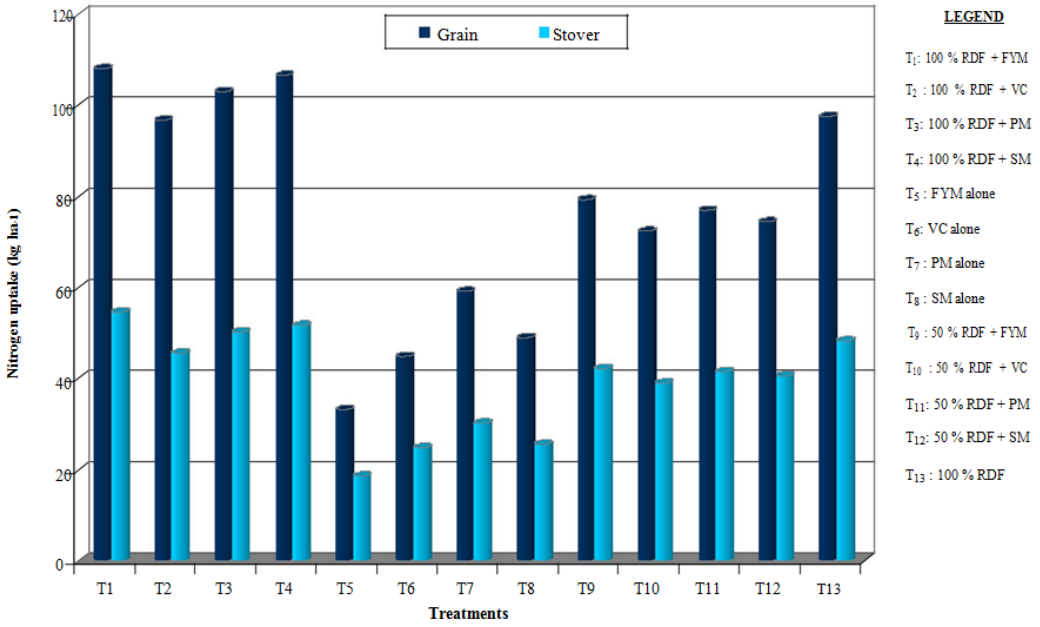

Fig. 4: Effect of different organics and inorganics on nitrogen uptake in plant at harvest

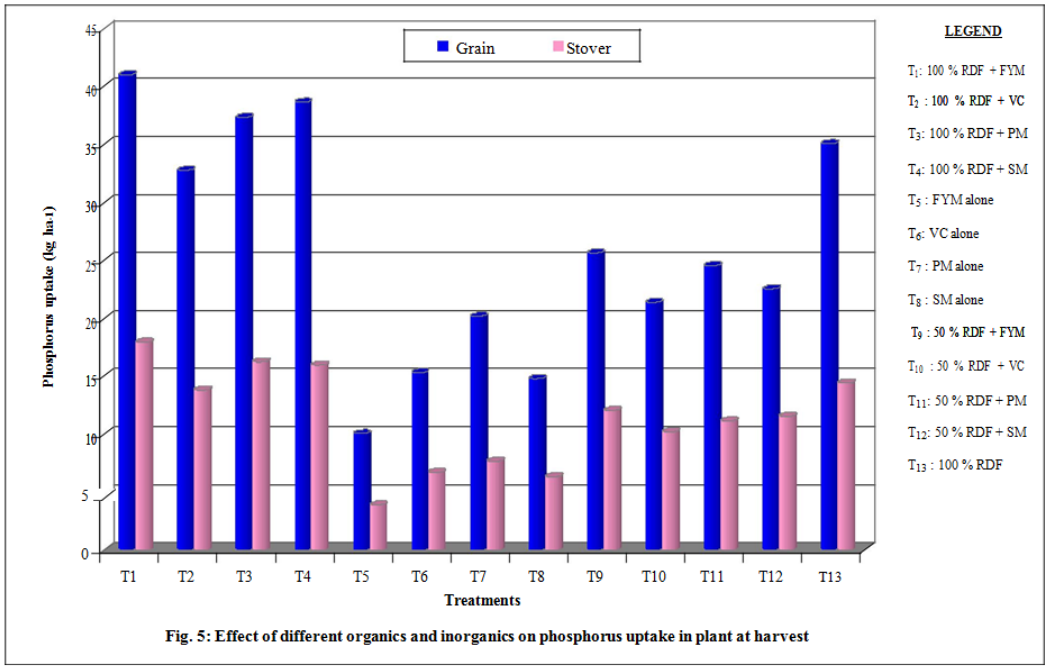

Fig. 5: Effect of different organics and inorganics on phosphorus uptake in plant at harvest

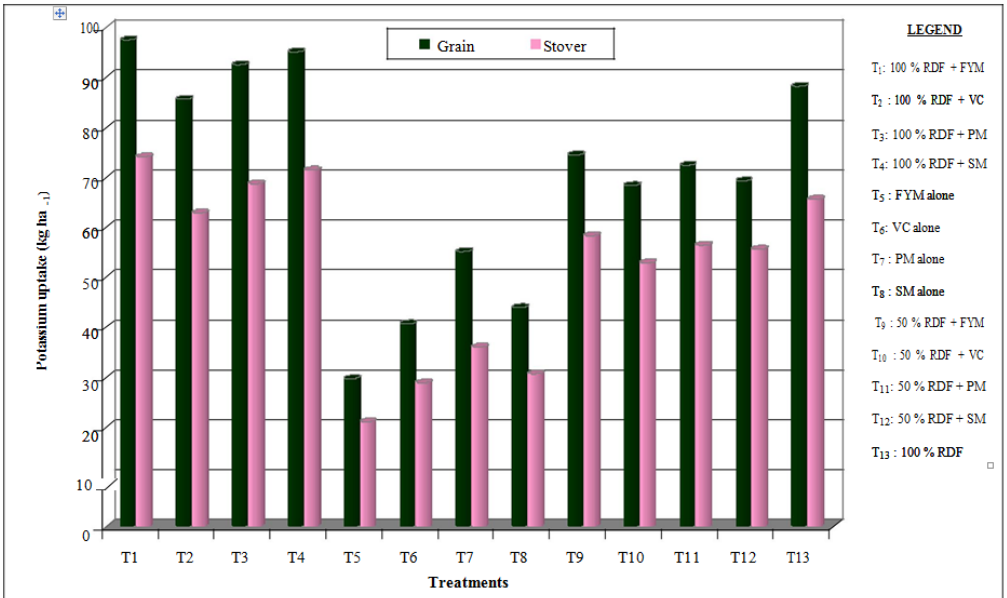

Fig. 6: Effect of different organics and inorganics on potassium uptake in plant at harvest

CONCLUSION

The total uptake of major nutrients by maize increased significantly with the incorporation of organic manures along with RDF and the highest uptake of nitrogen (162.68 kg ha^{-1}), phosphorus (59.22 kg ha^{-1}), potassium (171.67 kg ha^{-1}) and sulphur (32.80 kg ha^{-1}) and micronutrients *viz*., zinc (381.53 g ha^{-1}), iron (579.63 g ha^{-1}), manganese (781.38 g ha^{-1}) and copper (162.52 g ha^{-1}) uptake of these nutrients was recorded in the treatment with 100 per cent RDF + FYM (T_1) which was significantly higher than the treatments receiving only RDF and organics alone.

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