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Residual Effect of Fertility Levels and Straw Mulch on Growth and Yield of Rice

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Abstract

A field experiment was carried out during the wet seasons of 2003 and 2004 to find out the residual effect of levels of fertility and straw mulch on growth and yield of rainfed, direct-seeded, upland rice in a rapeseed-greengram-rice system of cropping. The DM accumulation, LAI and CGR showed higher values with the residual fertility treatment having both organic and inorganic sources of nutrient. Residual effect of mulch did not influence the growth attributes significantly; however, it gave rise to higher values of LAI, CGR and higher DM yield. Crop raised with residual effect of mulch recorded higher grain yield irrespective of fertility levels. The increase in yield due to increased number of matured panicles and number of filled grains are attributed to the residual effect of legumes (preceding greengram) and organic mulches.
Key words : Residual effect, Fertility levels, Straw mulch, Yield, Rice.

Adequate soil moisture and optimum soil temperature are essential for successful crop production. Application of mulch materials can fulfill those requirements. Moreover, incorporation of straw materials will result in better soil environment for crop production by supplying a fair quantity of nutrients and by improving the soil physico-chemical properties. It was evident that when straw materials were incorporated in the soil along with the organic manures and fertilizers, the residual effect gave higher yield of rice (1). Ammonium nitrogen content of soil decreased and nitrate nitrogen content increased with an increase in depth of soil profile up to feeding zone of roots under straw incorporation along with animal manure (2). Crops grown with organic mulches during summer add organic matter to soil, increase organic C and N content of soil resulting in increased grain yield of upland, direct-seeded rice under rainfed condition (3). Keeping those aspects in mind the field experiment was designed to study the residual effect of levels of fertility and straw mulch on growth and yield of rainfed, direct-seeded, upland rice in a rapeseed-greengram-rice system of cropping.

Methods

The experiment was conducted at C Block Farm of BCKV, Kalyani during the wet seasons of 2003 and 2004. The experimental soil was sandy loam in texture with a good drainage facility and having pH 7.7, organic C 0.59%, mineralizable N 127.80 kg/ha, available P 9.77 kg/ha and available K 120.83 kg/ha. The rice variety used in this experiment was Rasi (IET 1444).

The experiment was laid out in a split-plot design having 14 treatment combinations in three replicates. Levels of fertility were allotted randomly in seven main plots while treatments related to straw mulch were randomly allocated in two sub-plots. The treatments were as follows. Main plot treatments : T_1—No application of manures and fertilizers, T_2—Recommended dose to all the crops in the sequence, T_3—Recommended dose to all the crops except N in greengram, T_4—Recommended dose to all the crops except K in rapeseed, T_5—Organic manure at 10 t/ha (applied to rapeseed only), T_6—50% of recommended dose to all the crops in the sequence, T_7—Organic manure at 10 t/ha + 50% of recommended dose to all the crops. Sub-plot treatments : M_0—Without application of mulch, M_1—Application of rice straw mulch at 7.0 and 3.5 t/ha to rapeseed and greengram, respectively.

Straw mulch was incorporated in the soil with the help of country plough during land preparation

Table 1. Residual effect of fertility levels and straw mulch on growth attributes of rice. PI—Panicle initiation, F—Flowering, DAF—Days after flowering, M—Maturity, NS—Not significant.

	DM accumulation (g/m²)								LAI							
Treat-	PI		F		15 DAF		M		PI		F		15 DAF		M	
ments	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004
Fertility Levels																
T_1	313.1	271.3	549.9	472.7	565.8	506.5	840.7	763.4	2.01	1.99	5.04	4.80	2.36	2.30	0.88	0.81
T_2	335.1	290.6	615.6	512.3	638.6	550.1	939.7	833.9	2.15	2.09	5.35	5.14	2.60	2.45	1.10	1.10
T_3	330.5	294.6	610.6	514.8	632.2	552.3	933.6	841.5	2.13	2.07	5.31	5.16	2.53	2.46	1.07	1.07
T_4	330.3	288.2	610.1	508.5	631.6	545.7	933.7	833.8	2.13	2.08	5.32	5.19	2.59	2.42	1.07	0.98
T_5	318.2	276.7	563.3	482.2	581.3	516.3	863.2	787.8	2.07	2.03	5.13	4.92	2.46	2.33	0.93	0.84
T_6	325.6	281.8	575.1	492.3	597.6	527.5	893.9	806.0	2.08	2.04	5.02	5.02	2.51	2.33	0.97	0.87
T_7	353.3	308.3	651.2	556.5	675.0	602.7	1001.8	907.0	2.19	2.08	5.50	5.28	2.75	2.63	1.19	1.07
SE (±)	0.63	0.88	2.23	0.80	1.81	0.78	1.93	1.39	0.02	0.01	0.02	0.02	0.04	0.02	0.01	0.01
CD (*P*= 0.05)	1.94	2.70	6.86	2.46	5.57	2.41	5.95	4.30	0.07	0.03	0.07	0.05	0.14	0.05	0.02	0.02
Mulch																
M_0	319.2	278.7	574.5	484.4	594.1	520.3	876.9	791.9	2.09	2.02	5.19	5.01	2.47	2.36	0.99	0.88
M_1	339.7	296.0	618.6	526.8	640.8	565.7	953.5	857.6	2.13	2.09	5.35	5.14	2.62	2.48	1.06	0.98
SE (±)	10.55	7.90	18.71	19.14	13.99	15.04	28.44	23.73	0.06	0.06	0.17	0.14	0.07	0.07	0.03	0.03
CD (*P*= 0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.09

Table 1. Continued.

	CGR (g / m² / day)					
	PI—F		F—15 DAF		15 DAF-M	
Treatments	2003	2004	2003	2004	2003	2004
Fertility Levels						
T_1	10.30	9.16	1.06	2.26	18.38	17.13
T_2	12.20	10.08	1.46	2.52	20.08	18.93
T_3	12.18	10.08	1.44	2.49	20.09	19.28
T_4	12.17	10.02	1.44	2.48	20.15	19.21
T_5	10.51	9.34	1.20	2.28	18.80	18.10
T_6	10.96	9.57	1.30	2.35	19.79	18.56
T_7	12.96	11.28	1.59	3.08	21.79	20.28
SE (±)	0.06	0.02	0.01	0.02	0.07	0.06
CD (*P*=0.05)	0.19	0.07	0.04	0.05	0.20	0.20
Mulch						
M_0	11.06	9.37	1.29	2.39	18.88	18.11
M_1	12.15	10.49	1.43	2.60	20.85	19.46
SE (±)	0.30	0.28	0.06	0.07	0.66	0.58
CD (*P*=0.05)	0.86	NS	NS	NS	NS	NS

of the subsequent crop. Fertilizers were applied as per recommendation. The data on various growth attributes and yield parameters were recorded accordingly.

Results and Discussion

Due to residual effect of different fertility treatments DM accumulation at PI, flowering, 15 days af-

Table 2. Residual effect of fertility levels and straw mulch on yield attributes and grain yield of rice. NS—Not significant.

Treatments	No. of matured panicles/m^2		No. of filled grains/panicle		Test weight (g)		Grain yield (t/ha)	
	2003	2004	2003	2004	2003	2004	2003	2004
Fertility Levels								
T_1	199.17	196.83	60.44	62.08	20.67	20.22	1.905	1.798
T_2	237.67	234.83	69.12	69.18	20.97	20.89	2.738	2.563
T_3	233.33	236.17	69.23	69.46	20.89	21.09	2.720	2.632
T_4	232.83	228.16	68.92	69.93	20.99	21.03	2.708	2.492
T_5	203.17	195.50	64.71	62.26	20.84	20.62	1.967	1.932
T_6	213.33	206.33	66.17	66.50	20.91	20.93	2.197	2.303
T_7	253.83	249.33	73.83	76.02	21.82	21.77	2.977	2.953
SE (±)	2.51	2.47	0.84	0.80	0.21	0.23	0.012	0.009
CD (P=0.05)	7.70	7.61	2.59	2.46	0.66	0.72	0.037	0.028
Mulch								
M_0	217.95	214.33	65.66	65.19	20.52	20.46	2.357	2.332
M_1	231.57	228.00	69.55	70.64	21.51	21.41	2.560	2.449
SE (±)	6.55	6.23	1.90	1.83	0.60	0.61	0.067	0.068
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS

ter flowering (DAF) and at maturity were found to differ significantly during both the years of study. The highest accumulation of DM was recorded at maturity stage irrespective of fertility levels (1001.8 and 907.0 g/m^2 during 2003 and 2004, respectively). At all the stages, the residual fertility treatments having both organic and inorganic sources of nutrient recorded higher DM yield as compared to the residual effect of other fertility treatments. Appreciable rise in DM accumulation during PI to flowering followed by marginal increase during flowering to 15 DAF and again a sharp rise in the value up to maturity reflected the trend of crop growth rate (CGR). The highest LAI, ranging between 5.04 to 5.50 and 4.80 to 5.80, was recorded at flowering stage irrespective of fertility levels during 2003 and 2004, respectively. Again, residual effect in T_7 treatment recorded significantly higher LAI and CGR as compared to the other fertility levels (Table 1). Higher availability of nutrients might be the reason for these increased values of growth parameters. The results are corroborated with the findings of Brar et al. (4) and Sharma et al. (5).

The residual effect due to mulching did not produce any significant effect on DM accumulation, CGR and LAI of rice at all the four stages of observations. However, residual effect of mulch gave rise to the higher values as compared to no mulch treatment. This was probably because the winter and summer crops grown with organic mulches improved the physico-chemical properties of the soil resulting in increased growth (Table 1).

Grain yield increased significantly due to residual fertility treatments during both the years. The supply of nutrients through inorganic sources and residual effect of FYM applied to preceding *rabi* crop resulted in higher nutrient availability for which there was an appreciable increase in number of matured panicles per unit area, number of filled grain per panicle, test weight and ultimately the grain yield (Table 2). This was in conformity with the findings of Rajput and Warsi (6) and Brar et al. (4). Preceding legume (greengram) might have a complementary role towards supplying nitrogen to the crop.

Crops raised with residual effect of mulch yielded higher amount of grain (2.560 and 2.449 t/ha during 2003 and 2004, respectively) as compared to residual effect of no-mulch treatment although the differences were not statistically significant. The increase in grain yield through the increase in yield components can be attributed to the residual effect of legumes and organic mulches improving physico-chemical properties of the soil (Table 2).

It was found that the interaction between fertility levels and mulch towards growth attributes, yield components and grain yield were not found to be statistically significant during both the years of

study.

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