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Efficacy of Various *Rhizobium* Strains to Different Varieties of Groundnut (*Arachis hypogea* L.)

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Abstract

Groundnut variety BARD-699 produced significantly the most promising yield than that of variety BARI-89 at Attock, Fatehjang and NARC, Islamabad. *Rhizobium* strains, NC-92 was found to be less efficient as compared to TAL-1000; TAL-1371. Nodule dry mass and number of pods per plant were much higher than that of control treatment. Although a significant difference in growth and yield of both the varieties due to *Rhizobium* inoculation was observed but on average basis TAL-1000 and TAL-1371 gave significantly better response for both the varieties in improving growth and yield at all sites. Nevertheless, future prospects for groundnut production are good in Pakistan if the farmers are realized to practice inoculation technology in their fields.

Introduction

Groundnut is one of the most important established oilseed legume crops in Pakistan and cash crop in rain-fed areas of Potohar (Chaudhary, 1986). Studies for its maximization and the development of early maturing and high yielding cultivars have been approved. Extensive areas of groundnut are planted after harvesting wheat where there is sufficient soil moisture for such rotational cropping. However the best yields are obtained when groundnut follows maize. The crop is also grown after pulses and millets (Aslam *et al*., 1997). The normal rotation used in the rain-fed farming (Barani) areas of the Punjab, the major groundnut growing zone, is Groundnut-Wheat-Groundnut. This is a long, uneconomical rotation and needs to take special attention for nutrient management after exhaustive crops such as wheat, maize, sorghum and millets, etc. The nutrient requirements for groundnut have been found to vary from place to place, depending on soil types and moisture regimes. Farmers of the region seldom use the recommended dose of chemical fertilizers because of uncertain climatic situations. It is possible to increase yield of groundnuts from such areas by inoculation with *Rhizobium*, even in fields where groundnut have been grown for many years and also to obtain residual benefits for subsequent crops (Elkan, 1986). Therefore research on *Rhizobium* inoculation, suitable variety selection and physiological factors affecting production needs to be initiated. Current study comprises fundamental, applied and development practices and includes the verification of new technology on farmer's fields under rain-fed environments.

Materials and Methods

Three *Rhizobium* strains (TAL-1000; TAL-1371 and NC-92) were tested in all possible combinations with two groundnut varieties (BARI-89 and BARD-699) in field at three sites, i.e., Attock, Fatehjang and National Agricultural Research Centre (NARC), Islamabad. All the selected sites were cultivated by wheat previously. Fertility level estimated (Richards, 1954; Soltanpour and Workman, 1979) from the air dried, ground to pass through 2 mm sieve bulk soil samples collected with 0-15 cm depths were as in Table 1.

The eight different treatments were imposed in four replications according to randomized complete block design. All the treatments received a uniform dose of P_2O_5 at 80 kg ha^{-1} as triple super phosphate at the time of sowing. Recommended seed rate of both the varieties were inoculated with either strains of *Rhizobium* as seed coating just before sowing except control treatment. After germination necessary thinning and weeding were done to keep the uniform crop stand. At flowering five plants from each treatment of all the sites under study were uprooted carefully to record nodule data and at maturity plant samples per meter square were harvested to collect the data regarding number of pods per plant and yield as well. The data thus obtained were subjected to analysis of variance for treatments according to Steel and Torrie, 1980.

Results and Discussion

Nodulation: Nodulation in both varieties increased with inoculation at all the sites (Table 2). Maximum nodule mass per plant were observed where *Rhizobium* inoculation was applied as TAL-1000 or TAL-1371 followed by NC-92. There was no significant difference among the individual *Rhizobium* strains but performed better than that of control treatment. BARD-699 proved to be the most efficient in nodulation and hence nitrogen fixation ultimately in improving crop yield as compared to the variety BART-89 (Table 3). Nodules variation by *Rhizobium* strains in legume crops has been reported by many other investigators (ICRISAT, 1986; Nambiar *et al*., 1988; Doughton, 1995; Herridge *et al*., 1995; Shaheen and Rahmatullah, 1996; Aslam *et al*., 1997).

Generally no inoculation is practiced by farmers, but natural *Rhizobium* is abundant in soils growing groundnut crop. Groundnuts grown after wheat may need more nutrition requirements due to which control treatment has less

Table 1: Physio-chemical characteristics of three sites under study

Site	Soil type	pHs	P	NO_3-N	N	OM
			($\mu g\ g^{-1}$)		(%)	
Attack	Sandy	7.4	0.326	1.881	0.0291	0.697
Fatehjang	Sandy loam	7.2	0.402	2.007	0.0317	0.732
NARC	Sandy loam	7.7	0.347	1.964	0.0259	0.661

Table 2: Effect of various *Rhizobium* strains on nodule dry mass (mg $plant^{-1}$) of two groundnut varieties grown at different sites

	Attock		Fatehjang		NARC	
Rhizobium strain	BARI-89	BARD-699	BART-89	BARD-699	BARI-89	BARD-699
Control	307.98f	371.37e	397.45d	398.36d	306.83g	324.11f
TAL-1000	394.62c	421.74a	449.92c	456.18ab	393.09b	401.28a
TAL-1371	39.6.63c	419:62a	451.94bc	458.02a	381.57d	402.06a
Nc-92	378.13d	402.14b	447.74c	454.63bc	364.29e	385.68c

Values with different letter(s) for each parameter differ significantly at 0.05.

Table 3: Effect of various *Rhizobium* strains on pods/plant and yield of two groundnut varieties at three different sites

		Rhizobium strains		
Sites/Varieties	Control	TAL-1000	TAL-1371	NC-92
Attock				
BART-89				
Pods ($plant^{-1}$)	54.81f	65.86c	64.98c	63.27d
Yield (t ha^{-1})	2.67d	3.02b	3.14a	3.00b
BARD-699				
Pods ($plant^{-1}$)	60.86e	71.89ab	72.61a	70.48b
Yield (t ha^{-1})	2.80c	3.15a	3.17a	3.08b
Fatehjang				
BARI-89				
Pods ($plant^{-1}$)	61.21g	74.33d	75.24cd	70.68e
Yield (t ha^{-1})	3.08c	3.86ab	3.84b	3.79b
BARD-699				
Pods ($plant^{-1}$)	66.46f	81.37a	79.74b	76.12c
Yield (t ha^{-1})	3.29c	3.91a	3.93a	3.87ab
NARC				
BART-89				
Pods ($plant^{-1}$)	57.86e	62.92c	63.76c	60.72d
Yield (t ha^{-1})	2.53d	3.06a	2.98ab	2.81 b
BARD-699				
Pods ($plant^{-1}$)	54.73f	69.61a	68.93a	67.02b
Yield (t ha^{-1})	2.64c	3.10a	3.09a	2.98ab

Values with different letter(s) for each parameter differ significantly at 0.05

nodulation. *Rhizobium* strains enhanced nodulation and the host plant component in plant nutrition in an attempt to increase nitrogen fixation and so yield at all the sites of harsh climate. Therefore, it is possible to increase nodulation causing improvement in yield from marginal lands by inoculation with *Rhizobium*.

Growth and Yield: Inoculation by low cost *Rhizobium* strains had significant effect on growth and yield of both the varieties (Table 3). The variety BARD-699 has been found to be the most promising for increasing number of pods and yield than that of BARI-89. Rhizobial strains (TAL- 1000 and TAL-1371) performed well to produce more yield for both the varieties. The reason might be better nodulation (Table 2) because of perfect *Rhizobium* supply in the rhizosphere and thus nitrogen fixation giving healthy

environment for plant growth and ultimately better yield production. A large number of *Rhizobium* strains increase nitrogen fixing ability with a range of cultivars and germplasm lines (ICRISAT, 1986). There was a strong effect of *Rhizobium* strains on growth and yield of both the varieties. This is in agree with earlier researchers. Minimum number of pods per plant and yields were observed with non-inoculated treatment at all the sites. This might be due to poor nutrition in the soils and inefficiency of natural *Rhizobium* present in the soil. Similar conclusions had been reported by Elkan (1986).

Inoculation by different *Rhizobium* strains raised the yield production of both the varieties under study. Rhizobial strains performed well with variety BARD-699 under the specific environment usually occurring with in the Potohar region. Although the selection of variety is also a main factor to produce higher yields but there is a need to extend inoculation practice in groundnut growing areas which will turn out to be an interesting research for the farmers of the region.

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