Annals of Arid Zone 37(4): 373-376, 1998

Interactive Effect of Tillage and Phosphate Fertilizers in Conjunction with FYM to Sorghum+Greengram Intercropping System on Performance of Crops

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Abstract: Disc ploughing gave significantly higher grain and stover yields of sorghum, greengram and sorghum equivalent under semi-arid agro-ecoregion of Rajasthan. Incorporation of 10 t ha^{-1} FYM and phosphorus upto 30 kg ha^{-1} increased grain and stover yields of intercrops and sorghum equivalent as well. Uptake of N, P and K by the crops under intercrop system increased when different tillage practices were followed in conjunction with 10 t ha^{-1} FYM and 30 kg P_2O_5 ha^{-1}.

Key words: Tillage, phosphate, sorghum, greengram, intercropping.

Land preparation with bullock-drawn country plough is not only time and energy consuming, but results in the formation of hard pan at plough depth, limiting the rain water intake and root development, and enhancing the runoff losses. The wide spread use of high yielding varieties necessitates breaking of the hard layer to provide a greater soil volume for root access. The integrated system of nutrient supply, through organic manures and inorganic fertilizer, along with proper tillage, are the salient features of rainfed farming. Reduced tillage has been found highly useful in improving soil physical environment and the yield of crop without adverse effects on the environment (Gupta and Aggarwal, 1992). Optimum tillage requirement, in relation to organic and inorganic sources of nutrient, needs to be investigated.

Materials and Methods

A field experiment was undertaken at Agriculture Research Station, Arjia, Bhilwara during *kharif* 1989 and 1990. The soil of the experimental field was sandy loam in texture, non-saline (EC 0.31 dS m^{-1}) having a pH of 7.4 and was low in nitrogen, medium in phosphorus and high in potash (Laddha and Totawat, 1998). The experiment, consisting of five tillage operations (conventional tillage, disc ploughing, chisel ploughing, minimum tillage and zero tillage), two levels of FYM (0 and 10 t ha^{-1}), and three levels of phosphorus (0, 30 and 60 kg P_2O_5 ha^{-1}) was conducted in split plot design with four replications. The tillage treatments were imposed during seed bed preparation as described earlier (Laddha and Totawat, 1998).

A basal dose of 30 kg N ha^{-1}, through urea was given at sowing; remaining 30 kg N ha^{-1} was top dressed only to sorghum crop by applying it between two rows at 40-45 days of crop growth.

The varieties, CSH-6 of sorghum and K-851 of greengram, were used as the test crops. Sorghum was sown at 30 cm spacing within pair, and 60 cm spacing between

Table 1. Effect of tillage, FYM and levels of phosphorus on crop yield (q ha^{-1})

Treatment	Sorghum				Greengram				Sorghum equivalent	
	Grain		Stover		Grain		Stover			
	1989	1990	1989	1990	1989	1990	1989	1990	1989	1990
Tillage										
Conventional	25.5	30.7	113.8	74.7	2.2	2.9	8.3	8.8	30.7	37.5
Disc.	26.3	31.2	119.4	76.8	2.4	3.0	8.5	11.6	31.8	38.0
Chisel	26.2	31.2	117.0	75.0	2.3	2.9	7.7	8.8	31.5	37.9
Minimum	26.0	31.0	117.3	73.6	2.3	2.9	7.4	7.5	31.4	37.7
Zero	22.7	28.5	94.1	73.0	2.0	2.6	7.3	7.5	27.3	34.6
S.Em ±	0.6	0.3	3.7	2.0	0.1	0.1	0.2	0.3	0.5	0.4
CD at 5%	1.9	0.9	11.3	NS	0.2	0.2	0.7	1.0	1.7	1.1
FYM (t ha^{-1})										
F_0	23.8	29.1	107.4	71.9	2.0	2.7	7.4	8.6	28.4	35.3
F_{10}	26.9	31.9	117.2	77.3	2.5	3.0	8.2	9.4	32.7	38.9
S.Em ±	0.5	0.4	1.9	1.3	0.1	0.1	9.1	0.3	0.5	0.4
CD at 5%	1.4	1.0	5.5	3.7	0.1	0.3	0.3	0.7	1.4	1.2
Phosphorus levels (kg P_2O_5 ha^{-1})										
P_0	23.6	29.1	111.0	73.3	2.0	2.5	6.9	7.9	28.4	34.9
P_{30}	26.9	31.7	117.8	74.9	2.3	3.2	8.4	10.3	32.3	39.2
P_{60}	25.5	30.7	114.2	75.7	2.3	2.8	8.2	8.8	30.9	37.3
S.Em ±	0.6	0.4	2.4	1.6	0.1	0.1	0.2	0.3	0.6	0.5
CD at 5%	1.7	1.2	NS	NS	0.2	0.3	0.4	0.9	1.7	1.5
CV %	14.6	9.1	13.3	13.5	17.9	24.2	12.2	21.7		

paired rows. Interspace between paired rows was sown with one row of greengram. For valid comparison of yield data, seed yield obtained for the component crop in intercrop system was converted to sorghum-equivalent yield, using prevailing rate of the produce. The grain and stover samples were analysed for N, P and K contents and their uptake was computed.

Results and Discussion

Yield

When compared with zero tillage, disc ploughing invariably recorded significantly higher yields of sorghum and greengram grains and sorghum equivalent during both the years, as well as when data were pooled (Table 1). The magnitudes of increases recorded for these components were to the tune of 15.9 and 9.5; 20.7 and 14.1; 16.7 and 9.9% for the year 1989 and 1990, respectively. Mean data for two years indicated that disc ploughing resulted in the highest grain yield of both the crops and was followed by chisel ploughing. Stover yield also showed similar trend. Various tillage operations, at par amongst themselves, increased yield over zero tillage.

Incorporation of 10 t ha^{-1} of FYM and 30 kg P_2O_5 ha^{-1} markedly increased grain, stover and sorghum equivalent yields of

Table 2. Effect of tillage, FYM and levels of phosphorus on total uptake (kg ha^{-1}) of nutrients

Treatment	Sorghum						Greegram					
	Nitrogen		Phosphorus		Potassium		Nitrogen		Phosphorus		Potassium	
	1989	1990	1989	1990	1989	1990	1989	1990	1989	1990	1989	1990
Tillage												
Conventional	71.6	71.2	27.4	22.6	145.7	118.9	19.6	22.4	2.5	3.0	5.4	5.9
Disc	82.8	74.3	30.0	24.3	159.6	120.3	21.3	27.8	2.9	3.8	5.7	7.7
Chisel	77.1	72.3	27.7	22.8	157.9	124.7	19.5	22.0	2.6	3.0	5.3	6.3
Minimum	71.6	69.1	28.3	22.9	154.2	125.0	18.6	22.1	2.5	2.9	5.2	6.0
Zero	58.3	64.9	22.4	20.9	120.7	113.3	17.1	19.2	2.1	2.5	4.8	5.4
CD at 5%	5.0	3.4	2.4	1.3	13.5	NS	1.0	1.1	0.1	0.3	0.4	0.7
FYM (t ha^{-1})												
F_0	63.4	63.6	24.3	20.7	134.0	111.2	16.8	20.4	2.1	2.5	4.7	5.7
F_{10}	82.4	77.2	30.1	24.6	161.2	129.6	21.6	25.0	2.9	3.6	5.8	6.8
CD at 5%	2.5	2.1	1.1	0.7	8.5	6.0	0.8	1.3	0.1	0.2	0.2	0.4
Phosphorus levels (kg P_2O_5 ha^{-1})												
P_0	64.4	63.5	22.5	19.4	138.2	109.5	16.6	19.4	1.8	2.0	4.4	5.1
P_{30}	75.5	73.3	28.8	23.6	152.8	124.1	20.3	26.0	2.8	3.8	5.7	7.3
P_{60}	78.7	74.2	30.2	25.1	152.0	127.6	20.8	22.7	3.0	3.4	5.7	6.4
CD at 5%	3.1	2.6	1.3	0.9	10.4	7.4	0.1	1.62	0.1	0.2	0.3	0.5

sorghum-greengram intercropping system. The response curve indicated that phosphorus application gave quadratic response for both the crops during either years of research. Grewal *et al.* (1985) reported that application of FYM enhanced the harvesting of rain water, leading to increased moisture in the soil profile, leading to better crop yields.

Uptake

The total uptake of N, P and K by the component crops of the intercropping system under various tillage treatments was significantly higher than that under zero tillage (Table 2). Disc ploughing was superior over rest of the tillage treatments for nutrient uptake. Raman and Islam (1989) reported that N, P and K uptake was higher in deep tillage treatments, as compared to traditional ploughing.

Incorporation of FYM and phosphorus appreciably increased the uptake of N, P and K by grain, stover and also total uptake of sorghum and greengram at harvest. However, in general, the response of phosphorus was well marked only upto 30 kg ha^{-1}. Increased uptake of N, P and K is attributed to the favorable nutritional status of the soil, resulting in increased biomass production of the crops.

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