CULTIVARS AND NITROGEN LEVELS INFLUENCE ON YIELD ATTRIBUTES, YIELD AND PROTEIN CONTENT OF PEARL MILLET UNDER SEMI-ARID CONDITION OF VINDHYAN REGION

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KEYWORDS

Bajra
Nutrition
Vertical performance
Agri-horti system

ABSTRACT

The field experiment was taken under agri-horti system at RGSC farm of BHU, at Mirzapur (UP) during kharif season of 2013 with aim to find out suitable cultivar and nitrogen levels for pearl millet production. The field experiment was laid out in a randomized complete block design (factorial) with three cultivars viz. Pioneer 86M86, Kaveri Super Boss and ICTP-8203 and four nitrogen levels: 0, 60, 90 and 120 kg N/ha with constant rates of phosphorus and potassium at 40 and 30 kg ha\(^{-1}\), respectively. Pioneer 86M86 recorded 17.07 and 27.31 per cent higher yield and 9.3 and 12.41 per cent higher N uptake in grain than Super Boss and ICTP-8203, respectively. Nitrogen levels had variable response on yield attributing characters and maximum grain yield was recorded with 120 kg N ha\(^{-1}\) however; it was statistically at par with 90 kg N ha\(^{-1}\). The increase in grain yield with 120 kg N ha\(^{-1}\) was in tune of 10.04, 19.13 and 36.84 per cent from 90, 60 and 0 kg N ha\(^{-1}\), respectively. Nitrogen uptake in grain with 120 kg N ha\(^{-1}\)was higher than 90, 60 and 0 kg N ha\(^{-1}\) in tune of 16.28, 24.26 and 43.30 per cent, respectively.

INTRODUCTION

Millet is a group of small-grained cereal grown around the world for food and fodder. Millets is known to be ‘crops of the future’ as it well adapted and cultivated under harsh environment of arid and semi-arid region (RESMISA, 2012). Arid and semi-arid regions constitute more than 50 percent of the total area of India, inhabited by nearly 60 percent of the rural population (ICAR, 2006). The Vindhyan region represent a typical semi arid ecosystem viz. low and erratic rainfall, intense solar radiation, high wind velocity, recurring drought and famines. To ease out these agroclimatic problems, the integration of fruit trees with agricultural crops (agri-horti system) is most suitable option which provides more diverse, productive, profitable, healthy and sustainable land-use systems (Singh et al., 2007).

Development of hybrids with good adaptation to diverse production environments with short maturity duration (mostly 75-85 days) develop new vista for cultivation of pearl millet under agri-horti system. In agri-horti system, the fruit trees not only supplement the fuel needs of the farmers but also provide additional income, employment and nutritious food material required for a balanced diet. Fruit trees ensure efficient use of land and water, higher profits per unit area and also mitigate the micronutrient malnutrition through food diversification. Pearl millet grains have higher protein content (10.6%), more balanced amino acid profile, and also contribute about one third of iron and zinc requirements (Manga and Kumar, 2011). Pearl millet is an indispensable arid and semi arid crop (Ramesh et al., 2006) ranks first under the category of millets in terms of area (9.07 M ha), production (10.05 MT), productivity (1.1 ton/ha) and contributing 8.89% to total production of coarse cereals in India (NRAA, 2012a). A total of 150 improved cultivars were released during the last 50 years, which provided a wider cultivar choice to farmers in various agro-ecological regions (NRAA, 2012b). The increase in productivity of pearl millet from 0.31 t/ha to 1.08 t/ha from 1950-55 to 2010-11 (NRAA, 2012c) was attributed not only for adoption of improved technology but also for exploitation of improved varieties and hybrids.

Poor soil fertility and erratic rains are the most important constraints to crop production in arid and semi arid region. Soil fertility management i.e nutrient management particularly nitrogen plays a major role in increasing production and productivity of pearl millet. Nitrogen (N) is an essential nutrient and key limiting factor in crop production of different agro-ecosystems. Nitrogen is the major nutrient required by pearl millet under agri-horti system which positively increases the growth attributes, length and width of panicle, test weight, number of grain panicle\(^{-1}\), grain weight panicle\(^{-1}\) and finally improve the yield (Prasad et al., 2014). Keeping the importance of pearl millet under semi arid region and importance of nitrogen fertilizer, an experiment was conducted to assess the yield attributes, yield and protein content of pearl millet cultivars with nitrogen levels under agri-horti system at Vindhyan region.

MATERIALS AND METHODS

The experiment was conducted during rainy (kharif) season of 2013-14 at the
The research was tested with three cultivars, randomized complete block design (factorial) and replicated as per procedure of Gomez and Gomez (1984). From the field experiment were subjected to statistical analysis for total nitrogen content (A.O.A.C., 1970). The data collected for protein content in grain was estimated by multiplying the nitrogen content in yield with its respective nitrogen content. Protein content in grain was estimated by multiplying the nitrogen content in yield with the factor 6.25 (A.O.A.C., 1970). The uptake of nitrogen by pearl millet cultivars was sown with 45 × 15 cm spacing in between the alleys of guava tree planted at 7x7 m. Growth parameters particularly dry matter accumulation, yield attributes (length of panicle, girth of panicle, number of grain per panicle and test weight) and yield (grain and stover) of each plot was recorded at harvest. Yield obtained from each plot was converted to kg/ha. After harvest of crop the grain and stover samples were analysed for total nitrogen content (Jackson, 1973). Uptake of nitrogen (grain and stover) was calculated through grain and stover yield with its respective nitrogen content. Protein content in grain was estimated by multiplying the nitrogen content in grain with the factor 6.25 (A.O.A.C., 1970). The data collected from the field experiment were subjected to statistical analysis as per procedure of Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Nitrogen had recorded significant effect on pearl millet cultivars under agri-horti system (Table 1). The yield attributing characters viz. length of panicle, girth of panicle and number of grain per panicle was recorded higher with Pioneer 86M86 which was significantly higher than ICTP-8203 but statically at par with Kaveri Super Boss. The increase in length of panicle, girth of panicle and number of grain per panicle was in tune of 23.23, 19.82 and 27.82 % with ICTP-8203. However, the Pioneer 86M86 recorded significantly maximum test weight and was higher than Kaveri Super Boss and Pioneer 86M86 in tune of 30.89 and 23.98 %, respectively. This finding corroborates the findings of Obeng et al. (2012) and Dalal et al. (2005).

The variable performance of pearl millet was recorded with nitrogen levels on yield attributing characters (Table 1). The significant maximum length of panicle and number of grain per panicle was recorded with 120 kg N ha⁻¹. However, length of panicle and number of grain per panicle with 120 kg N ha⁻¹ was statistically at par with all lower nitrogen levels, except control. Significantly maximum girth of panicle was recorded with 120 kg N ha⁻¹ followed by 90, 60 kg N ha⁻¹ and control. The increase in girth of panicle from 0, 60 and 90 kg N ha⁻¹ was in tune of 37.66, 16.00 and 2.45 per cent, respectively. The increase in length and girth of panicle at higher level of nitrogen might be attributed to better nutrition of panicle primodia. Higher number of grain might be associated with length and girth of panicle. Similar research finding was reported by Prasad et al. (2014). Test weight was significantly influenced by nitrogen levels (Table 1). The significantly maximum test weight was recorded with 120 kg N ha⁻¹ followed by 90, 60 and 0 kg N ha⁻¹. Test weight is associated with genetic makeup of variety however ample availability of nitrogen leads to better nutrition of spikelets which confirms with the findings of Kumar et al. (2005) and Vermel et al. (2006).

The Pioneer 86M86 recorded significantly maximum grain yield than Kaveri Super Boss and ICTP-8203. The increased grain yield of Pioneer 86M86 was in tune of 17.07 and 27.31 per cent with Kaveri Super Boss and ICTP-8203, respectively under agri-horti system. However, the significantly maximum stover yield was recorded with Kaveri Super Boss followed by Pioneer 86M86 and ICTP-8203. The increase of grain yield in response to nitrogen levels under agri-horti system was significant. The maximum grain yield was recorded with 120 kg N ha⁻¹ however; it was statistically at par with 90 kg N ha⁻¹. The increase in grain yield with 120 kg N ha⁻¹ was in tune of 19.13 and 36.84 per cent than 60 and 0 kg N ha⁻¹, respectively. The stover yield was recorded to reverse to grain yield and maximum with 90 kg N ha⁻¹. Grain yield is the outcome of yield attributing characters and adequate metabolic activities of crop. Nitrogen application increases the physico-chemical processes of crop leads to higher grain yield. The results are

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Length of panicle (cm)</th>
<th>Girth of panicle (cm)</th>
<th>No. of grain panicle</th>
<th>Test weight (g)</th>
<th>Yield (t ha⁻¹)</th>
<th>Nitrogen content (%)</th>
<th>Uptake (kg ha⁻¹)</th>
<th>Protein content (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cultivars (V)</td>
<td></td>
<td></td>
<td>No. of grain panicle</td>
<td>Test weight</td>
<td>Yield (t ha⁻¹)</td>
<td>Nitrogen content (%)</td>
<td>Uptake (kg ha⁻¹)</td>
<td>Protein content (%)</td>
</tr>
<tr>
<td>Pioneer 86M86</td>
<td>25.06</td>
<td>6.53</td>
<td>2163.09</td>
<td>7.48</td>
<td>2.05</td>
<td>7.79</td>
<td>1.97</td>
<td>12.31</td>
</tr>
<tr>
<td>Kaveri Super Boss</td>
<td>24.37</td>
<td>6.10</td>
<td>2028.02</td>
<td>6.80</td>
<td>1.70</td>
<td>8.10</td>
<td>1.79</td>
<td>11.17</td>
</tr>
<tr>
<td>ICTP-8203</td>
<td>19.24</td>
<td>5.25</td>
<td>1561.44</td>
<td>9.84</td>
<td>1.49</td>
<td>5.97</td>
<td>1.73</td>
<td>10.79</td>
</tr>
<tr>
<td>C.D at 5%</td>
<td>2.78</td>
<td>0.87</td>
<td>189.16</td>
<td>0.85</td>
<td>0.25</td>
<td>0.46</td>
<td>0.15</td>
<td>0.95</td>
</tr>
<tr>
<td>Nitrogen levels (N)</td>
<td>20.21</td>
<td>4.32</td>
<td>1692.96</td>
<td>6.90</td>
<td>1.32</td>
<td>6.34</td>
<td>1.31</td>
<td>8.19</td>
</tr>
<tr>
<td>60 kg ha⁻¹</td>
<td>22.87</td>
<td>5.82</td>
<td>1834.66</td>
<td>7.68</td>
<td>1.69</td>
<td>7.17</td>
<td>1.75</td>
<td>10.94</td>
</tr>
<tr>
<td>90 kg ha⁻¹</td>
<td>23.81</td>
<td>6.76</td>
<td>2040.16</td>
<td>8.13</td>
<td>1.88</td>
<td>7.91</td>
<td>1.94</td>
<td>12.10</td>
</tr>
<tr>
<td>120 kg ha⁻¹</td>
<td>24.66</td>
<td>6.93</td>
<td>2102.29</td>
<td>9.44</td>
<td>2.09</td>
<td>8.73</td>
<td>2.31</td>
<td>14.45</td>
</tr>
<tr>
<td>C.D at 5%</td>
<td>1.09</td>
<td>0.34</td>
<td>74.47</td>
<td>0.33</td>
<td>0.10</td>
<td>0.06</td>
<td>0.02</td>
<td>0.37</td>
</tr>
</tbody>
</table>

NS: not significant
Nitrogen content and uptake in grain and stover was recorded maximum with Pioneer 86M86 and followed by Kaveri Super Boss and ICTP-8203. Nitrogen levels recorded significantly maximum nitrogen content and uptake in both grain and straw with 120 kg N ha⁻¹ followed by the lower levels of nitrogen. The nutrient uptake of plant depends on biomass production, nutrient concentration in plant and genetical feature of plant (Binjola and Kumar, 2013). Similar results were observed by Ayub et al. (2009) and Yakadri et al. (2009). Protein content is dependent on genotype of cultivars and also influenced by environmental variables viz. nitrogen application, soil moisture and temperature during phenophase especially during the grain filling period (Abedi et al., 2011). The maximum protein content in grain was recorded with Pioneer 86M86 which was higher in tune of 9.26 and 12.34 per cent from Kaveri Super Boss and ICTP-8203, respectively. Nitrogen levels had positive effect on protein content and maximum protein content was recorded with 120 kg N ha⁻¹. Nitrogen is the major constituent of protein and increases in nitrogen levels frequently lead to an increase in protein content. These results are in conformity with the findings of recorded by Ayub et al. (2002).

The pearl millet cultivar ‘Pioneer 86M86’ recorded maximum yield attributes, yield and nitrogen content and uptake under agri-horti system. Nitrogen levels significantly improved dry matter production, length of panicle, girth of panicle, number of grain, test weight and yield of pearl millet. Nitrogen fertilizer also increases the content and uptake of nitrogen in pearl millet grain. The result indicated that the cultivation of pearl millet under alley of guava tree not only compatible and sustainable the land use but also improve the nutrition security of rural people. However, further more such studies need to be conducted by using appropriate cultivars of pearl millet and nitrogen levels under agri-horti system to increases the sustainability of land use and also enhance the food and nutritional security of rural people.

REFERENCES


