Nitrogen management for productivity and quality of macaroni wheat (Triticum durum)

A.M. PATEL, N. AUGUSTINE AND D.R. PATEL

Wheat Research Station, S.D. Agricultural University, Vijapur, Gujarat 382 870

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ABSTRACT

A field trial was conducted during the winter seasons of 1996–99 at Vijapur, to find out the economic rate and optimum time of nitrogen application for better quality and higher yield of irrigated durum or macaroni wheat (Triticum durum Desf.). Though the level of nitrogen did not differentiate among the grain and biomass yields and to some extent grain apperance score and yellow-berry incidence, other quality parameters, viz. protein and beta carotene content and sedimentation value, were improved and test weight was decreased with successive increase in N from 120 to 180 kg/ha. Application of N in 2 equal splits (basal and first node stage) recorded highest production and good quality with low yellow-berry incidence. Different levels of N showed non-significant effect on N uptake by grain and straw, while among the time of application, N in 2 equal splits (basal and first node stage) showed significant difference in grain N uptake. Maximum net realization and benefit : cost ratio were registered under 120 kg N/ha applied at sowing and first node stage in equal quantity.

Key words: Nitrogen, Yield, Quality constituents, Net realization, Benefit : cost ratio, First node

Durum wheat has the potential of export, as it fetches premium price in international market and can earn good foreign exchange. As more than 50% of its production is converted into pasta product, which demands better grain quality, the technologies for enhancing production with better quality are to be standardized. Among the different agricultural inputs, mineral nutrition, especially different strategies of nitrogen management, are important in improving quality and productivity of wheat. The balanced use of fertilizer as a single factor can increase the wheat productivity 5 times more than the use of all components such as high-yielding varieties, irrigation facility and plant protection (Pasricha and Brar, 1999). Hence present investigation was undertaken to determine the effect of time and level of nitrogen application on productivity and quality of durum wheat.

MATERIALS AND METHODS

A field experiment was conducted at Wheat Research Station, S.D. Agricultural University, Vijapur, during winter (rabi) season from 1996–97 to 1998–99. The soil was sandy loam, slightly alkaline (pH 8.1) with EC 0.23 dSm. It had medium fertility status, containing low amount of nitrogen (180 kg/ha), medium of phosphorus (52 kg/ha) and potash (360 kg/ha.)

The experiment was laid out in split-plot design with nitrogen levels (120, 150 and 180 kg/ha) in main plot and its time of application in sub-plot. Five schedules of N application, viz. half amount of N at sowing and half at crown-root initiation (CRI) stage (T₁), half N at sowing and half at first node (FN) stage (T₂), one-third N at sowing and two-thirds N at FN stage (T₃), one-third N each at sowing, CRI and flowering stage (T₄), and one-third N each at sowing, FN and flowering stage (T₅), were studied. A uniform basal dose of 60 kg P₂O₅/ha was applied in all plots.

Wheat variety 'Raj 1555' was sown at 23 cm row spacing during the second fortnight of November under irrigated conditions. Other field operations were carried out as per recommendations. Grain samples were analysed for protein content, β carotene content and sedimentation value.

RESULTS AND DISCUSSION

Yield

Different levels of nitrogen application (120, 150 and 180 kg N/ha) showed non-significant and inconsistent trend in grain yield (Table 1), wherein application of 180 kg N/ha recorded higher grain yield during 1996–97 and 1998–99 and in pooled analysis, while application of 120 kg N/ha recorded higher grain yield in 1997–98. During 1996–97 significantly higher straw yield was recorded with the application of 120 kg N/ha, but once again inconsistent response of applied N was observed in 1997–98.
and 1998–99, in providing higher straw yield with application of 150 and 180 kg N/ha respectively. On pooled basis, application of 180 kg N/ha recorded higher straw yield. Such inconsistent response to applied N in grain and straw yield might be attributed to fluctuating temperature and moisture availability. This findings confirm those of Auti et al. (1998) and Kumar et al. (2000). Similarly, biomass also showed same inconsistent response. During first, second and third years, higher straw yield was recorded with application of 120, 150 and 180 kg N/ha respectively (Table 1). Under different nitrogen splitting grain and biomass yields in 1996–97 only and grain yield in mean too, enhanced significantly. Application of N in 2 equal splits (basal and first node stage) resulted in the maximum grain and biomass yields. The average increase in yield might be owing to continuous and sufficient availability of nitrogen during the formation of spikelets in miniature plant around first node stage.

**Quality characters**

There was significant decline in 1,000-grain weight with the increasing rate of nitrogen and the lowest nitrogen level of 120 kg/ha recorded higher test weight with successive increase in nitrogen rate could be owing to increased lodging of the crop plant. Protein and β carotene content in wheat grain showed positive improvement with nitrogen levels. Tonayotova and Gorbanov (1999) reported improvement in protein content and Nanwal et al. (1998) revealed increase in β carotene content with increasing level of nitrogen. Sedimentation value showed a tendency to increase with the increase nitrogen level (Table 2). Similar observations were reported by Xu Yong Chun et al. (1999). More or less similar grain appearance score and yellow berry incidence were observed with the change in nitrogen rate (Table 2). Equal application of nitrogen at sowing and first node stage of plant recorded the maximum test weight, protein content and sedimentation value over the rest of nitrogen timings (Sato et al., 1999). There was not much variation in grain appearance score due to different times of nitrogen application. However, the nitrogen nourishment in 3 equal splits, i.e. at sowing, CRI and flowering stage of crop, resulted more β carotene content than the rest of treatments, followed by nitrogen supply at basal and first node. Nitrogen application at the time of sowing and first node stage of crop with equal quantity recorded the maximum yellow berry incidence. It was almost 2 and 3 times higher with rest of the nitrogen schedules.

**Nitrogen uptake**

Different levels of nitrogen application (120, 150 and 180 kg N/ha) showed non-significant effect on total N uptake by crop on pooled basis (Table 2). Optimum growth attained in all the 3 levels has resulted in almost similar content of N in plant. The results confirm those of Patil and Patil (1996).

Time of N application showed significant effect on N uptake, wherein application of half N at sowing and half at first node stage recorded significantly higher total N uptake, might be due to constant supply of N up to first node stage and onwards. Patil and Patil (1996) also reported similar results.

**Economics**

The economic analysis of various treatments indicated that increased level of nitrogen from 120 kg N/ha to 180 kg N/ha could manage to earn only Rs 100 more net returns. It was quite marginal increment in profit. Its reflection was seen in benefit: cost ratio, which was better under 120 kg N/ha then declined with further increase in N

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Grain yield (q/ha)</th>
<th>Biomass yield (q/ha)</th>
<th>Net returns (q/ha)</th>
<th>Benefit: cost ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>N (kg/ha)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>120</td>
<td>38.81</td>
<td>96.28</td>
<td>17,749</td>
<td>1.93</td>
</tr>
<tr>
<td>150</td>
<td>37.86</td>
<td>95.57</td>
<td>16,758</td>
<td>1.86</td>
</tr>
<tr>
<td>180</td>
<td>39.52</td>
<td>97.77</td>
<td>17,868</td>
<td>1.91</td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>NS</td>
<td>NS</td>
<td></td>
<td></td>
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<tr>
<td>Time of N application</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>1/2 N each at sowing and CRI stage</td>
<td>37.95</td>
<td>96.10</td>
<td>16,874</td>
<td>1.87</td>
</tr>
<tr>
<td>1/2 N each at sowing and FN stage</td>
<td>40.99</td>
<td>100.79</td>
<td>19,431</td>
<td>2.01</td>
</tr>
<tr>
<td>1/3 N at sowing and 2/3 N at FN</td>
<td>37.59</td>
<td>93.28</td>
<td>16,290</td>
<td>1.84</td>
</tr>
<tr>
<td>1/3 N at sowing, CRI and flowering</td>
<td>38.38</td>
<td>98.04</td>
<td>17,279</td>
<td>1.89</td>
</tr>
<tr>
<td>1/3 N at sowing, FN and flowering</td>
<td>38.75</td>
<td>94.50</td>
<td>17,194</td>
<td>1.89</td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>1.46</td>
<td>NS</td>
<td></td>
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</table>
rate. Thus higher rate of nitrogen was not beneficial. The time of nitrogen application, irrespective of its rate, influenced the net returns and benefit: cost ratio. Maximum net returns with the highest benefit: cost ratio were obtained with 2 equal splits of nitrogen, at basal and first node stage.

Application of 120 kg N/ha, in 2 equal splits (basal + first node stage), fetched higher net profit and benefit: cost ratio, in spite of the higher grain and straw production recorded under 180 kg N/ha. The higher rate of N up to 180 kg N/ha improved the quality constituents when applied at sowing and first node stage with equal rate.

REFERENCES


