

IPNS approach on yield attributes and yield of finger millet in finger millet – horse gram cropping system

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Abstract

A field experiment was conducted at Valiyampattu Village, Sankarapuram Taluk, Kallakurichi District, Tamilnadu during June-September, 2021 with an objective to enhance productivity of finger millet by different levels of inorganic fertilizers with different composts. The study comprised of twelve treatments, three replications and design of the experiment was RBD. The treatments were T₁ - Absolute Control, T₂ - 100% RDF (N:P₂O₅:K₂O) (60:30:30 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% 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 recommended dose of fertilizers (N:P₂O₅:K₂O) (60:30:30 kg ha⁻¹) were applied to the field through Urea, SSP and MOP, respectively. Different composts *viz.*, GLMC, GOC, PMC and CPC were imposed to the treatment as per N equivalent. The results of the study inferred that combined application of 50 % recommended nitrogen through chemical fertilizer + 25% RN through GLMC + 25% RN through GOC (T₇) recorded significantly highest yield attributes *viz.*, number of productive tillers hill⁻¹, number of earhead plant⁻¹, number of fingers earhead⁻¹, fingers length (cm), 1000 grain weight (g) and grain yield and straw yield in ragi. IPNS practice of 50 % RN(C.F) + 25% RN (GLMC) + 25% RN(GOC) showed its best results with respect to grain yield 2975.6 kg ha⁻¹ and straw yield of 7419.3 kg ha⁻¹ as compared to other treatments.

Key words : Composts, NPK – fertilizers, ragi, yield attributes and yield.

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Finger millet (*Eleusine coracana* L. Gaertn) is an important small millet crop grown in India and has the pride of place in having highest productivity among millets. It is also known as ragi, African millet and birds foot millet and an important staple food crop in part of eastern and central Africa and India. Millets is known to be “crops of the future” as it is well adapted and cultivated under harsh environment of arid and semi-arid region⁹ According to Singh *et al.*,¹³ in India, it is grown in an area of 1.19 million hectares with the production of 1.98 million tonnes and the productivity is 1661 kg ha⁻¹. In Tamilnadu, it is grown with an area of 0.61 lakh hectares resulting in production of 0.11 million tonnes with the productivity of 1966 kg ha⁻¹, provides food and nutritional security to the marginal farmers in the rainfed dry lands and hilly tribal areas⁷. Compost is commonly prepared by decomposing plant and animal wastes and recycling organic materials. Production of compost from lingo- cellulosic residues of by-products of sugar industries is found to be worthy for maintaining health of plant and soil properties and protects the plant from various soil borne diseases¹⁰. Pressmud is a good media of both organic and inorganic plant nutrients as it contains organic carbon, nitrogen, phosphorus, potassium, calcium and sulphur and abundance¹⁵. 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. Pongamia pinnata has high nutritious value with macro and micronutrients such as nitrogen, phosphorus, potassium, calcium, magnesium, zinc, copper

and iron as an excellent fertilizer source in organic agriculture. Pongamia has a good soil nutrient source improves soil fertility helped in nitrification and resulted in better root development and thus resulted in higher root length, resulting in better growth¹. Coir pith is very poor in nitrogen content and has higher C: N ratio mounting to 112:1 which is undesirable for any organic waste for application as organic manure in agricultural farms because it causes deleterious effect to the crops. Hence, coir pith has to be composted before application⁶. IPNS is an approach through which the management of plant nutrition and soil fertility in cropping and farming systems is adapted to site characteristics and to locally-available resources ensures that plant nutrition be environmentally, socially and economically viable.

The field investigation was carried out at the Farmers Field, Valiyampattu Village, Sankarapuram Taluk, Kallakurichi District, Tamilnadu to explore the effect of IPNS approach on yield attributes and yield of ragi CO 14 as test crop. The experiment was laid out in RBD with twelve treatments replicated thrice using different composts (GLMC, GOC, PMC and CPC) and NPK fertilizers. The twelve treatments were T₁ - Absolute Control, T₂ - 100% RDF (N:P₂O₅:K₂O) (60:30:30 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), T_{11} - 50% RN(C.F) + 25% RN(GOC) + 25% RN(PMC) and T_{12} - 50% RN(C.F) + 25% RN (GOC) + 25% RN(CPC). The recommended dose of fertilizers (N:P₂O₅:K₂O) (60:30:30 kg ha⁻¹) were applied to the field through Urea, SSP and MOP, respectively. The composts viz., GLMC, GOC, PMC and CPC were applied as basal on N equivalent basis. Ragi cv. CO 14 was grown with proper cultural practices and yield attributes and yield from each treatment were studied and recorded.

The yield attributes viz., number of productive tillers hill⁻¹, number of earhead plant⁻¹, number of fingers earhead⁻¹ and finger length were significantly influenced by the different combinations of composts and fertilizers supplements. 1000 grain weight was not significantly influenced by different treatments.

Number of productive tillers hill⁻¹ :

Significantly highest number of productive tillers hill⁻¹ (6.29) was observed with 50 % RN (C.F) + 25% GMC + 25% GOC (T_7). The next best treatments was 50% RN(C.F) + 25% GOC + 25% PMC (T_{11}) registered number of productive tillers hill⁻¹ (5.88) and 100% RDF (60:30:30) (T_2) recorded number of productive tillers hill⁻¹ (5.75). The treatment T_{11} on par with T_2 . The treatments T_3 , T_4 and T_5 registered number of productive tillers hill⁻¹ were 3.94, 5.37 and 4.51 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 lower number of

productive tillers hill⁻¹ of 2.35 was noticed in control (T_1). This might be due to higher macro and micro nutrient content of the ground oilcake and chemical fertilizers which enables continuous slow and steady release of nutrients. This ensures continuous availability of nutrients throughout the crop growth stages. Due to steady transformation, mineralization, solubilization, decomposition of minerals and nutrients, that might helped in ensuring the superior yield attributing characteristics by composts³.

Number of earhead plant⁻¹ :

The maximum number of earhead plant⁻¹ (4.65) was obtained in 50 % RN (C.F) + 25% GMC + 25% GOC (T_7) and followed by application of 50% RN(C.F) + 25% GOC + 25% PMC (T_{11}) registered number of earhead plant⁻¹ (4.41) and 100% RDF (60:30:30) (T_2) recorded number of earhead plant⁻¹ (4.38). The treatment T_{11} on par with T_2 . The treatment T_4 i.e., application of 75% RN (C.F)+ 25% RN (GOC) registered number of earhead plant⁻¹ of 4.16. The lowest value of 2.71 was found to be with control (T_1) which was not received composts and chemical fertilizers. The highest earhead plant⁻¹ (4.65) might be due to readily availability of nutrients from mineral fertilizers and mineralization of composts throughout the growing period did not put the plants in nutrient stress at any stage and resulted in maximum ear head¹² plant⁻¹. These results are in accordance with that of Ullasa *et al.*¹⁴.

Number of fingers earhead⁻¹ :

The maximum and minimum number of fingers earhead⁻¹ were 7.10 and 3.20

noticed under T_7 (50 % RN (C.F) + 25% GMC + 25% GOC) and T_1 (Control), respectively. Application of 50% RN (C.F) + 25% GOC + 25% PMC (T_{11}) and 100% RDF (T_2) registered number of fingers earhead⁻¹ of 6.67 and 6.60 respectively. These treatments were on par with each other. It was followed by 75% RN (C.F) + 25% RN (GOC) (T_4) registered number of fingers earhead⁻¹ of 6.12. Application of 50 % RN (C.F) + 25% RN (GLMC) + 25% RN (PMC) (T_9) and 50 % RN(C.F)+25% RN(GLMC) + 25% RN(CPC) (T_{10}) recorded number of fingers earhead⁻¹ of 5.71 and 5.69, respectively. The beneficial response of groundnut oilcake to number of fingers earhead⁻¹ might also be attributed to the availability of sufficient amount of easily utilizable form of plant nutrients throughout the growth period and especially at critical growth periods of crop resulting in better uptake, plant vigour and superior yield attributes. The results were found to be similar with the Fazily and Hanshul⁵.

Finger length (cm) :

Application of 50 % recommended N through chemical fertilizers + 25 % recommended N through green leaf manure compost (GLMC) + 25 % recommended N through groundnut oil cake (GOC) (T_7) recorded significantly highest finger length of 9.21 cm, which was superior as compared to all the other treatments. Application of 50% RN (C.F) + 25% GOC + 25% PMC (T_{11}) registered finger length of 8.64cm and 100% RDF (60:30:30) (T_2) recorded finger length of 8.60cm, respectively. Which were found to be statistically at par. The treatments T_3 , T_4 and T_5 registered finger length of 5.46, 8.02 and

6.73cm 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. This might be due to application of inorganics and N though composts was probably due to higher uptake of nutrients that led to better translocation of photosynthates².

1000 grain weight (g) :

Among the different treatments tried, application of 50 % RN (C.F) + 25% GMC + 25% GOC (T_7) registered highest 1000 grain weight (2.92 g). Which was followed by 50% RN (C.F) + 25% GOC + 25% PMC (T_{11}) and 100% RDF (T_2) registered 1000 grain weight of 2.88 and 2.86 g respectively. However, lowest 1000 grain weight was found to be with control (T_1) (2.64 g). This might be due to more vigorous and luxuriant vegetative growth due to application of composts along with inorganic fertilizer, which in turn favoured a better partitioning of assimilates from source to sink. The present results were in accordance with the findings of Divya *et al.*⁴.

Grain yield :

Data pertaining to the grain and straw yield are presented in table-2. The treatment 50 % recommended N through chemical fertilizers + 25 % recommended N through green leaf manure compost (GLMC) + 25 % recommended N through groundnut oil cake (GOC) (T_7) recorded highest grain yield of 2975.6 kg ha⁻¹ which was significantly superior as compared to all other treatments. The next best treatment 50% RN (C.F) + 25% GOC + 25% PMC (T_{11}) registered grain yield of

Table-1. Effect of different levels of inorganic fertilizers and different compost on yield attributes of finger millet cv. CO14

Treatments Details	No. of productive tillers hill ⁻¹ plant ⁻¹	Number of ear heads	Number of fingers ear head ⁻¹	Finger length (cm)	1000 grain weight (g)
T ₁ Absolute Control	2.35	2.71	3.20	4.60	2.64
T ₂ 100% RDF (N:P ₂ O ₅ :K ₂ O) (60:30:30 kg ha ⁻¹)	5.75	4.38	6.60	8.60	2.86
T ₃ 75% RN(C.F) + 25% RN(GLMC)	3.94	3.18	4.28	5.46	2.67
T ₄ 75% RN(C.F) + 25% RN (GOC)	5.37	4.16	6.12	8.02	2.82
T ₅ 75% RN(C.F) + 25% RN (PMC)	4.51	3.64	5.21	6.73	2.72
T ₆ 75% RN(C.F) + 25% RN(CPC)	3.29	2.95	3.79	4.89	2.66
T ₇ 50 % RN(C.F) + 25% RN (GLMC) + 25% RN(GOC)	6.29	4.65	7.10	9.21	2.92
T ₈ 50 % RN(C.F) + 25% RN(PMC) + 25% RN(CPC)	4.06	3.22	4.25	5.54	2.68
T ₉ 50 % RN(C.F) + 25% RN(GLMC) + 25% RN(PMC)	4.95	3.97	5.71	7.42	2.79
T ₁₀ 50 % RN(C.F) + 25% RN(GLMC) + 25% RN(PMC)	4.86	3.88	5.69	7.36	2.76
T ₁₁ 50% RN(C.F) + 25% RN(GOC) + 25% RN(PMC)	5.88	4.41	6.67	8.64	2.88
T ₁₂ 50% RN(C.F) + 25%RN (GOC) + 25% N(CPC)	4.49	3.45	5.14	6.11	2.70
S.Ed	0.19	0.08	0.18	0.25	0.037
CD (p=0.05)	0.39	0.17	0.38	0.52	NS

Table-2. Effect of different levels of inorganic fertilizers and different compost on yield of finger millet cv.CO14

Treatments Details	Grain yield (kg ha ⁻¹)	Straw yield (kg ha ⁻¹)
T ₁ Absolute Control	1732.4	4925.7
T ₂ 100% RDF (N:P ₂ O ₅ :K ₂ O) (60:30:30 kg ha ⁻¹)	2759.6	7086.5
T ₃ 75% RN(C.F) + 25% RN(GLMC)	2013.7	5791.2
T ₄ 75% RN(C.F) + 25% RN (GOC)	2630.1	6805.4
T ₅ 75% RN(C.F) + 25% RN (PMC)	2371.8	5437.8
T ₆ 75% RN(C.F) + 25% RN(CPC)	1897.3	6425.6
T ₇ 50 % RN(C.F) + 25% RN (GLMC) + 25% RN(GOC)	2975.6	7419.3
T ₈ 50 % RN(C.F) + 25% RN(PMC) + 25% RN(CPC)	2061.5	5859.4
T ₉ 50 % RN(C.F) + 25% RN(GLMC) + 25% RN(PMC)	2484.2	6514.8
T ₁₀ 50 % RN(C.F) + 25% RN(GLMC) + 25% RN(PMC)	2413.2	6470.9
T ₁₁ 50% RN(C.F) + 25% RN(GOC) + 25% RN(PMC)	2836.1	7133.7
T ₁₂ 50% RN(C.F) + 25%RN (GOC) + 25% N(CPC)	2187.4	6147.3
S.Ed	54.6	130.8
CD (p=0.05)	109.2	261.6

2836.1 kg ha⁻¹. It was followed by 100% RDF (60:30:30) (T₂) recorded grain yield of 2759.6 kg ha⁻¹. These two treatments were statistically at par with each other. The treatments T₃, T₄ and T₅ registered grain yield were 2013.7, 2630.1 and 2371.8 kg ha⁻¹ 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. The highest grain yield of 2975.6 kg ha⁻¹ was due to higher increase in the yield has been reported to be associated with the release of macro and micro nutrients during the course of microbial decomposition of organic matter also functions as source of energy for soil microflora which brings about the transformation of other nutrients held in soil or applied through other means, in a form that is readily utilized by growing plants which helped in increase of grain yield. These results were in accordance with Aravind *et al.*³. However, lowest grain yield of 1732.4 kg ha⁻¹ was noticed in control (T₁). This was mainly due to lesser yield attributes. This was in line with finding of Praveen Kumar *et al.*,¹¹.

Straw yield :

The highest straw yield of 7419.3 kg ha⁻¹ was observed with 50 % RN (C.F) + 25% GMC + 25% GOC (T₇). The next best straw yield of 7133.7 kg ha⁻¹ and 7086.5 kg ha⁻¹ were found to be with application of 50% RN(C.F) + 25% GOC + 25% PMC (T₁₁) and 100% RDF (60:30:30) (T₂). The treatment T₁₁ statistically on par with T₂. The treatments T₃, T₄ and T₅ registered straw yield of 5791.2, 6805.4 and 5437.8 kg ha⁻¹ 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, the control treatment registered lowest straw yield of 4925.7 kg ha⁻¹. This might be attributed to better supply of nutrients along with conducive physical environment leading to better root activity and higher nutrient absorption, which resulted in more plant growth and superior yield attributes responsible for higher straw yield. The present findings are in accordance with findings of Singh *et al.*¹³.

Results of the experiments revealed that combined application of 50 % recommended nitrogen through chemical fertilizer + 25 % recommended nitrogen through green leaf manure compost (GLMC) + 25 % recommended nitrogen through groundnut oilcake found superior with respect to yield attributes and yield of finger millet grown in sandy loam soil. It can be recommended for farmers to achieve highest productivity in finger millet.

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