Response of green gram to phosphorus application in the arid zone

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ABSTRACT

A field experiment on green gram (S-12) involving four levels of P$_2$O$_5$ (0, 30, 60, 90 kg/ha) and four methods of phosphorus application (broadcast and incorporate, placement 10 cm deep, placement 15 cm deep and band placement 5 cm on both sides of the seeded rows and 10 cm deep) was carried out for three consecutive years (1972 to 1974) at Central Arid Zone Research Institute, Jodhpur. Application of phosphorus (30 to 60 kg P$_2$O$_5$/ha) to green gram significantly increased the yield over control in two out of three years. Placement of fertilizer (10–15 cm deep) also resulted in significantly higher seed yield over control (broadcast and incorporate) in one out of two years. The response varied from 1.3 to 2.7 in normal sown crop and 0.9 to 2.0 in case of the late sown crop. The response decreased with an increase in the level of phosphorus.

INTRODUCTION

Of the several factors responsible for low yields of green gram, absence of fertilizer use is one of them. Singh and Virk (1965) found that fertilizer use in green gram was uneconomical. Moolani and Jana (1965) reported 40 per cent increase in seed yield of green gram grown on late rite soils due to fertilizer use. In view of the meagre information available it was considered desirable to conduct an experiment on varying levels of phosphorus and different methods of its application, under the arid environment.

MATERIAL AND METHODS

An experiment involving four levels of P$_2$O$_5$ (0, 30, 60, 90 kg/ha) and four methods of phosphorus application (broadcast and incorporate, placement 10 cm below the soil, placement 15 cm below the soil and band placement 5 cm on both sides of the seeded rows and 10 cm deep) was carried out on green gram (Vigna radiata), variety S-12, under rainfed condition for three consecutive years, 1972 to 1974, at Central Arid Zone Research Institute, Jodhpur. Methods of phosphorus application were tried in 1973 and 1974 only. Band placement 10 cm deep was not tried in 1974. The experiment was laid out in the factorial randomised block design. The plot size was 4×2.4 m in the first year and 4×3 m in the subsequent years. Phosphorus was applied in the form of single superphosphate (16% P$_2$O$_5$).
The crop was sown late on August 21, 1972 and 1974 and at normal sowing time on July 3, 1973. It was harvested on October 18, 15 and 31, in 1972, 1973 and 1974, respectively.

The soil on which the experiment was carried out was deep sandy loam with low moisture storage capacity (130 mm). The chemical analysis of the soil showed the organic matter and the available phosphorus to be 0.38 per cent and 18 kg/ha, respectively. Soil pH ranged from 7.5 to 7.7.

RESULTS AND DISCUSSION

Rainfall distribution during the cropping season

The rainfall received during the cropping season in 1972, 1973 and 1974 was 331, 446 and 177 mm in 15, 24 and 10 rainy days, respectively. In 1972, rainfall distribution was quite unusual. The season started with 18 mm of rainfall received in the second week of July, followed by a prolonged drought of 35 days. There was revival of monsoon in the third week of August, the total rainfall received in 11 days (14-25, August) was 299 mm. Green gram, sown late (21, August) suffered from moisture stress at flowering and pod formation stage, resulting in low seed yield (3.4 q/ha).

Kharif 1973 was highly favourable season for crop growth. The total rain fall received during the cropping season was 446 mm in 24 days. Good rainfall with favourable distribution led to higher yield of green gram (14 q/ha).
It was observed that seed yield obtained in 1973 was about three to four times higher than the yields obtained in 1972 and 1974. This was due to very favourable moisture availability conditions during 1973. Although the productivity levels of the late sown crops (1972 and 1974) were quite low (1.2 to 3.8 q/ha), application of 60 kg P₂O₅/ha in 1972 and 30 kg P₂O₅/ha in 1974 led to significantly higher seed yields over control (0 P₂O₅).

In 1973, although the yield levels were quite high (13.2 to 14.4 q/ha), the differences in yield among different levels of P₂O₅ tried were not significant (Table 1). It is possible that due to favourable rainfall conditions part of the native phosphorus might have become available to plants. As such, at least part of the applied phosphorus became superfluous. The yields were thus, not affected significantly. On the contrary, under late sown conditions (1972 and 1974), application of phosphorus resulted in significantly higher seed yields over control (0 P₂O₅). The additional yield levels were, however, low. It is thus revealed that the plants of green gram were able to make use of the applied phosphorus to a limited extent in drought and low rainfall years. These results are in conformity with the findings of Singh et al. (1981).

The response (kg grains per kg P₂O₅) varied from 1.33 to 2.67 in the normal sown crop and 0.89 to 2.00 in case of the late sown crops. The response decreased with an increase in levels of phosphorus in both the cases (Table 2). This shows that use of phosphorus if at all required, has to be kept minimum under these soil-climatic conditions.

**Effect of methods of phosphorus application**

Methods of phosphorus application did not influence seed yield of green gram significantly in 1973, while in 1974 placement of phosphorus either 10 cm or

<table>
<thead>
<tr>
<th>'P' levels (kg P₂O₅/ha)</th>
<th>Seed yield (q/ha)</th>
<th>Additional yield (q/ha)</th>
<th>Response (kg grains/kg P₂O₅)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Late sown</td>
<td>Normal sown</td>
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<td></td>
<td>1972 1974 Mean</td>
<td>(1973)</td>
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<tr>
<td>0</td>
<td>3.0 1.2 2.1</td>
<td>13.2</td>
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<tr>
<td>30</td>
<td>3.3 2.0 2.7</td>
<td>14.0</td>
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<tr>
<td>60</td>
<td>3.8 2.3 3.1</td>
<td>14.3</td>
<td></td>
</tr>
<tr>
<td>90</td>
<td>3.4 2.3 2.9</td>
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<tr>
<td>SE±</td>
<td>0.12 0.11</td>
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<td>C. D. 5%</td>
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Table 2. Additional yield (q/ha) and response (kg grains/kg P₂O₅) of green gram as influenced by fertilizer use.
15 cm deep resulted in significantly higher seed yield over the broadcast method (Table 1). The favourable response to the placement of phosphorus in 1974 could be attributed to the low rainfall conditions that prevailed during the season. Phosphorus placed in the moist zone was much easily and readily available to plants as against the broadcast.

ACKNOWLEDGEMENTS

My grateful thanks are due to Dr. H.S. Mann, Director and Dr. R. P. Singh, Chief Scientist, Central Arid Zone Research Institute, Jodhpur, for providing necessary facilities for conducting the present investigation.

REFERENCES

