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Effect of Fertilizer NPK and FYM on Yield of Cotton and Nutrient Status in Black Soil

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Abstract: A field experiment was conducted to study the effect of N, P and K fertilization with FYM in cotton (var KC 2) at Agricultural Research Station, Tamil Nadu Agricultural University, Kovilpatti. The treatments included two levels of FYM (0 and 5 t ha^{-1}) with five combinations of NPK *viz.* recommended levels of N, P and K (80, 40 and 40 kg N, P_2O_5 and K_2O ha^{-1}, respectively) (T_1); NP_0K (T_2); N_0PK (T_3); NPKo (T_4); $N_0P_0K_0$ (T_5) and were replicated thrice in randomized block design. The results showed that the different combinations of treatments and FYM tried did not have significant effect on the seed cotton yield. The recommended level of fertilizer nutrients application recorded significantly highest seed cotton yield. The omission of P application did not affect the seed cotton yield. However the omission of N and K significantly reduced the seed cotton yield. The FYM application had effect only on the N uptake and the nutrients taken up by the crop at square forming stage had significant and positive correlation with the total seed cotton yield. The different treatments tried in the experiment had significant influence on available N status in the soil.

Key words: **seed cotton yield, FYM and nutrients uptake**

Introduction

Cotton response to fertilizer is more critical than other crops. However the haphazard fertilization results in increasing the amount of nutrients not needed by the plant and increases the fertilizer costs of the farmer unnecessarily. Furthermore, incorrect fertilization leads to economic losses due to productivity falls besides environmental hazard (Bisson *et al.* 1994). For instance, excessive usage of nitrogenous fertilizer leads to yield's remaining behind schedule (Steenkamp and Jansen, 1998), lowers the resistance of the plant against diseases caused by fungus and greater attractiveness to insect pests (Constable and Rochester, 1988; Hearn, 1981).

Similarly, the addition of phosphorous fertilizers to the soil as a part of composed fertilizers used as the fundamental fertilizers without considering the real need lowers the amount of zinc taken by the plants and decreases the productivity as well. Hence the adequate phosphorus nutrition is critical in optimizing yield, quality, and profit potential in cotton production. Insufficient phosphorous results in dwarfed plants, delayed fruiting and maturity, and reduced yield. Also to ensure proper seed and lint development, adequate soil phosphorus levels must be built and maintained (Holden and Constable, 1994). In general, Tamil Nadu soils are high in potassium. Hence, it is expected that the yield response to applied potassium is low in most cotton growing areas in Tamil Nadu. However, there is a net removal of potassium with each crop of cotton, and it is perhaps only a matter of time before soils reach K levels that will adversely affect crop yield. With this background this study was conducted to find out the effect of fertilizer N, P, K and FYM on the yield of cotton and nutrient status of the soil.

Table 1. Initial characteristics of the experimental soil

Characteristics	Values	
	0-15 cm depth	15-30 cm depth
Soil reaction	8.1	8.4
Electrical Conductivity (dSm^{-1})	0.15	0.17
Organic carbon (%)	0.25	0.13
Available N (kg ha^{-1})	179	102
Available P (kg ha^{-1})	14.3	11.4
Available K (kg ha^{-1})	567	412

Table 2. Seed cotton yield (kg ha^{-1}) of cotton Cv. KC 2.

Treatments	Without FYM	With FYM	T Mean*
T_1	2970	3066	3018a
T_2	2733	2373	2553ab
T_3	3023	2916	2970a
T_4	2583	2370	2476ab
T_5	2175	2225	2200b
F Mean	2697	2590	

* In a column, means followed by common letter(s) are not significantly different at the 5% level by DMRT.

Materials and Methods

A field experiment was conducted during 2001 - 2002 to study the effect of N and P fertilization with FYM in cotton (var KC 2) at Agricultural Research Station, Tamil Nadu Agricultural University, Kovilpatti. The experimental field soil was alkaline in pH, calcareous, low in available N and medium in Olsen-P and high in NNH_4OAc-K status (Table 1). The treatments included two levels of FYM (0 and 5 t ha^{-1}) with five combinations of NPK viz., recommended levels of N, P and K (80, 40 and 40 kg N, P_2O_5 and K_2O ha^{-1}, respectively) (T_0; NP_0K (T_2); N_0PK (T_3); NPKo (T_4); $N_0P_0K_0$ (T_5) and were replicated thrice in randomized block design. Basal N was applied as urea @ 40 kg N ha^{-1}, P as single super phosphate @ 40 kg P_2O_5 ha^{-1} and K as muriate of potash @ 40 kg K_2O ha^{-1} as stipulated in the treatment structure. On 45th day after sowing, N as urea was top-dressed @ 40 kg N ha^{-1}. During flowering stage, the soil and plant samples were collected and analyzed for nutrient status as per the standard procedures given by Jackson (1976) and Piper (1966). After the last picking, the total seed cotton yield was recorded in each treatment and expressed in kg ha^{-1}.

Table 3. Total biomass and uptake of N, P and K in the above ground biomass flowering stage.

Treatments	Biomass (t ha^{-1})	Nutrient uptake (kg ha^{-1})		
		Nitrogen	Phosphorous	Potassium
Without FYM				
T_1	5.75	90.25	6.22	69.50
T_2	4.57	74.34	4.14	54.00
T_3	4.69	90.59	4.55	55.45
T_4	5.26	83.23	5.20	59.84
T_5	3.81	62.90	2.86	46.16
Mean	4.81	80.26	4.59	56.98
SD	0.73	11.74	1.25	8.56
CV%	15.19	14.63	27.18	15.03
With FYM				
T_1	5.80	99.06	8.12	65.69
T_2	4.68	78.57	4.75	54.91
T_3	4.78	82.94	5.51	59.84
T_4	5.19	87.11	5.28	55.48
T_5	4.07	66.04	3.58	48.80
Mean	4.90	82.75	5.45	56.94
SD	0.64	12.06	1.67	6.27
CV%	13.08	14.58	30.65	11.02

Results and Discussion

Seed Cotton and Biomass Yields

The seed cotton yield (Table 2) ranged from 2370 kg ha^{-1} to 3066 kg ha^{-1}. The different combinations of nutrients tried and FYM used did not have any effect. Since FYM was applied @ 5 t ha^{-1}, it was not sufficient to produce any significant effect on seed cotton yield. By DMRT, it was found that the recommended level of nutrients (N, P and K) applied treatment (T_1) produced significantly highest seed cotton yield of 3018 kg ha^{-1} and the lowest yield of 2200 kg ha^{-1} in control (T_5). Similar results was reported by Jaganathan *et al.* (1994). The treatment T_5 was on par with T_1 and showed that the omission of P application did not affect the seed cotton yield. However, the omission of N (T_2) and K (T_4) significantly reduced the seed cotton yield. Hence, the balanced application of N, P_2O_5 and K_2O in the ratio of 2:1:1 is essential to sustain long term cotton yields (Kairon and Venugopalan, 1999).

The biomass production at flowering stage (Table 3) was influenced by the different treatments. The NPK applied treatment (T_1) recorded the highest biomass and the lowest was in Control (T_5). However, the application of FYM did not influence the biomass and showed that the quantity applied is not sufficient to influence the biomass production.

Table 4. Available nutrient status (kg ha^{-1}) in the cotton soil at flowering stage.

Treatments	Without FYM	With FYM	T Mean
T_1	373	405	389
T_2	345	354	350
T_3	388	395	392
T_4	399	415	407
T_5	339	334	336
F Mean	369	380	
Phosphorous			
T_1	20.57	25.30	22.94
T_2	16.79	19.59	18.19
T_3	19.15	15.78	17.46
T_4	27.47	21.97	24.72
T_5	16.05	18.88	17.46
F Mean	16.73	20.31	
Potassium			
T_1	498	520	509
T_2	554	584	569
T_3	442	548	495
T_4	424	504	464
T_5	378	480	429
F Mean	459	527	
CD (5%)	Nitrogen	Phosphorus	Potassium
FYM	NS	NS	61.89
T	27.05	NS	NS
FxT	NS	NS	NS

Nutrient Uptake

The uptake of N, P and K at flowering stage (Table 3) ranged from 62.90 to 99.06, 2.86 to 8.12 and 46.16 to 65.61 kg ha^{-1} respectively and the cotton crop taken up the N, P and K in the ratio of 16:1:11. respectively. The uptake of N, P and K showed that the control (T_5) recorded the lowest uptake and the highest in the recommended level (T_1). The FYM application had effect only on the N uptake by the plant sample. The nutrients taken up by the crop at square forming stage had significant and positive relationship (Figure 1) with the total seed cotton yield. The seed cotton yield have highly significant correlation with N uptake ($r = 0.848^{**}$) followed by K uptake ($r = 0.807^{*}$) and P uptake ($r = 0.752^{*}$). Mitsios *et al.* (1998) reported similar result with respect to nitrogen uptake at blooming stage and seed cotton yield.

Soil nutrient status

The different treatments tried in the experiment had significant influence on available