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RESEARCH ARTICLE

Residual Effect of Organic Manures on Growth and Yield of Black Gram in Rice Blackgram Sequence

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ABSTRACT

A field experiment was conducted to study the residual effect of organic manures on black gram crop in a rice-blackgram cropping sequence during summer seasons of 2017 and 2018 at Thoppur, Thirupparankundram, Madurai. Twelve treatments comprising various sources of nutrients in a randomized block design with three replication laid out for rice was used to study the residual effect by growing blackgram in sequence and replicated thrice. Basal Incorporation of green manure @ 6.25 t ha^{-1} along with split application of vermicompost in four equal splits @ 4 t ha^{-1} as basal, at active tillering, panicle initiation and flowering stages + panchagavya @ 3 per cent per cent as foliar spray twice at active tillering and panicle initiation stages recorded the highest plant height, leaf area, dry matter production and grain yield. Increase in grain yield of 42.8 and 47.7 % was observed respectively during summer 2017 and summer 2018 over absolute control due to the residual effect of incorporation of green manure @ 6.25 t ha^{-1} + split application of vermicompost @ 4 t ha^{-1} in four equal splits for rice along with Panchagavya @3 per cent as foliar application during active tillering and panicle initiation stages.

Keywords: *Organic Manures, Green manure, Rice-blackgram, Residual effect, Yield.*

INTRODUCTION

Organic farming is a holistic approach of crop production with an aim of conserving the natural resources through the agronomic practices and the use of locally available inputs so as to maintain soil fertility and conserve the bio-diversity. Organic nutrition is a remedy to manage the ill effects of inorganic farming and to manage soil health for sustaining soil productivity and produce quality output. Increase in productivity of crops or produce quality or even both can be achieved by an optimum and balanced supply of nutrients through organic sources to meet the requirement of crops. In addition to primary nutrients, organic manures are also a potential source of micro nutrients, as a result, it provides a favourable soil environment to produce crops of high nutritional quality in sufficient quantity. Organic manures also protect the long term fertility of the soil by maintaining soil organic matter level and enhancing the soil biological activity (Ladha *et al*., 2009).

Black gram (*Vigna mungo* L.) is one of the most ancient crops among cultivated pulses. It is a multipurpose crop grown for pulse and forage purposes. It is one of the major sources of protein (21%) in southern states of India and mostly confined to the peninsular region. Tamil Nadu records production of 1.21 lakh tonnes from an area of 1.89 lakh hectares which accounts for nearly 7.63 and 5.48 per cent in terms of both area and production in the country, respectively during the year 2016-2017. Rice-blackgram cropping sequence is common in some of the areas in Tamil Nadu state and growing the rice crop organically is expected to enhance the yield and quality of succeeding blackgram. Keeping these points in view, a field experiment was conducted to study the residual effect of organic manures on blackgram crop in a rice-black gram cropping sequence.

Methodology

Field experiments were conducted at farmer's holding at Thoppur village, Thirupparankundram block of Madurai district during summer seasons of 2017 and 2018. The geographical location of the field has the reference to 9.9°N latitude and 78°E longitude at an altitude of 101 m above MSL. The soil was clay loam, slightly alkaline (pH 8.1), low in available nitrogen (262 kg ha^{-1}), medium in available P_2O_5 (18.2 kg ha^{-1}) and high in available K_2O (576 kg ha^{-1}) and medium in organic matter content (0.62%). The experiment was laid out in randomized complete block design with three replications. A total of twelve

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treatments which include eleven organic manure combinations and one with blanket recommendation (ie. inorganic fertiliser) namely T_1 : Green manure @ 6.25 t ha^{-1} + neem cake@250 kg ha^{-1},T_2:Enriched FYM (EFYM) @1.0 t ha^{-1},T_3: Green manure @ 6.25 t ha^{-1}+ tamarind seed powder @ 100kg ha^{-1} + neem cake @ 250 kg ha^{-1},T_4: EFYM @ 1.0 t ha^{-1} + tamarind seed powder @ 100 kg ha^{-1}+ neem cake @ 250 kg ha^{-1},T_5: Split application of vermicompost @ 4 t ha^{-1}(as basal, AT, PI and F)+neem cake @ 250 kg ha^{-1},T_6 : T_3 + Panchagavya@ 3 per cent as foliar spray twice at (PI & F),T_7 : T_4 + Panchagavya@ 3 per cent as foliar spray twice (PI & F),T_8 :T_5 + Panchagavya@ 3 per cent as foliar spray twice (PI & F),T_9 : Green manure @ 6.25t ha^{-1}+ split application of vermicompost in four equal splits @ 4 t ha^{-1} (as basal, AT, PI & F) +Panchagavya@ 3 per cent as foliar spray twice at AT& PI,T_{10}:Organic farmers practice (Multi varietal seed technique +herbal pest repellant spray,T_{11}: Absolute Control (FYM 12.5 t ha^{-1}) and T_{12}: Control – State recommendation (FYM @ 12.5 t ha^{-1}+ Recommended NPK).The crops were raised under the irrigated condition with the recommended package of practices. The treatments were imposed only to rice crop and rice fallow blackgram was raised as a residual crop.

After the harvest of rice, the residual crop of black gram was sown in the same plots by adopting a seed rate of 25 kg ha^{-1} and a spacing of 30 x 10 cm. The blackgram variety VBN 6 was used in summer 2017 and 2018.

Biometric observations were recorded as per the guidelines stipulated by the All India Co-ordinated Rice Improvement Project (Haveten, 1977). Five plants in each plot were selected at random and labeled for recording observations in all the three replications. Growth parameters were recorded at harvest. Yield and yield attributes were recorded as per standard methods. Soil analysis was carried out before and after growing of blackgram crop.

RESULTS AND DISCUSSION

The residual effect of green manure (*Tephrosia purpurea*) @ 6.25 t ha^{-1} + split application of vermicompost into four equal splits @ 4 t ha^{-1} as basal, at active tillering, panicle initiation and flowering stages + Panchagavya @ 3 per cent as foliar spray twice at active tillering and panicle initiation applied to precede rice was noticed on growth components *viz*., plant height (48.9 cm, 46.1cm and number of nodules per plant (47.2 and 47.5) at maturity. All these values were higher in this treatment during the years 2017 and 2018 summer seasons. However, it was on par with state-level recommendation (Recommended NPK+ FYM @ 12.5 t ha^{-1}) The lower values of plant height (39.3 and 40.2 cm) and a number of nodules (28.5 and 26.2) were observed in untreated control during the years 2017 summer and 2018 summer , respectively. Significantly higher leaf area (656 cm^2 $plant^{-1}$ and 602 cm^2 $plant^{-1}$) and leaf area index (2.19 and 2.01) during summer 2017 and 2018, respectively were recorded due to the incorporation of green manure @ 6.25 t ha^{-1} + split application of vermicompost @ 4 t ha^{-1} as basal, at active tillering, panicle initiation and flowering stages + Panchagavya 3 per cent as foliar spray twice at active tillering and panicle initiation stages of rice (Table 1).

Table 1.Residual effect of organic manures on growth attributes of blackgram at maturity stage (Summer 2017 and 2018)

Treatments	Number of nodules		Leaf area		LAI		DMP	
	2017	2018	2017	2018	2017	2018	2017	2018
T_1	38.3	39.8	578	530	1.93	1.77	2281	2098
T_2	36.9	36.5	436	399	1.45	1.33	1946	1837
T_3	38.9	41.8	579	530	1.93	1.77	2435	2238
T_4	36.9	37.2	514	471	1.71	1.57	2081	1909
T_5	37.9	39.5	534	518	1.78	1.73	2135	2014
T_6	42.1	41.8	614	551	2.05	1.84	2589	2337
T_7	37.0	38.2	525	486	1.75	1.62	2111	1940
T_8	37.6	38.2	530	489	1.77	1.63	2121	1964
T_9	47.2	47.5	656	602	2.19	2.01	3267	2679
T_{10}	36.6	35.5	435	398	1.45	1.33	1757	1626
T_{11}	28.5	26.2	378	346	1.26	1.15	1516	1405
T_{12}	46.9	46.2	621	592	2.07	1.97	3068	2947
SEd	2.0	2.4	30	22	0.10	0.07	87	107
CD (P=0.05)	4.2	4.9	63	45	0.21	0.15	180	222

The superiority of green manure and vermi compost in improving the growth characters of black gram crop after a rice crop was observed in the present study. The growth characters of summer grown black gram showed a similar trend as that of *samba* rice which survived entirely on residual moisture and fertility left over by the preceding crop of rice. This would have also been due to the better residue addition in rice-based cropping system. Similar observations have been made by Rajarathinam (2002). The treatment that received

green manure @ 6.25 t ha^{-1} + split application of vermicompost in four equal splits @ 4 t ha^{-1} as basal, at active tillering , panicle initiation and flowering stages + Panchagavya 3 per cent as foliar spray twice at active tillering and panicle initiation stages has recorded significantly higher DMP of 3267 kg ha-1 during 2017 and the treatment that received fertilizers as per state recommendation + FYM @ 12.5 t ha^{-1} 2947 kg ha^{-1} registered higher DMP of 2947 kg ha^{-1} during 2018 (Table 1). De Britto and Girija (2006) reported that organic treatments produced higher growth in terms of plant height, DMP, leaf area and a number of branches in blackgram when compared to inorganic treatments.

Table 2. Residual effect of organic manures on yield attributes and yield of blackgram at maturity stage (Summer 2017 and 2018)

Treatments	Number of pods per plant		Pod length (cm)		Number of seeds per pod		100 seed weight (g)		Seed yield (kg ha^{-1})		Haulm yield (kg ha^{-1})	
	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
T_1	41	43	5.3	5.6	5.4	5.3	3.40	3.67	553	520	2266	1985
T_2	33	35	4.8	5.1	4.6	4.7	3.26	3.50	395	368	1779	1558
T_3	44	46	5.4	5.5	5.6	5.7	3.53	3.70	611	577	2365	2081
T_4	33	36	4.8	5.1	4.7	4.7	3.33	3.57	425	395	1859	1628
T_5	37	40	4.9	5.4	5.1	5.0	3.43	3.63	531	502	2199	1926
T_6	43	45	5.4	5.7	5.7	5.7	3.49	3.67	580	558	2333	2274
T_7	33	36	4.8	5.1	4.9	4.7	3.30	3.57	395	423	1960	1716
T_8	36	39	4.9	5.2	4.9	5.0	3.33	3.57	517	502	2154	1886
T_9	50	52	5.5	5.7	5.9	6.0	3.74	3.77	653	625	2617	2553
T_{10}	30	32	4.8	4.9	4.5	4.3	3.24	3.47	360	331	1668	1461
T_{11}	29	30	4.8	4.9	4.4	4.3	3.01	3.43	318	293	1512	1324
T_{12}	45	48	5.4	5.7	5.8	6.0	3.53	3.70	647	618	2596	2545
SEd	2.5	2.5	0.09	0.22	0.32	0.55	0.28	0.11	19	21	115	127
CD (P=0.05)	5.1	5.1	0.19	0.46	0.67	1.14	NS	NS	40	43	239	263

Increased values of growth components of residual black gram might be due to the nutrient reserves in the soil through the application of green manure @ 6.25 t ha^{-1} as basal and split application of vermicompost in four equal splits @ 4 t ha^{-1} (as basal, at active tillering, panicle initiation and flowering stages) along with Panchagavya 3 per cent as foliar spray(both at active tillering and panicle initiation stages) for the preceding rice crop, consequent to the improvement in soil fertility and soil health properties which led to effective nodulation and nutrient availability that resulted in better growth attributes of black gram. These results corroborate the findings of Sankaramoorthy *et al*. (2017).

During summer 2017 and 2018, the residual effect of green manure @ 6.25 t ha^{-1} + split application of vermicompost into four equal splits @ 4 t ha^{-1} (as basal, at active tillering, panicle initiation and flowering stages) + Panchagavya 3 per cent as foliar spray twice (at active tillering and panicle initiation stages) was witnessed through the enhancement in blackgram yield attributes *viz*., number of pods $plant^{-1}$ (50 and 52), pod length (5.5 cm and 5.7 cm)and number of seeds pod^{-1} (5.9 and 6.0) during both the years 2017 and 2018 respectively. The increase in a number of pods, pod length and test weight under green manure and vermicompost applied plots along with Panchagavya as foliar spray might be the residual effect of organic manures applied to precede rice crop, that might have increased the availability of nutrients throughout the growth period resulting in better assimilation of nutrients by blackgram.

Grain yield of blackgram was higher at 653 kg ha^{-1} and 625kg ha^{-1} during summer 2017 and 2018 respectively in the plots due to the residual effect of green manure @ 6.25 t ha^{-1} + split application of vermicompost in four equal splits @ 4 t ha^{-1} as basal, at active tillering, panicle initiation and flowering stages + Panchagavya 3 per cent as foliar spray twice at active tillering and panicle initiation stages and was statistically comparable with state recommendation (FYM @ 12.5 t ha^{-1} + recommended dose of NPK as fertilizers) i.e., 647 kg ha^{-1}in summer 2017 and 618 kg ha^{-1} in summer 2018. Absolute control recorded significantly lower grain yield of 318 and 293kg ha^{-1} in summer 2017 and 2018, respectively and was on par with organic farmers practice – (Multi varietal seed technique + herbal pest repellant spray) during 2018. Seed yield of summer black gram, contributed by a number of pods and pod size, is greatly influenced by organic manure application (Table 2). Significant yield improvement was observed due to the cumulative effect of organic manures and other inputs applied

to precede rice crop. Sangeetha (2009) reported that organic manure incorporation had shown the residual effect on the growth parameters, yield attributes and yield in rice fallow black gram. The residual effect was more pronounced with enriched and composted poultry manure than the recommended dose of NPK through fertilizers.

The result on yield (seed and haulm) of black gram once again proved the superiority of incorporation of green manure @ 6.25 t ha^{-1} + split application of vermicompost into four equal splits @ 4 t ha^{-1}(as basal, at active tillering, panicle initiation and flowering stages) along with Panchagavya @ 3 per cent as foliar spray (twice at active tillering and panicle initiation stages) to preceding rice which increased the seed yield by 42.8 and 47.7 percent during summer 2017 and 2018 respectively over absolute control and haulm yield by 40.7 per cent and 41.2 per cent during summer 2017 and 2018 respectively over absolute control (Table 2). This was due to the slow decomposition of organic manures, which probably might have released the nutrients slowly to the benefit of succeeding blackgram under the study. The maximum influence on seed and haulm yield of blackgram might be attributed to the increased yield attributes due to a concomitant increase in dry matter accumulation (Kumpawat *et al.*2009). Haulms yield was also maximum (2617 kg ha^{-1} and 2553 kg ha^{-1} respectively in summer 2017 and 2018) due to the residual effect of green manure as the basal and split application of vermicompost along with Panchagavya as a foliar spray to the preceding rice crop. Significantly least haulm yield (1512 and 1324 kg ha^{-1} during summer 2017 and 2018, respectively) was recorded under absolute control.

Table 3. Effect of organic manures on soil available nutrients (kg ha^{-1}) in rice-blackgram cropping sequence (2017 - 2018)

Treatments	Available N (kg ha^{-1})		Available P_2O_5 (kg ha^{-1})		Available K_2O (kg ha^{-1})	
	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18
T_1	340	330	21.2	29.6	274	282
T_2	324	308	19.0	22.1	224	233
T_3	342	332	22.9	30.4	290	295
T_4	327	319	19.8	25.4	236	251
T_5	336	325	21.4	26.5	271	278
T_6	344	335	27.9	31.9	292	308
T_7	329	318	20.5	23.1	260	262
T_8	332	320	20.7	23.7	262	268
T_9	348	342	30.9	35.6	315	304
T_{10}	325	310	18.6	17.1	219	216
T_{11}	292	279	15.8	16.1	192	198
T_{12}	346	339	29.5	32.3	281	290
SEd	14	12	2.1	2.6	23	25
CD (P=0.05)	28	25	4.4	5.3	48	52
Initial	306	311	26.0	24.0	287	286

With respect to available soil nutrients, residual effect of green manure @ 6.25 t ha^{-1} + split application of vermicompost into four equal splits @ 4 t ha^{-1} as basal, at active tillering, panicle initiation and flowering stages + Panchagavya 3 percent as foliar spray twice at active tillering and panicle initiation stages had registered higher values of available N, P and K nutrients (Table 3).

Improvement in the soil available N, P and lower decline in K at the end of two-year cropping sequence was observed by Sangeetha (2009) with the application of enriched poultry manure compost and composted poultry manure.

CONCLUSION

Thus, the basal incorporation of green manure @ 6.25t ha^{-1} along with vermicompost in four equal splits @ 4 t ha^{-1} as basal, at active tillering , panicle initiation and flowering stages + Panchagavya 3 per cent as foliar spray twice at active tillering and panicle initiation stages to proceeding rice crop has established a significant residual effect on blackgram growth and seed yield besides maintaining soil available nutrients and observed to be an effective nutrient management package for rice- blackgram sequence.

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