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Influence of NPK fertilizers on blast incidence, productivity and profitability of short duration improved finger millet genotypes

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Abstract
High yielding varieties are more responsive to NPK fertilizers compared to the traditional varieties in increasing the grain yield. A field experiment was conducted during *kharif*, 2018-19 at Agricultural Research Station, Vizianagaram to assess the performance of two finger millet improved genotypes (PR 10-35 and KOPN 942) at various levels of NPK fertilizers (75% RDF,100% RDF& 125% RDF) compared to the national checks (GPU 45& GPU 67) and local check (PR 202) varieties. Results revealed that, grain yield and B:C ratio increased significantly from 75% RDF to 100% RDF but was non significant from 100% RDF to 125% RDF. PR 10-35 recorded highest growth and yield attributes among different varieties. Grain yield, B:C ratio were also significantly high for PR 10-35 than KOPN 942 and is also found superior to national and local check varieties. Neck and finger blast incidences were also less in PR 10-35.

Keywords: NPK fertilizers, productivity, blast, finger millet

Introduction

Finger millet has an excellent nutritional value. It contains high calcium (344mg), phosphorus (283mg), protein (6-8%), dietary fibre (18-20%), minerals (2-2.25%) (Shobana *et al*., 2009) [10] and two sulphur containing amino acids methionine and cysteine (Fayisa *et al*., 2016) [2]. Hence, it is considered as an wholesome food for prevention of malnutrition in under developed areas. Finger millet is a hardy crop grows very well in semiarid tropics and act as a staple food to the millions of people in Asia and Africa. However, the productivity of finger millet is significantly low to meet the needs of the consumers, as it is predominantly grown by the poor farmers under suboptimal conditions. Using low yielding traditional varieties along with non adoption of improved agronomic practices further aggravate the problem of obtaining low yields. In recent times, due to the prevalence of lifestyle diseases and increased awareness about the nutritional importance of small millets, much demand has been created for millets. In order to increase the finger millet productivity, it is necessary to introduce the high yielding varieties in the areas where traditional low yielding varieties are rampant. Further, high yielding varieties require high input management. Improved varieties differ from one another in their responsiveness towards inputs like fertilizers. Hence it is essential to screen different high yielding varieties at various fertilizer doses in order to facilitate judicious use of costly chemical fertilizers and also for selection of varieties based on soil fertility status. Keeping this in view, this study has been conducted to evaluate the performance of high yielding finger millet genotypes and their responsiveness towards various levels of nutrients.

Materials and Methods

A field experiment was conducted at Agricultural Research Station, Vizianagaram, Andhra Pradesh under rainfed conditions during *kharif*, 2018. The experimental site was sandy loam in texture, neutral in reaction (pH 7.33), low in organic carbon content (0.36%) with the electric conductivity 0.43 dS/m. The available nitrogen, phosphorus and potassium in the soil were low (188 kg/ ha), high (55 kg/ha) and medium (172 kg/ha) respectively. Average maximum temperature during crop season was 30.4 ºC and average minimum temperature was 27.3 °C. Mean maximum relative humidity was 79.7% and mean minimum relative humidity was 43.6% during crop season. The total amount of rainfall received during crop season was 845 mm in 43 rainy days. Experiment was laid out in split plot design replicated thrice with fertilizer levels were assigned to main plot treatments (F_1: 75% RDF, F_2: 100% RDF, F_3: 125% RDF) and improved finger millet varieties (V_1: PR 10-14, V_2: KOPN 942) along with national checks (V_3: GPU 45, V_4: GPU 67) and local check (V_5: PR 202) were assigned to subplots.

Recommended Dose of Fertilizers (50-40-25 kg/ha) were applied as per treatments in the form of urea, single super phosphate and murate of potash. Half dose of nitrogen and potassium and entire dose of phosphorus was applied as basal and remaining half dose of nitrogen was applied 30 days after transplanting. Second half dose of potassium was applied at the time of panicle initiation stage. Nursery sowing and transplantation were taken up on 22.06.2018 and 19.07.2018 respectively. Pre emergence herbicide Pendimethalin was applied immediately after transplanting. At 30DAT, one inter cultivation was taken up with hand hoes. Plant protection measures were followed whenever necessary. As Agricultural Research Station, Vizianagaram is a hotspot for blast disease, disease data on leaf blast, neck blast and finger blast were recorded from five randomly selected plants from each plot for recording the observations. Five plants from each plot were selected randomly at harvest to record the observations. After harvest, grain yield (kg/ha), straw yield (kg/ha) and test weight (g) were taken. By taking into consideration of all costs incurred and returns obtained in the form of grain and straw yield, economics were worked out. The soil samples were collected after harvest of the crop from respective treatments and were analysed for available nutrient status. All the recorded observations were statistically analyzed.

Results and Discussion

Different varieties vary significantly in flowering time and days to maturity. However, various fertilizer levels have slightly influenced the days to flowering and maturity of the varieties. PR 10-35 has shown early flowering and maturity which was comparable with GPU 45 and PR 202. However, KOPN 942 has taken one and two weeks more time to flowering and maturity respectively compared to PR 10-35. Increased fertilizer dose from 75% RDF to 125% RDF has extended flowering time and maturity by 1-3 days (Table 1). Tenywa *et al*., 1999 [11] stated that application of inorganic fertilizers delay the flowering and physiological maturity by 1-2 weeks. Plant height and productive tillers have significantly increased with increase in the fertilizer dose upto 125% RDF compared to 75% and 100% RDF. Nitrogen plays a significant role in increasing the plant height through cytokinin production which in turn effects cell wall elasticity, increase in number of meristematic cells and cell growth (Razaq *et al*. 2017) [9]. However, fingers per ear and ear head length were not increased significantly at 125% RDF compared to 100% RDF. Similar results were reported by Triveni *et al*. (2018) [13].

Among all the varieties, KOPN 942 was the tallest variety (111.2cm) while, GPU 67 was the shortest variety (98.7cm). PR 10-35 has maximum number of productive tillers per plant and fingers per ear and was on par with national and local check varieties but significantly higher than KOPN 942. Length of the ear head in PR 10-35 was significantly higher (7.9 cm) than all other varieties. Genetic variation among the varieties might have contributed to the differences in growth and yield attributes.

Grain yield at 125% RDF was on par with 100% RDF and the increase was only 7.5% compared to 100% RDF. However, straw yield increased by 11.0% at 125% RDF and was significant compared to lower levels of recommended dose of fertilizer (Table 2). Munirathnam and Kumar (2015) [8] also reported significant increase in grain yield upto 60kg N/ha. However, the grain yield increase was not significant with further increase in the nitrogen dose upto 80kg/ha. Hegde and Gowda (1986) [4] reported that factor productivity of nitrogen was declined from 23.1 kg grain/kg N to 19.9 kg grain / kg N with increase in nitrogen application from 20 kg N ha^{-1} to 60 kg N ha^{-1} in finger millet. In contrast to this, grain and straw yield increase were significant in finger millet at 150% RDF compared to 100% RDF (Triveni *et al*., 2017) [12]. Divyashree *et al*., 2018 stated that, application of the highest dose of NPK (30-20-10 kg/ha) produced higher grain yield, straw yield and grain protein content in little millet compared to the lower levels of NPK fertilizers. No significant difference in test weight, net return, B:C ratio was observed in 125% RDF compared to 100% RDF, wherein, significant differences were found compared to 75% RDF.

PR 10-35 recorded significantly highest grain yield (2933 kg/ha) among all the varieties, while KOPN 942 recorded the lowest grain yield (1760 kg/ha) (Table 2). However, straw yield recorded by KOPN 942 was found maximum (6763 kg/ha) and was on par with PR 202 and PR 10-35. Maximum plant height might have contributed to maximum straw yield in KOPN 942. Gupta *et al*., 2012 [3] reported that finger millet genotypes vary in their response to N fertilizers. PRM-1 is high nitrogen responsive and has high nitrogen use efficiency, whereas PRM-701 and PRM-801 are low nitrogen responsive genotypes. PR 10-35 recorded maximum test weight(3.2g) and was comparable with the local check PR 202(3.13g) and national check GPU 45(3.03 g).Further, net returns and B:C ratio were significantly high in PR 10-35 compared to all other varieties. Interaction between fertilizer levels and varieties was non-significant for all the growth, yield attributes and grain yield.

Leaf blast incidence was significantly high at 125% RDF compared to 100% RDF and 75% RDF. Neck blast and finger blast were not statistically significant at different fertilizer levels. However, numerically 125%RDF recorded maximum neck and finger blast percentage. (Table 3) Similar results were reported in finger millet and rice respectively by Kumar and Yadav (2012) [5] and Long *et al*. (2000) [6]. Blast infection is favored by cloudy skies, frequent rain and drizzles, which support accumulation of dew on leaves for a long time which helps in the conidial germination of blast spores (Mgonja *et al*. 2011) [7]. Among the varieties, GPU-45 recorded highest leaf blast, wherein GPU-67 recorded lowest leaf blast. Neck blast percentage was significantly high in PR-202 and significantly low in PR 10-35. Finger blast percentage was highest in GPU-45 and KOPN 942.PR-202 and PR 10-35 were recorded lowest finger blast percentage.

Fertilizer levels and varieties were not significantly affected the soil pH, electric conductivity and organic carbon content. Soil available nitrogen and phosphorus were significantly high in 125% RDF compared to 75% RDF and 100% RDF. However, soil available potassium at 125% RDF was on par with soil available potassium at 100% RDF. Among the varieties, soil available NPK were significantly low in PR 10-35 while, significantly high in GPU 67. Higher grain and straw yields in PR 10-35 might have extracted more nutrients from applied fertilizers as well as from soil available forms of nutrients. Interaction between fertilizer levels and varieties was significant in case of soil available nitrogen and was non-significant for soil available phosphorus and potassium (Table 4).

From this study, it is concluded that, PR 10-35 is identified as a good yielder and fertilizer responsive and is also found superior to existing national and local check varieties. Neck and finger blast incidences were also less in PR 10-35 compared to KOPN 942. Among different NPK fertilizer levels, response to grain yield was significant upto 100%RDF and thereafter with further increase upto 125% RDF, response was not significant.

Table 1: Effect of different levels of NPK fertilizers on growth and yield attributes of pre release Finger millet varieties

Treatments	Days to 50% flowering	Days to maturity	Plant height (cm)	Productive tillers/ plant	Fingers/ear	Ear head length
Main plots :Fertilizer levels (F)						
F1: 75% RDF	87	120	103.0	3.0	7.1	6.5
F2: 100% RDF	88	121	105.8	3.5	7.6	7.0
F3: 125% RDF	88	123	108.9	3.7	7.8	7.4
S.Em±	0.22	0.28	0.78	0.06	0.14	0.18
CD (p=0.05)	0.88	1.09	3.05	0.24	0.56	0.69
Subplots: Pre release varieties(V)						
V1:PR 10-35	85	115	108.8	3.6	8.0	7.9
V2: KOPN 942	91	127	111.2	3.2	7.2	6.4
V3:GPU-45(National check)	83	112	104.9	3.4	7.5	6.9
V4:GPU-67(National check)	91	131	98.7	3.4	7.4	6.6
V5:PR-202(Local check)	86	116	105.2	3.5	7.8	7.1
S.Em±	0.25	0.23	0.76	0.07	0.19	0.12
CD (p=0.05)	0.72	0.66	2.16	0.20	0.53	0.34
Interaction	NS	NS	NS	NS	NS	NS

Table 2: Effect of different levels of NPK fertilizers on yield and economics of pre release Finger millet varieties

Treatments	Grain yield(kg/ha)	Straw yield (kg/ha)	Test weight(g)	Net returns ($\times 10^4$ Rs/ha)	B:C
Main plots :Fertilizer levels (F)					
F1: 75% RDF	2096	5077	2.45	2.47	1.09
F2: 100% RDF	2297	5647	3.01	3.39	1.44
F3: 125% RDF	2469	6265	3.21	3.74	1.54
S.Em±	50.0	139.0	0.08	0.13	0.052
CD (p=0.05)	196.4	545.8	0.33	0.49	0.202
Subplots: Pre release varieties(V)					
V1:PR 10-35	2933	6443	3.20	4.82	2.04
V2: KOPN 942	1760	6763	2.46	1.88	0.80
V3:GPU- 45 (National check)	2333	5389	3.03	3.31	1.41
V4:GPU- 67 (National check)	2123	4057	2.86	2.79	1.18
V5:PR-202(Local check)	2689	6481	3.13	4.21	1.78
S.Em±	73.1	126.0	0.07	0.18	0.077
CD (p=0.05)	208.9	360.1	0.21	0.52	0.221
Interaction	NS	NS	NS	NS	NS

Table 3: Effect of different levels of NPK fertilizers on blast incidence of various finger millet varieties.

Treatments	Leaf Blast (Grade)	Neck blast (%)	Finger Blast (%)
Main plots :Fertilizer levels (F)			
F1: 75% RDF	2.1	26.9	23.0
F2: 100% RDF	2.6	32.9	27.6
F3: 125% RDF	3.5	38.3	34.1
S.Em±	0.16	3.95	2.5
CD (p=0.05)	0.63	NS	NS
Subplots: Pre release varieties(V)			
V1:PR 10-35	2.9	28.7	23.9
V2: KOPN 942	2.3	35.6	31.6
V3:GPU-45 (National check)	3.7	33.3	31.9
V4:GPU-67 (National check)	2.1	33.3	25.5
V5:PR-202(Local check)	3.0	48.9	23.2
S.Em±	0.27	2.32	1.51
CD (p=0.05)	0.77	6.64	4.33
Interaction			
i. Two sub plots means at same level of main plot means			
S.Em±	0.46	4.0	2.62
CD (p=0.05)	NS	NS	NS
ii. Two main plots means at same (or) different level of sub plot means			
S.Em±	0.45	5.3	3.43
CD (p=0.05)	NS	NS	NS

Table 4: Effect of different levels of NPK fertilizers and pre release Finger millet varieties on soil properties and nutrient availability.

Treatments	pH	EC (dS/m)	OC (%)	Available N	Available P	Available K
Main plots :Fertilizer levels (F)						
F1: 75% RDF	7.32	0.41	0.352	183.42	53.8	169.1
F2: 100% RDF	7.34	0.43	0.357	189.42	54.9	174.0
F3: 125% RDF	7.33	0.44	0.369	193.58	56.9	175.2
S.Em±	0.04	0.006	0.004	1.05	0.13	0.59
CD (p=0.05)	NS	NS	NS	4.13	0.50	2.3
Subplots: Pre release varieties(V)						
V1:PR 10-35	7.30	0.43	0.358	181.9	53.9	169.4
V2: KOPN 942	7.36	0.43	0.357	187.9	55.2	172.4
V3:GPU-45 (National check)	7.39	0.44	0.359	190.9	55.8	173.5
V4:GPU-67 (National check)	7.26	0.42	0.363	194.6	55.9	175.9
V5:PR-202(Local check)	7.33	0.43	0.359	185.2	54.6	170.9
S.Em±	0.03	0.007	0.006	0.39	0.15	0.60
CD (p=0.05)	NS	NS	NS	1.12	0.43	1.71
Interaction						
i. Two sub plots means at same level of main plot means						
S.Em±	0.05	0.012	0.01	0.68	0.26	1.04
CD (p=0.05)	NS	NS	NS	1.94	NS	NS
ii. Two main plots means at same (or)different level of sub plot means						
S.Em±	0.06	0.013	0.01	1.21	0.27	1.1
CD (p=0.05)	NS	NS	NS	4.51	NS	NS

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