

RESIDUAL EFFECT OF ORGANIC MANURES ON RICE FALLOW SUMMERBLACKGRAM (*VIGNA MUNGO* L.)

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Abstract

Field experiments were undertaken to ascertain 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 (green manure, neem cake, enriched FYM, Panchagavya, tamarind seed powder) in a randomized block design with three replications laid out for rice were used to study the residual effect by growing blackgram in sequence. Basal incorporation of green manure @ 6.25 t/ha along with split application of vermicompost in four equal splits @ 4 t/ha 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 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 same treatment.

Introduction

Organic farming is a holistic approach to crop production that aims to protect natural resources through agronomic practices and the use of locally accessible inputs in order to preserve soil fertility and biodiversity. Organic manuring is a way to counteract the negative impacts of inorganic farming while still maintaining soil health and producing high-quality output. Increased crop productivity or product quality, or possibly both, can be obtained by providing crops with an optimal and balanced supply of nutrients from organic sources. Organic manures, in addition to primary nutrients, are a potential supply of micronutrients, resulting in a favourable soil environment for the production of high nutritional quality crops in sufficient quantities. Organic manures also help to sustain soil fertility over time by increasing soil biological activity and preserving soil organic matter levels (Ladha *et al.* 2009).

Black gram (*Vignamungo* L.) is a multifunctional crop that can be used as a pulse or fodder. It is one of the most important protein sources (21%) in India's southern states. Tamil Nadu records a 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 (Indiastat, 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.

Materials and Methods

Field experiments were conducted at farmer's field at Thoppur village, Thirupparankundram block of Madurai district, Tamil Nadu, India during summer seasons of 2017 and 2018. The

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geographical location is 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), medium in available P₂O₅ (18.2 kg/ha) and high in available K₂O (576 kg/ha) 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 treatments which include eleven organic manure combinations and one with state recommendation (ie. inorganic fertiliser) namely T₁ : Green manure @ 6.25 t/ha + neem cake @ 250 kg/ha, T₂: Enriched FYM (EFYM) @ 1.0 t/ha, T₃: Green manure @ 6.25 t ha⁻¹ + tamarind seed powder @ 100 kg/ha + neem cake @ 250 kg/ha, T₄: EFYM @ 1.0 t/ha + tamarind seed powder @ 100 kg/ha + neem cake @ 250 kg/ha, T₅: Split application of vermicompost @ 4 t/ha (as basal, AT, PI and F) + neem cake @ 250 kg/ha, T₆: T₃ + Panchagavya @ 3 per cent as foliar spray twice at (PI & F), T₇ : T₄ + Panchagavya @ 3 per cent as foliar spray twice (PI & F), T₈ : T₅ + Panchagavya @ 3 per cent as foliar spray twice (PI & F), T₉ : Green manure @ 6.25 t/ha + split application of vermicompost in four equal splits @ 4 t/ha (as basal, AT, PI & F) + Panchagavya @ 3 per cent as foliar spray twice at AT & PI, T₁₀: Organic farmers practice (Multi varietal seed technique + herbal pest repellent spray @ 10%), T₁₁: Absolute Control (FYM 12.5 t/ha) and T₁₂: Control – State recommendation (FYM @ 12.5 t/ha + Recommended NPK). The crops were raised under irrigated condition with recommended package of practices. The treatments were imposed only to rice crop and rice fallow blackgram was raised as residual crop. After harvest of rice, the residual crop of black gram (VBN 6) was sown in the same plots by adopting a seed rate of 25 kg/ha and a spacing of 30 x 10 cm.

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.

Results and Discussion

The residual effects of organic manure treatments in enhancing the growth components of blackgram were superior when compared to that of absolute control in both the years of study (Table 1). The residual effect of T₉ on growth components *viz.*, plant height (48.9 cm in 2017 and 46.1 cm in 2018) and number of nodules per plant (47.2 in 2017 and 47.5 in 2018) at maturity was higher and which was however comparable with T₁₂ (State recommendation) on growth components *viz.* plant height (46.6 & 49.6 cm during 2017 & 2018 respectively), number of nodules (46.9 and 46.2 in both years, respectively). The lower values of plant height (39.3 cm in 2017 and 40.2 cm in 2018) and number of nodules (28.5 and 26.2) were observed in T₁₁ (Absolute control), however plant height was at par with T₂, T₄, T₅, T₇, T₈ and T₁₀ treatments during both the years of study.

The data on leaf area and leaf area index have shown the significant residual effect of organic manures on succeeding blackgram after rice crop. Significantly higher leaf area (656 cm²/plant and 602 cm²/plant during 2017 and 2018, respectively) and leaf area index i.e. 2.19 and 2.01 was recorded in T₉ and it was at par with T₆ and T₁₂ treatments during 2018. Significantly lower leaf area (378 and 346 cm²/plant) and leaf area index (1.26 and 1.15) was noticed under T₁₁ (Absolute control) which was comparable with T₂ and T₁₀ during 2017.

Perusal of the data on dry matter production showed that the same treatment (T₉) was significantly higher (3267 kg/ha) during 2017 and 2947 kg/ha of DMP was registered in T₁₂ (State recommendation) during 2018. Significant lower values (1516 and 1405 kg/ha) were observed in absolute Control (T₁₁) in both the years which were comparable with T₁₀ during 2018.

The superiority of green manure and vermicompost in improving the growth characters of blackgram crop after a rice crop was observed in the present study.

The growth characters of summer grown blackgram 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). Increased growth components of residual blackgram was due to the residues left behind by the application of green manure vermicompost. T₉ and also might have had an improvement in soil physical, chemical and biological properties, which led to better uptake of nutrients and crop growth. De Britto and Girija (2006) reported that organic treatments produced higher growth in terms of plant height, DMP, leaf area and number of branches in blackgram when compared to inorganic treatments.

Increased values of nodules of residual black gram might be due to the nutrient reserves in the soil due to the treatment T₉ 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.

Data on days to 50 per cent flowering was significantly influenced by the residual effect of organic manures (Table 2). The days taken to 50 per cent flowering reached six days early (32.2 and 32.9) in T₉ over absolute control (38.5 and 38.9) and it was at par with T₁₂. During 2017 and 2018, the residual effect of T₉ improved the yield attributes viz., number of pods plant⁻¹ (50 in 2017 and 52 in 2018), pod length (5.5 cm in 2017 and 5.7 cm in 2018) and number of seeds pod⁻¹ (5.9 in 2017 and 6.0 in 2018) which was at par with T₁₂ for number of pods and T₁, T₃, T₆, T₅ and T₈ (for pod length and number of seeds/pod) during both the years. However, numerically higher 100 seed weight was noticed in T₉ (3.74 and 3.77 in both years, respectively) and which was not significantly varied due to the residual effect of organic manures.

The increase in number of pods, pod length and test weight number in T₉ is due to residual effect of organic manures have increased the availability of nutrients throughout the growth period and higher-end in nitrogen fixation and their assimilation could have improved leaf source (by photosynthetic rate, chlorophyll and dry matter) and also by enhancing nitrogen uptake primarily.

The lower yield attributes were registered in absolute control (T₁₁) which was comparable with T₂, T₄, T₅, T₇, T₈ and T₁₀ treatments. The 100 seed weight also lower under during both the years.

Grain yield was higher (653 kg/ha and 625 kg/ha during summer 2017 and 2018, respectively) in the residual effect of T₉ and which was statistically comparable with T₁₂. This was followed by T₃. Absolute control (T₁₁) recorded significantly lower grain yield of 318 and 293 kg/hain 2017 and 2018, respectively, and it was at par with T₁₀ during 2018.

Haulms yield was maximum (2617 kg/hain 2017 and 2553 kg/hain 2018) due to the residual effect of treatment T₉ whereas, it was at par with T₁₂ during both the years. These were followed by the T₃ during 2017; T₃ and T₆ (being at par with each other) during 2018. Significantly least haulm yield (1512 and 1324 kg/ha during summer 2008 and 2009, respectively) was recorded under absolute control (T₁₁) which was at par with T₁₀ during 2017; T₂ and T₁₀ (being at par with each other) during 2018. Seed yield of summer blackgram, contributed by number of pods and pod size, is greatly influenced by organic manure application. Detectable yield improvement was observed due to the incorporation of organic manures could be documented to the cumulative effect of organics in improving the yield appreciably. This is in accordance with Akbari *et al.* (2011).

The result in yield (seed and haulm) of blackgram once again proved the superiority of the same treatment (T₉) which increased grain yield by 51.3 per cent during 2017 and 53.1 per cent in 2018 over absolute control (T₁₁) and haulm yield by 42.2 per cent during 2017 and 48.1 per cent

Table 1. Residual effect of organic manures on growth parameters of blackgram at maturity stage.

Treatments	Plant height (cm)		Number of nodules		Leaf area (cm ²)		LAI		DMP (kg/ha)	
	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
T ₁	43.6	43.7	38.3	39.8	578	530	1.93	1.77	2281	2098
T ₂	40.2	40.5	36.9	36.5	436	399	1.45	1.33	1946	1837
T ₃	43.5	44.8	38.9	41.8	579	530	1.93	1.77	2435	2238
T ₄	40.4	40.8	36.9	37.2	514	471	1.71	1.57	2081	1909
T ₅	42.2	42.4	37.9	39.5	534	518	1.78	1.73	2135	2014
T ₆	44.3	45.0	42.1	41.8	614	551	2.05	1.84	2589	2337
T ₇	40.5	41.1	37.0	38.2	525	486	1.75	1.62	2111	1940
T ₈	41.7	42.4	37.6	38.2	530	489	1.77	1.63	2121	1964
T ₉	48.9	46.1	47.2	47.5	656	602	2.19	2.01	3267	2679
T ₁₀	39.7	40.3	36.6	35.5	435	398	1.45	1.33	1757	1626
T ₁₁	39.3	40.2	28.5	26.2	378	346	1.26	1.15	1516	1405
T ₁₂	46.6	49.6	46.9	46.2	621	592	2.07	1.97	3068	2947
SEd	1.33	1.57	2.04	2.36	30	22	0.10	0.07	87	107
CD (P=0.05)	2.77	3.25	4.22	4.89	63	45	0.21	0.15	180	222

Table 2. Residual effect of organic manures on yield attributes of blackgram (Summer 2018).

Treatments	Days to 50% flowering		Number of pods per plant		Pod length (cm)		Number of seeds per pod		100 seed weight (g)	
	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
T ₁	32.9	33.9	41	43	5.3	5.6	5.4	5.3	3.40	3.67
T ₂	34.6	34.9	33	35	4.8	5.1	4.6	4.7	3.26	3.50
T ₃	32.6	33.5	44	46	5.4	5.5	5.6	5.7	3.53	3.70
T ₄	34.5	34.9	33	36	4.8	5.1	4.7	4.7	3.33	3.57
T ₅	34	34.5	37	40	4.9	5.4	5.1	5.0	3.43	3.63
T ₆	32.5	33.2	43	45	5.4	5.7	5.7	5.7	3.49	3.67
T ₇	34.5	34.9	33	36	4.8	5.1	4.9	4.7	3.30	3.57
T ₈	34.3	34.5	36	39	4.9	5.2	4.9	5.0	3.33	3.57
T ₉	32.2	32.9	50	52	5.5	5.7	5.9	6.0	3.74	3.77
T ₁₀	37.7	38.5	30	32	4.8	4.9	4.5	4.3	3.24	3.47
T ₁₁	38.5	38.9	29	30	4.8	4.9	4.4	4.3	3.01	3.43
T ₁₂	32.4	33.2	45	48	5.4	5.7	5.8	6.0	3.53	3.70
SEd	0.68	0.85	2.5	2.5	0.09	0.22	0.32	0.55	0.28	0.11
CD (P=0.05)	1.41	1.76	5.1	5.1	0.19	0.46	0.67	1.14	NS	NS

Table 3. Residual effect of organic manures on seed, haulm yield and per day crop productivity (kg/ha) of blackgram (Summer 2017 and 2018).

Treatments	Seed yield (kg/ha)		Haulm yield (kg/ha)		Per day crop productivity (kg/ha)	
	2017	2018	2017	2018	2017	2018
T ₁ : Green manure @ 6.25 t/ha + neem cake @250 kg/ha	553	520	2266	1985	7.9	7.1
T ₂ : Enriched FYM (EFYM) (E @ 1.0 t/ha	395	368	1779	1558	5.6	5.0
T ₃ : Green manure @ 6.25 t/ha + tamarind seed powder @ 100 kg/ha + neem cake @ 250 kg/ha	611	577	2365	2081	8.7	7.9
T ₄ : EFYM @ 1.0 t/ha + tamarind seed powder @ 100 kg/ha + neem cake @ 250 kg/ha	425	395	1859	1628	6.1	5.4
T ₅ : Split application of vermicompost @ 4 t ha ⁻¹ (as basal, AT, PI & F) + neem cake @ 250 kg/ha	531	502	2199	1926	7.6	6.9
T ₆ : T ₃ + Panchagavya @ 3% as foliar spray twice at (PI & F)	580	558	2333	2274	8.3	7.6
T ₇ : T ₄ + Panchagavya @ 3% as foliar spray twice (PI & F)	395	423	1960	1716	5.6	5.8
T ₈ : T ₅ + Panchagavya @ 3% as foliar spray twice (PI & F)	517	502	2154	1886	7.4	6.9
T ₉ : Green manure @ 6.25 t/ha + split application of vermicompost in four equal splits @ 4 t/ha (as basal, AT, PI & F) + Panchagavya @ 3% as foliar spray twice at AT & PI	653	625	2617	2553	9.3	8.6
T ₁₀ : Organic farmers practice (Multi varietal seed technique + herbal pest repellent spray	360	331	1668	1461	5.1	4.5
T ₁₁ : Absolute Control (FYM 12.5 t/ha)	318	293	1512	1324	4.5	4.0
T ₁₂ : Control – State recommendation (FYM @ 12.5 t/ha + recommended NPK as fertilizers)	647	618	2596	2545	9.2	8.5
SED	19	21	115	127	0.29	0.28
CD (P=0.05)	40	43	239	263	0.61	0.59

*AT- Active Tillering, PI- Panicle Initiation; F- Flowering

during 2018 over absolute control (T₈). This was due to slow decomposition of organic manures, which probably released the nutrients slowly. Besides, the maximum improvement in seed and haulm yield might be associated with increased yield attributes due to a concomitant increase in dry matter accumulation. This is in accordance with the findings of Kumawat *et al.* (2009).

The results of per day blackgram productivity revealed that the residual effect of organic manures was significant and the treatment T₉ attained significantly higher per day blackgram productivity (9.3 and 8.6 kg/ha) which was statistically at par with T₁₂ during both the years of study. These were followed by T₃. Significantly lesser per day blackgram productivity of 4.5 and 4.0 kg/ha (2017 and 2018, respectively) was observed under absolute control (T₁₁); however it was comparable with T₁₀ during 2018.

Thus, the basal incorporation of T₉ to preceding 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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