

## Residual effects of integrated plant nutrients management practices (IPNM) on yield attributes and yield of succeeding black gram and available soil nutrient status

C. BABOU\*<sup>1</sup>, G. POYYAMOLI<sup>2</sup>, B. GUNA<sup>3</sup> AND K. SIVAGAMY<sup>1</sup>

Department of Agronomy, Agricultural College and Research Institute (TNAU), MADURAI (T.N.) INDIA

### ABSTRACT

A Field experiment was carried out at Agricultural College and Research Institute, Madurai during 2001 - 2002 to study the residual effect of cotton crop residue management practices and levels of inorganic fertilizer N and K applied to preceding rice on succeeding black gram (*Phaseolus mungo* L.) in rice [*Oryza sativa* (L.)] - black gram (*Phaseolus mungo* L.) cropping system. After harvest of rice, Black gram was sown as residual crop. No inorganic fertilizer was applied to the black gram. The results revealed that incorporation of cotton stalks @ 5 t ha<sup>-1</sup> with *Trichoderma viride* to preceding rice crop significantly improved yield attributes (number of pods per plant, number of seeds per pod and 1000 seeds weight) and yield of black gram and soil available nutrient status. Similar improved yield trend and soil available nutrient status was observed in increasing levels of N and K fertilizers applied to rice.

**Key words :** Cotton crop residue incorporation, Fertilizer levels, Black gram, Soil properties, IPNM.

### INTRODUCTION

Rice-black gram is one of the major cropping systems in Tamil Nadu, India. The wider adoption of this system by the farmers is due to its better economic return. Growing high yielding varieties, fertilizer response hybrids and adoption of intensive cultivation resulted in large volume accumulation of crop wastes *viz.*, leaves, twigs, stubbles in our agricultural land. Their disposal is a major problem. But, their effective use in agriculture is limited due to low nutrient content, bulkiness and difficulty in direct application. By proper degradation with appropriate bio-agents the crop residues can be used effectively (Bhudhar and Palaniappan, 1994). Depending on chemical fertilizers alone for increasing production will cause environmental pollution, degradation of soil health. Hence, a judicious combination of organics, crop residues, bio agents and inorganic fertilizer will sustain productivity and maintain soil health. An integrated approach of plant nutrient management will achieve the sustainable productivity.

Application of crop waste to rice crop has exhibited its beneficial effect on the succeeding crops, since crop waste are having substantial residual effect. Incorporation of composted coir pith (5 t ha<sup>-1</sup>) and rice straw (5 t ha<sup>-1</sup>) in rice had residual effect of P and K on green gram (Sharma and Mittra, 1991). Incorporation of cane trash at 5 t ha<sup>-1</sup> showed considerable residual effect on the succeeding maize due to the improvement in soil

physico-chemical properties of soil and also increased nutrient availability (Srivastava and Omprakash, 1998). Ranganathan and Selvaseelan (1994) reported that mushroom spent rice straw compost could serve as a good reserve of plant nutrient which increased the yield of residual crop of green gram substantially due to enhanced supply of N, Ca and Mg.

The application of wheat straw to rice with inorganic fertilizer has residual effect on subsequent gram, which produced higher grain yield (Babou *et al.*, 2001). The literatures perused indicated that there is better scope for inclusion of bio-inoculants treated crop residue as organic source along with inorganic in rice.

Therefore, investigation on the possibility of utilizing the crop waste as a source of nutrient in combination with or without bio-inoculants and inorganic fertilizer in rice based cropping system was carried out during 2001-2002 at Agricultural College and Research Institute, Madurai, India to find out a suitable and economical methods of black gram cultivation for improving their production potential in the prevalent rice-black gram system, different integrated plant nutrients management methods were compared under field conditions.

### MATERIALS AND METHODS

A field experiment was carried out at Agricultural College and Research Institute, Madurai, during 2001-

\* Author for correspondence. Present Address : Department of Agronomy, Adhiparasakthi Agricultural College, G.B. Nagar, Kalavai, VELLORE (T.N.) INDIA

<sup>1</sup> Department of Ecology and Environmental Sciences, Salim Ali School of Ecology and Environmental Science, Pondicherry Central University, PUDDUCHERRY (U.T.) INDIA

<sup>2</sup> Department of Science, Technology and Environment, PUDDUCHERRY (U.T.) INDIA

2002. The experimental soil was sandy clay loam with pH of 8.05, which was medium in organic carbon (0.52 per cent), low in available nitrogen (186.3 kg ha<sup>-1</sup>), medium in phosphorus (17.80 kg ha<sup>-1</sup>) and high in potassium (285.80 kg ha<sup>-1</sup>). The field experiment was laid out in split-plot design with three replications. The experiment in main plots consisted of five treatment combinations on incorporation of cotton stalks @ 5 t ha<sup>-1</sup> alone or with bio-inoculants viz., control - without cotton stalks incorporation (M<sub>1</sub>), cotton stalks incorporation @ 5 t ha<sup>-1</sup> (M<sub>2</sub>), cotton stalks incorporation @ 5 t ha<sup>-1</sup> + *Trichoderma viride* (M<sub>3</sub>), cotton stalks incorporation @ 5 t ha<sup>-1</sup> + *Pleurotus sajor caju* (M<sub>4</sub>) and cotton stalks incorporation @ 5 t ha<sup>-1</sup> + *Trichoderma viride* + *Pleurotus sajor caju* (M<sub>5</sub>) done to the preceding rice. In subplots, however, four (S<sub>1</sub>, S<sub>2</sub>, S<sub>3</sub> and S<sub>4</sub>) inorganic fertilizers levels, i.e. 125, 100, 75 and 50 per cent of the recommended dose of inorganic fertilizer N and K to the preceding rice were kept, respectively. Rice cv. CO 43 was sown (*rabi* season) in the first week of September in wet land area and rice fallow black gram variety T9 was raised during January-March. After harvest of rice, black gram was sown as residual crop. No inorganic fertilizer was applied to the black gram. Other management practices were adopted as per recommendations of the crops. In the cropping season, a total rain fall of 538 mm (26 rainy days) was received during experiment.

## RESULTS AND DISCUSSION

### *Residual effects of IPNM on yield attributes and yield of succeeding black gram:*

The yield attributes (number of pods per plant, number of seeds per pod and 1000 seeds weight), seed and haulm yields of black gram was markedly increased due to the residual effect of incorporation of cotton stalks with or with out bio-inoculants to rice crop (Table 1). The increase in seed yield of black gram in treatment receiving cotton stalks incorporation @ 5 t ha<sup>-1</sup> plus *Trichoderma viride* and cotton stalks incorporation @ 5 t ha<sup>-1</sup> + *Trichoderma viride* + *Pleurotus sajor caju* was 164, 149 kg ha<sup>-1</sup>, respectively resulting in 38.95, 35.39 per cent over no cotton stalks incorporation treatment (Table 1). This was possibly due to the substantial improvement in the soil nutrient status after the harvest of rice crop. Chinnusamy (1997) also reported similar result. More leaf area with high photosynthetic efficiency increased dry matter production, more number of seeds per pod and higher uptake of nutrients could be contributed for increased seed production.

Higher levels of inorganic fertilizer N and K applied to the rice crop had a great residual effect on growth and yield attributes of black gram and seed yield was increased with 125 per cent of the recommended dose of N and K fertilizer (S<sub>1</sub>) applied to preceding rice crop as compared with 50 per cent of the recommended dose of N and K

**Table 1: Residual effects of IPNM on yield attributes and yield of succeeding black gram and soil available N, P, K and organic carbon status after harvest of black gram (pooled data of 2 years)**

Treatments	Yield attributes			Seed yield (Kg ha <sup>-1</sup> )	Haulm yield (Kg ha <sup>-1</sup> )	Available nutrient status of soil (kg ha <sup>-1</sup> )			
	Pods / plant	Seeds / pod	Test weight of 1000 seeds (g)			N	P	K	Organic carbon (%)
Initial soil sample	-	-	-	-	-				
<b>Organic and bio-inoculants</b>									
M <sub>1</sub>	24.0	4.81	3.47	421	1370	165.2	13.2	212	0.651
M <sub>2</sub>	27.6	5.39	3.52	522	1601	194.6	15.8	225	0.785
M <sub>3</sub>	36.2	6.03	3.56	585	1753	227.8	18.8	243	0.823
M <sub>4</sub>	30.8	5.64	3.53	545	1661	207.8	17.0	231	0.799
M <sub>5</sub>	34.0	5.89	3.55	570	1716	219.7	18.2	238	0.813
S.E.±	1.2	0.08	0.03	8	19	4.5	0.4	2.3	0.004
C.D. (P=0.05)	2.8	0.19	NS	18	44	10.8	0.8	5.5	0.011
<b>Inorganic Fertilizers</b>									
S <sub>1</sub>	37.2	6.20	3.57	551	1702	235.8	18.9	246	0.801
S <sub>2</sub>	35.2	5.95	3.55	527	1642	223.6	18.3	240	0.794
S <sub>3</sub>	32.7	5.72	3.52	505	1584	210.6	17.7	235	0.787
S <sub>4</sub>	23.8	5.5	3.49	472	1442	191.6	15.3	225	0.710
S.E.±	1.2	0.13	0.06	12	30	6.4	0.3	2.9	0.003
C.D. (P=0.05)	2.9	0.30	NS	28	68	15.36	0.7	6.9	0.008
Interaction	NS	NS	NS	NS	NS	NS	NS	NS	NS

NS- Non significant

(S<sub>4</sub>) and it was at par with application of 100 per cent of the recommended dose of inorganic N and K (Table 1). This increase in seed yield may be due to increased availability of N, P, K and organic carbon after the harvest of rice.

**Residual effect of IPNM on available soil nutrient status after harvest of black gram:**

The incorporation of cotton stalks with bio-inoculants to rice crop had a significant residual effect on the soil organic carbon content, available nitrogen, phosphorus and potassium in the soil after the harvest of black gram (Table. 1). Incorporation of cotton stalks @ 5t ha<sup>-1</sup> with *Trichoderma viride* (M<sub>3</sub>) to preceding rice has recorded higher residual organic carbon content, available nitrogen, phosphorus and potassium which were 26.42, 37.89, 42.42 and 14.62 per cent higher than that of control (M<sub>1</sub>), respectively. It was at par with the treatment in which cotton stalks incorporation @ 5t ha<sup>-1</sup> with *Trichoderma viride* and *Pleurotus sajor caju* (M<sub>5</sub>) were applied to preceding rice crop. This was possible due to the greater accumulation of dry matter production, which might have left larger volume of residues in the soil, resulting in higher available N in soil surface. This corroborates with the findings of Gururajan *et al.* (2001). Similarly high buildup of available P and K was also seen due to the residual effect of cotton stalks incorporation to the first crop. Over all residual nutrient status at the end of the crop sequence was considerably improved by the incorporation of cotton stalks, inspite of high removal of nutrient by the two crops together. The long term effect of soil fertility buildup due to the use of organic in rice nutrition is brought out from the above observation. This was in agreement with the results of Singh *et al.* (1998).

Increment in fertilizer levels adapted to first crop significantly increased the soil organic carbon content, available nitrogen, phosphorus and potassium of the soil after the harvest of black gram (Table. 1). Application of 125 per cent of recommended dose of inorganic N and K (S<sub>1</sub>) to preceding rice crop had perceptible residual effect resulting in higher soil organic carbon content after harvest of succeeding black gram. It was at par with the treatment that received 100 per cent of recommended dose of inorganic N and K (S<sub>2</sub>) in the preceding rice crop. Which was at par with the treatment receiving 75 per cent of recommended dose of inorganic N and K (S<sub>3</sub>).

**Conclusion :**

It can be concluded from the study that incorporation of cotton stalks @ 5 t ha<sup>-1</sup> and *Trichoderma viride* with 100 per cent recommended fertilizer level to *rabi* rice is the best integrated plant nutrient management (IPNM) practice for getting eco-friendly and sustainable yield and higher nutrient status in rice- black gram system.

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