Table 1 *Vesicular-arbuscular (VA) mycorrhizal spore population (10 g soil) in root zone of Ascochyta blight resistant and susceptible varieties of chickpea*

Variety	Resistant (R)/ Susceptible(S)	*n*	Mean ± S E.	Value of C D.
ICC 8160	R	5	$212^{c} \pm 7.5$	
ICC 8161	R	5	$184^{b} \pm 2.3$	27.87 at
ICC 2664	S	5	$178^{b} \pm 15.2$	5% level
Annegeri	S	5	$86^{a} \pm 7.3$	

n = Number of replicates; S.E. = Standard error; The mean values of each variety without common letters in their superscripts are significantly different.

As is evident from table 1, the soil from root zone of resistant cultivars harboured larger number of resting spores of VA-mycorrhizal fungi than susceptible varieties except ICC 2664 where the number of mycorrhizal spores was not significantly different from those observed in the case of ICC 8161 a resistant variety. There was, however, a marked difference in the number of VA-mycorrhizal spores harbouring the root zone of resistant varieties as it was always higher than the number of spores associate with susceptible cultivars.

Reduced VA-mycorrhizal spore population in the root zone of susceptible cultivars of chickpea could be explained on the basis of the fact that mycorrhizal fungi remain active inside the roots to maintain the vigour of the diseased host producing less of extramatrical spores. On the other hand, in resistant plants, nutritional dependence of host on VA-mycorrhiza decreases as it matures and VA-mycorrhizal fungi start producing extramatrical spores in soil[6].

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BIOCHEMICAL CHARACTERIZATION OF THE ROOT EXUDATES OF COCONUT PALM

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PLANT root exudes a great variety of organic compounds including aminoacids, sugars[1,2], organic acids[3], vitamins[4] and nucleotides. The nature and the amount of exudates of certain field crops have been characterized[5–7]. It is difficult to collect the root exudates under aseptic conditions in some of the plantation crops, especially in coconut where the seed size is large. Although a method of collection of root exudates of coconut has been outlined[8], the biochemical nature has not been studied. In the present investigation, an attempt is made on the biochemical characterization of root exudates of coconut. Root exudate was collected from the intact roots of coconut by following the procedure of Ramadasan *et al*[8], with a slight modification. Roots were sequentially surface-sterilized in 80% ethanol (30 sec), 0.1% mercuric chloride (3 min) followed by washing with sterile water, 0.003% streptomycin sulphate (1 min) and 0.2% copper oxychloride (1 min). Then the roots were introduced aseptically into the sterilized test tubes (150 × 22 mm) containing Whatman No. 1 filter paper strip and plugged with cotton and the tubes were then buried in soil. After 5 days, the roots were cut at the top of the test tube. The filter paper strips were checked for microbial contamination and only those showing negative features were used for the extraction of root exudates.

The filter paper strips were extracted with 80% ethanol and fractioned into sugars, aminoacids and organic acids by ion exchange chromatography using Dowex 1 and $50H^{+}$. The sugars (total[9] and reducing sugars[10]), aminoacids[11] and phenol[7] were estimated. Six replications were maintained in the experiment. The mean value and the standard error of the mean in μg/g dry weight of roots were computed. The experimental results indicated that the root exudate contained 993 ± 174 μg/g total sugars and

226 ± 43 μg/g reducing sugars. The sugars present in the root exudates were raffinose, lactose, glucose and fructose. The total aminoacid content was 18.6 ± 3.9 μg/g. Among the amino acids, serine/glycine, glutamine, alanine, phenyl alanine and isoleucine/leucine were detected. The exudate also contained 11.6 ± 3 μg/g phenol. Only succinic acid was found in the organic acid fraction of the root exudate. The nature and the amount of substances exuded by the roots of plants depend on the plant species[6,12], age and environmental condition under which it is grown. The root exudates may play a role in neutralizing the soil pH and altering the microclimate of the rhizosphere through the liberation of water and carbon dioxide. Normally, a coconut tree has 4000 to 7000 roots; each tree exudes large quantities of sugars and other compounds into the rhizosphere which may directly or indirectly influence the number and quality of the microorganisms in the rhizophere.

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NITRATE REDUCTION IN RELATION TO NITROGENASE ACTIVITY IN SUMMER MUNG (*VIGNA RADIATA*) AS INFLUENCED BY BACTERIAL INOCULATION AND PHOSPHORUS APPLICATION

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Biological nitrogen fixation and nitrate assimilation represent two major sources of reduced nitrogen for plant growth and seed yield in legume crops. Enzyme nitrogenase and nitrate reductase are responsible for the operation of these two systems in the legumes. In general, different legumes derive 25–80% of the total plant nitrogen from nitrogen fixation[1] and the additional source of nitrogen is thought to be the nitrate via the enzyme nitrate reductase[2]. Since nitrate is considered to be the primary source of nitrogen available from the soil, it was presumed that the characterization of both nitrogen fixation and nitrate reduction throughout the crop growth period would be highly useful for proper understanding of nitrogen contribution from the two important sources. Levels of nitrogen fixation and specific nodule activity were highly correlated with supply of phosphatic fertilizer[3] and bacterial inoculation[4]. There is, however, paucity of information on nitrate reduction in relation to nitrogenase activity in summer mung as influenced by bacterial inoculation and phosphorus application.

The experiment was conducted in a factorial randomized block design having four levels of bacterial seed inoculation (*Rhizobium*, *Rhizobium* along with *Azotobacter chroococcum*, *Rhizobium* along with *Azospirillum brasilense* and no inoculation) and three levels of phosphorus (0, 13 and 26 kg P/ha) with three replications. The soil of the experimental field was sandy-loam in texture and alkaline (pH 8.1) in reaction with low in organic carbon (0.41%) and available P (7.2 kg/ha) and medium in available K (159.3 kg/ha). The strain of *Rhizobium* was obtained from NifTAL Project, University of Hawaii, USA, while *A. chroococcum* and *A. brasilense* were obtained from the Division of Microbiology, IARI, New Delhi. Single superphosphate was used as the source of supplying phosphorus. Nitrogen and potassium were not applied. Nitrate reductase activity in the uppermost 2–3 fully expanded leaves was assayed at 25, 45 and 55 days after sowing following the *in vivo*