Effect of integrated nitrogen management on nutrient content, uptake, quality and yield of rabi sorghum (Sorghum bicolor L.) under South Gujarat condition

JB Patil, MK Arvadia and DS Thorave

Abstract
A field experiment was conducted at the College Farm, Navsari Agricultural University, Navsari (Gujarat) during the year 2015-16 and 2016-17 on clayey soil to study the effect of INM on growth, yield and economics of rabi sorghum. The treatment consisted of integrated nitrogen management viz., 100% RDF (80:40:0 NPK/ha) through inorganic fertilizer + biocompost @ 10 t/ha (T1), 100% RDN through inorganic fertilizer (T2), 75% RDN through inorganic fertilizer + 25% RDN through biocompost (T3), 75% RDN through inorganic fertilizer + 25% RDN through biocompost + biofertilizer (T4), 50% RDN through inorganic fertilizer + 50% RDN through biocompost (T5) and 50% RDN through inorganic fertilizer + 50% RDN through biocompost + biofertilizer (T6) replicated four times in randomized block design. Result revealed that 100% RDF (80:40:0 NPK/ha) through inorganic fertilizer + biocompost @ 10 t/ha recorded numerically higher nutrient NPK content in grain and stover as well as protein content in grain of sorghum. Treatment 100% RDF (80:40:0 NPK/ha) through inorganic fertilizer + biocompost @ 10 t/ha registered significantly higher total uptake of nutrient NPK by sorghum crop and protein yield over rest of treatment.

Key words: Yield, Nutrient content, uptake, Economics and protein yield

Introduction
Sorghum (Sorghum bicolor L.) is a unique drought resistant crop among the major cereals and the fifth most important cereal in the world after wheat, rice, maize and barley. Due to heavy rains and winds during kharif season losses are observed in agricultural crops. So, rabi sorghum may be an option for the kharif sorghum in such areas. Rabi sorghum may help to reduce the production gap caused due to replaced kharif sorghum in sorghum producing states viz., Maharashtra, Gujarat, Karnataka and Andhra Pradesh. The appropriate combination of mineral fertilizers and organic manures for higher productivity varies according to the system, land use, ecological, social and economic conditions. Experiences from long term fertilizer experiments revealed that integrated use of farm yard manures, vermicompost, biocompost, etc. with graded levels of chemical fertilizers is promising not only in maintaining higher productivity but also improves the nutrient content, uptake and protein yield (Patel, 2015). Also, among several bio-agents, Azospirillum alone and in combination with PSB increases the yield of sorghum (Patidar and Mali, 2004). Relatively little is known about the response of rabi sorghum to INM with biocompost and biofertilizers. Hence, the said study was undertaken at NAU, Navsari (Gujarat).

Materials and methods
A field experiment was conducted at the College Farm, Navsari Agricultural University, Navsari during the year 2015-16 and 2016-17. The soil of the experimental field was clayey in texture, low in organic carbon (0.39%) and available nitrogen (204.50 kg/ha), medium in available phosphorus (39.20 kg/ha) and high in available potassium (302.50 kg/ha). The soil was slightly alkaline in reaction (pH 7.7). The treatment consisted of integrated nitrogen management viz., 100% RDF (80:40:0 NPK/ha) through inorganic fertilizer + biocompost @ 10 t/ha (T1), 100% RDN through inorganic fertilizer (T2), 75% RDN through inorganic fertilizer + 25% RDN through biocompost (T3), 75% RDN through inorganic fertilizer + 25% RDN through biocompost + biofertilizer (T4), 50% RDN through inorganic fertilizer + 50% RDN through biocompost + biofertilizer (T5) and 50% RDN through inorganic fertilizer + 50% RDN through biocompost + biofertilizer (T6) replicated four times in randomized block design.
RDN through biocompost (T3) and 50% RDN through inorganic fertilizer + 50% RDN through biocompost + biofertilizer (T6) to sorghum in rabi season. The treatments are evaluated in randomized block design (RBD) with four replications. Sorghum cv. GJ-38 was sown with spacing of 45 cm x 10 cm in the third week of October and harvested in second week of February during both the years. Biocompost was applied as per treatment before sowing and mixed well in soil. Biofertilizers (Azospirillum and PSB) are also applied as per treatment in liquid form @ 2.5 lit/ha each in soil before sowing. Net plot yield was converted into hectare basis. In case of chemical analysis, soil samples are collected and analyzed for various nutrients by standard procedure. Statistical analysis was worked out as per the method described by Panse and Sukhatme (1967).

Result and discussion

Nutrient content and uptake

Nitrogen content in grain and stover, while N, P and K uptake by grain, stover and total uptake were significantly influenced due to different INM treatments (Table 1). Treatment 100% RDF through inorganic fertilizer + biocompost @ 10 t/ha recorded maximum nitrogen, phosphorus and potassium content in grain and stover. The higher concentration of nutrient in sorghum grain and stover might be due to addition of more nutrient in soil through application of organic and inorganic sources of nutrients which in turn increased efficiency of applied nitrogen. The findings in sorghum crop are in accordance with those reported by Jat et al (2003) and Patel (2015). On pooled data basis, significantly higher total uptake of N, P and K by sorghum crop was observed with 100% RDF through inorganic fertilizer + biocompost @ 10 t/ha. The nutrient uptake is a function of yield and nutrient concentration in plant. This might be due to higher crop biomass production due to better nourishment resulted into higher uptake. The findings were in accordance with Gangwar and Niranjan (1991) and Patel (2015) who reported higher nutrient uptake by sorghum in application of organic with inorganic fertilization.

Protein content and protein yield

Protein content in sorghum grain and protein yield was found significant due to influence of INM treatments (Table 2). On basis of pooled result, maximum protein content was recorded under application of 100% RDF through inorganic fertilizer + biocompost @ 10 t/ha. The increase in protein content of sorghum grain due to more quantity of nitrogen content in grain which resulted in improvement in metabolic activities in the plant. This results support the findings of Jat et al (2003). Similarly, significantly maximum protein yield being under the application 100% RDF through inorganic fertilizer + biocompost @ 10 tonnes/ha over rest of INM treatments. This was may be due to the higher protein content and higher grain yield under this treatment. Jat et al (2003), Patidar and Mali (2004) and Patel (2015) also reported the significant response of protein yield to INM in sorghum.

Grain and stover yield

The differences in grain yield and stover yield were up to the level of significance (Table 2). Among INM, 100% RDF through inorganic fertilizer + biocompost @ 10 t/ha gave significantly superior grain and stover yield compared to rest of treatments. On pooled data basis, the magnitude of increase in grain yield with application of 100% RDF through inorganic fertilizer + biocompost @ 10 t/ha (T1) was 13.99, 14.40, 21.61, 31.62 and 38.97 per cent over T2, T4, T3, T6 and T5 treatments, respectively. The remarkable increase in grain yield and stover yield under treatment 100% RDF through inorganic fertilizer + biocompost @ 10 t/ha might be due to higher values of various growth attributes and yield attributes. All these parameters showed positive and significant correlation with grain and stover yield of sorghum. These findings are in close agreement with those reported by Ponnuswamy et al (2002) in 100% RDF + FYM @ 10t/ha + biofertilizers, Sonune et al (2003) with RDF + 10t/ha FYM, Patidar and Mali (2004) in application of 100% RDF + 10 t/ha as well as Patel (2015) with 100% RDF + FYM 10t/ha.

Economics

Maximum net returns of 59146 ₹/ha with BCR of 2.64 was recorded with the treatment receiving 100% RDF through inorganic fertilizer + biocompost @ 10 t/ha followed by application of 100% RDF through inorganic fertilizer with net returns of 53449 ₹/ha with BCR of 2.72 over rest of treatments. This might be due to higher yield of crop with this treatment. Similar results reported earlier by Mahakulkar et al (1998), Jat et al (2003) and Patel (2015) in sorghum crop.
Table 2: Protein content, protein yield and yield of sorghum as influenced by INM different treatments

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Protein content (%)</th>
<th>Protein yield (kg/ha)</th>
<th>Grain yield (pooled)</th>
<th>Stover yield (pooled)</th>
<th>Net monetary returns (Rs/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1: 100% RDF through inorganic fertilizer + bio compost @ 10 tonnes/ha</td>
<td>9.41</td>
<td>9.64</td>
<td>9.53</td>
<td>319.64</td>
<td>338.81</td>
</tr>
<tr>
<td>T2: 100% RDN through inorganic fertilizer</td>
<td>9.25</td>
<td>9.28</td>
<td>9.27</td>
<td>275.98</td>
<td>286.01</td>
</tr>
<tr>
<td>T3: 75% RDN through inorganic fertilizer + 25% RDN through bio compost</td>
<td>8.95</td>
<td>9.03</td>
<td>8.99</td>
<td>250.50</td>
<td>260.38</td>
</tr>
<tr>
<td>T4: 75% RDN through inorganic fertilizer + 25% RDN through biofertilizers</td>
<td>9.01</td>
<td>9.17</td>
<td>9.09</td>
<td>267.67</td>
<td>281.89</td>
</tr>
<tr>
<td>T5: 50% RDN through inorganic fertilizer + 50% RDN through bio compost</td>
<td>8.59</td>
<td>8.79</td>
<td>8.69</td>
<td>204.01</td>
<td>228.15</td>
</tr>
<tr>
<td>T6: 50% RDN through inorganic fertilizer + 50% RDN through biofertilizers</td>
<td>8.72</td>
<td>8.97</td>
<td>8.85</td>
<td>216.89</td>
<td>247.84</td>
</tr>
<tr>
<td>S.Em±</td>
<td>0.18</td>
<td>0.16</td>
<td>0.11</td>
<td>11.38</td>
<td>10.72</td>
</tr>
<tr>
<td>C.D. at 5%</td>
<td>0.54</td>
<td>0.48</td>
<td>0.34</td>
<td>34.30</td>
<td>32.32</td>
</tr>
<tr>
<td>C.V.%</td>
<td>3.95</td>
<td>3.51</td>
<td>2.46</td>
<td>8.90</td>
<td>7.83</td>
</tr>
</tbody>
</table>

References
5. Patel BK. Effect of land configuration and integrated nutrient management on productivity of different varieties of sorghum (Rabi) grown on fluventic ustochepts, Ph.D. thesis submitted to NAU, Navsari. (Gujarat)., 2015.