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ORGANIC MATTER AND NUTRIENT ADDITION THROUGH CROP RESIDUES BY DIFFERENT RICE BASED CROPPING SYSTEMS

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ABSTRACT

Field experiments were carried out during 1986-'88 with five rice based cropping systems, two irrigation regimes and two fertilizer levels at the Agricultural College and Research Institute, Madurai, Tamil Nadu. Appreciable amount of crop residue was added by sorghum + vegetable cowpea - rice - soybean system. Addition of N and K through crop residue was greatest in rice - rice-green gram while cropping of sorghum + vegetable cowpea - rice - soybean added highest amount of P. Irrigating the rice crop at 5 cm depth on the day of disappearance of ponded water and irrigating the *kharif* and summer crops at 0.75 and 0.60 IW/CPE ratios, respectively, added higher amount of crop residue in the second year. Similarly more N through crop residue in the first year, while addition of P was more in the second year was also observed. Application of N, P and K as per soil test recommendations resulted in higher crop residue addition in first year and fertilizer level with more N and K through crop residue in first year.

KEY WORDS : Crop residues, Component crops, Nutrients added

Information on the quantity of crop residue added by different crops in the sequence, after harvest is important as crop residue contributes considerable amount of organic matter and essential plant nutrients. Intensive rice based triple cropping systems added 5000 to 6000 kg of organic matter per ha to soil by way of roots and stubbles (Allison, 1973). Mongia *et al.*,. (1989) observed more accu mulation of organic matter where legumes were included. The nitrogen available in the form of humus protein in crop residue, is continuously supplied as ammonia and nitrate during the growing seasons of the crops in the sequence. On decomposition of humus compounds, phosphorus compounds are slowly made available to crops.

MATERIALS AND METHODS

Field experiments were conducted from 1986-'88 at the Agricultural College and Research Institute, Madurai, Tamil Nadu, with five cropping systems, two fertiliser and two irrigation levels. The experiments were conducted in split plot design replicated three times. The main plot was allotted with five cropping systems *viz.*, rice - rice - fallow; rice - rice - green gram; sorghum + vegetable cowpea - rice - soybean; maize + soybean - rice - vegetable cowpea, and groundnut + black gram - rice- sesamum, The subplots were allotted with each two levels of fertilizer and irrigation.

Treatments

Fertilizer levels

Application of N,P and K as per soil test values

As in F_1 for all crops except for rice to which P and K alone skipped

Irrigation levels (as indicated against each crop)

Rice : Irrigation to 5 cm depth on the day of disappearance of ponded water (recommended)

: Maintaining submergence of 5 cm depth at reproductive stage (critical stage)

In other stages as in recommended dose

Irrigated dry crops (depth of irrigation : 6 cm)

Sorghum, maize and groundnut

- Irrigation at 0.75 IW/CPE ratio (recommended)

- Irrigation at critical stages

Green gram, soybean, vegetable cowpea and sesamum

- Irrigation at 0.60 IW/CPE ratio (recommended)

- Irrigation at critical stages

The soil of the experimental field was well drained sandy clay loam with available N, P and K of 244.7, 18.1 and 239.7 kg.ha^{-1}, respectively.

Table 1. Crop residue, nitrogen, phosphorus and potassium added by the component crop in the cropping system.

Treatments	Crop residue (t.ha^{-1})		Nitrogen (kg ha^{-1})		Phosphorus (kg ha^{-1})		Potassium (kg ha^{-1})	
	1986-'87	1987-'88	1986-'87	1987-'88	1986-'87	1987-'88	1986-'87	1987-'88
Cropping system								
Rice - rice - fallow	6.05	6.23	15.41	26.25	4.08	4.17	39.94	41.39
Rice - rice - green gram	6.50	6.93	29.00	30.67	4.22	4.48	43.20	44.96
Sorghum + vegetable cowpea - rice - soybean	6.87	7.24	26.39	28.07	4.89	5.10	36.87	39.06
Maize + soybean - rice - vegetable cowpea	4.94	5.17	23.24	22.95	3.06	3.21	33.80	34.69
Groundnut + black gram - rice - sesamum	4.86	5.09	23.54	24.61	3.20	3.56	28.20	29.33
SEd	0.07	0.03	0.34	0.09	0.06	0.03	0.28	0.53
CD (5%)	0.15	0.08	0.79	0.20	0.13	0.06	0.65	1.22
Fertiliser levels								
N, P and K as per soil test values	5.93	6.18	25.93	26.69	3.97	3.81	36.96	38.01
As above for all crops except for rice to which P and K alone skipped	5.76	6.08	25.10	26.33	4.10	4.11	35.36	37.77
SEd	0.07	0.00	0.10	0.39	0.08	0.04	0.39	0.39
CD (5%)	0.15	NS	0.25	NS	NS	NS	0.96	NS
Irrigation regimes								
Recommended	5.91	6.24	25.83	26.97	3.93	4.18	36.50	38.28
Critical stage	5.78	6.02	25.21	26.05	3.85	4.03	36.23	37.50
SEd	0.07	0.06	0.10	0.39	0.08	0.04	0.39	0.39
CD (5%)	NS	0.14	0.25	NS	NS	0.09	NS	NS

NS : Not Significant

Organic carbon content was 0.39 per cent. After each crop, a pit (50 x 50 x 30 cm) was dug out, the soil particles along with crop residue removed from the pit was sieved and separated in water tub. The separated crop residue was dried in oven to constant weight and expressed in t.ha^{-1}. Total N content in the crop residue was estimated by micro-kjeldahl method (Humphries, 1956), total P as per vanadomolybdophosphoric yellow colour method (Jackson, 1967) and K with flame photometer using triacid extract. The nutrient addition was computed by multiplying per cent content with that of residue added by component crops.

RESULTS AND DISCUSSION

Residue added by component crops

Variation in component crops of different cropping system caused significant changes in the addition of crop residue. The cropping of sorghum + vegetable cowpea - rice - soybean added 6.87 and 7.24 t.ha^{-1} of crop residue during 1986-'87 and 1987-'88, respectively (Table 1). Highest amount of crop residue added by sorghum + vegetable cowpea - rice - soybean was due to the addition of stubbles, fibrous roots and root bits of sorghum. During first and second year, sorghum added 2.54 and 2.59 t.ha^{-1}, vegetable cowpea added 0.18 and 0.18 t.ha^{-1}, winter rice added 3.41 and 3.61 t.ha^{-1} and soybean added 0.74 and 0.86 t.ha^{-1} of crop residue. Cropping of sorghum + vegetable cowpea - rice - soybean was followed by rice - rice - green gram, rice - rice - fallow, maize + soybean - rice - vegetable cowpea, and groundnut + black gram - rice - sesamum.

Irrigation levels recorded significant influence during the second year (Table 1). Recommended level of irrigation was superior to critical stage irrigation during both years. Higher moisture availability during the crop growth period in

1987-'88, and availability of total rainfall of 627.4 cm in 1986-'87 and against 964.0 cm in 1987-'88 facilitated higher root development thus resulting in the addition of higher quantity of crop residue. The addition of crop residue under fertiliser application as per soil test value during 1986-'87 was due to additional availability of P and K to rice crop. The nutrient availability, especially P produced deeper and prolific roots (Tandon, 1987). Due to higher residual effect of applied nutrients added through crop residue, the effect of fertiliser levels was not found during 1987-'88.

Nutrients added by the crop residue of component crops

Nitrogen added through crop residue

Nitrogen addition into soil through the crop residue by the crop components in rice - rice - green gram might be due to relatively higher N content in stubble of rice and green gram. The least addition of N by crop residue was recorded by maize + soybean - rice - vegetable cowpea. Cropping of rice - rice - green gram was followed by sorghum + vegetable cowpea - rice soybean, rice - rice - fallow, groundnut + balck gram - rice - sesamum, and maize + soybean - rice - vegetable cowpea. Cropping system groundnut + black gram - rice - sesamum was comparable with maize + soyabean - rice - vegetable cowpea during 1986-'87. Better development and higher quantity of stubbles in recommended level of irrigation added higher N in soil through crop residue. The addition of P and K to rice in addition to N resulted in better root development. As a result, the rice stubbles added more N to soil under N, P and K as per soil test values. Superiority of critical stage irrigation over recommended level of irrigation in enriching the soil with N through the addition of crop residue was observed in rice - rice - fallow.

Phosphorus added through crop residue

Phosphorus addition by crop residue was higher in cropping of sorghum + vegetable cowpea - rice - soybean. The residue added by th component crops in sorghum + vegetable cowpea rice - soybean was higher and the P content wa more in sorghum stubbles. This corroborates th findings of Singh and Faroda (1986). The least cro residue was observed in maize + soybean - rice vegetable cowpea. Higher moisture availability i recommended level of irrigation to irrigated dr crops at IW/CPE ratios, produced prolific roo development in the second year which might be th reason for higher addition of P through cro residue.

Potassium added through crop residue

All the cropping systems were distinctly superior over each other and rice - rice - green gram recorded higher K addition at 43.2 and 44.9 $kg.ha^{-1}$ in 1986-'87 and 1987-'88, respectively This might be due to higher K content in ric stubbles and roots of green gram. Whil considering the fertiliser levels, significan variation was observed in 1986-'87. Application o N,P and K as per soil test values added more K i soil through crop residue which was partly due to the role played by P in enhancing better root development in 1986-'87.

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