Response of Indian mustard (Brassica juncea) to nitrogen and phosphorus on Torripsamments of north-western Rajasthan

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A field experiment was conducted during winter (rabi) season of 1993-94, 1994-95 and 1995-96 to study the effect of nitrogen (30, 60, 90 and 120 kg N/ha) and phosphorus (0, 15, 30 and 45 kg P₂O₅/ha) on Indian mustard [Brassica juncea (L.) Czernj. & Cosson]. Application of N up to 120 kg/ha resulted in significant increase in plant height, primary and secondary branches and siliquae/plant except for seeds/siliqua and 1,000-seed weight up to 90 kg N/ha. Phosphorus application up to 45 kg P₂O₅/ha resulted in significant increase in plant height, secondary branches and siliquae/plant. With the increased supply of P up to 45 kg P₂O₅/ha, the N need of the crop was raised up to 120 kg/ha for significantly higher seed yield (17.05 q/ha). Irrespective of P application, the seed yield increased up to the application of 120 kg N/ha.

Key words: Nitrogen, Phosphorus, Seed yield, Sandy soil, Indian mustard

Indian mustard can be grown under wide range of agro-climatic conditions with varying agronomic management practices. Brassicas respond to N and P nutrients positively in terms of growth and yield (Dhingra et al., 1998; Thakur and Chand, 1998). The light-textured soils of North-Western Rajasthan are deficient in nutrients due to very low organic carbon content. Since information on fertilizer management in mustard on light soils of this region is lacking, the present investigation was undertaken for determining the optimum dose of N and P for Indian mustard crop.

MATERIALS AND METHODS

The study was carried out at Mechanized Agricultural Farm, Rozari, during winter (rabi) season of 1993–94, 1994–95 and 1995–96. The soils of the area come under Typic Torripsamments sub-group. The soil of the experimental site was sandy in texture having pH 8.1, ECe 0.2 dS/m, organic matter 0.09%, available phosphorus 24.5 kg P₂O₅/ha and available potassium 275.0 kg K₂O/ha. Sixteen
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treatments, comprising 4 levels each of
nitrogen (30, 60, 90 and 120 kg N/ha) and
phosphorus (0, 15, 30 and 45 kg P₂O₅/ha),
were replicated thrice in factorial
randomized block design. Test variety
‘Varuna (‘T, 59’) of Indian mustard was
sown on 4 November, 10 and 30 October
during 1993, 1994 and 1995 respectively.
Seeds were sown in rows 30 cm apart and
thinned 25 days after sowing. Half dose of
nitrogen and whole dose of phosphorus
were applied basal at sowing and remaining
N was top-dressed at pre-flowering stage
after the second irrigation. Four irrigations
were applied to the crop at intervals of 25–
30 days, excluding 1 pre-sowing irrigation,
in all the 3 years.

RESULTS AND DISCUSSION

Growth and yield attributes

Plant height at harvest increased
significantly with increasing levels of N up
to 120 kg/ha. The pooled data (Table 1)
revealed that the maximum height was
observed under 120 kg N/ha application.
Similar trend in plant height was also noted
with the graded levels of P application up to
45 kg P₂O₅/ha.

The yield-contributing characters
significantly increased with increasing N
levels (30–120 kg/ha) (Tables 1 and 2).
Application of N up to 120 kg/ha resulted
in significantly higher number of primary
and secondary branches and siliquae/plant
than lower N levels. Both 90 and 120 kg N/
ha were equal for seeds/siliqua and 1,000
seed weight. The effect of phosphorus
levels was significant on yield attributes
except for primary branches/plant, seeds/
siliqua and 1,000-seed weight. A trend of
increase in secondary branches and
siliquae/plant up to 45 kg P₂O₅ level was
observed. The results confirm the findings
of Tyagi and Rana (1992) and Punia et al.
(1993).

Interaction effect of N and P was found
significant on secondary branches/plant
(Table 3). At each P level, there was a
significant response to increasing levels of
N from 30 to 120 kg/ha for the secondary
branches. On the other hand, increasing
phosphorus levels up to 45 kg P₂O₅/ha
resulted in non-significantly effect on the
secondary branches/plant at each N level,
except at 120 kg N/ha whereby each
successive increase in P level resulted in
significantly higher number of secondary
branches/plant with the maximum value at
45 kg P₂O₅/ha. This indicates a synergistic
effect of phosphorus with the higher levels
of N application for better growth and
secondary branches.

Seed yield

The seed yield of Indian mustard crop
increased significantly with N and P. An
increasing level of N up to 120 kg/ha
significantly increased the seed yield during
all the years (Table 2). Pooled results on
seed yield revealed that there was an
increase of 42, 97 and 141% with 60, 90
and 120 kg N/ha respectively over the 30
kg N/ha. This might be due to very low
organic matter content in the experimental
soil. The results confirm the findings of
Shukla and Kumar (1994).

An increase in P level up to 45 kg P₂O₅/
ha significantly increased seed yield (Table
2). The increase in yield (pooled mean)
with 15, 30 and 45 kg P₂O₅/ha over the
Table 1. Effect of nitrogen and phosphorus levels on growth and yield attributes of Indian mustard

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Plant height (cm)</th>
<th>Primary branches/plant</th>
<th>Secondary branches/plant</th>
<th>Silique/plant</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1993–94 95 96</td>
<td>Mean 1993–94 95 96 Mean</td>
<td>Mean 1993–94 95 96 Mean</td>
<td>Mean 1993–94 95 96</td>
</tr>
<tr>
<td>N (kg/ha)</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>177.6 176.3 158.0 170.5</td>
<td>3.1 3.1 3.0 3.1</td>
<td>6.3 6.3 5.2 5.9</td>
<td>281 284 224 263</td>
</tr>
<tr>
<td>60</td>
<td>180.4 183.5 159.2 174.4</td>
<td>3.3 3.3 3.2 3.3</td>
<td>6.6 6.6 5.3 6.2</td>
<td>303 312 251 289</td>
</tr>
<tr>
<td>90</td>
<td>187.1 191.3 160.7 179.7</td>
<td>3.5 3.5 3.2 3.4</td>
<td>9.6 9.4 6.4 8.5</td>
<td>352 359 274 328</td>
</tr>
<tr>
<td>120</td>
<td>191.7 197.1 177.2 188.7</td>
<td>3.7 3.7 3.5 3.6</td>
<td>11.2 11.7 9.5 10.8</td>
<td>433 441 291 388</td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>1.5 0.9 0.7 1.0</td>
<td>0.12 0.14 0.18 0.14</td>
<td>0.17 0.22 0.23 0.20</td>
<td>18.1 16.6 9.5 14.8</td>
</tr>
<tr>
<td>P₂O₅ (kg/ha)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>177.9 182.0 152.9 170.9</td>
<td>3.3 3.3 3.1 3.2</td>
<td>8.1 8.2 6.3 7.5</td>
<td>322 334 250 302</td>
</tr>
<tr>
<td>15</td>
<td>183.1 185.8 157.9 175.6</td>
<td>3.4 3.4 3.2 3.3</td>
<td>8.1 8.3 6.6 7.7</td>
<td>335 339 255 310</td>
</tr>
<tr>
<td>30</td>
<td>186.4 188.8 167.5 180.9</td>
<td>3.4 3.4 3.2 3.3</td>
<td>8.6 8.6 6.6 7.9</td>
<td>343 347 264 318</td>
</tr>
<tr>
<td>45</td>
<td>189.5 191.5 176.8 185.9</td>
<td>3.5 3.5 3.2 3.4</td>
<td>8.9 8.9 6.9 8.2</td>
<td>369 376 269 338</td>
</tr>
<tr>
<td>CD (P = 0.05)</td>
<td>1.5 0.9 0.7 1.0</td>
<td>NS NS NS NS</td>
<td>0.17 0.22 0.23 0.20</td>
<td>18.1 16.6 9.5 14.8</td>
</tr>
</tbody>
</table>

NS, Not significant
Table 2. Effect of nitrogen and phosphorus levels on yield attributes, seed yield and economics of Indian mustard

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Seeds/siliqua (No.)</th>
<th>1,000-seed weight (g)</th>
<th>Seed yield (q/ha)</th>
<th>Net Benefit: returns cost ratio*</th>
</tr>
</thead>
<tbody>
<tr>
<td>N (kg/ha)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>13.0    13.1    12.1    12.7    3.2    3.2    2.9    3.1    6.58    7.76    5.74    6.69   946   0.21</td>
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</tr>
<tr>
<td>60</td>
<td>13.6    13.7    12.5    13.3    3.5    3.4    3.1    3.3    9.64    10.51   8.34    9.49   3,269 0.71</td>
<td></td>
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</tr>
<tr>
<td>90</td>
<td>14.2    13.8    13.2    13.7    3.6    3.6    3.3    3.5    13.48   14.53   11.59  13.20   6,192 1.35</td>
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</tr>
<tr>
<td>120</td>
<td>14.3    14.4    13.4    14.0    3.8    4.1    3.4    3.8    16.12   17.92   14.34  16.13   8,588 1.87</td>
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<tr>
<td>CD (P=0.05)</td>
<td>0.33    0.49    0.53    0.45    0.42    0.20    0.27    0.31    0.11    0.19    0.27    0.19   159.3</td>
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<tr>
<td>P₂O₅ (kg/ha)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>13.6    13.6    12.7    13.3    3.4    3.5    3.1    3.3    10.64   11.70   8.72    10.43   3,857 0.84</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>15</td>
<td>13.7    13.7    12.8    13.4    3.5    3.6    3.2    3.4    11.15   12.22   9.72    10.95   4,418 0.97</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>13.9    13.8    12.7    13.5    3.6    3.6    3.2    3.4    11.82   13.14   10.36  11.77   5,026 1.10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>13.9    14.0    12.9    13.6    3.6    3.6    3.2    3.5    12.21   13.65   11.21  12.36   5,509 1.20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>NS       NS       NS       NS       NS       NS       NS       NS       0.11    0.19    0.27    0.19   159.3</td>
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</tr>
</tbody>
</table>

NS, Not significant; *Mean data of 3 years
control was 5, 13 and 19% respectively. The response of the crop to P application may be ascribed to the medium level of available P (24.5 kg P₂O₅/ha) in the soil. The results are in agreement with those of Saran and Giri (1990) and Tomar et al. (1997).

An interaction effect of N and P on the mustard crop yield was significant (Table 3). The seed yield was significantly higher with 45 kg P₂O₅ and 120 kg N/ha. On the other hand, irrespective of doses of P, mustard crop responded up to 120 kg N/ha. Thus maximum seed yield (17.05 q/ha) of Indian mustard was harvestable with the combined application of 120 kg N and 45 kg P₂O₅/ha on sandy soils under the irrigated conditions.

### Economics

The maximum net returns were obtained from 120 kg N/ha. The benefit:cost ratio was also highest with 120 kg N/ha. Similarly, the highest net returns with benefit:cost ratio of 1.20 were obtained with 45 kg P₂O₅/ha.

### REFERENCES


Shukla, Anil and Kumar, Arvind. 1994. Dry-matter accumulation, nitrogen content, its uptake and seed yield of Indian mustard (Brassica juncea) as influenced by varieties and rates of nitrogen fertilization. *Indian Journal of Agronomy* 39 (1): 38–42.

