Fertilizer responsiveness of short duration improved finger millet genotypes to different levels of NPK fertilizers

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ABSTRACT
A field experiment was carried out at Agricultural Research Station, Vizianagaram, during kharif, 2016 under rainfed conditions to know the fertilizer responsiveness of promising finger millet varieties to graded dose s of NPK fertilizers. Twenty treatment combinations were tested in split-plot design with three replications. Experimental results revealed that with 125% RDF grain yield increase was 10%, 27% and 48% higher than 100% RDF, 75% RDF and 50% RDF respectively. Among the finger millet genotypes, grain yield of VL-379(2037 kg/ha) and VL-352(1989 kg/ha) was significantly high and was at par with national check variety VR-708(1959 kg/ha). Both the test varieties (VL-379 and VL-352) were far superior to local check variety in terms of growth and yield characteristics. Higher net monetary returns and B:C ratio were obtained with VL-379, followed by VR-708 and VL-352 at 125% RDF.

Key words: Finger millet, Fertilizer response, RDF, Grain yield, Straw yield.

INTRODUCTION
Finger millet (Eleusine coracana (L.) Gaertn.) is a small seeded cereal grown in low rainfall areas of the semi arid tropics of the world. It is a hardy crop capable of providing reasonable grain yield under circumstances where most crops give negligible yield. Finger millet is a staple food crop in drought prone areas of the world and often considered as component of food security strategies. It plays an important role in both the dietary needs and income of many rural households where the crop is grown. It contains relatively higher concentration of calcium and dietary fibre than other cereals (Wondimu et al. 2001). In Andhra Pradesh, finger millet is a prominent crop among small millets. It has been growing in an area of 0.29 L.ha with 0.03 L.tonnes production and 952 kg/ha productivity. Andhra Pradesh occupied third place in finger millet production next to Karnataka and Tamil Nadu; However, its yields are lower in Andhra Pradesh due to different production problems like shortage of improved varieties, little research emphasis given to the crop, non adoption of improved technologies, improper fertilization, poor attitude towards the crop, prevalence of diseases like blast and banded sheath blight, lodging and moisture stress, etc. All the finger millet varieties will not respond alike to chemical fertilizers due to their extensive genetic diversity. Knowing of fertilizer responsiveness of a variety is very useful for its efficient fertilizer management. In this connection, this experiment was proposed to know the fertilizer responsiveness of some short duration improved genotypes of finger millet.

MATERIALS AND METHODS
A field experiment was conducted at Agricultural Research Station, Vizianagaram, Andhra Pradesh under rainfed conditions during kharif, 2016. The soil of the experimental site was sandy loam in texture, neutral in reaction (7.38), low in organic carbon content (0.31%) with the electric conductivity 0.09 dS/m. The available nitrogen, phosphorus and potassium in the soil were low (171.43 kg/ha), high (69.55 kg/ha) and medium (258.23 kg/ha) respectively. Average maximum temperature during crop season was 30.5°C and average minimum temperature was 28.6°C. The total amount of rainfall received during crop season was 886.8 mm in 50 rainy days. Experiment was laid out in split plot design replicated thrice with fertilizer levels were assigned to main plot treatments (F1:50% RDF, F2:75% RDF, F3:100% RDF, F4:125% RDF) and improved finger millet genotypes to subplot treatments (V1:VL-379, V2:VL-352, V3:VR-708 (National check), V4:GPU-45(National check) and V5: Udaramalligae(Local check)).

Recommended dose of NPK was 50-40-25 kg/ha applied in the form of urea, single super phosphate and muriate of potash. Nursery was sown on 17.06.2016. Transplanting was done with 25 days old seedlings on 12.07.2016. Gross plot and net plot sizes were 3.0m × 4.5m and 2.4 m × 4.2 m respectively. Two inter cultivations were taken up at 30 and 45 days after sowing. The recommended plant protection measures were followed whenever necessary. Five plants from each plot were selected randomly at harvest to record the biometric observations like...
plant height, number of productive tillers per plant, ear head length, number of fingers per ear and dry matter production. After harvest, grain yield (kg/ha), straw yield (kg/ha) and test weight (g) were taken. By taking into account the cost of cultivation and returns, benefit cost ratio and partial budgeting were calculated. The soil samples were collected after harvest of the crop from respective treatments and were analysed for available nutrient status. All the data was analyzed statistically following the standard procedures as described by Gomez and Gomez (1984).

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\text{Per day productivity} = \frac{\text{Grain yield per hectare (kg)}}{\text{Crop duration (days)}}
\]

Partial budgeting = \[\frac{\text{[(Added income + Reduced costs) - (Added costs + Reduced income)]}}{\text{Crop duration}}\]

RESULTS AND DISCUSSION

Growth and yield attributes: Growth and yield attributes were significantly affected by different treatments. Days taken to attain 50% flowering was increased with increasing dose of NPK fertilizers (Table 1). Among the finger millet genotypes, VL-352 took minimum days (63.1) to attain 50% flowering, whereas GPU-45 took more days (91.8). Plant height was maximum in 125% RDF (115 cm) compared to 100%, 75% and 50% RDF. Lemesa Amente (2016) and Rashid and Khan (2008) also reported linear increase in plant height of finger millet and barley respectively with increasing level of fertilizer. Among all the varieties VL-352 was shorter in height (99 cm), whereas VR-708 was taller (114.9 cm). Productive tillers per plant, fingers per ear and earhead length were found maximum in 125% RDF followed by 100% RDF (Table 1). Similar results of increased yield attributes with increased dose of NPK fertilizers were reported by Triveni et al. (2017), Mesfin and Zemach (2015) and Maitra et al. (2001). Among the varieties maximum number of productive tillers per plant, fingers per ear and earhead length were recorded in VL-379; however, it was on par with VL-352. Minimum yield attributes were recorded in the local check variety Udaramalligae.

Earhead weight per hill and seed index were significantly high in 125% RDF (17.7 g and 3.5 g) followed by 100% RDF (16.5 g and 3.3 g). Among the finger millet genotypes, VL-379 had maximum earhead weight per hill (19.2 g), while it was minimum in local check variety Udaramalligae (12.3 g). Dry matter production was significantly high with 125% RDF; however, it was on par with 100% RDF and 75% RDF. Among the varieties, maximum dry matter production was recorded with VL-379, whereas lowest dry matter was recorded in GPU-45 followed by VL-352 and Udaramalligae.

Yield and economics: Grain yield and straw yield were higher with 125% RDF (2204 kg/ha & 6308 kg/ha respectively), while they were minimum with 50% RDF (1487 kg/ha and 5056 kg/ha respectively) (Table 2). These results are in line with the results obtained by Triveni et al. (2017) who reported significant increase in grain yield at 150% RDF for long duration finger millet varieties. Application of 125% RDF to short duration finger millet genotypes resulted in significant improvement in grain yield at Begaluru and Perumalapalli (Anonymous, 2015-16). Among the improved genotypes, VL-379 had maximum grain and straw yields (2037 kg/ha & 6468 kg/ha respectively) followed by VL-352 and VR-708. Interaction between fertilizer levels and improved genotypes was not significant for all the growth and yield parameters.

Per day productivity of VL-352 was significantly high with 125% RDF and 100% RDF followed by VL-379 at 125% RDF (Table 2). This might be attributed to their shorter duration and higher yield. Considering the economics, highest net monetary returns and benefit cost ratio were observed with VL-379, VR-708 and VL-352 at 125% RDF (Table 2).

Table 1: Effect of different levels of NPK fertilizers on growth and yield attributes of improved genotypes of finger millet.

| Treatment          | Days to 50% flowering | Plant height (cm) | Productive tillers/plant | Fingers/ear | Ear head length (cm) | Ear wt(g)/hill | Seed index (g) |
|--------------------|------------------------|-------------------|---------------------------|-------------|----------------------|---------------|----------------|
| **Fertilizer levels** |                        |                   |                           |             |                      |               |                |
| 50% RDF            | 76.3                   | 105.0             | 2.3                       | 7.8         | 7.9                  | 13.6          | 2.6            |
| 75% RDF            | 77.8                   | 106.5             | 2.5                       | 8.2         | 8.3                  | 14.6          | 3.0            |
| 100% RDF           | 78.7                   | 107.7             | 3.1                       | 8.6         | 8.5                  | 16.5          | 3.3            |
| 125% RDF           | 79.9                   | 115.4             | 3.4                       | 8.9         | 8.8                  | 17.7          | 3.5            |
| C.D (p=0.05)       | 1.5                    | 6.3               | 0.35                      | 0.7         | 0.6                  | 1.9           | 0.23           |
| **Improved genotypes** |                        |                   |                           |             |                      |               |                |
| VL-379             | 73.2                   | 108.8             | 3.2                       | 9.7         | 9.4                  | 19.2          | 3.1            |
| VL-352             | 63.1                   | 99.0              | 3.1                       | 9.4         | 9.1                  | 17.0          | 3.1            |
| VR-708             | 75.8                   | 114.9             | 3.0                       | 8.2         | 7.9                  | 15.9          | 3.8            |
| GPU-45             | 91.8                   | 107.3             | 2.7                       | 7.7         | 7.7                  | 13.7          | 2.9            |
| Udaramalligae      | 87.2                   | 113.2             | 2.2                       | 7.0         | 7.7                  | 12.3          | 2.2            |
| C.D (p=0.05)       | 1.2                    | 6.0               | 0.37                      | 0.5         | 0.5                  | 2.0           | 0.21           |

**Interaction effect of fertilizer levels and improved genotypes**

| C.D (p=0.05) | NS | NS | NS | NS | NS | NS | NS |
Table 2: Effect of different levels of NPK fertilizers on grain and straw yield of improved genotypes of finger millet.

| Treatments | Dry matter (kg/ha) | Grain yield (kg/ha) | Straw yield (kg/ha) | Net monetary returns (Rs/ha) | B:C ratio | Per day productivity (kg/ha) |
|------------|--------------------|---------------------|--------------------|------------------------------|-----------|-----------------------------|
| **Fertilizer levels** |                     |                     |                    |                              |           |                             |
| 50% RDF    | 9402               | 1487                | 5056               | 14142                        | 0.76      | 12.9                        |
| 75% RDF    | 9775               | 1742                | 5563               | 18995                        | 0.98      | 16.4                        |
| 100% RDF   | 10240              | 1998                | 5992               | 23860                        | 1.19      | 18.7                        |
| 125% RDF   | 10476              | 2204                | 6308               | 27615                        | 1.32      | 20.7                        |
| C.D (p=0.05) | 7488               | 111                 | 503                | -                            | -         | -                           |
| **Improved genotypes** |                     |                     |                    |                              |           |                             |
| VL-379     | 10801              | 2037                | 6468               | 25092                        | 1.26      | 19.3                        |
| VL-352     | 9794               | 1989                | 6194               | 24035                        | 1.21      | 21.7                        |
| VR-708     | 10077              | 1959                | 5963               | 23380                        | 1.18      | 18.6                        |
| GPU- 45    | 9345               | 1789                | 5331               | 19646                        | 0.99      | 14.2                        |
| Udaramalligae | 9848              | 1515                | 5526               | 13612                        | 0.68      | 12.2                        |
| C.D (p=0.05) | 584                | 129                 | 318                | -                            | -         | -                           |
| **Interaction effect of fertilizer levels and improved genotypes** |                     |                     |                    |                              |           |                             |
| C.D (p=0.05) | NS                 | NS                  | NS                 | -                            | -         | -                           |

For calculation of partial budgeting, minimum fertilizer dose i.e. 50%RDF was taken as control. In all the finger millet genotypes, net income after deducting the fertilizer costs was increased with the increasing dose of fertilizers. Maximum net income (Rs.15584) was obtained with VL-379 with the increase in the fertilizer dose from 50%RDF to 125% RDF (Table 3).

Post harvest soil properties: Soil reaction, electric conductivity and organic carbon content were not altered significantly with varying levels of fertilizers and with different improved genotypes of finger millet. But post harvest soil available nitrogen, phosphorus and potassium were found maximum with 125%RDF compared to lower doses (Table 4). Among the finger millet genotypes, soil available nitrogen, phosphorus and potassium were high with Udaramalligae variety. Low yields due to minimum nutrient uptake might have contributed to higher soil available NPK.

**CONCLUSION**

Both the finger millet improved genotypes VL-379 and VL-352 were found superior in terms of growth and yield attributing characters at 125% RDF as against 100% RDF.
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