**Abstract**

A field experiment on “Long term effect of integrated nutrient management on finger millet (Eleusine coracana G.) growth and yield was recorded at AICRPDA, GKVK, UAS, Bengaluru, during kharif 2018 with 8 treatments, replicated thrice laid out in RCBD. The results of the field experiment revealed that growth and yield parameters of finger millet such as plant height (96.53 cm), number of tillers per hill (7.60), number of ear heads per hill (7.37), number of fingers per ear head (6.61), test weight (3.56 g) and total dry matter production (82.67g per hill) were higher with the application of FYM @ 10 t ha\(^{-1}\) + 100% RDF. The grain (20.96 q ha\(^{-1}\)) and straw (25.40 q ha\(^{-1}\)) yield was found to be higher with the application of 10 tonnes FYM ha\(^{-1}\) and 100% RDF. This clearly indicated that application of organic and inorganic sources of nutrients increases growth and yield of finger millet as compare to inorganic only.

**Keywords**

LTFE, INM, Growth, Yield and finger millet

**Introduction**

Long-term experiments are those, which are conducted on the same set of experimental units over a sequence of years with pre-planned sequence of treatments or crops or both on crop productivity, soil health and economics. Long-term fertilizer experiments provide valuable information on agricultural sustainability, environmental quality, nutrient uptake and physico-chemical changes of soil. Besides, providing information on better understanding of soil and plant processes, it also provides data on benefits to farmers, policy makers and extension functionaries. Intensive cultivation, growing of exhaust crops, use of imbalanced and inadequate fertilizers, restricted use of organic manures which have made the soils not only deficient in nutrients but also deteriorate soil health resulting decline in crop response to recommended dose of NPK fertilizers. Under such conditions, integrated nutrient management assumes greater significance and...
A long-term fertilizer trial established during 1978 at All India Co-Ordinated Project on Dryland Agriculture, GKVK, Bengaluru provides some direction for better management of finger millet-groundnut cropping system. The continuous dressing of organic manure and crop residues could undoubtedly match the nutrient requirement of crop plants, where nutrient demands are comparatively smaller but will be inadequate under finger millet-groundnut cropping system in the long run. However, integrated use of organics, crop residues and chemical fertilizers has been found promising not only in maintaining and sustaining high productivity but also in providing stability to crop production. In this context, combination of organic with inorganic nutrients and crop residues at different levels were evaluated finger millet growth and yield as a test crop.

Materials and Methods

Experimental site

The experiment was a permanent trial under dryland agricultural project. It was initiated as a long term integrated nutrient management trial during 1978, with different nutrient levels of recommended dose of fertilizer and FYM as an organic nutrient source. Later one more source of organic manure (maize residue) was introduced during 1984 considering the reduced availability of FYM. Totally, 40 years of experimentation was maintained previously during kharif2018. Finger millet in mono-cropping was tested. The land was left fallow during summer season of all the years. The soils of Dryland Agriculture Project represent the typical lateritic area of Bengaluru plateau and belong to Vijayapura series, which is a dominant soil series of Bengaluru plateau. As per USDA classification, soils are classified as fine, Kaolinitic, isohyperthermic, Typic Kandiustalf. These soils are yellowish red, lateritic and are derived from granite-gneiss under sub-tropical semi-arid climate. They are very deep, well drained sandy clay loam occurring in nearly level to gently sloping lands. Initial physio-chemical properties of experimental soil given in Table 1.

Experimental details

The test crop selected was finger millet, variety GPU 28. Experiment was carried out following randomized complete block design (RCBD) with 8 treatments and three replications. Treatment details are T1: absolute control, T2: 100% RDF, T3: FYM @ 10 t ha\(^{-1}\), T4: FYM @ 10 t ha\(^{-1}\) + 50% RDF, T5: FYM @ 10 t ha\(^{-1}\) + 100% RDF, T6: Maize residue @ 5 t ha\(^{-1}\), T7: Maize residue @ 5 t ha\(^{-1}\) + 50% RDF, T8: Maize residue @ 5 t ha\(^{-1}\) + 100% RDF

Sources of fertilizer’s

Two organic sources were used in our experiment such as FYM (Farmyard manure) and Maize Residue at the rate of 10 t ha\(^{-1}\) and 5 t ha\(^{-1}\) respectively. Whereas inorganic sources includes urea, DAP, MOP.

Plant growth observation

Plant growth parameters like plant height, number of tillers per plant number of ear heads per hill and numbers of fingers per ear head were recorded at harvest by employing standard procedures

Yield observation

Yield and yield attributes such as test weight, total dry mater, grain and straw yield were recorded at harvest as per standard protocol.
Results and Discussion

Effect of long-term integrated nutrient management on growth parameters of finger millet

The results of the field experiment carried out during kharif, 2018, to study the effect of long-term integrated nutrient management on the growth parameters of finger millet are presented in Table 2.

Plant height (cm)

The results of the present investigation revealed that T₅ (FYM @ 10 t ha⁻¹ + 100% RDF) recorded significantly higher values for plant height (96.53 cm), followed by treatment T₄ (FYM @ 10 t ha⁻¹ + 50% RDF) where plant height (80.13 cm) was recorded, T₈ (Maize residue @ 5 t ha⁻¹ +100% RDF) (79.43 cm) which was on par with the treatment T₄, where as absolute control recorded lower plant height (43.33 cm), The increase in the plant height might be due to enhanced sugar translocation and turgor pressure in plant cell that leads to cell enlargement and multiplication (Hooda (2002) and Abbasi et al., (2014).

Number of tillers / hill

The results of the present investigation revealed that recorded significantly higher values for No. of tillers/hill (7.6), followed by treatment T₄ (FYM @ 10 t ha⁻¹ + 50% RDF) where (5.73), was recorded, T₈ (Maize residue @ 5 t ha⁻¹ +100% RDF) (5.90) which was on par with the treatment T₄, where as absolute control recorded lower No. of tillers/hill (1.67).

Combined application of organic matter and chemical fertilizers increased number of fingers per ear head in finger millet (Gangadhar Nanda, 2015).

Number of ear heads / hill

Significantly higher values for No. of ear heads/hill (7.37) was recorded in T₅ (FYM @ 10 t ha⁻¹ + 100% RDF), followed by treatment T₄ (FYM @ 10 t ha⁻¹ + 50% RDF) where as absolute control recorded lower No. of ear heads / hill (1), greater availability of macro and micronutrients from FYM and inorganic sources of nutrients, which helped in acceleration of various metabolic processes (Umesh (2002), Govindappa (2003)).

Number of fingers per ear head

Significantly higher values for number of fingers per ear head (6.61) noticed in T₅ (FYM @ 10 t ha⁻¹ + 100% RDF), followed by treatment T₄ (FYM @ 10 t ha⁻¹ + 50% RDF) where as absolute control recorded lowest number of fingers per ear head (3.40), The possible reason could be due to N, P₂O₅ and K₂O which improves root growth and tillering, resulting in increase in amount of interception of photo synthetically active radiation and greater photosynthesis by crop (Gill and Singh, 1985) (Dhurandher and Tripathi, 1999).

Effect of long-term integrated nutrient management on yield parameters of finger millet

The results of the field experiment carried out during kharif, 2018, to study the effect of long-term integrated nutrient management on the yield parameters of finger millet are presented in Table 3.

Test weight

1000 seed weight of finger millet varied significantly among the different treatments. Significantly higher test weight (3.56 gm) was recorded with the application of FYM @ 10 t ha⁻¹ + 100% RDF. (T₅). Kalaivanan and
Hattab (2016) reported that the increase in 1000 seed weight might be due to rapid nitrogen mineralization from organic sources with adequate supply of inorganic nitrogen leading to increased nutrition of crop that resulted in translocation of photo-syntheses to seeds, which ultimately recorded more test weight of seeds.

**Total dry matter production (g hill⁻¹)**

The total dry matter production (g hill⁻¹) varied significantly among the different treatments. Significantly higher total dry matter production (g hill⁻¹) (82.67) was recorded with the application of FYM @ 10 t ha⁻¹ + 100% RDF (T₅). Lower value was recorded for the absolute control (1.11 g hill⁻¹) the positive effect of farmyard manure in increasing the nutrients uptake leading to higher dry matter production as reported by Jayabharath and Sharanappa (2003), Avinish and Kushwaha (2006).

**Grain and straw yield**

Significant variations were observed in grain and straw yield of finger millet between the treatments. Significantly higher grain yield (20.96 q ha⁻¹) and straw yield (25.46 q ha⁻¹) was obtained with FYM @ 10 t ha⁻¹ + 100% RDF (T₅). The positive effect of increase in grain and straw yield of finger millet might be due higher and balanced supply of plant nutrients through organic sources and inorganic fertilizers (Rangaraj *et al*., 2007 and Selvamurugan *et al*., 2013).

**Table 1** Physical and chemical properties of soil prior to the experiment in 1978

| Physical properties                  |        |
|-------------------------------------|--------|
| Coarse sand (%)                     | 42.00  |
| Fine sand (%)                       | 30.50  |
| Silt (%)                            | 6.20   |
| Clay (%)                            | 21.20  |
| Textural class                      | Sandy clay loam |
| Maximum water holding capacity (%)  | 29.40  |
| Pore space (%)                      | 41.80  |
| Volume expansion (%)                | 2.40   |
| Bulk density (Mg m⁻³)               | 1.64   |

| Chemical properties                 |        |
|-------------------------------------|--------|
| pH                                  | 5.00   |
| EC (dS m⁻¹)                         | 0.20   |
| Organic carbon (%)                  | 0.40   |
| Available nitrogen (kg ha⁻¹)        | 200.0  |
| Available phosphorus (kg ha⁻¹)      | 8.70   |
| Available potassium (kg ha⁻¹)       | 132.80 |
| Exchangeable calcium (cmol (p⁺) kg⁻¹) | 2.30   |
| Exchangeable magnesium (cmol (p⁺) kg⁻¹) | 0.75   |
| Exchangeable potassium (cmol (p⁺) kg⁻¹) | 0.30   |
Table 2 Effect of long-term integrated nutrient management on growth and yield of finger millet

| Treatments                  | Plant height (cm) | No. of tillers/hill | No. of ear heads/hill | No. of fingers/ear head |
|-----------------------------|-------------------|---------------------|-----------------------|-------------------------|
| T₁: Absolute control       | 43.33             | 1.00                | 1.67                  | 3.40                    |
| T₂: 100% RDF               | 67.50             | 4.33                | 4.30                  | 5.20                    |
| T₃: FYM @ 10 t ha⁻¹        | 73.10             | 4.57                | 4.70                  | 5.32                    |
| T₄: FYM @ 10 t ha⁻¹ + 50% RDF | 80.13             | 5.73                | 6.17                  | 6.06                    |
| T₅: FYM @ 10 t ha⁻¹ + 100% RDF | 96.53             | 7.60                | 7.37                  | 6.61                    |
| T₆: Maize Residue @ 5 t ha⁻¹ | 61.53             | 4.37                | 4.00                  | 5.07                    |
| T₇: Maize Residue @ 5 t ha⁻¹ + 50% RDF | 77.50             | 5.57                | 5.67                  | 5.77                    |
| T₈: Maize Residue @ 5 t ha⁻¹ + 100% RDF | 79.43             | 5.67                | 5.90                  | 5.90                    |
| S.Em±                       | 3.59              | 0.32                | 0.32                  | 0.30                    |
| CD @ 5%                     | 10.89             | 0.97                | 0.99                  | 0.92                    |

Table 3 Effect of long-term integrated nutrient management on yield parameters of finger millet

| Treatments                  | Test weight (g) | Total dry matter production (g hill⁻¹) | Yield (qha⁻¹) |
|-----------------------------|-----------------|----------------------------------------|---------------|
|                             |                 | Grain                                  | Straw         |
| T₁: Absolute control        | 2.03            | 1.11                                   | 0.94          | 1.79          |
| T₂: 100% RDF               | 3.11            | 38.18                                  | 11.64         | 18.63         |
| T₃: FYM @ 10 t ha⁻¹        | 3.17            | 42.17                                  | 12.58         | 22.18         |
| T₄: FYM @ 10 t ha⁻¹ + 50% RDF | 3.47            | 56.87                                  | 18.09         | 21.73         |
| T₅: FYM @ 10 t ha⁻¹ + 100% RDF | 3.56            | 82.67                                  | 20.96         | 25.40         |
| T₆: Maize Residue @ 5 t ha⁻¹ | 3.06            | 28.80                                  | 7.64          | 12.90         |
| T₇: Maize Residue @ 5 t ha⁻¹ + 50% RDF | 3.28            | 46.13                                  | 15.45         | 20.65         |
| T₈: Maize Residue @ 5 t ha⁻¹ + 100% RDF | 3.32            | 50.17                                  | 16.37         | 21.28         |
| S.Em±                       | 0.20            | 2.77                                   | 0.72          | 0.99          |
| CD @ 5%                     | 0.60            | 8.40                                   | 2.19          | 3.01          |

In conclusion, application of organic fertilizers along with inorganic fertilizers had positive impact on crop growth and yield of finger millet and maintained good soil health. Among all the treatments imposed application of FYM @ 10 t ha⁻¹ + 100% RDF (T₅) was found to increase the growth and yield of finger millet.
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