Table 1. Grain yield of chickpea (t ha^{-1}) as influenced by different treatments of irrigation.

Treatments	Evaporation (mm)	Delta[1] of water (mm)	Seed yield (t ha^{-1})	WUE[2] (kg seed ha^{-1} mm^{-1} water used)
Irrigations based on calendar dates: (Days after sowing)				
45	-[3]	140	2.24	16.0
45 and 75	-	210	2.46	11.7
45, 75, and 90	-	280	2.66	9.5
Irrigations based on IW/CPE[4] ratios:				
0.4 (69)	175	140	2.01	14.0
0.6 (54 and 84)	117	210	2.47	11.8
0.8 (49, 72, and 92)	87	280	2.84	10.0
SE			±0.121	

1. Delta of water = Includes one common irrigation (70 mm) in all the treatments for field preparation.
2. WUE = Water-use efficiency.
3. - = data not recorded.
4. IW/CPE = Quantity of irrigation water applied/ cumulative pan evaporation.

apart. Fertilizer (diammonium phosphate) was applied at the rate of 100 kg ha^{-1} 5–7 cm below the seeds. The variety used was JG 74 and this was sown on 4 Dec 1986. The depth of irrigation was 70 mm per irrigation applied to individual plots with the help of aluminium pipes. One common irrigation of 70 mm per irrigation was given to all the treatments just after sowing, to ensure proper germination. It is evident from the data (Table 1) that chickpea responded significantly to irrigations. In both the approaches, three irrigations were found significantly superior to one irrigation. In case of interval between irrigations, two irrigations at 45 and 75 days after sowing were not found to be a right schedule as the difference was not significant over one irrigation. But in case of IW/CPE ratio, two irrigations at 54 days and 84 days after sowing were found significantly superior to one irrigation and on par with three irrigations. We recommend two irrigations based on the IW/CPE ratio of 0.6 for late-sown chickpea as it permits an economic use of irrigation water and higher water-use efficiency (WUE). Mandal et al. (1979), and Raghu and Chaubey (1983) also reported similar results. The WUE (kg seed ha^{-1} mm^{-1} water used) decreased with increase in water supply. The highest WUE was recorded with one irrigation. Further, two irrigations in either of the irrigation methods gave higher WUE than did three irrigations. It can be concluded from the present study, that late-sown chickpea should be irrigated twice at a IW/CPE ratio of 0.6.

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Variability in Different Characters of Bacteria Nodulating Chickpea

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Bacteria nodulating chickpea (*Cicer arietinum* L.) are specific and do not show cross inoculation affinity with any members of the known cross-inoculation groups (Gaur and Sen 1979). According to Bergey's Manual of Systematic Bacteriology this group of bacteria has been named as *Bradyrhizobium* sp. (*Cicer*) (Jordan 1984) because of its slow growth rate. Not much research work of a basic nature has been done on chickpea rhizobia. This may partly be due to the lack of ready availability of well-characterized strains. In this note we share some information on variability in a range of characters of large numbers of this bacteria. Some of these characters have also been indicated in a recently published catalog on rhizobial strains of chickpea, pigeonpea, and groundnut (Rupela et al. 1991).

The 259 strains of chickpea listed in the catalog represent nine countries but the majority (80%) are from India, which also has the largest area under chickpea in the world. Most of the 73% rhizobia characterized were effective to highly-effective on chickpea genotypes ICC 4918 (Annigeri), ICC 496 (BEG 482 = Jyothi), or ICC 5003 (K 850 = 850–3/27), the genotypes generally used for evaluations in Leonard jars or pots. Almost all the 101 strains studied for pH reaction were acidic or neutral when grown on yeast-extract mannitol agar (YEMA) containing bromothymol blue. The rhizobia of chickpea were the slowest growing of the three legumes listed in the catalog. Time taken by a colony to grow to 2 mm size on YEMA plates at 28°C ranged from 4 to 12 days. This variability for chickpea strains is not apparent in the catalog because the rhizobia taking 2-3 days to grow to 2 mm size colonies are listed as 'Fast' and all others as 'Slow' growers. One-hundred-and-seventy-two of the 259 strains tested for inherent resistance to low levels (0.25 to 20 mg L^{-1}) of 10 antibiotics and antimetabolites, carbenicillin, erythromycin, kanamycin, nalidixic acid, neomycin, polymyxin, rifampicin, streptomycin, tetracycline, and vancomycin, showed tolerance to very low levels, generally 0.25 to 10 mg L^{-1}. This therefore indicates good scope of using antibiotically marked strains as inoculants for specific studies.

At least 8 of the 18 strains from which antisera production was attempted, resulted in poor antibody titer, generally around 1:100. These recalcitrant strains were IC 13, -24, -56, -60, -76, -94, -2058, and -2099. Strains that generally showed good antibody titer were IC 53, -59, -2002, and -2019. Other traits represented in the collection include resistance to high level (200 mg L^{-1}) of streptomycin, strains from wild *Cicer* sp, strains from saline soils, ineffective strains, and strains with variability in colony morphology.

All the strains in the collection have recently been rechecked for nodulation in axenic culture conditions described by Toomsan et al. (1984) and multiple copies of these as freeze dried ampules have been deposited at the *Rhizobium* culture collection recently set up at the Division of Microbiology, Indian Agricultural Research Institute, New Delhi 110 012, India. The Institute has agreed to provide the rhizobia of these legumes to any interested user worldwide.

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