TABLE 3

Joint segregation of panicle shape (3:1) with panicle density (3:1)

<table>
<thead>
<tr>
<th>Joint ratio</th>
<th>Assumption</th>
<th>Obs/Exp</th>
<th>AB</th>
<th>Ab</th>
<th>aB</th>
<th>ab</th>
<th>X²</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:3:3:1</td>
<td>Obs</td>
<td>752</td>
<td>298</td>
<td>314</td>
<td>74</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Exp</td>
<td>808.9</td>
<td>269.6</td>
<td>269.6</td>
<td>89.9</td>
<td>17.1</td>
<td>&lt; 0.01</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Linkage</td>
<td>783.7</td>
<td>294.7</td>
<td>294.8</td>
<td>64.7</td>
<td>3.9</td>
<td>0.3-0.2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Cross-over value 42.4%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

gave gene symbol \(Pa_1\) for the character concerned.
The joint segregation (table 3), revealed that the factors \(Pa_1\) (panicle density) and \(Op\) (panicle shape) were linked with a cross-over value of 42.43 Morgan Units. Two genes: \(Pa_1\) and \(Z\) (pearly grains), were found to be linked by Ayyangar and Ayyar\(^6\). Ghawghawe et al\(^7\) added another four factors, \(Bs\), \(Stp\), \(Oy\) and \(Gh\) to this group and termed this as fourth linkage group. The linear order was as follows:

\[Bs(25.8)\ Z(16.39)\ Pa_1?\ Stp(21.02)\ Oy(41.5)\ Gh.\]

The gene \(Op\) in the present study was found to be associated with \(Pa_1\). As \(Pa_1\) was located\(^7\) in the fourth linkage group, it was inferred that the gene \(Op\) also belonged to the very group. The recombination value between \(Op\) and \(Pa_1\) was 42.43 Morgan Units. The location of the gene \(Op\) with respect to other loci already mapped, could not be determined for want of the required contrasting characters in the cross studied. However, as the gene \(Op\) was located at a distance of 42.43 Morgan Units to \(Pa_1\), it may be that the gene \(Op\) would lie beyond \(Bs\) or it may lie between \(Stp\) and \(Oy\) or \(Oy\) and \(Gh\). The exact location of the gene \(Op\) with respect to other loci, cannot be determined because Ghawghawe et al\(^7\) did not indicate the distance between \(Pa_1\) and \(Stp\). The total mapped genes in this fourth linkage group of sorghum with the addition of \(Op\) from the present study would thus be seven.

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**A NEWLY INTRODUCED FODDER LEGUME (HEDYSARUM CORONARIUM—FAMILY LEGUMINOZAE JUSS)**

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**HEDYSARUM Coronarium** is a mediterranean forage legume able to grow, survive and give valuable fodder production, in extremely unfavourable conditions in clay/sandy soils up to pH 8.5-9, hot dry wet summers, etc. Its potential had been overlooked where nitrogen of chemical synthesis was not a limiting factor for crop production. Testing of rhizobia strains for the improved production of this crop was carried out by the senior author at the Institute of Microbiology Agraria Italy in 1981.

To determine symbiotic effectiveness, seeds of *H. coronarium* were grown in polythene pots 25 cm in dia containing substrate made from an equal mixture (V/V) of vermiculite and river sand. Surface sterilized germinated seeds were sown (30/pot) and inoculated wherever necessary with heavy suspensions prepared
from broth cultures of the various strains of rhizobia grown in YEM media. The uninoculated served as the control. The pots were irrigated on alternate dates with dil, nitrogen-free McKnight solution or water. The plants were grown in a heated glass-house with a photoperiod of 11–13 hr and a daily maximum and minimum temperatures of 27 and 22°C. Plants were harvested after 8 weeks of sowing. Roots were examined for nodulation and nitrogenase activity of nodules were measured by acetylene reduction assay using Packward Model 419 Backer Gas Chromatograph (table 1). The results of the infection test with

<table>
<thead>
<tr>
<th>Strains</th>
<th>mg. d.w.</th>
<th>nMC₂H₄×plant⁻¹×h⁻¹ (Aver. 1,2,3, hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>0.02328</td>
<td>22.9</td>
</tr>
<tr>
<td>CC 1335 (Australia-Canberra)</td>
<td>0.03045</td>
<td>319.6</td>
</tr>
<tr>
<td>CC 1337 (Australia-Canberra)</td>
<td>0.03186</td>
<td>205.1</td>
</tr>
<tr>
<td>HCNTI (Pisa)</td>
<td>0.04000</td>
<td>59.1</td>
</tr>
<tr>
<td>RH-19 (Sicilia-S. Italy)</td>
<td>0.03150</td>
<td>237.9</td>
</tr>
<tr>
<td>HCNA (Volterra-Pisa)</td>
<td>0.04536</td>
<td>162.5</td>
</tr>
</tbody>
</table>

The roots were exposed to 10% acetylene in air at 25°C for 1, 2 and 3 hr.

Figure 2. New Fodder Legume—*Hedysarum coronarium* growing in saline-alkali soil of Karnal.

These 5 strains show clearly that the response to inoculation by various lines of *H. coronarium* are quite marked (figure 1) compared to uninoculated which remained free of nodules. The CC 1335 (Australia-Canberra) seems to have a better nitrogenase activity.

It is interesting to note that this fodder legume was able to grow well in our saline-alkali soils of Karnal, Haryana (figure 2). Further investigations are in progress.

The authors’ thanks are due to Prof. Giovanni Picci, Head, Institute of Microbiology, Agraria University of Pisa, Italy for facilities and Department of Science and Technology and ICAR for sponsoring his visit under the Exchange Programme.

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**LATE QUARTERNARY FOSSIL BONE FROM GOA**

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The quarternary formations of Goa includes, coastal beaches tidal flats, the riverine alluvium, gravel and laterites. Though the laterites (less than 100 m) have been tentatively dated as early quarternary and the other formations to the late quarternary, accurate