

TABLE 3

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

Joint ratio	Assumption	Obs/Exp	Phenotypes				X <sup>2</sup>	Probability
			AB	Ab	aB	ab		
9:3:3:1	Independence	Obs	752	298	314	74	17.1	< 0.01
		Exp	808.9	269.6	269.6	89.9		
	Linkage	Exp	783.7	294.7	294.8	64.7	3.9	0.3-0.2
(Cross-over value 42.4%)								

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<sup>6</sup>. Ghawghawe *et al*<sup>7</sup> 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<sup>7</sup> 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*<sup>7</sup> 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 upto 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<sup>1</sup> solution or water. The plants were grown in a heated glass-house with a photoperiod of 11–13hr 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 Packard Model 419 Backer Gas Chromatograph (table 1). The results of the infection test with

TABLE 1

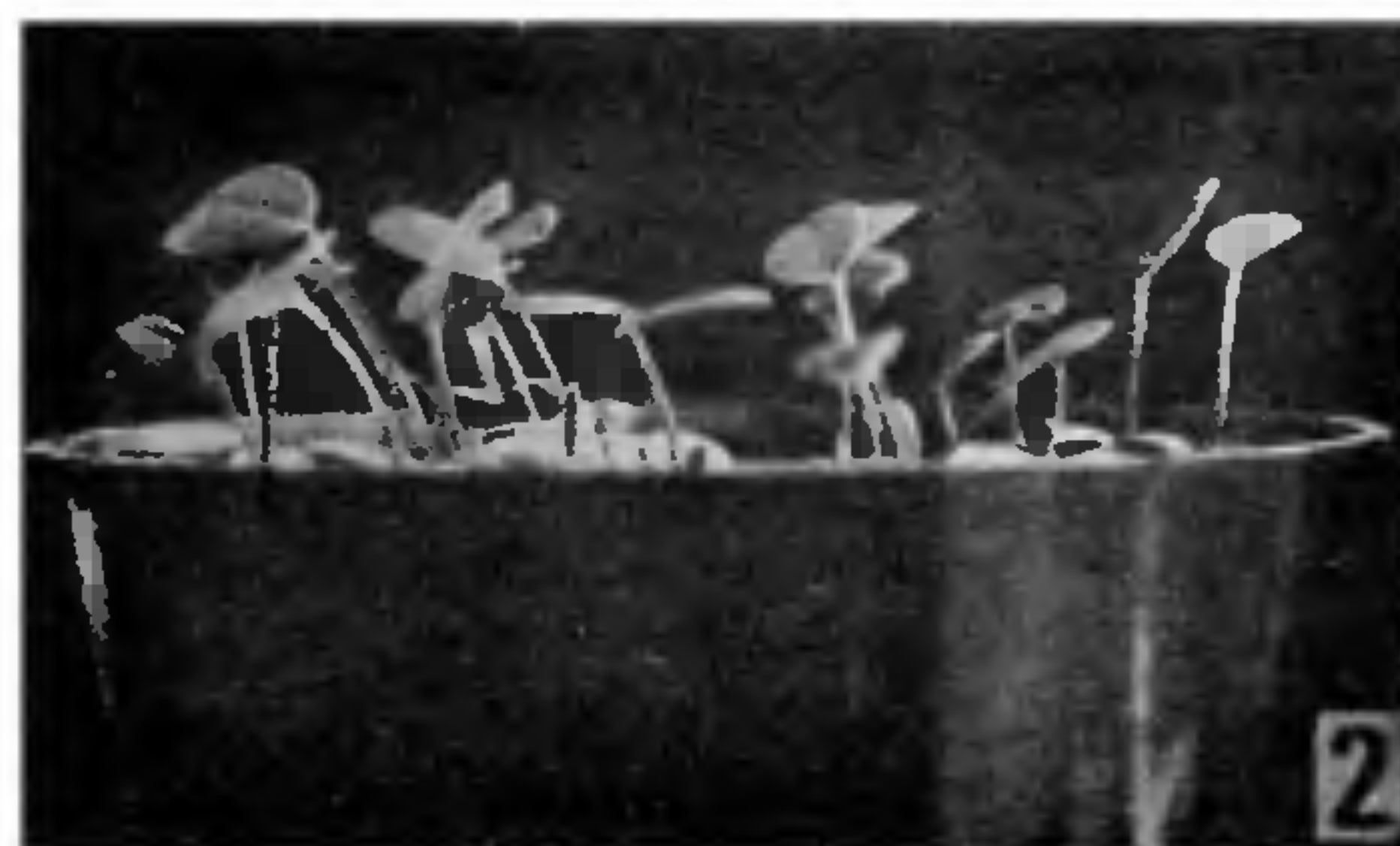
*Acetylene reduction assay of H. coronarium nodules following inoculation with different strains*

Strains	mg. d.w. × plant	nMC <sub>2</sub> H <sub>4</sub> × plant <sup>-1</sup> × h <sup>-1</sup> (Aver. 1,2,3, hr)
Control	0.02328	22.9
CC 1335 (Australia- Canberra)	0.03045	319.6
CC 1337 (Australia- Canberra)	0.03186	205.1
HCNTI (Pisa)	0.04000	59.1
RH-19 (Sicilia- S. Italy)	0.03150	237.9
HCNA (Volterra- -Pisa)	0.04536	162.5

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



**Figure 1.** Effect of inoculation with different strains on the growth of *Hedysarum coronarium* (Top L.R.) strains CC 1335, RH. 19. RH-Bact (Middle) strains HCNA Control, CC 1335 CaCO<sub>3</sub> pelleted (Bottom) strains CC 1337, HCNTI, CC 1335 CaSO<sub>4</sub> pelleted.



**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.

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## LATE QUARERNARY 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 100m) have been tentatively dated as early quaternary and the other formations to the late quaternary, accurate