



Residual and Cumulative Effect of Different Levels of Inorganic Fertilizers and Organic Composts on Growth and Dry matter Production of Horsegram in Ragi-Horsegram Sequence

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ABSTRACT

The field experiment was carried out at the Farmers Field, ValiyampattuMllage, Sankarapuram Taluk, Kallakurichi District, Tamilnadu to evaluate the residual and cumulative effect of different levels of inorganic fertilizers and different composts on growth parameters on horsegram in ragi- horsegram sequence. The experiment consisted of twelve treatments which was replicated thrice under RBD (Randomized Block Design). The twelve treatments were T₁ - Absolute Control, T₂ - 100% RDF (N:P₂O₅:K₂O) (12.5:25:12.5 kg ha⁻¹), T₃ - 75% RN(C.F) + 25% RN(GLMC), T₄ - 75% RN(C.F) + 25% RN (GOC), T₅ - 75% RN(C.F) + 25% RN (PMC), T₆ - 75% RN(C.F) +25% RN(CPC), T₇ - 50 % RN(C.F) + 25% RN (GLMC) + 25% RN(GOC), T₈ - 50 % RN(C.F) + 25% RN(PMC) + 25% RN(CPC), T₉ - 50 % RN(C.F) + 25% RN(GLMC) + 25% RN(PMC), T₁₀ - 50 % RN(C.F) + 25% RN(GLMC) + 25% RN(CPC), T₁₁ - 50% RN(C.F) + 25% RN(GOC) + 25% RN(PMC) and T₁₂ - 50% RN(C.F) + 25%RN (GOC) + 25% RN(CPC). The results of residual and cumulative study shows that the combined application 50 % recommended nitrogen through chemical fertilizer, 25% N through green leaf manure compost and 25% N through groundnut oilcake (50 % RN (C.F) + 25% RN (GLMC) + 25% RN (GOC) (T₇) significantly increased plant height of 29.86, 36.85, 46.39 cm and number of branches plant⁻¹ of 1.56, 2.52 and 6.03 and dry matter production of 1120.8, 1631.7 and 2004.5 kg ha⁻¹ at 30 DAS, 60 DAS and at harvest stage, respectively.

Keywords: Inorganic fertilizers, organic composts, ragi, horsegram, growth and DMP.

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INTRODUCTION

Horsegram (*Macrotyloma uniflorum*) is the fifth most widely grown pulse species in modern India. It is a food, feed and having medicinal value with immense pertinence in sustaining and enhancing soil fertility by checking soil erosion and fixation of atmospheric nitrogen. The sprouted grain and allied preparations of horsegram are extensively used for getting better sleep, curing irregular menstrual cycle and urinary problems in women, reducing acidity, curing whooping cough, constipation and piles. In India, it is cultivated as a pulse crop contributing about 0.33 per cent of the total food grain production. The area of horsegram in India during 2020 was 4.57 lakh hectares with production of 2.96 lakh tonnes and productivity of 649 kg ha⁻¹ [5]. Whereas in Tamilnadu it covers an area of 0.75 lakh hectares with a production of 0.44 lakh tonnes with a productivity of 588 kg ha⁻¹ during 2015-16 [7]. It is an excellent source of protein (25%), carbohydrates (60%), essential amino acids, energy, and low content of lipid (0.58%), iron and molybdenum [3]. Oil cake is considered as the concentrated organic manure due to its high amount of nutrients content. In addition to N, P and K, it also supplies considerable amount of secondary and micronutrients and improved growth and yield of crops. It is also used as a potential, effective, cheaper and non-polluting organic source of nitrogen and other growth promoting substances [16]. Pongamia leaf manure contains nitrogen as well as several compounds that exhibit toxic properties against several insects and microbes [15]. Pressmud as a compost used to maintain soil fertility and enhance crop production because it is rich in sugar and contains appreciable amount of essential plant nutrients viz., organic carbon, nitrogen, phosphorus, potassium, calcium and magnesium along with traces of micronutrients viz., Zn, Fe, Cu and Mn. [2] Coir pith is comparatively rich in potash, but low in nitrogen and phosphorus besides higher proportion of lignin, cellulose and hemicelluloses [1]. Continuous application of inorganic fertilizer such as nitrogen not only degrades soil but can also lead to pest problems.

However, the use of organics alone might not meet the plant requirements because of the relatively low nutrient content. Application of organics with chemical fertilizers stimulates microbial activity, promotes efficiency in the use of nutrients [11] and increases accessibility of the surrounding nutrients, resulting in adequate nutrient uptake by plants. Therefore, in order to increase the soil productivity by supplying all the plant nutrients in readily available form and to maintain good soil health, it is necessary to use organic composts in combination with inorganic fertilizers to obtain optimum yields [12]. The present study aimed to explore the residual and cumulative effect of different levels of inorganic fertilizers with different composts on growth parameters on horsegram in ragi – horsegram sequence.

MATERIAL AND METHODS

To find out the residual and cumulative effect of different levels of inorganic fertilizers with different composts on growth parameters on horsegram, the field experiment was conducted at the Farmers Field, Valiyampattu Village, Sankarapuram Taluk, Kallakurichi District, Tamilnadu, India. The experimental soil was sandy loam in texture. The experiment consist of twelve treatments which was replicated thrice. The twelve treatments were T₁ - Absolute Control, T₂ - 100% RDF (N:P₂O₅:K₂O) (12.5:25:12.5 kg ha⁻¹), T₃ - 75% RN(C.F) + 25% RN(GLMC), T₄ - 75% RN(C.F) + 25% RN (GOC), T₅ - 75% RN(C.F) + 25% RN (PMC), T₆ - 75% RN(C.F) + 25% RN(CPC), T₇ - 50 % RN(C.F) + 25% RN (GLMC) + 25% RN(GOC) , T₈ - 50 % RN(C.F) + 25% RN(PMC) + 25% RN(CPC), T₉ - 50 % RN(C.F) + 25% RN(GLMC) + 25% RN(PMC), T₁₀ - 50 % RN(C.F) + 25% RN(GLMC) + 25% RN(CPC), T₁₁ - 50% RN(C.F) + 25% RN(GOC) + 25% RN(PMC) and T₁₂ - 50% RN(C.F) + 25%RN (GOC) + 25% RN(CPC). The experiment was laid out in RBD (Randomized Block Design). After ragi crop harvested, horsegram cv. Paiyur-1 was sown on the same plot to investigate residual and cumulative effect of above treatments. The recommended dose of fertilizers (N:P₂O₅:K₂O) (12.5:25:12.5 kg ha⁻¹) was applied to the field through Urea, SSP and MOP, respectively. The different composts *viz.*, green lean manure compost (GLMC), Pressmud compost (PMC) and coir pith compost (CPC) and groundnut oil cake were applied as per the N equivalent to the respective plot. The residual and cumulative effect of treatments on growth parameters of horsegram paiyur-1 were studied and incorporated.

RESULT AND DISCUSSION

Plant height (cm)

The plant height is the visible indicator of growth. The data on plant height (cm) of horsegram paiyur-1 as influenced by different treatments are presented in table 1.

30 DAS

In the residual studies, the highest plant height of 23.78 cm was observed with 50 % RN (C.F) + 25% GMC + 25% GOC (T₇). Which was followed by application of 50% RN (C.F) + 25% GOC + 25% PMC (T₁₁) registered plant height of 22.07 cm and 100% RDF (T₂) recorded plant height of 21.75 cm. The treatments T₁₁ on par with T₂. The treatments T₃, T₄ and T₅ registered plant height of 15.60, 21.16 and 18.28 cm which were received 75% RN (C.F) + 25% RN(GMC), 75% RN(C.F) + 25% RN(GOC) and 75% RN (C.F) + 25% RN(PMC), respectively. However, lowest plant height of 11.72 cm was noticed in control (T₁).

In the cumulative studies also, application of 50 % RN (C.F) + 25% GMC + 25% GOC (T₇) recorded highest plant height of 29.86 cm. Which was followed by application of 50% RN (C.F) + 25% GOC + 25% PMC (T₁₁) registered plant height of 27.15 cm and 100% RDF (T₂) recorded plant height of 26.80 cm, respectively. However, lowest plant height of 12.61 cm was found to be with control (T₁).

60 DAS

In the residual studies, application of different levels of inorganic fertilizers and different composts significantly increased plant height at 60 DAT ranged from 22.17 to 36.85 cm. Application of 50 % RN (C.F) + 25% GMC + 25% GOC (T₇) registered highest plant height (36.85 cm). Application of 50% RN (C.F) + 25% GOC + 25% PMC (T₁₁) and 100% RDF (T₂) registered plant height of 34.62 and 33.92 cm, respectively. These treatments were on par with each other. However, lowest plant height was found to be with control (T₁) (22.17cm). Compared to residual study the plant height was slightly higher in cumulative study. Application of 50 % RN (C.F) + 25% GMC + 25% GOC (T₇) registered significantly highest plant height of 42.69 cm against lowest plant height of 23.61 was found to be with control (T₁). The second best plant height of 39.82 cm was noticed in T₁₁ was on par with T₂ 100 % RDF (39.67 cm).

At harvest

Significantly highest plant height of 46.39 cm in horsegram at harvest was observed in T₇ which was received 50 % RN (C.F) + 25% GMC + 25% GOC for previous ragi crop. Which was followed by 40.78 and 39.67 cm were found to be with 50% RN (C.F) + 25% GOC + 25% PMC (T₁₁) and 100% RDF (T₂), respectively. Application of 75% RN (C.F) + 25% RN (GMC) (T₃), 75% RN(CF) + 25% RN(GOC)(T₄), 75% RN (C.F) + 25% RN(PMC) (T₅) and 75% RN (C.F) + 25% RN(CPC)(T₆) registered plant height of 31.24, 39.30, 35.28 and 28.10 cm, respectively. However, control (T₁) treatment recorded the lowest plant height of

24.63 cm.

Compared to residual study, plant height was higher in cumulative study. Similar trend was also observed. Application of 50 % RN (C.F) + 25% GMC + 25% GOC (T₇) registered highest plant height (55.83 cm) against control (26.15cm). Among the different treatments, T₁₁ (51.49cm) and T₂ (51.26 cm) were on par with each other. Similarly T₉ (43.52cm) was on par with T₁₀ (43.14 cm). This could be due to increase in the availability of essential nutrients such as N and P in available form to plants. The de oiled cake helped in nitrification and resulted in better availability of N for plants and thus resulted in enhanced N uptake by plants, resulting in better growth parameters. This is in accordance with the results observed by [4]. The increase in plant height in response to combined application of organics and chemical fertilizer is probably due to enhanced availability of nitrogen which enhanced more leaf area resulting in higher photo assimilates and thereby resulted in more dry matter accumulation [10]. Rapid division and elongation of cells with increasing fertility level particularly N and greater availability of nitrogen at higher fertilizer doses which improved photosynthesis as well as protein synthesis ultimately led to vigorous plant growth [13].

Number of branches plant⁻¹

The data revealed that number of branches plant⁻¹ in horsegram cv. Paiyur-1 as influenced by different treatments are presented in table 2. The residual and cumulative effect of different levels of inorganic fertilizers and different composts significantly influenced the number of branches plant⁻¹ at all the growth stages of horsegram.

30 DAS

In the residual study, the highest number of branches plant⁻¹ (2.14) was observed with 50 % RN (C.F) + 25% GMC + 25% GOC (T₇). Which was followed by application of 50% RN (C.F) + 25% GOC + 25% PMC (T₁₁) (1.87) and 100% RDF (T₂) (1.88). The treatments T₁₁ on par with T₂. The treatments T₃, T₄ and T₅ registered number of branches plant⁻¹ of 1.47, 1.84 and 1.68 which were received 75% RN (C.F) + 25% RN(GMC), 75% RN (C.F) + 25% RN(GOC) and 75% RN (C.F) + 25% RN(PMC), respectively. However, lowest value 1.25 was noticed in control (T₁).

In the cumulative studies also, application of 50 % RN (C.F) + 25% GMC + 25% GOC (T₇) recorded the highest number of branches plant⁻¹ of 1.56. Which was followed by application of 50% RN (C.F) + 25% GOC + 25% PMC (T₁₁) (2.65) and 100% RDF (T₂) recorded number of branches plant⁻¹ of 2.58. However, lowest number of branches plant⁻¹ of 1.30 was found to be with control (T₁).

60 DAS

The number of branches plant⁻¹ at 60 DAS ranged from 2.52 to 4.69. Application of 50 % RN (C.F) + 25% GMC + 25% GOC (T₇) registered highest number of branches plant⁻¹ (4.69). Application of 50% RN (C.F) + 25% GOC + 25% PMC (T₁₁) and 100% RDF (T₂) registered number of branches plant⁻¹ of 4.24 and 4.20, respectively. These treatments were on par with each other. However, lowest number of branches plant⁻¹ was found to be with control (T₁) (2.52).

Compared to residual study the number of branches plant⁻¹ was higher in cumulative study. Application of 50 % RN (C.F) + 25% GMC + 25% GOC (T₇) registered significantly highest number of branches plant⁻¹ of 5.53 against lowest number of branches plant⁻¹ of 2.58 was found to be with control (T₁).

At harvest

Significantly highest number of branches plant⁻¹ of 6.03 was observed in T₇ which was received 50 % RN (C.F) + 25% GMC + 25% GOC for previous ragi crop. Which was followed by 5.69 and 5.61 were found to be with 50% RN (C.F) + 25% GOC + 25% PMC (T₁₁) and 100% RDF (T₂), respectively. However, in residual study, control (T₁) treatment recorded the lowest number of branches plant⁻¹ of 4.43.

Compared to residual study, number of branches plant⁻¹ of horsegram was higher in cumulative study. Similar trend was also observed. Application of 50 % RN (C.F) + 25% GMC + 25% GOC (T₇) registered highest number of branches plant⁻¹ (6.98) against control (T₁) (4.65). This was due to combined application of composts and inorganic fertilizers helped to increase the organic matter content in soil and improved soil fertility and productivity through its affirmative effect on soil physical, chemical and biological properties and balanced the plant nutrition [9]. This might be also due to fact that more nutrient availability under INM treatments resulted into increased conversion of carbohydrates into protein which in turn elaborated into protoplasm and cell wall material increased the size of the cell, which expressed morphologically in terms of number of branches [6].

Dry matter production (kg ha⁻¹)

The residual and cumulative effect of different levels of inorganic fertilizers and different composts significantly influenced dry matter production at all the growth stages of horsegram are presented in table 3.

30 DAS

In the residual study, highest dry matter production 962.7 kg ha⁻¹ was observed with 50 % RN (C.F) + 25% GMC + 25% GOC (T₇). Which was followed by application of 50% RN (C.F) + 25% GOC + 25% PMC (T₁₁) (931.2 kg ha⁻¹) and 100% RDF (T₂)(924.9 kg ha⁻¹). The treatments T₁₁ on par with T₂. However, lowest dry matter production of 850.2 kg ha⁻¹ was noticed in T₁.

In the cumulative studies also, application of 50 % RN (C.F) + 25% GMC + 25% GOC (T₇) recorded the highest dry matter production of 1120.8 kg ha⁻¹ and lowest dry matter production of 857.4 kg ha⁻¹ was found to be with control (T₁).

60 DAS

In the residual study, application of 50 % RN (C.F) + 25% GMC + 25% GOC (T₇) registered dry matter production of 1320.9 kg ha⁻¹. Application of 50% RN (C.F) + 25% GOC + 25% PMC (T₁₁) and 100% RDF (T₂) registered dry matter production of 1258.8 and 1251.6kg ha⁻¹, respectively. These treatments were on par with each other. However, lowest dry matter production was found to be with control (T₁) (991.5 kg ha⁻¹).

In the cumulative study, application of 50 % RN (C.F) + 25% GMC + 25% GOC (T₇) registered significantly highest dry matter production of 1631.7 kg ha⁻¹ against lowest dry matter production of 998.6 kg ha⁻¹ was found to be with control (T₁).

At harvest

Significantly highest dry matter production of 1504.5 kg ha⁻¹ in horsegram was observed in T₇ which was received 50 % RN (C.F) + 25% GMC + 25% GOC for previous ragi crop. Which was followed by 1429.4 and 1421.1 kg ha⁻¹ were found to be with 50% RN (C.F) + 25% GOC + 25% PMC (T₁₁) and 100% RDF (T₂), respectively. However, control (T₁) recorded lowest dry matter production of 1124.6 kg ha⁻¹.

Compared to residual study, dry matter production was higher in cumulative study. Similar trend was also observed. Application of 50 % RN (C.F) + 25% GMC + 25% GOC (T₇) registered highest dry matter production (2004.5 kg ha⁻¹) against control registered lowest dry matter production of 1131.9 kg ha⁻¹. This could be attributed to significant improvement in growth parameters to adequate supply of nutrients in maintaining higher auxin levels which had favourable effect on cell enlargement and cell division. Higher plant height and LAI resulted in more interception and utilization of radiant energy, leading to higher photosynthetic rate, which resulted in higher accumulation of dry matter [14]. Similar result was also reported by [8].

Table 1. Residual and cumulative effect of different levels of inorganic fertilizers and different composts on plant height (cm) at different growth stages of horsegram cv. Paiyur-1.

Treatments Details		Plant height (cm)			Cumulative effect		
		30 DAS	60 DAS	At harvest	30 DAS	60 DAS	At harvest
T ₁	Absolute Control	11.72	22.17	24.63	12.61	23.61	26.15
T ₂	100% RDF (N:P ₂ O ₅ :K ₂ O) (12.5:25:12.5 kg ha ⁻¹)	21.75	33.92	39.67	26.80	39.67	51.26
T ₃	75% RN(C.F) + 25% RN(GLMC)	15.60	26.96	31.24	17.16	28.76	34.59
T ₄	75% RN(C.F) + 25% RN (GOC)	21.16	33.58	39.30	26.62	37.19	47.43
T ₅	75% RN(C.F) + 25% RN (PMC)	18.28	30.12	35.28	22.15	34.09	42.79
T ₆	75% RN(C.F) + 25% RN(CPC)	13.70	24.65	28.10	14.95	26.22	30.41
T ₇	50 % RN(C.F) + 25% RN (GLMC) + 25% RN(GOC)	23.78	36.85	46.39	29.86	42.69	55.83
T ₈	50 % RN(C.F) + 25% RN(PMC) + 25% RN(CPC)	15.85	27.18	31.49	19.43	31.24	38.46
T ₉	50 % RN(C.F) + 25% RN(GLMC) + 25% RN(PMC)	19.32	31.27	36.04	24.60	34.62	43.52
T ₁₀	50 % RN(C.F) + 25% RN(GLMC) + 25% RN(PMC)	19.08	30.84	35.71	24.43	34.37	43.14
T ₁₁	50% RN(C.F) + 25% RN(GOC) + 25% RN(PMC)	22.07	34.62	40.78	27.15	39.82	51.49
T ₁₂	50% RN(C.F) + 25%RN (GOC) + 25% N(CPC)	16.64	27.60	31.86	19.74	31.40	38.61
S.Ed		0.70	1.02	1.40	1.09	1.20	1.87
CD (p=0.05)		1.39	2.04	2.82	2.16	2.40	3.72

Table 2. Residual and cumulative effect of different levels of inorganic fertilizers and different composts on number of branches plant⁻¹ at different growth stages of horsegram cv. Paiyur-1.

Number of branches plant ⁻¹							
Treatments Details		Residual effect			Cumulative effect		
		30 DAS	60 DAS	At harvest	30 DAS	60 DAS	At harvest
T ₁	Absolute Control	1.25	2.52	4.43	1.30	2.58	4.65
T ₂	100% RDF (N:P ₂ O ₅ :K ₂ O) (12.5:25:12.5 kg ha ⁻¹)	1.88	4.20	5.61	2.58	4.69	6.67
T ₃	75% RN(C.F) + 25% RN(GLMC)	1.47	2.92	4.90	1.79	3.45	5.23
T ₄	75% RN(C.F) + 25% RN (GOC)	1.84	3.87	5.56	2.54	4.59	6.52
T ₅	75% RN(C.F) + 25% RN (PMC)	1.68	3.46	5.23	2.15	4.02	5.92
T ₆	75% RN(C.F) + 25% RN(CPC)	1.34	2.86	4.66	1.56	3.04	4.96
T ₇	50 % RN(C.F) + 25% RN (GLMC) + 25% RN(GOC)	2.14	4.69	6.03	2.89	5.53	6.98
T ₈	50 % RN(C.F) + 25% RN(PMC) + 25% RN(CPC)	1.48	2.97	4.94	1.85	3.49	5.51
T ₉	50 % RN(C.F) + 25% RN(GLMC) + 25% RN(PMC)	1.70	3.58	5.34	2.27	4.17	6.24
T ₁₀	50 % RN(C.F) + 25% RN(GLMC) + 25% RN(PMC)	1.69	3.51	5.27	2.21	4.06	6.19
T ₁₁	50% RN(C.F) + 25% RN(GOC) + 25% RN(PMC)	1.87	4.24	5.69	2.65	4.86	6.71
T ₁₂	50% RN(C.F) + 25%RN (GOC) + 25% N(CPC)	1.53	3.12	4.99	1.89	3.53	5.63
S.Ed		0.05	0.13	0.10	0.11	0.20	0.13
CD (p=0.05)		0.10	0.26	0.20	0.21	0.39	0.24

Table 3. Effect of different levels of inorganic fertilizers and different composts on dry matter production (kg ha⁻¹) at different growth stages of horsegram cv. Paiyur-1 in residual and cumulative studies.

Dry matter production (kg ha ⁻¹)							
Treatments Details		Residual effect			Cumulative effect		
		30 DAS	60 DAS	At harvest	30 DAS	60 DAS	At harvest
T ₁	Absolute Control	850.2	991.5	1124.6	857.4	998.6	1131.9
T ₂	100% RDF (N:P ₂ O ₅ :K ₂ O) (12.5:25:12.5 kg ha ⁻¹)	924.9	1251.6	1421.1	1079.1	1497.2	1893.4
T ₃	75% RN(C.F) + 25% RN(GLMC)	883.4	1090.3	1239.3	919.6	1152.4	1338.1
T ₄	75% RN(C.F) + 25% RN (GOC)	922.3	1240.6	1407.9	1048.6	1417.6	1787.4
T ₅	75% RN(C.F) + 25% RN (PMC)	902.3	1156.8	1325.4	981.7	1320.4	1554.9
T ₆	75% RN(C.F) + 25% RN(CPC)	867.1	1041.3	1182.2	888.8	1081.4	1240.6
T ₇	50 % RN(C.F) + 25% RN (GLMC) + 25% RN(GOC)	962.7	1320.9	1504.5	1120.8	1631.7	2004.5
T ₈	50 % RN(C.F) + 25% RN(PMC) + 25% RN(CPC)	884.8	1097.5	1260.7	950.4	1226.5	1442.2
T ₉	50 % RN(C.F) + 25% RN(GLMC) + 25% RN(PMC)	906.0	1190.7	1350.6	1017.8	1342.5	1678.1
T ₁₀	50 % RN(C.F) + 25% RN(GLMC) + 25% RN(PMC)	904.8	1178.4	1341.3	1011.2	1334.7	1659.5
T ₁₁	50% RN(C.F) + 25% RN(GOC) + 25% RN(PMC)	931.2	1258.8	1429.4	1086.5	1512.8	1899.7
T ₁₂	50% RN(C.F) + 25%RN (GOC) + 25% N(CPC)	886.1	1106.2	1271.4	952.1	1241.3	1456.4
S.Ed		7.75	23.4	26.6	14.2	34.8	48.6
CD (p=0.05)		15.4	46.8	53.2	28.4	69.7	97.1

CONCLUSION

Based on the results of field experiment, it can be concluded that the combined application of 50 % recommended nitrogen through chemical fertilizer, 25% N through green leaf manure compost and 25% N through groundnut oilcake resulted in significantly higher plant height, number of branches plant⁻¹ and dry matter production on horsegram grown as residual and cumulative in ragi-horsegram sequence. This study also showed that excess and imbalance use of chemical fertilizer has reduced growth, DMP of horsegram

and soil fertility status. Application of organic nutrients is of more appropriate because it contributes to the improvement and sustainability of natural resources and environment.

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