looking M2 plants from each dose/concentration were randomly selected and advanced to M3. In M3, a group of 20 normal-looking plants with visual improvement in yield, earlines and other economic characters were selected from each dose/concentration. Selected superior plant/elite progenies were advanced from M4 onwards. Overall 114 M4 and M5 (gamma and EMS) mutant progenies were evaluated in 1986 for yield and other economic characters. Oil content in 10 g samples of delinted and dried seeds from 15 high-yielding M4 and M5 mutant progenies and their parents was determined on a Newport NMR analyser. Oil index, which is the weight of oil per seed in mg, was obtained by multiplying seed index and oil percentage and dividing by 10.

The results showed that 13.15% of the M4 and M5 progenies were high yielders. Seeds of all these elite progenies showed an overall increase in oil percentage and oil index over respective parents as also over the standard cv. SRT-1 (Table 1). Two high-yielding progenies (P 20 of Laxmi at 5 kR gamma and P 18/38 of L147 at 0.05% EMS) had relatively higher levels of oil. Progeny P6/20 of Laxmi at 5 kR gamma had increased levels of both oil percentage and oil index (Table 1) which were significantly higher than Laxmi. In general, oil index was higher in gamma progenies and oil percentage in EMS progenies. Thus induced mutations can help in obtaining simultaneous improvement of seed yield and oil content in cotton.

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Influence of associative rhizobia on yield of chickpea and soybean

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Seed inoculation with pea, soybean, mung and *Cicer-Rhizobium* of two cultivars of chickpea (Pusa 256 and 261) was adapted to study their associative effects on growth and nitrogen assimilation. Nitrogen enrichment and increase in grain yield occurred as a result of seed bacterization. Similar beneficial effects on yield of non-nod (T-201) and nod (T-202) isolines of soybean were observed due to inoculation with a strain of *Bradyrhizobium japonicum*. The root system of non-nodulating isoline was completely free of nodules.

AMONG the highly promiscuous tropical legumes, chickpea is known to exhibit somewhat more specific requirement for the *Symbiotic Rhizobium*[1]. Soybean is another legume which is susceptible to invasion by specific rhizobia. Rhizobia carry the genetic information required for reduction of atmospheric nitrogen. Taxonomically diverse group of plants are known to derepress these *nif* genes in rhizobia[2]. Certain non-nodulating isolines of soybean resist invasion by most rhizobia. It is thus clear that elaborate symbiosis may not be always necessary to derive benefits of such plant–rhizobial associations. Results of two such preliminary experiments are described below. Two chickpea cultivars Pusa 256 and Pusa 261 were grown in pots. The seeds were inoculated with strains of *Cicer-rhizobium* (F-75) *Bradyrhizobium japonicum* (SB-16), *R. leguminosarum* (2009) and a strain from green gram (*Vigna radiata* L., M-10). These strains were obtained from the Division of Microbiology, Indian Agricultural Research Institute, New Delhi. Urea and single superphosphate (N_{20} and P_{60} kg ha^{-1}) were applied at the time of planting. During *kharif* season non-nodulating and nodulating isolines T 201 and T 202 respectively of soybean were inoculated with an effective strain of *Bradyrhizobium japonicum* (SB-16) and grown in pots. The non-nodulating isoline received 80 kg N and nodulating isoline 20 kg urea-N ha^{-1} and 60 kg P_2O_5 ha^{-1} as single superphosphate. Yield data were recorded in both the experiments.

Seed inoculation with *Cicer*, soybean and pea *Rhizobium* increased number and fresh weight of nodules, grain, dry matter and nitrogen content of plants in case of Pusa 256 (Table 1). Variation in fresh weight of nodules of Pusa 261 was observed. Plants of this cultivar were infested with disease and died hence no further data could be recorded.

Unlike many promiscuous tropical legumes, chickpea plants are nodulated by some specific rhizobia. It is, therefore, unlikely that heterologous rhizobia used for inoculation in this experiment have produced nodules on chickpea. Data on average number of nodules per plant indicate natural variation among the treatments. Increase in fresh weight of nodules over the control in Pusa 256, a better nodulating variety than cv. 261, may be ascribed to synergistic effect of inoculated rhizobia on native rhizobia × plant genome interactions. Nitrogen content of plants inoculated with different rhizobia also supports such synergistic response. Inoculation with non-invasive diazotrophic bacteria, viz. *Azospirillum*[3] and *Azotobacter*[4] has been shown to enhance nodulation and yield of legumes.

To sum up, *Cicer* and soybean rhizobia increased yield and nitrogen content of chickpea, while *Rhizobium* from green gram had favourable effect on grain yield.

The non-nod isoline of soybean (T-201) supplied with urea (80 kg N ha^{-1}) and rhizobial inoculation produced more grain yield than uninoculated non-nod (80 kg N ha^{-1}) and nodulating (20 kg N ha^{-1}) isolines (Table 2). Inoculated nod isoline T 202 (20 kg N ha^{-1}) of soybean, however, produced more grain than all other treatments. No nodules were observed in non-nod isoline (T 201) while the same strain of *Rhizobium* enhanced number of nodules in nodulating isoline. Thus a nod^{+}, fix^{+}

Table 1. Nodulation, nitrogen content and yield of chickpea as influenced by rhizobia.

Treatment	Pusa 261 nodule		Nodule		Pusa 256 yield (g/pot)		N content (mg/pot)	
	Number	Fresh wt (mg/plant)	Number	Fresh wt.	Grain	Dry matter	Grain	Dry matter
No-inoculation	12	293	22	338	4.8	9.0	182.7	69.3
Cicer-Rhizobium	10	222	43	503	8.9	12.7	299.5	120.3
B. japonicum	5	57	31	552	8.3	12.3	335.8	102.5
R. leguminosarum	16	296	22	406	8.2	12.8	289.8	127.3
Green gram-*Rhizobium*	13	164	19	307	6.8	10.3	250.8	113.7
C.D. 0.05					1.85	2.21	67.29	20.07
CV%					23.20	18.00	23.00	17.50

Average of three replicates. *Average number of nodules per plant.

Table 2. Biomass production in soybean isolines.

Treatment	Grain (g/pot)	Shoot	Root
80 kg N ha^{-1}			
Non-nod, uninoculated	2.1	15.6	5.6
Non-nod, inoculated	4.1	13.8	5.5
20 kg N ha^{-1}			
Nod-uninoculated	3.1	27.0	6.8
Nod-inoculated	4.8	19.7	4.8

Average of three replicates.

strain of *Bradyrhizobium japonicum* unable to invade and produce nodules on the non-nod type of soybean was found to influence plant growth. Reduction in shoot and root weight in nodulating isoline may be ascribed to competition between host and *Rhizobium* for photosynthates.

Symbiotic association between legumes and *Rhizobium* implies invasion, nodule formation and fixation of atmospheric N, however the role played by the latter in absence of nodules, in providing N and enhancing yield of plants, is not fully understood. Competition and synergistic effects amongst strains in mixed cultures of rhizobia, *Rhizobium* and *Azotobacter/Azospirillum* have been observed[5,6].

Instances of successes and failures of inoculation with strains of *Rhizobium* occupying between 30 and 75% of nodules have been reported[7,8]. Decrease in ^{15}N content of plants — an indicator of possible N_2 fixation in Clark-63, a non-nodulating isoline of soybean inoculated with strain SB 113 of *B. japonicum* was observed (Raverkar, personal communication).

In general, most of the native soil rhizobia are ineffective and are known to compete with inoculated strain causing delay and/or reduction in nodulation[7]. Beneficial effects of seed inoculation with different rhizobia to wheat, where no nodules are formed, have also been observed even under field conditions[9,10].

Favourable effects of heterologous rhizobia on yield of chickpea and, that of homologous *B. japonicum* on non-nodulating soybean observed in these experiments, thus point out possibility of beneficial effects of rhizobia on leguminous plants in absence of nodulation.

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Cytoplasmic polyhedrosis virus infecting redpalm weevil of coconut

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A highly potent cytoplasmic polyhedrosis virus (CPV) has been detected for the first time in Kerala in stages of the redpalm weevil, *Rhynocophorus ferrugeneus* F., which infests coconut. It infects all the life stages of the pest, including the adult. Infection in the late grub stage resulted in malformed adults and suppressed the insect population drastically. The midgut of infected insects was enlarged and filled with thousands of polyhedral inclusion bodies (PIBs) visible under a light microscope. Electron microscopic studies revealed characteristics surface projections of viral bodies characteristic of CPV.

INVESTIGATION on a disease prevalent among the life stages