

Effect of inorganic fertilizer and organic manure on cotton-sorghum rotation in rainfed Vertisol

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Abstract : Field experiments were conducted during 1996-97 to 1999-2000 at Regional Research Station, Aruppukottai to find out the optimum combination of inorganic fertilizers with organic manure to cotton and their residual effect on sorghum grown after cotton in rainfed Vertisol. The four years mean data revealed that application of inorganic fertilizer at 40:20:0 kg NPK ha⁻¹ every year and FYM 25 t ha⁻¹ once in two years recorded higher mean gross income (Rs.14119 ha⁻¹) with a cotton yield equivalent of 949 kg ha⁻¹ and net income, (Rs.8439 ha⁻¹) which was closely followed by application 40:20:0 kg NPK + FYM 12.5 t ha⁻¹. Application of either inorganic fertilizer or organic manure alone gave lesser yield and income.

Key words: Cotton-sorghum crop sequence, Inorganic fertilizers, Organic manure

Introduction

Continuous use of inorganic fertilizers affects the soil fertility on long term basis. For maintaining optimum productivity of the land and building up of soil fertility, the use of organic manures is highly essential. Organic manures have direct and indirect effect on crop production. Further the crops grown in a definite sequence may require differential application of N, P and K through organic and inorganic fertilizers. This necessitates to make adjustment in scheduling NPK application in crop sequence. Hence the present investigation was undertaken to find out the optimum combination of inorganic fertilizers with organic manure to cotton and their residual effect on sorghum grown after cotton in rainfed Vertisol.

Materials and Methods

Field experiments were conducted during 1996-97 to 1999-2000 for four years at Regional Research Station, Aruppukottai. The field was clay loam soil with 8.0 pH, 0.3 per cent organic carbon, 130 kg ha⁻¹ available N, 12.6 kg ha⁻¹ available P₂O₅ and 325 kg ha⁻¹ of K₂O. Farm Yard Manure (FYM) with and without inorganic fertilizers formed a set of eight treatments (Table 1) which was laid out in randomised block design with three replications. The FYM contained 0.9, 0.5 and 1.1 per cent NPK respectively. The Enriched Farm Yard Manure (EFYM) was prepared by mixing 750 kg of FYM and 125 kg (recommended level of P₂O₅, viz. 20 kg P₂O₅ ha⁻¹) of single super phosphate and kept in an air tight polythene containers for one month. At the time of sowing, recommended level of

nitrogen as urea was mixed with EFYM and applied in the seed line. In the other treatments, FYM was applied before last ploughing and inorganic fertilizers were applied at the time of sowing. MCU 10 cotton was used for the first crop and APK 1 sorghum was sown after cotton during the second year. Soil samples were collected at the end of fourth year after the harvest of sorghum and analysed for organic carbon per cent, available N, P and K content.

Results and Discussion

The results of the experiments revealed that the combined application of organic manure and recommended level of inorganic fertilizers registered significantly and consistently higher seed cotton and sorghum grain yield. Application of FYM at 25 t ha⁻¹ once in two years and recommended level of inorganic fertilizers at 40:20:0 kg NPK ha⁻¹ produced significantly higher seed cotton yield of 1098 and 1307 kg ha⁻¹ during 1996-97 and 1998-99 respectively, which was on par with application of FYM at 12.5 t ha⁻¹ every year along with inorganic fertilizers at 40:20:0 kg ha⁻¹. In sorghum, the highest grain yields of 1916 and 3151 kg ha⁻¹ were obtained by application of FYM at 12.5 t ha⁻¹ every year along with the recommended level of inorganic fertilizers at 40:20:0 kg NPK ha⁻¹ during 1997-98 and 1999-2000 respectively, which was at par with application of FYM at 25 t ha⁻¹ once in two years along with 100 per cent inorganic fertilizers at 40:20:0 kg ha⁻¹ or 50 per cent of the recommended level of fertilizer at 20:10:0 kg ha⁻¹. (Table 1). The yield increase was due to the beneficial effect

Table 1. Effect of treatments on yield of cotton and sorghum

Treatment details		Yield of crops (kg ha ⁻¹)				
For Cotton	For Sorghum	1996-97 Cotton	1997-98 Sorghum	1998-99 Cotton	1999-2000 Sorghum	
T ₁	No fertilizer	No fertilizer	384	862	304	913
T ₂	40:20:0 kg ha ⁻¹	40:20:0 kg ha ⁻¹	914	1674	1010	2366
T ₃	40:20:0 kg ha ⁻¹ + FYM 12.5 t ha ⁻¹	40:20:0 kg ha ⁻¹ + FYM 12.5 t ha ⁻¹	1024	1916	1213	3151
T ₄	40:20:0 as EFYM	40:20:0 as EFYM	995	1810	1033	2699
T ₅	FYM 25 t ha ⁻¹	FYM 25 t ha ⁻¹	832	1690	1082	2853
T ₆	FYM 25 t ha ⁻¹	No fertilizer	840	1547	940	2243
T ₇	40:20:0 kg ha ⁻¹ + FYM 25 t ha ⁻¹	40:20:0 kg ha ⁻¹	1098	1856	1307	3096
T ₈	20: 10: 0 kg ha ⁻¹ + FYM 25 t ha ⁻¹	20: 10: 0 kg ha ⁻¹	890	1784	1134	2842
	CD 5%	CD 5%	70.5	124	98	269

Table 2. Pooled data on cotton yield equivalent and economics

Treatment details		Cotton yield equivalent (kg ha ⁻¹)	Gross income (Rs.)	Net income (Rs.)	Cost- Benefit ratio
T ₁	No fertilizer	299	4489	774	1.20
T ₂	40:20:0 kg ha ⁻¹	766	11491	7073	2.57
T ₃	40:20:0 kg ha ⁻¹ + FYM 12.5 t ha ⁻¹	915	13722	7617	2.24
T ₄	40:20:0 as EFYM	824	12363	7746	2.65
T ₅	FYM 25 t ha ⁻¹ for cotton & Sorghum	797	11959	5249	1.81
T ₆	FYM 25 t ha ⁻¹ for cotton alone	712	10679	5844	2.25
T ₇	40:20:0 kg ha ⁻¹ + FYM 25 t for cotton	949	14119	8439	2.48
T ₈	20: 10: 0 kg ha ⁻¹ + FYM 25 t for cotton	831	12459	7029	2.37
	CD 5%	139	1693	1777	0.48

of combined application of FYM and inorganic fertilizers in the rotational system of cropping. There was a significant yield increase in second crop of sorghum due to the residual effect of FYM than unfertilized control. Cumulative application of FYM (application of FYM to cotton and sorghum) improved the grain yield of sorghum than the residual effect of FYM. This was in agreement with the findings of Rameshwar and Singh (1998). However the residual effect of FYM was well pronounced in the succeeding sorghum crop only with 100 per cent or 50 per cent of recommended level of inorganic fertilizer.

Similar findings on the dual effect of FYM in sequential system of cropping were reported by Rathore *et al.* (1995). The minimum yield was observed in control plot. The four years mean data on gross income revealed that application of inorganic fertilizer at 40:20:0 kg NPK ha⁻¹ every year and FYM 25 t ha⁻¹ once in two years recorded higher mean gross income (Rs. 14119 ha⁻¹) with cotton yield equivalent of 949 kg ha⁻¹ and net income (Rs. 8439 ha⁻¹) which was closely followed by application of 40:20:0 kg NPK ha⁻¹+FYM 12.5 t ha⁻¹ and application of 20:10:0 kg ha⁻¹ along with FYM

Table 3. Soil available nutrients and microbial population in the post harvest soil samples (end of 4th year)

Treat-ments	EC ds m ⁻¹	pH	OC (%)	N (kg ha ⁻¹)	p (kg ha ⁻¹)	K (kg ha ⁻¹)	Fungi (10 ³)	Bacteria (10 ⁶)
T ₁	0.3	8.2	0.29	108	11.4	306	5.33	7.50
T ₂	0.4	8.3	0.30	123	12.1	318	6.00	7.67
T ₃	0.3	7.9	0.348	135	13.3	341	29.67	23.83
T ₄	0.3	8.1	0.320	127	12.8	325	12.33	9.67
T ₅	0.3	7.9	0.346	136	13.0	345	33.83	27.67
T ₆	0.3	8.0	0.335	132	12.8	330	29.33	22.00
T ₇	0.3	8.0	0.340	134	13.2	340	25.67	19.33
T ₈	0.3	7.9	0.338	132	13.0	330	25.00	20.67

25 t ha⁻¹ once in two years (Table 2). Application of either inorganic fertilizer (40:20:0 kg NPK ha⁻¹) or organic manure (FYM 25 t ha⁻¹) alone gave lower gross and net income whereas combination of inorganic fertilizer and FYM as EFYM (Gross income Rs.12363 ha⁻¹ and net income Rs.7746 ha⁻¹) or application of FYM 25 t ha⁻¹ once in two years and 50 per cent of the recommended dose of inorganic fertilizer at 20-10-0 kg NPK ha⁻¹ every year (Gross income Rs.12459 ha⁻¹ and net return Rs, 7029 ha⁻¹) gave substantially higher gross and net income.

From the nutrient status of the soil at post harvest stage, it was inferred that the combined application of inorganic fertilizer and organic manure recorded the highest mean values of N, P, K and organic carbon content (Table 3). The continuous addition of inorganic fertilizers and FYM might have improved the microbial activity and enhanced the availability of native and applied nutrients which in turn increased the yield of crops (Mathur, 1997 and Mishra and Sharma, 1998). Hence it can be concluded that both farm yard manure (every year @ 12.5 t ha⁻¹ or once in two years @ 25 t ha⁻¹ and inorganic

fertilizer must be applied for getting sustainable yield and income in cotton and sorghum rotational system of cropping in rainfed Vertisol.

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