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INFLUENCE OF INTERCROPPING AND MULCHING ON CHEMICAL PROPERTIES OF SOIL AND CROP PRODUCTIVITY IN RAINFED COTTON

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ABSTRACT

Field experiments were conducted at the Agricultural Research Station, Kovilpatti to study the effect of intercropping and mulching on chemical properties of soil and productivity of cotton in rainfed situation. The post harvest estimates of the available soil nutrients revealed that depletion of N was more in pre-monsoon sown crops. Intercropping of cotton with blackgram or clusterbean had increased the residual N and organic carbon content of soil, but it depleted more of P. The application of subabul loppings or bajra straw as mulches improved the level of available N, K and organic carbon content. The cotton + clusterbean sown under pre- monsoon and mulched situations recorded higher cotton yield equivalent.

KEY WORDS : Cotton , intercropping, mulching

Legume intercropping has attracted the attention of the agronomists, which may be due to some of the stabilised and speculated advantage of the system such as higher grain yield, greater land use effeciency and improvement of soil fertility through the addition of nitrogen by fixation and excretion from the component legumes (Chatterjee *et al.*, 1989). Due to slow growing nature of cotton in the initial stages, growing of short and early maturing legumes was found ideal and compatible (Rajat De and Singh, 1979). High intensity of rains during the monsoon period and poor infiltration rate of the vertisol provides considerable scope for soil erosion and run-off (Itnal *et al.*, 1994). Surface cover with organic mulches facilitates better infiltration for improving the soil moisture and fertility status under rainfed situation. Hence, the present investigation was undertaken to study the influence of inter-cropping and mulching on the improvement of the soil chemical properties and crop productivity in rainfed cotton.

MATERIALS AND METHODS

Field experiments were conducted during the rabi season of 1993-94 and 1994-95 at Agricultural Research Station, Kovilpatti to study the influence of intercropping and mulching practices on chemical properties of the soil and productivity of cotton under rainfed condition. Treatments consisted of three sowing times viz., Pre-monsoon, monsoon and late-monsoon sowings and three intercropping system viz., sole cotton, cotton + blackgram and cotton + clusterbean as main plot treatments and three mulching practices viz., no mulch, subabul loppings and bajra straw as sub-plot treatments. The experiment was laid out in split-plot design replicated thrice. Cotton cv. MCU 10, blackgram cv. CO5 and clusterbean cv. pusa navbhagar were used as test crops. The crops were sown on 30th September, 14th October and 28th October during 1993-94 and 1994-95 under pre-monsoon, monsoon and late monsoon situation, respectively, by adopting a spacing of 45 cm between rows for pure stand of cotton and 30/60 cm for paired row system at 2:1 ratio for intercropping of cotton. Intra-row spacing of 10 cm and 15 cm were adopted for blackgram and clusterbean respectively. The mulch materials were cut into small pieces and applied at the rate

of 6 t/ha. 15 days after the germination in between the crop rows. Cotton yield equivalent was worked out by adding blackgram and clusterbean yield into cotton yield after multiplying it by the ratio of their costs. During the crop season, a total rainfall of 464 mm (31 rainy days) and 473 mm (26 rainy days) was received during 1993-94 and 1994-95 respectively. The soil samples at the initiation as well as at the end of the investigation were taken and analysed for the available nutrients.

RESULTS AND DISCUSSION

Soil chemical properties

The systems of intercropping had a significant influence on available soil nitrogen, phosphorus and organic carbon content. Higher residual nitrogen and organic carbon under the intercrop combinations were perhaps due to the nodulation effect of the legume components, besides, the addition of organic residues. Legumes do not compete for nitrogen with the component crop and provide some nitrogen benefit (CIAT, Columbia 1974) to a non- legume, growing in association or a residual benefit to a subsequent crop (Mandal *et al.*, 1987). Similar increase in residual N and organic carbon was obserd by Sheoran and Malik (1986), and Adhikary *et al.* (1991) under intercropping, systems. The reduction in residual phosphorus, under intercropping system was probably due to the legume component as well as the increased cropping intesity, which might have depleted more quantity of soil phosphorus. This is in accordance with the findings of Raghavan (1987), who had reported high residual P in pure stand of cotton as compared to intercropped cotton. With regard to residual K, although no definite trend could be noted, the data clearly showed that increasing the cropping intensity through intercropping, had no adverse effect on K exhaustion.

Application of subabul loppings or bajra straw as mulch materials had increased the available N, K and organic carbon content in the post harvest soil samples. Increase in available soil N and organic carbon content under mulching treatments, might be assigned to suppression of weeds, build-up of organic matter, improvement in physical properties of soil and increased microbial activity. All these favoured the rate of mineralisation and release of available nitrogen in greater proportion to the cotton plants.

Organic mulches had a favourable influence in increasing the available K content of soil at the end of the second year. Build up of organic matter, release of organic acids during decomposition

Table 1. Available N, P, K (Kg ha^{-1}) and organic carbon (%) content in post-harvest soil samples

Treatments	1993-94				1994-95			
	Nitrogen (kg ha^{-1})	Phosphorus (kg ha^{-1})	Potassium (kg ha^{-1})	Organic carbon (%)	Nitrogen (kg ha^{-1})	Phosphorus (kg ha^{-1})	Potassium (kg ha^{-1})	Organic carbon (%)
Sowing time								
Pre-monsoon	126.7	8.28	343.6	0.263	124.3	8.34	344	0.271
Monsoon	130.4	8.27	344.4	0.262	128.1	8.35	343	0.269
Late monsoon	131.4	8.29	344.0	0.261	129.4	8.36	344	0.268
SEd	1.0	0.04	2.4	0.002	1.13	0.08	1.8	0.002
CD (P=0.05)	2.1	NS	NS	NS	2.40	NS	NS	NS
Intercropping								
Sole Cotton	126.7	8.49	344.3	0.255	124.5	8.54	345	0.261
Cotton + Blackgram	131.9	8.21	344.0	0.265	129.5	8.25	343	0 273
Cotton + Cluster bean	129.9	8.15	343.7	0.265	127.7	8.25	343	0.273
SEd	1.0	0.04	2.4	0.002	1.13	0.08	1.8	0 002
CD (P=0.05)	2.1	0.08	NS	0.004	2.40	0.17	NS	0.005
Mulching								
No mulch	124.0	8.25	339.8	0.248	121.6	8.20	334	0.249
Subabul loppings	134.0	8.31	346.3	0.270	131.9	8.44	349	0 280
Bajra straw	130.4	8.29	345.9	0.267	128.3	8.40	348	0.279
SEd	2.6	0.14	4.8	0 006	2.4	0 16	3.7	0 005
CD (P=0.05)	5.2	NS	NS	0 012	4.9	NS	7 6	0 011

Table 2. Effect of sowing time, intercropping and mulching on cotton yield equivalent

Treatments	Cotton yield equivalent (kg/ha)	
	1993-94	1994-95
Sowing time		
Pre-monsoon	876	832
Monsoon	869	683
Late monsoon	648	506
CD (P=0.05)	25	16
Intercropping		
Sole Cotton	671	554
Cotton + Blackgram	760	647
Cotton + Cluster bean	963	820
CD (P=0.05)	25	16
Mulching		
No mulch	729	612
Subabul loppings	840	717
Bajra straw	825	691
CD (P=0 05)	39	38

processes, solubilization of minerals, change over from non exchangable to exchangable form under mulched condition, might be the reasons for improving the available K and organic carbon content of the soil under mulched environment. These results confirmed the findings of Helkiah (1982), and Venugopal and Shivashankar (1989).

Cotton equivalent

The yield in terms of cotton equivalent was higher (876 and 832 kg/ha during 1993-94 and 1994-95 respectively) when cotton was sown under premonsoon situation (Table 2). This was mainly due to the favourable weather and availability of moisture through the rainfall and its distribution which exerted greater influence on growth and yield of cotton and intercrops. Such yield increase in pre-monsoon cotton has been reported earlier by Dason and Krishnasamy (1995). Among the intercrop combinations, cotton + cluster bean recorded significantly higher cotton yield equivalent than sole cotton and cotton + blackgram and the increase was 43.5 and 48.0 per cent over sole cotton during 1993-94 and 1994-95. This was due to high pod yield in clusterbean as compared to blackgram. Application of subabul loppings had significantly increased the cotton yield equivalent as compared to unmulched control, but at par with bajra straw mulching. Adequate soil moisture, nutrient availability and nutrient uptake under mulched environment were responsible for enhanced growth and yield. Similar yield increase in cotton was observed by Venkatachalam *et al.*, (1981) due to mulching practice.

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