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Effect of Rhizobial Inoculants and Chemical Fertilizers on Nodulation and Yield of Groundnut

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Abstract: Two different experiments were conducted in widely separated farmers field at Phulpur MLT site of On-Farm Research Division (OFRD), Mymensingh during the two consecutive rabi seasons of 1997-98 and 1998-99 to study the effectiveness of two promising strains of *Rhizoblum* BARI and BAU along with chemical fertilizers on nodulation and yield of groundnut (var. Dhaka-1) and also to select the suitable combination of *Rhizobium* inoculum and NPKS fertilizers. Five treatment combinations such as control, NPKS, PKS, Inoculum and PKS + Inoculum each replicated 4 times in randomized complete block design were included in the study. Significant differences were observed in all the parameters studied. Among the two strains of *Rhizobium* tested BAU strains performed better than BARI strain. *Rhizobium* inoculation alone or with PKS fertilizers produced significantly higher nodule number, pod number, pod weight, nut yield and stover yield compared to uninoculated ones. The highest nut and stover yield was produced by the treatment PKS + Inoculum. However, the economic evaluation of the crop suggested that the treatment Inoculum was most suitable for groundnut production.

Key words: Rhizobial inoculants, chemical fertilizers, nodulation, yield, groundnut

Introduction

Nitrogen is the most deficient nutrient in Bangladesh soil limiting crop production. Urea, the most commonly used nitrogenous fertilizer in the country is becoming costly day by day and most of the farmers in Bangladesh cannot afford to buy the required quantities of the fertilizer for successful crop production.

Groundnut is one of the major oil seed legume crops in Bangladesh covering about 7% of the total area under oil crops and 9% of the total oilseed production (Anonymous, 1993). It is capable of fixing and utilizing atmospheric nitrogen in symbiotic association with *Rhizobium* bacteria. The benefits of inoculation on groundnut in Bangladesh has been demonstrated by Hoque (1988; 1993) . The use of appropriate *Rhizobium* strain for groundnut production may reduce the use of commercial nitrogenous fertilizer in one hand and increase the profitability of production on the other hand. With this view point, Bangladesh Agricultural Research Institute (BARI) and Bangladesh Agricultural University (BAU) have developed *Rhizobium* inoculants for different food legume crops. In the present study an effort was made to evaluate the effectiveness of both BARI and BAU strains of *Rhizobium* on the yield performance and economic benefit of groundnut.

Materials and Methods

Two separate experiments, one with BARI strain and the other with BAU strain of *Rhizobium* were conducted in two widely separated farmers fields at Phulpur MLT site of OFRD, Mymensingh during the two consecutive rabi seasons of 1997-98 and 1998-99 with Dhaka-1 groundnut variety. There were five treatments such as Control, NPKS, PKS, Inoculum and PKS + Inoculum each replicated 4 times in randomized complete block design. Before planting. *Rhizobium* inoculants were mixed with groundnut seeds with the addition of water in such a way that the inoculants were just adherent to the surfaces of seeds. Fertilizers were applied at the time of sowing according to the treatment as per BARC Fertilizer Recommendation Guide (1997). Seeds were sown on 15-18 January with recommended spacing of 40 × 15 cm. Weeding was done when necessary and fungicides were applied to control Tikka disease.

Ten randomly selected plants were uprooted from each plot at nut formation stage of crop and data on nodule number and pod number per plant were recorded. At maturity, the crop was harvested and nut and stover yields were recorded. The data were analysed statistically by means of ANOVA technique. The differences among the treatment means were evaluated by Duncan's New Multiple Range Test (DMRT) (Steel and Torrie, 1960).

Results and Discussion

Results on nodule number, pod number and pod weight are presented in Table 1; on nut yield and stover yield are presented in Table 2 and economic evaluations are presented in Table 3.

Both BARI and BAU strain of Rhizobia inoculation in presence of phosphorus, potassium and sulphur resulted significant increase in nodule number, pod number and pod weight during the two consecutive rabi seasons of 1997-98 and 1998-99 (Table 1). *Rhizobium* inoculation without any chemical fertilizer gave significantly higher nodule number, pod number and pod weight compared to uninoculated control. This result is in agreement with Rahman *et al.* (1992) who found that Dhaka-1 variety of groundnut with *Rhizobium* strain RAH-805 recorded 32 and 140% higher nodule number. Plant receiving NPKS and PKS fertilizers produced identical nodule number, pod number and 100 pod weight. In case of all parameters recorded BAU strain performed better than BARI strain.

Inoculated plants along with nitrogen, phosphorus, potassium and sulphur fertilization produced significantly higher nut and stover yield compared to uninoculated ones during the two consecutive rabi seasons (Table 2). Plant receiving inoculum alone gave higher nut and stover yield than control. The treatment PKS + inoculum produced the highest nut and stover yield. The yields produced by NPKS was at par with PKS.

The economic evaluation of groundnut production through *Rhizobium* inoculation reveals that the highest nut yield and gross margin were obtained from the treatment PKS + Inoculum but the benefit cost ratio was highest only for inoculum treatment. Bhuiyan *et al.* (1996) also found similar result in a trial of groundnut with rhizobial inoculant. Hence application of only inoculum was the most suitable treatment for groundnut production from economic point of view. However, the rich farmers may use the treatments PKS + Inoculum through additional investment to increase

Table 1: Nodulation and yield components of groundnut as affected by inoculants and NPKS fertilization

Parameters		Control	NPKS	PKS	Inoculum	PKS + Mac	Sx	CV%
No. of nodule /plant								
BARI strain	1997-98	53.02c	71.28ab	74.10ab	61.10bc	76.72a	2.66	7.97
	1998-99	76.13c	128.8a	96.79b	109.3b	109.9b	3.65	7.01
BAU strain	1997-98	73.85	111.8ab	123.5a	102.6b	107.Bab	4.31	8.31
	1998-99	110.5b	142.2a	124.5ab	145.5a	137.6a	4.67	7.05
No. of pod /plant								
BARI strain	1997-98	15.8	18.58	17.85	15.32	18.5	NS	8.49
	1998-99	12.75b	15.88a	13.63b	14.25ab	13.94b	0.576	8.19
BAU strain	1997-89	19.05	21.05	21.85	18.08	21.73	NS	10.14
	1998-99	12.00b	17.25a	15.88a	15.25ab	17.38a	0.826	10.64
Pod weight/plant (gm)								
BARI strain	1997-98	15.00ab	17.10a	16.75a	13.75b	16.84a	0.566	7.12
	1998-99	9.50b	12.25a	11.38ab	10.75ab	10.50ab	0.429	7.9
BAU strain	1997-89	18.54	20.88	21.31	58.88	22.75	NS	9.37
	1998-99	10.886	16.00a	14.75a	14.13ab	16.25a	0.83	11.53
100 pod weight (gm)								
BARI strain	1997-98	59.25b	62.25ab	66.00a	59.75b	64.75ab	1.253	7.12
	1998-99	52.88b	60.13a	58.75ab	62.00a	62.38a	1.45	4.92
BAU strain	1997-89	56.00b	65.25a	70.50a	64.75a	670.50a	0.959	4.34
	1998-99	58.38b	68.25a	66.38a	68.13a	68.35a	1.09	3.32

Figures in a column having letter (s) in common do not differ significantly but figures bearing dissimilar letter(s) differ significantly at 1%level of probability

Table 2: Pod and stover yield of groundnut as affected by inoculant and NPKS fertilization

Treatment	Pod yield (kg/ha)				Stover yield (kg/ha)			
	BARI strain		BAU strain		BARI strain		BAU strain	
	1997-98	1998-99	1997-98	1998-99	1997-98	1998-99	1997-98	1998-99
Control	2281.00c	1625.00	2975.00c	2750.00	3456.00	4640.00b	4544.00b	5875.00
NPKS	2776.00a	2400.00	3794.00a	2994.00	4475.00	7548.00a	4706.00b	6862.00
PKS	2681.00ab	2162.00	3494.00ab	3062.00	4256.00	5409.00b	4725.00b	6087.00
Inoculum	2369.00c	2344.00	3200b.00c	2837.00	3656.00	5501.00b	4763.00b	6775.00
PKS + Inoculum	2775.00a	2194.00	3844.00a	3225.00	4006.00	5755.006	5319.00a	6537.00
Sx	84.16	NS	88.81	NS	NS	261.4	109.4	NS
CV%	6.53	24.20	5.13	7.08	12.23	9.06	4.55	10.55

Figures in a column having letter (s) in common do not differ significantly but figures bearing dissimilar letter(s) differ significantly at 1% level of probability

Table 3: Cost and return analysis of groundnut production through *Rhizobium* inoculation

Treatment	Gross return (Tk./ha)				Total variable cost (Tk./ha)				BC ratio			
	BARI strain		BAU strain		BARI strain		BAU strain		BARI strain		BAU strain	
	1997-98	1998-99	1997-98	1998-99	1997-98	1998-99	1997-98	1998-99	1997-98	1998-99	1997-98	1998-99
Control	35079.00	26535.00	45761.00	42718.75	11450.00	11450.00	11450.00	11450.00	3.06	2.23	3.99	3.73
NPKS	42758.75	37886.50	58086.50	48625.50	16621.05	16521.05	16621.05	16621.05	2.57	2.28	3.54	2.81
PKS	41279.00	33782.25	58091.25	47451.75	16338.44	16338.44	16338.44	16338.44	2.53	2.07	3.56	2.91
Inoculum	36449.00	36535.25	49190.75	442483.75	12450.00	12450.00	12450.00	12450.00	2.93	2.93	3.95	3.55
PK5 + Inoc.	42626.50	34348.75	58989.75	50009.25	17338.44	17338.44	17338.44	17338.44	2.46	1.98	3.40	2.88

Input:
* Urea at 8.5 Tk/kg *TSP at 16 Tk/kg *MP at 12 Tk/kg * Gypsum at 4 Tk/kg * Inoculum at 100 Tk/kg
* Seed at 55 Tk/kg * Seed rate at 100 kg/ha * Fertilizer dose- kg/ha- 20-80-80-20, N-P_2O_5 -K_2O-S * Inoculum rate 10 kg/ha
Output :
'Groundnut at 15Tk/kg * Stover at 0.25 Tk/kg

gross margin profitable. Moreover, in all respects BAU strain of *Rhizobium* is better than BARI strain. Results of two years indicate that the costly nitrogenous fertilizer can be substituted by *Rhizobium* inoculum. Nitrogen is a chemical fertilizer while rhizobial inoculant is a natural biofertilizer which has no adverse effects on soil health and environment. Therefore, it can be suggested that rhizobial inoculant is a better substitute of chemical fertilizer nitrogen.

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