Residual and direct effect of different sources of nutrients on growth and yield of rice fallow cotton cultivars

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ABSTRACT

Field experiment was carried out at the Annamalai University, Experimental Farm, Department of Agronomy, Annamalai Nagar, Tamil Nadu to study the residual and direct effect of different sources of nutrients on growth and yield of rice fallow cotton cultivars during January to June 2005. The whole research consist of two experiments, first experiment include rice and second experiment with rice fallow cotton. First experiment (rice) comprised of eight treatments with recommended dose of nitrogen and graded dose of nitrogen along with different organic manures. It was laid out in a randomized block design (RBD) and replicated thrice. With regard to second experiment (cotton) all the main plots of rice (experiment-I) was divided in to three equal sub plots in which rice fallow cotton varieties was raised *viz.*, MCU 7, Anjali and LRA 5166. This paper mainly deals with cotton crop under rice – cotton cropping system. The results of the experiment showed that among the main plots treatment, residual effect of 100% RDN + vermicompost @ 5 t ha^{-1} had significantly registered higher plant height, LAI, DMP, monopodial branches $plant^{-1}$, sympodial branches $plant^{-1}$, squares $plant^{-1}$, bolls $plant^{-1}$ and boll weight. Also the same treatment registered significantly higher seed cotton yield. With regard to cotton varieties, LRA 5166 performed better under rice fallow condition than MCU 7 and Anjali cotton.

Keywords: Rice fallow cotton, cotton varieties, residual effect, vermicompost, nitrogen, growth and seed cotton yield.

Introduction

Cotton (Gossypium *spp*.) crop has been associated with ancient civilizations, which has contributed greatly to the industrial and economic development of many countries. The need for cotton products have ensured its survival as one of the world's most widely cultivated crop, despite the stiff competition it faces from man-made fibers. Cotton is grown in about 76 countries, covering more than 32 million hectares, under different environmental conditions world wide and world cotton commerce is about US$20 billion annually (Saranga *et al.*, 2001). It has played a significant role in agriculture, industrial development, employment, financial stability and economic viability ever since the country attained the independence. It is the most beneficial fiber and cash crop of India and earns a good fortune for the country in the form of foreign exchange. In canal irrigated deltaic area of southern India, recently this crop is recognized as a best substitute for the existing rice fallow crops like pulse and gingelly under assured water supply (Rammohan, 1997). Although the yield of rice fallow cotton fetches higher monetary returns than other crops, the average yield was much lower than the potential yield of the crop. Lower cotton productivity could be attributed to highly varying factors and management practices mainly low soil fertility status.

Intensive agriculture involving exhaustive high yielding varieties of rice has led to heavy withdrawal of nutrients from the soil, imbalanced and discriminate use of chemical fertilizers has resulted in deterioration of soil health (John *et al.*, 2001). The various implications of commercial fertilizer

particularly in decreasing the soil fertility and productivity and the ever increasing cost of chemical fertilizers compels one to think of the use of organic manures (Bhardwaj and Gaur, 1985). Organic materials were practically the only external source of nutrients to crops before introduction of inorganic fertilizers. Sustainability in crop yield and soil health could be achieved by applying mineral fertilizers along with organic manures. Organic manures like green manure, pressmud and vermicompost deserves priority for sustained production and better utilization in intensive cropping system. The existing system of fertilizer management in cropping system is based on the nutrient requirement of individual crop ignoring the carry over effect of manure or fertilizer applied to the preceding crop. Indications are also available of saving some fertilizer, if fertilizer management is done for the cropping system as a whole. Residual effect of nutrients may be more pronounced for organic sources of nutrients applied to the preceding crop, benefiting the succeeding crop to a greater extent (Hegde, 1998) and the system productivity becomes sustainable through integrated use of organic and inorganic sources of nutrients (Singh and Yadav, 1992). Therefore, the present investigation was study the residual and direct effect of different sources of nutrients on growth and yield of rice fallow cotton cultivars under tail end area of Cauvery Deltaic Zone of Tamil Nadu (India). This article is mainly deals with cotton crop under rice – cotton cropping system.

Materials and methods

Field experiment was carried out in farmlands of Faculty of Agriculture, Annamalai University to study the residual and direct effect of different sources of nutrients on growth and yield of rice fallow cotton cultivars during January to June 2005. The average annual rainfall of Annamalainagar is 1250 mm, distributed over 51 rainy days. The mean maximum and minimum temperature are 30.8°C and 24.7°C respectively. The soil of the experimental field was having a pH of 7.1 and EC of 0.32 dSm^{-1}. Taxonomically the soil is classified as Udic chromustert, low in available nitrogen (201 kg ha^{-1}), medium in available phosphorus (20.9 kg ha^{-1}) and high in available potassium (277 kg ha^{-1}). The whole research consist of two experiments, first experiment include rice and second experiment with rice fallow cotton. The first experiment (rice) comprised of eight treatments. It was laid out in a randomized block design (RBD) and replicated thrice. In respect of cotton, All the main plots of field experiment I on rice (September 2004 - January 2005) was divided in to three equal sub plots in which rice fallow cotton varieties *viz.*, MCU 7, Anjali and LRA 5166 were raised (January to June 2005).

Treatment details:

Rice (Experiment-I) : T_1 - Control (No fertilizer and no organic manure), T_2 - 100% RDN (Recommended dose of nitrogen), T_3 - T_2 + Green manure @ 6.25 t ha^{-1}, T_4 - 75% RDN + Green manure @ 6.25 t ha^{-1}, T_5 - T_2 + Vermicompost @ 5 t ha^{-1}, T_6 - 75% RDN + Vermicompost @ 5 t ha^{-1}, T_7 - T_2 + Pressmud @ 10 t ha^{-1}, T_8 - 75% RDN + Pressmud @ 10 t ha^{-1}.

Cotton (Experiment- II) : Main plot treatments: Residual effect of INM practices of rice (experiment I) on rice fallow cotton. : T_1 - Control (No fertilizer and no organic manure), T_2 - 100% RDN (Recommended dose of nitrogen), T_3 - T_2 + Green manure @ 6.25 t ha^{-1}, T_4 - 75% RDN + Green manure @ 6.25 t ha^{-1}, T_5 - T_2 + Vermicompost @ 5 t ha^{-1}, T_6 - 75% RDN + Vermicompost @ 5 t ha^{-1}, T_7 - T_2 + Pressmud @ 10 t ha^{-1}, T_8 - 75% RDN + Pressmud @ 10 t ha^{-1}. **Sub plot treatments**: rice fallow cotton varieties *viz.*, MCU 7, Anjali and LRA 5166.

For rice, recommended dose of 150:50:50 kg ha^{-1} of N, P_2O_5 and K_2O was applied. The following organic manures were used in the study ***viz.,*** vermicompost, pressmud and green manure**.** All the organic manures were applied as per treatment schedule basally one week before transplanting of rice.

For cotton, adopting a seed rate of 7.5 kg ha^{-1} (acid delinted) for all cotton varieties. The seeds were dibbled in rice stubbles immediately after harvest of rice. Two seeds hill^{-1} were dibbled at a depth of 3 cm at waxy condition of the soil and adopting a spacing of 60 x 30 cm. Recommended dose of 60:30:30 kg ha^{-1} of N, P_2O_5 and K_2O was uniformly applied to all plots. All other improved recommended package of practices were followed to rice fallow cotton, as per the Crop Production Guide. The following growth attributes was recorded *viz.*, plant height, LAI, DMP and yield parameters like monopodial branches plant^{-1}, sympodial branches plant^{-1}, squares plant^{-1} , number of bolls plant^{-1} and boll weight. Seed cotton yield was recorded plot wise for every picking. The total yield was computed and recoded as quintal ha^{-1}.

Leaf area index

The leaf area index (LAI) was calculated using the following formula as suggested by Iruthayaraj and Sivaraj (1979).

$$LAI = \frac{K(LxW)\,(\text{Number of leaves hill}^{-1})}{\text{Area occupied by the plant}}$$

Where,

K = Adjustment factor (0.7)

L = Leaf length (cm)

W = Leaf width (cm)

The data on various studies recorded during the investigation were subjected to statistical scrutiny as suggested by Gomez and Gomez (1984).

Result and Discussion

Residual and direct effect of organic and inorganic fertilizer on rice fallow cotton cultivars

Growth and yield attributes

Residual effect of INM practices significantly influenced the all growth and yield parameters. Among the treatments, T_5 (residual effect of 100% RDN + vermicompost @ 5 t ha^{-1}) significantly registered higher plant height with 112.72 cm, LAI of 4.39, DMP of 6778 kg ha^{-1} , than other treatments. The same treatment also significantly recorded maximum number of monopodial branches of 2.69 plant^{-1}, sympodial branches of 10.83 plant^{-1}, number of squares plant^{-1} 40.17 , number of bolls 21.84 plant^{-1} and boll weight of 4.20 g . This could be due to effective utilization of nutrients compared to single source. Moreover, organics like vermicompost supplied some micronutrients besides major nutrients, beneficial growth promoting substances that might have helped in enhancing the growth and yield attributes. Similar reports were indicated by Pagaria *et al.* (1995) and Gawai and Pawar.(2005). It was followed by T_4 (100% RDN + green manure @ 6.25 t ha^{-1}).

Among the varieties, V_3 (LRA 5166) recorded significantly higher plant height with 110.67 cm, LAI of 4.21, DMP of 6365 kg ha^{-1}. Similarly, maximum number of monopodial branches with 2.48 plant^{-1}, sympodial branches of 10.18 plant^{-1} , number of squares plant^{-1} 37.73, number of bolls 20.51 plant^{-1} and boll weight of 4.31g was significantly registered under V_3 (LRA 5166). This might be due to genetic makeup of this cotton cultivar and better utilization of all the available nutrients over other varieties. The similar findings were in accordance with Satao *et al*. (1984). It was followed by V_1 (MCU 7). The interaction effect was not significant.

Seed cotton yield

The residual effect INM practices of main plots significantly influenced the seed cotton yield. Among the residual effect of main plots, T_5 (100% RDN + vermicompost @ 5 t ha^{-1}) recorded significantly maximum seed cotton yield of 19.50 q ha^{-1}. This could be due to higher residual nutrient

availability and subsequent better uptake, which might have resulted in higher growth and yield attributes and ultimately reflected on higher yield. Similar results were indicated by Patidar and Mali (2001) and Singh and Ghosh (1999). The next best was T_4 (residual effect of 100% RDN + green manure @ 6.25 t ha^{-1}) and T_8 (residual effect of 100% RDN + pressmud @ 10 t ha^{-1}). The lowest seed cotton yield of 13.60 q ha^{-1} was registered in T_1 (No fertilizer and no organic manure).

In respect of cotton cultivars, V_3 (LRA 5166) recorded significantly maximum seed cotton yield of 18.32 q ha^{-1}. This might be attributed to better foraging ability of LRA 5166 (V_3) to take up nutrients which would have helped in development of higher number of squares $plant^{-1}$, bolls $plant^{-1}$ and boll weight and finally resulted in higher seed cotton yield. These results are in line with the findings of Bavaji *et al.* (1989). It was followed by V_2 (Anjali). The interaction effect between main plots and sub plots was not significant.

Table 1 Residual and direct effect of different sources of nutrients on plant height (at harvest) and leaf area index (at flowering) and DMP (kg ha^{-1}) in cotton

Treatments	Plant height (cm)				LAI (flowering)				Dry matter production (kg ha^{-1})			
	V_1 MCU 7	V_2 Anjali	V_3 LRA5166	Mean	V_1 MCU 7	V_2 Anjali	V_3 LRA5166	Mean	V_1 MCU 7	V_2 Anjali	V_3 LRA5166	Mean
T_1	104.89	101.24	106.56	104.23	3.58	3.79	3.96	3.78	4132	4597	5451	4727
T_2	105.83	102.31	107.54	105.23	3.65	3.85	4.02	3.84	4244	4722	5600	4855
T_3	109.18	105.26	111.13	108.52	3.87	4.03	4.21	4.04	4892	5429	6439	5587
T_4	111.17	107.25	113.23	110.55	4.13	4.25	4.41	4.26	5167	5707	6765	5880
T_5	113.35	109.38	115.42	112.72	4.26	4.39	4.52	4.39	5925	6593	7815	6778
T_6	106.92	103.24	109.32	106.49	3.74	3.92	4.1	3.92	4506	5012	5942	5153
T_7	107.98	104.31	110.03	107.44	3.81	3.97	4.15	3.98	4765	5302	6287	5451
T_8	110.21	106.19	112.16	109.52	3.99	4.16	4.32	4.16	5052	5585	6625	5754
Mean	108.69	104.90	110.67		3.88	4.05	4.21		4836	5368	6365	
	Main	**Sub**	**M at S**	**S at M**	**Main**	**Sub**	**M at S**	**S at M**	**Main**	**Sub**	**M at S**	**S at M**
S.E$_D$.	o.45	0.48	2.02	2.26	0.01	0.04	0.04	0.10	o.45	0.48	2.02	2.26
CD(p=0.05)	0.89	0.96	NS	NS	0.02	0.09	NS	NS	0.89	0.96	NS	NS

Table 2. Residual and direct effect of different sources of nutrients on monopodial branches $plant^{-1}$, sympodial branches $plant^{-1}$ and number of squares $plant^{-1}$ in cotton

Treatments	Monopodial branches $plant^{-1}$				Sympodial branches $plant^{-1}$				Number of squares $plant^{-1}$			
	V_1 MCU 7	V_2 Anjali	V_3 LRA5166	Mean	V_1 MCU 7	V_2 Anjali	V_3 LRA5166	Mean	V_1 MCU 7	V_2 Anjali	V_3 LRA5166	Mean
T_1	1.91	2.08	2.21	2.07	6.61	7.35	8.71	7.56	24.49	27.25	32.31	28.02
T_2	1.95	2.15	2.24	2.11	6.78	7.55	8.95	7.76	25.16	27.99	33.19	28.78
T_3	2.16	2.36	2.47	2.33	7.82	8.68	10.29	8.93	29.00	32.18	38.16	33.11
T_4	2.38	2.57	2.7	2.55	8.26	9.12	10.81	9.40	30.63	33.83	40.10	34.85

T_5	2.56	2.69	2.82	2.69	9.47	10.54	12.49	10.83	35.12	39.08	46.32	40.17
T_6	2.06	2.25	2.36	2.22	7.20	8.01	9.50	8.24	26.71	29.70	35.22	30.54
T_7	2.09	2.31	2.42	2.27	7.62	8.47	10.05	8.71	28.24	31.42	37.26	32.31
T_8	2.28	2.48	2.59	2.45	8.08	8.93	10.59	9.20	29.94	33.11	39.27	34.11
Mean	2.17	2.36	2.48		7.73	8.58	10.18		28.66	31.82	37.73	
	Main	**Sub**	**M at S**	**S at M**	**Main**	**Sub**	**M at S**	**S at M**	**Main**	**Sub**	**M at S**	**S at M**
S.E$_D$.	0.015	0.02	0.07	0.10	0.23	0.26	1.15	1.31	0.47	0.54	2.42	2.79
CD(p=0.05)	0.03	0.04	NS	NS	0.46	0.52	NS	NS	0.94	1.08	NS	NS

Table 3. Residual and direct effect of different sources of nutrients on number of bolls plant^{-1}, boll weight (g) and seed cotton yield (q ha^{-1}) in cotton

Treatments	Number of bolls plant^{-1}				Boll weight (g)				Seed cotton yield (q ha^{-1})			
	V_1 MCU 7	V_2 Anjali	V_3 LRA5166	Mean	V_1 MCU 7	V_2 Anjali	V_3 LRA5166	Mean	V_1 MCU 7	V_2 Anjali	V_3 LRA5166	Mean
T_1	13.32	14.81	17.57	15.23	3.75	4.02	4.2	3.99	11.89	13.23	15.68	13.60
T_2	13.68	15.22	18.05	15.65	3.79	4.05	4.22	4.02	12.21	13.59	16.11	13.97
T_3	15.77	17.50	20.75	18.00	3.85	4.15	4.32	4.11	14.08	15.62	18.53	16.07
T_4	16.65	18.39	21.80	18.95	3.89	4.21	4.38	4.16	14.87	16.42	19.46	16.92
T_5	19.09	21.25	25.18	21.84	3.93	4.24	4.42	4.20	17.05	18.97	22.49	19.50
T_6	14.52	16.15	19.15	16.61	3.8	4.09	4.26	4.05	12.97	14.42	17.10	14.83
T_7	15.36	17.08	20.26	17.57	3.83	4.12	4.29	4.08	13.71	15.25	18.09	15.68
T_8	16.28	18.00	21.35	18.54	3.87	4.17	4.35	4.13	14.54	16.07	19.06	16.56
Mean	15.58	17.30	20.51		3.84	4.13	4.31		13.91	15.45	18.32	
	Main	**Sub**	**M at S**	**S at M**	**Main**	**Sub**	**M at S**	**S at M**	**Main**	**Sub**	**M at S**	**S at M**
S.E$_D$.	0.24	0.27	1.25	1.37	0.005	0.01	0.03	0.04	0.13	0.17	0.68	0.85
CD(p=0.05)	0.48	0.55	NS	NS	0.01	0.02	NS	NS	0.26	0.34	NS	NS

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