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Research Paper

Influence of tillage and organics on yield and nutrient uptake of sorghum under sorghum – safflower cropping system

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ABSTRACT

An investigation was carried out to assess the influence of tillage and organics on yield and nutrient uptake of sorghum under sorghum – safflower-cropping system grown on Vertisols. The experiments were conducted for two successive years at Agronomy farm, Marathwada Agricultural University, Parbhani. The treatments comprised of three levels of tillage (T_1- Tillage with low weight wooden plough, T_2 – Tillage with heavy weight mould board plough and T_3 – Tillage with tractor plough), three levels of organic amendments (A_1 – No FYM/PMC, A_2 – PMC @ 5 Mg ha^{-1} and A_3- FYM @ 5 Mg ha^{-1}) and two levels of pulverization (P_1- two harrowings and P_2- one rotavation). Thus, eighteen treatment combinations were replicated four times in factorial randomized block design. The recommended dose of N, P_2O_5 and K_2O was applied at the time of sowing through urea, single super phosphate and muriate of potash, respectively. However, FYM and PMC were applied twenty days before the sowing of sorghum. Standard procedures were adopted for noting the observations, chemical analysis and interpretation of the data. The study revealed that the highest (grain and fodder) yield and the uptake of N, P and K were observed with the treatment including tillage with tractor plough (T_3) along with the press mud compost (A_2) and pulverization with rotavation (P_2).

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KEY WORDS : Tillage, Organics, Nutrient uptake, Yield

The development of tillage practices for rain fed crop production has been and will be a dynamic process. Tillage creates improved physical conditions of soil that bring about better water-nutrient and temperature relations. Different tillage operations may influence the physical properties such as soil porosity, air filled porosity, hydraulic conductivity (Singh and Singh, 1996). As a result soil becomes permeable, aerated and having good physical conditions for crop production. Deep tillage decreases soil bulk density. It also removes mechanical impedance of soil, which is the hindrance to root penetration and thereby accelerate the crop production. Deep tillage breaks the hard layers to help the roots to extend in the deeper layers (Campbell et al, 1974). It facilitates easy uptake of water as well as nutrients by the roots from different soil layers efficiently, which consequently increased the root growth and yield of crops (Varsa *et al*, 1997). Application of organic sources of nutrients as supplement to inorganic fertilizers has provided a befitting solution not only to the problem of soil degradation (Ray and Gupta, 2001) but also to the growing concerns about the sustainability of this system. Organics have a positive influence on the biological indicators of soil health, *viz*., soil microbial biomass, organic carbon, and C and N mineralization (Samrah and Bordoloi, 1994).

The present investigation was planned to determine the effect of different tillage systems in combination with organics on yield and nutrient uptake of sorghum.

RESEARCH PROCEDURE

A field experiment on a sorghum- safflower cropping sequence was initiated during 1998-99 to 1999-2000 in the Agronomy farm, Marathwada Agricultural University, Parbhani (MS.). The soil of experimental field belongs to order Vertisol. The soil is moderately well drained, with pH 7.97, organic carbon 4.2 gkg^{-1}, available nitrogen 196 kgha^{-1}, available phosphorus 12.78 kgha^{-1} and available potassium 356.68 kgha^{-1}. The experiment was laid out in Factorial Randomized Block Design with eighteen treatment combinations comprising three tillage treatments T_1 (Tillage with low weight wooden plough), T_2 (Tillage with heavy weight mould board plough), T_3 (Tillage with tractor plough), three levels of organic amendments A_1

(No FYM/PMC), A_2 (PMC @ 5 Mg ha^{-1}), A_3 (FYM @ 5 Mg ha^{-1}) and two levels of pulverization (P_1- two harrowing and P_2- one rotavation) were replicated four times. nitrogen, phosphorus and potassium were applied in the form of urea, single super phosphate and muriate of potash, respectively. The grain and fodder samples were collected, dried in hot air oven at 65^{0}C, powdered and digested using diacid (H_2SO_4: $HClO_4$) in the ratio of 4:1 and analyzed for the content of nitrogen, phosphorus and potassium using the procedure of Jackson (1973).

RESEARCH ANALYSIS AND REASONING

The results obtained from the present investigation have been discussed in the following sub heads :

Yield:

Data (Table 1) shows that during both the years of experimentation tillage with tractor plough (T_3) significantly increased the grain and fodder yield of sorghum. Tillage with tractor plough increased the grain and fodder yield by 25.09 and 24.81 per cent in 1998-99 and 41.54 and 38.25 per cent in 1999-2000 over tillage with heavy weight mould board plough (T_2) and tillage with low weight wooden plough (T_1), respectively. The better results of deep ploughing may be due to the reason that the soil becomes softer and roots were facilitated for penetration into the soil. Deep ploughing might be resulted in better conservation of soil moisture, which ultimately was used more efficiently by the crop for longer periods as compared with medium and shallow ploughing. Similar results were reported by Akhtar *et al.* (2005).

A perusal of data (Table 1) revealed that during both the years of experimentation there was a significant increase in grain (1293.00 and 1984.10 kgha^{-1}) and fodder (3173.70 and 4821.50 kgha^{-1}) yield of sorghum by application of PMC @ 5 Mgha^{-1} over FYM and control. The increase in yield might be due to incorporation of PMC create better condition by improving physical parameters, increased mineralization and availability nutrients by minimizing soil temperature and volume of soil cracks which can account to profound root growth and increased yield. The findings of present investigation are supported by Bharambe (1993). Grain and fodder yield of sorghum (Table 1) due to pulverization treatments varied between 1188.36 to1259.26 kgha^{-1} and 2926.33 to 3100.90 kgha^{-1} in 1998-99 and 1735.10 to 1868.00 and 4223.56 to 4529.00 kgha^{-1} in1999-2000, respectively. The highest grain and fodder yield was recorded in the treatment P_2 (pulverization by rotavation) over P_1 (pulverization by harrowings) treatments in both the years of experimentation.

Nitrogen uptake:

It is evident from the data in Table 2 that increase in depth of tillage increased the nitrogen in grain and fodder at harvest. Tillage with tractor plough (T_3) was significantly superior to increase total nitrogen (23.84 and37.49 kgha^{-1}) in grain and (23.26 and 38.14 kgha^{-1}) in fodder than heavy weight mould board plough (T_2) and low weight wooden plough (T_1) during both the years of experimentation. This increase in nitrogen uptake is attributed due to deep ploughing in turn provides better physical environment ultimately the vigorous root and shoot growth resulting in greater absorption of nitrogen from the soil. The increased N uptake due to deep ploughing has also been reported by Khaini and More (1984).

Table 1 : Yield of sorghum as influenced by tillage and organics

Treatments	Grain yield (kg ha^{-1})		Fodder yield (kg ha^{-1})	
	1998-99	1999-2000	1998-99	1999-2000
T_1	1072.20	1473.40	2650.00	3621.40
T_2	1258.00	1850.90	3083.00	4500.90
T_3	1341.30 (25.09)	2085.50 (24.81)	3307.70 (41.54)	5006.60 (38.25)
S.E.±	46.53	10.10	73.61	18.91
C.D. (P=0.05)	160.77	34.92	254.37	65.35
P_1	1188.36	1735.10	2926.33	4223.56
P_2	1259.26	1868.00	3100.90	4529.00
S.E.±	30.88	5.61	46.17	10.90
C.D. (P=0.05)	85.46	15.55	127.78	30.17
A_1	1142.30	1591.30	2833.30	3850.50
A_2	1293.00	1984.10	3173.70	4851.50
A_3	1236.20	1829.30	3033.70	4451.90
S.E.±	37.82	6.88	56.54	13.35
C.D. (P=0.05)	104.68	19.04	156.49	36.95

Table 2: Nutrient uptake (Kg ha^{-1}) by sorghum as affected by tillage and organics

Treatments	Nutrient uptake by grain (Kg ha^{-1})						Nutrient uptake by fodder (Kg ha^{-1})					
	1998-99			1999-2000			1998-99			1999-2000		
	N uptake	P uptake	K uptake	N uptake	P uptake	K uptake	N uptake	P uptake	K uptake	N uptake	P uptake	K uptake
T_1	17.01	2.68	3.41	24.45	4.10	5.24	14.85	4.02	15.18	20.51	6.33	23.62
T_2	20.92	3.58	4.61	32.88	5.73	7.49	20.16	5.55	19.57	31.74	8.92	31.64
T_3	23.84	3.98	5.27	37.49	6.80	9.14	23.26	6.79	22.64	38.14	11.22	36.80
S.E.	0.64	0.13	0.18	0.18	0.06	0.08	0.34	0.18	0.55	0.22	0.18	0.31
C.D. (P=0.05)	2.23	0.46	0.64	0.63	0.22	0.30	1.20	0.64	1.90	0.76	0.64	1.08
P_1	19.92	3.19	4.12	30.00	5.20	6.82	18.31	5.03	18.18	31.43	8.15	29.01
P_2	21.26	3.63	4.75	33.21	5.88	7.75	20.57	5.88	20.08	32.16	9.49	32.36
S.E.	0.52	0.09	0.12	0.13	0.06	0.07	0.41	0.10	0.33	0.23	0.11	0.18
C.D. (P=0.05)	1.44	0.25	0.33	0.37	0.17	0.19	1.13	0.28	0.93	0.63	0.30	0.52
A_1	17.76	2.90	3.71	26.48	4.53	5.91	15.84	4.56	19.66	23.38	6.71	25.40
A_2	22.82	3.93	5.12	36.21	6.47	8.60	22.20	6.37	24.96	35.93	10.89	35.49
A_3	21.20	3.41	4.47	32.12	5.63	7.35	20.24	5.44	23.31	31.09	8.87	31.17
S.E.	0.63	0.11	0.14	0.16	0.07	0.08	0.50	0.12	0.41	0.28	0.13	0.23
C.D. (P=0.05)	1.76	0.31	0.41	0.46	0.21	0.23	1.39	0.35	1.14	0.78	0.37	0.64

Application of organic amendments resulted in gradual increase (Table2) in nitrogen uptake over control. Application of PMC @ 5Mgha^{-1} was found significantly superior (22.82 and 36.81 kgha^{-1}) in grain and fodder (22.20 and 35.93 kgha^{-1}) to increase total nitrogen uptake over FYM and control in both the years of experimentation. In the present investigation, PMC and FYM are added to soil before sowing of crop increased availability of nitrogen in a better soil physical condition with sufficient moisture throughout growing period of crop. As a result sorghum in the present investigation have removed sufficient amount of nitrogen from the soil for their growth and development thereby increased N uptake. The results are in accordance with the findings of Ghonsikar and Chalvade (1986). The pulverization by rotavation treatments (P_2) proved its superiority over two harrowing treatments (P_1).

Phosphorus uptake:

Data presented in Table 2 show that the phosphorus uptake increased significantly with increasing depth of tillage. Among various treatments, deep tillage with tractor (T_3) recorded significantly higher P uptake (3.98 and 6.80 kgha^{-1}) in grain and (6.79 and 11.22 kgha^{-1}) in fodder in both the years of experimentation. The different organic treatments showed differential response on uptake of phosphorus by sorghum. PMC (A_2) recorded significantly greater values (3.93 and 6.47 kgha^{-1}) in grain and (6.37 and 10.89 kgha^{-1}) in fodder under both the years of experimentation followed by FYM (A_3) and control (A_1) treatments. The pulverization by rotavation (P_2) treatments proved its superiority over two harrowings (P_1) treatments. Increased uptake of P by the crops as a result of organic material with recommended doses of fertilizer and tillage was also reported by Hirekurubar *et al.* (1991) and Bhagat (1990).

Potassium uptake:

The tillage with tractor plough (T_3) recorded greater potassium content in both grain (5.27 and 9.14 kgha^{-1}) and fodder (22.64 and 36.80 kgha^{-1}) of sorghum in both the years of experimentation followed by treatments T_2 and T_1. The A_2 (PMC) treatment recorded K uptake of 5.12 and 8.60 kgha^{-1} in grain and 24.96 and 35.49 kgha^{-1} in fodder of sorghum followed by A_3 (FYM) and A_1 (control) treatments. The effect of pulverization due to rotavation (P_2) is also significant and positive over two harrowings (P_1) treatments. The findings are in the lines of Ghonsikar and Chalvade (1986).

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