Table 1. Composition of leaves of two chickpea crosses sown at NARC, Islamabad, Pakistan, 1987/88.

<table>
<thead>
<tr>
<th>Chickpea crosses</th>
<th>Crop condition</th>
<th>P (%)</th>
<th>K (%)</th>
<th>Ca (%)</th>
<th>Zn (mg kg⁻¹)</th>
<th>Fe (mg kg⁻¹)</th>
<th>Mn (mg kg⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PK 51832 x CM 72</td>
<td>Normal</td>
<td>0.14</td>
<td>0.2</td>
<td>4.0</td>
<td>28</td>
<td>14</td>
<td>310</td>
</tr>
<tr>
<td></td>
<td>Abnormal</td>
<td>0.12</td>
<td>0.3</td>
<td>4.1</td>
<td>27</td>
<td>21</td>
<td>155</td>
</tr>
<tr>
<td>PK 51835 x CM 72</td>
<td>Normal</td>
<td>0.13</td>
<td>0.4</td>
<td>6.5</td>
<td>27</td>
<td>21</td>
<td>343</td>
</tr>
<tr>
<td></td>
<td>Abnormal</td>
<td>0.13</td>
<td>1.0</td>
<td>6.0</td>
<td>30</td>
<td>14</td>
<td>129</td>
</tr>
</tbody>
</table>

Samples were digested in a HNO₃-HClO₄ mixture (2:1) and analyzed for P by colorimetry, K by flame photometry, and Ca, Zn, Fe, and Mn by atomic absorption spectrophotometry. The concentrations of P, Ca, Zn, and Fe were almost equal in the leaves of normal and abnormal plants (Table 1). Potassium concentration was lower in the normal plants than in the abnormal plants. However, the concentration of Mn in the leaves of abnormal plants was 50% (PK 51832 x CM 72), and 62% (PK 51835 x CM 72) less than those of normal plants of the respective crosses.

This investigation indicated that the abnormal growth of the affected plants of these crosses was probably due to Mn deficiency. Further studies are warranted to verify these results.

References


A Visual Rating System for Nodulation of Chickpea

O.P. Rupela (ICRISAT Center)

Characterization of chickpea genotypes for nodulation (node number and mass) and nitrogen fixation (acetylene-reduction test) is a time-consuming and laborious process. It is particularly difficult when many genotypes are involved, such as when screening germplasm lines or advanced breeding lines. Therefore visual rating, generally done for plant diseases, becomes a very handy tool. A visual rating system for nodulation of field-grown chickpea plants is described here. It has been successfully used to evaluate genotypes at two contrasting sites in India: in a Vertisol at ICRISAT...
Center (IC), Patancheru, India (18°N), and in an
Entisol at Hisar, India (29°N).

The rating system has been developed over
several years and is based on field experience.
Forty-five-day old, field-grown chickpea plants of
different genotypes showing a range of nodulation
matching a rating of '1' to '5' were selected in the
postrainy season of 1978/79. The lowest nodulation
was rated '1' and the highest as '5'. Photographs of
these plants (Fig. 1, copies available on request)
were used as a reference for nodulation rating in
future studies. This rating system was tested in field
trials sown at the recommended spacing of 30 cm x
10 cm at Hisar with 18 genotypes (including two
controls, K 850 and G 130) in three replications
and at IC with 16 genotypes (including two controls)
in four replications. The correlation between visual
rating and nodule number was 0.79 at both
locations, and between visual rating, and nodule
mass it was 0.84 at IC, and 0.85 at Hisar (Table
1).

Use of a crowbar was most convenient for
digging both types of soils. After loosening the soil
around the plant(s), roots and nodules were
removed from the soil with a small hand trowel
(about 25 cm long blade) such that most of the roots
and nodules were recovered. A 20-cm pointed metal
rod with a handle was useful in heavy soils to break
small clods containing roots and nodules. Ten plants
from an inside row of each plot were removed for
these observations. Soil adhering to roots and
nodules from each plot was washed off before
storing at 4°C for observations on nodule number,
nodule mass, and visual rating. In Vertisols, it was
generally possible to rate the plants without
washing. Each plant was rated separately, and loose
nodules recovered during digging were allocated
equally to all the uprooted plants. Procedures
followed to record nodule number and mass, shoot
mass, and acetylene-reduction activity have been
described by Gillier et al. (1988).

To minimize variations across locations and
within a genotype it is important that the test
genotypes should be grown in a field having
abundant effective chickpea rhizobia [at least 10^9
rhizobia (g soil)^{-1}], and that optimum soil
moisture for nodulation should be present at
germination and seedling stages, the test lines
should preferably be grown in a field with low
available soil-N (preferably less than 25 mg N kg^{-1}.

Table 1. Correlation between nodulation, acetylene reduction, plant growth, and visual rating for
nodulation of 18 chickpea genotypes at 106 days after sowing, Hisar, India, postrainy season 1978/79,
(n = 54)

<table>
<thead>
<tr>
<th>Character^1</th>
<th>Nodule dry mass</th>
<th>Shoot mass</th>
<th>Acetylene reduction (µM)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Plant^{-1} h^{-1}</td>
</tr>
<tr>
<td>Nodule number</td>
<td>0.69***</td>
<td>0.64***</td>
<td>0.65***</td>
</tr>
<tr>
<td>Nodule dry mass</td>
<td></td>
<td>0.63***</td>
<td>0.84***</td>
</tr>
<tr>
<td>Shoot mass</td>
<td></td>
<td></td>
<td>0.48***</td>
</tr>
<tr>
<td>µM plant^{-1} h^{-1}</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>µM g^{-1} nodule mass h^{-1}</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. µM = micro Moles.
Figure 1. Visual rating scale for nodulation in chickpea.
Field Screening of Chickpea for Salinity Resistance

H.A. van Rheenen¹, S.C. Sethi², and O.S. Tomar² (1. ICRISAT Center, 2. ICRISAT, Cooperative Research Station, Hisar, India)

Naturally saline fields often show great variations in salinity over short distances. This makes screening for salinity resistance in such fields very difficult. A method designed to overcome or even utilize this difficulty of soil variation is described by Saxena (1987) and involves sowing different chickpea varieties radially through saline patches, differences in growth occur along the line of sowing and these can be correlated with soil data for salinity. The method is interesting and useful for several purposes, but nonsuitable for large scale screening of germplasm and segregating populations. For such purposes we want a simple and reliable control as yardstick to compare all test material with.

Considering the difficulty because of variability in salinity over short distance, it was felt that one way to solve the problem perhaps would be by minimizing or removing the distance effect between the test material and the standard control. This can be done by sowing the test entry and the control

![Figure 1. Screening for salinity resistance at Hisar, with test entry and control seed sown in the same hole.](image)

References
