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Effects of Variety, Inoculum and Phosphorus on the Performance of Soybean

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Abstract: Effects of variety, *Bradyrhizobium* inoculum and phosphorus on soybean were studied through an experiment at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh from August 26 to November 30, 2001 with the views to observe the performance of soybean varieties using *Bradyrhizobium* inoculum and phosphorus fertilizer and thereby to select suitable soybean variety(s) with its optimum dose inoculum and phosphorus. Three varieties of soybean viz., Shohag (Pb-1), BS60 and BS16 were tested using two levels of *Bradyrhizobium* inoculum viz., 0 and 30 g kg^{-1} seed and three levels of phosphorus viz., 60, 72 and 84 kg P_2O_5 ha^{-1} in a split plot design with four replications. The varieties were accommodated in main plots and six combinations of inoculum and P_2O_5 were assigned to the sub plots. The single effect of variety, inoculum and phosphorus indicated that significantly the highest seed and stover yield was obtained from Shohag, using inoculum and higher dose of phosphorus. The combined effect of variety and inoculum was significant in respect of branches per plant, seed per plant, empty pod per plant, nodules per plant and seed yield and that of variety and phosphorus was significant only in case of empty pod per plant, nodules per plant and seed yield. That is the seed yield, nodules and seed per plant of Shohag increased with inoculum and higher dose of phosphorus except empty pod per plant both the cases. Though there was no significant differences in respect of all the characters studied except empty pod per plant and nodules per plant due to combined effect of inoculum and phosphorus; and variety, inoculum and phosphorus an increased trend was observed in all the studied characters except empty pod per plant. However the variety, Shohag gave the highest seed yield (2.29 t ha^{-1}) using inoculum and the highest dose (84 kg ha^{-1}) of P_2O_5. The over all results implies that the variety, Shohag in combination with inoculum at the rate of 30 g kg^{-1} seed and 84 kg P_2O_5 ha^{-1} can be grown planting on August in puddle soil for higher yield of soybean.

Key words: Soybean, *Bradyrhizobium* inoculum, phosphorus fertilizer

INTRODUCTION

Soybean (*Glycine max* L.) (Merr.) is one of the important crops of the world as well as a new prospective oil crop in Bangladesh. It is an oil crop as well as a pulse crop. From the view point of nutrient no pulse crop is equivalent to it, rather it is very much superior to any one of the pulse crops. Though the oil content of soybean is less than those of two major oil seeds, viz., mustard and groundnut, its protein content is quite high, 43.2% against 24-25% and 25-26% of mustard and groundnut, respectively. As a good source of protein, unsaturated fatty acids, minerals like Ca and P including vitamin A, B, C and D, soybean can meet up different nutritional needs. Soybean is regarded as an ideal food for the people of Bangladesh as it contains high quality of protein and reasonable quantity of oil as a source of energy[1]. The poor of our country cannot afford high priced animal protein like meat, egg, fish, milk, etc.

Soybean is not yet popular as a crop but its oil is very popular as cooking oil. From our internal production of the total oil crop, one-third of the oil requirement can be met-up. The shortfall is imported every year at the high cost. Soybean, producing in a very limited scale in Bangladesh, is mostly used for making nutritious food items like soyadal, soyakhechuri, soyapollao, soybori, soyachatni, soyaparata, soyamilk, soyacakes, soyabiscuits, soyabread, poultry feeds etc[1,2]. The green kernel of soybean may be taken as vegetable and also used in fried rice, 'singara and curry. Soyamilk is comparable to cow's milk[3].

Soybean belongs to the family Leguminosae under sub-family Papilionaceae. Being a Leguminous crop it improves the soil by fixing the atmospheric nitrogen

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through *Rhizobium* bacteria that lives in root nodules. According to Keyser and Li[4] the *Bradyrhizobium japonicum* can fix atmospheric nitrogen about 300 kg ha^{-1} $year^{-1}$ in symbiosis with soybean.

Soybean can be grown under a wide range of climatic and edaphic conditions. With well-adapted cultivars, soybean can be cultivated throughout the year in Bangladesh[5]. In the northern part, it can also be grown in summer without affecting the production of T. aman rice. Even, it can be grown in char and hoar areas after receding flood water with no tillage and minimum inputs. But, still the yield of soybean is very discouraging compared to other soybean producing countries. This is mainly due to use of low yielding varieties and poor cultivation technologies i.e. lack of application of inoculum, fertilizer etc.

Inoculation increased the soil *Rhizobium* population and nitrogen fixation. It also increased grain and nodule weight by 35-43%[6]. In Brazil, *Bradyrhizobium* inoculum has successfully replaced the use of N-fertilizer[7].

Phosphorus is one of the limiting plant nutrients to the productivity of soybean[8]. Phosphorus uptake and utilization by soybean is essential for proper growth and in ensuring higher yield and improved quality of the crop[9]. Inoculation and P application is necessary for high protein and oil yields from soybean seeds as well as for high forage protein yields from soybean planted for forage[9].

Thus, for successful soybean production and yield maximization per unit area a package of production technology will have to be developed using suitable variety, inoculum and appropriate doses of phosphorus. Therefore present study was undertaken to observe the performance of soybean varieties using *Bradyrhizobium* inoculum and phosphorus fertilizer and thereby to select suitable soybean variety(s) with its optimum dose of inoculum and phosphorus.

MATERIALS AND METHODS

The experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh, from 26 Aug. to 30 Nov., 2001. The experimental field was located at the 24°74" latitude and 90°5" E longitude at an altitude of 18 m above the sea level. The experimental area belongs to the Agro Ecological Zone-Old Brahmaputra Floodplain (AEZ-9) having loamy soil. The pH, organic matter and available phosphorus content of the soil were 6.7, 1.19 and 16 ppm, respectively.

The experiment was laid out in a split plot design with four replications. Three varieties (V) of soybean viz., Shohag (V_1), BS 60 (V_2) and BS 16 (V_3) were tested with the six combinations of *Bradyrizobium* inoculum (I) and phosphorus (P). There were two levels of inoculum (I_0: No inoculum and I_1: 30 g inoculum for 1 kg seed) and three levels of phosphorus (P_1: 60 kg P_2O_5 ha^{-1}, P_2: 72 kg P_2O_5 ha^{-1} and P_3: 84 kg P_2O_5 ha^{-1}). The three varieties were accommodated in main plots and the six combinations were assigned to the sub plots. The unit plot size was 4x2 m.

The land was opened with a power tiller and then ploughed twice with country plough. The weeds and stubbles were removed by hand. Rainwater was trapped by making ridge with spade along the perimeter of the experimental field and subsequently the land was puddled well with power tiller. After puddling there was no standing water in the field. The land was uniformly fertilized with 10 kg N and 60 kg K_2O ha^{-1} at the time of final land preparation. P_2O_5 was applied as per treatment in individual plots. Seeds of the three varieties of soybean and *Bradyrhizobium* inoculum were collected from the Department of Genetics and Plant Breeding, Bangladesh Agricultural University and the Bangladesh Institute of Nuclear Agriculture, Mymensingh, respectively. The seeds of each variety were mixed with molasses and then treated with *Bradyrhizobium* inoculum at the rate of 30 g kg^{-1} of seed to develop proper coating. The treated seeds were sown on 26 Aug., 2001 on the puddled soil in 40 cm apart rows maintaining 5 cm spacing from seed to seed.

Intercultural operations such as gap filling, weeding, soil loosening, disease and pest management, etc. were performed uniformly in all plots. Weeding was done three times at 15, 30 and 45 days after sowing. Necessary plant protection measures were taken as and when required. The crop was harvested at full maturity on 23 and 30 Nov., 2001. The variety BS60 and BS16 were matured 7 days earlier in all plots than the variety, Shohag.

Data on number of nodules $plant^{-1}$, plant height, number of branches $plant^{-1}$, length of pod, number of effective pods $plant^{-1}$, number of empty pods $plant^{-1}$, number of seeds pod^{-1}, 1000-seed weight, seed yield and stover yield were collected and analyzed and mean differences were adjusted by Duncan's Multiple Range Test.

RESULTS AND DISCUSSION

Effect of variety: Yield and other studied characters of different varieties varied significantly. Mishra and Vyas[10] also observed variation among three varieties of soybean. There was a correlation of seed yield with the yield contributing characters of the tested varieties. Wu *et al.*[11] reported that seed yield was

correlated with plant height, number of branches and number of pods per plant. Among the tested varieties, Shohag succeeded to produce significantly the highest seed (1.95 t ha^{-1}) and stover (2.01 t ha^{-1}) yield. The seed and stover yield obtained from other two varieties was statistically identical and it ranged from 1.29-1.31 t ha^{-1} and 1.45-1.51 t ha^{-1}, respectively. Higher number of inoculum, effective pod, seed per plant, seed size and plant height of Shohag attributed its higher yield (Table 1).

Effect of inoculum: *Bradyrhizoium* inoculum exerted significant effect on all the studied crop characters. Significantly higher number of nodules (24.1), branches (4.1), effective pods (40.6), seeds (60.0) and lower number of empty pods (2.60) $plant^{-1}$; higher plant height (51.41 cm), 1000-seed weight (111.6 g), seed yield (1.67 t ha^{-1}), stover yield (1.75 t ha^{-1}) and longer pods (3.71cm) was recorded from inoculum treated plots than that of no treated plots (Table 1).

Thananusant[12] also stated that rhizobium inoculum increased nodulation of soybean. The result obtained is in agreement with the findings of Bhuian *et al.*[13] and Kulhare[14]. The reasons behind maximum plant height in inoculation were probably higher rate of nitrogen fixation by inoculum, which played a vital role in the vegetative growth of soybean. Higher number of effective pods formed in inoculated plants was might be because of higher phosphorus uptake due to inoculum effect. Fan *et al.*[15] stated that *Bradyrhizobium* inoculum increased N and P content of soybean plant by 56.7-78.3% and 14.6-19.6%, respectively. Lower number of empty pods in inoculated plants was possibly due to the fact that inoculum increased the uptake and use efficiency of Phosphorus. Shah *et al.*[9] reported that inoculum increased P uptake and use efficiency in soybean. Higher seed yield in inoculated plants might have resulted due to cumulative favourable effects of length of pod, number of mature pods and seeds $plant^{-1}$ and 1000-seed weight. The result is in agreement with the findings of Vara *et al.*[16], Dubey *et al.*[17] and Raychaudhuri *et al.*[6].

Effect of phosphorus: Different dosage of phosphorus also significantly influenced all the studied parameters of soybean except number of effective pods $plant^{-1}$. All the units of studied characters increased with the increase of dose of phosphorus. The highest number of nodules $plant^{-1}$ (18.4), branches (4.1), seed (59.2); the highest pod length (3.70), plant height (51.7 cm), 1000 seed weight (111.8 g), seed yield (1.65 t ha^{-1}), stover yield (1.71 t ha^{-1}) and the lowest number of empty pods $plant^{-1}$ was obtained from the plots having the highest dose (84 kg ha^{-1}) of P_2O_5 and these differed significantly from other two lower dosage. Number of effective pod (40.3) was also the highest in the same treatment though there was no statistical difference among the treatments.

Bothe *et al.*[18] also reported that higher level of P_2O_5 (75 Kg ha^{-1}) produced higher plant height. Syafruddin *et al.*[19] found the lower number of empty pod $plant^{-1}$ in his study. The result in respect of 1000-seed weight is also in agreement with the findings of Tomar *et al.*[20]. Cumulative favourable effects of the number of effective pods $plant^{-1}$, seeds $plant^{-1}$ and 1000-seed weight possibly caused the highest seed yield. The results are in agreement with the findings of Osman *et al.*[21], Bothe *et al.*[18] and Shah *et al.*[9].

Combined effect of variety and *Bradyrhizobium* inoculum: The combined effect of variety and inoculum was found to be significant only on number of nodules $plant^{-1}$, number of branches $plant^{-1}$, number of empty pods $plant^{-1}$, number of seeds $plant^{-1}$, seed yield and biological yield and the remaining crop characters were not affected due to interaction of variety and inoculum. All the varieties produced significantly higher number of nodules, branches and seeds $plant^{-1}$; higher seed yield but the two varieties (Shohag and BS 60) produced lower number of empty pod $plant^{-1}$ using inoculum than that of using no inoculum. The unit of other studied parameters was also numerically higher in all varieties. Among the varieties Shohag succeeded to produce the highest seed yield (2.13 t ha^{-1}) with its highest number of nodules and seeds $plant^{-1}$ using inoculum but BS 16 produced the highest number of branches $plant^{-1}$. The seed yields (1.40 and 1.47 t ha^{-1}) of BS 60 and BS 16 were statistically identical in inoculated plots. Numerically the highest stover yield (2.07 t ha^{-1}) was also harvested from Shohag using inoculum. Higher seed yield in Shohag with the use of inoculum might have resulted due to cumulative favorable effects of length of pod, number of effective pods and seeds $plant^{-1}$ and 1000-seed weight (Table 2).

Combined effect of variety and Phosphorus: The combined effect of variety and phosphorus exerted significant influence on number of nodules $plant^{-1}$, number of empty pods $plant^{-1}$, seed yield and biological yield whereas plant height, number of branches $plant^{-1}$, length of pod, number of mature pods $plant^{-1}$, number of seeds $plant^{-1}$, 1000-seed weight, stover yield, seed to stover ratio and harvest index did not show any significant variation. There was a trend to produce significantly higher number of nodules $plant^{-1}$, higher seed yield and numerically higher plant height, number of branches $plant^{-1}$, length of pod,

Table 1: Single effect of Variety (V), Inoculum (I) and Phosphorus (P) on the yield, yield attributes and other characters of soybean

Treatments	Seed yield (t ha^{-1})	Stover yield (t ha^{-1})	1000 seed wt. (g)	Seed plant^{-1} (No.)	Effective pod plant^{-1} (No.)	Empty pod plant^{-1} (No.)	Pod length (cm)	Branch plant^{-1} (No.)	Nodules plant^{-1} (No.)	Plant height (cm)
Effect of variety										
V_1	1.95a	2.01a	121.8a	61.4a	41.9a	4.0a	3.68b	3.65b	19.7a	54.0a
V_2	1.29b	1.51b	98.5c	54.7b	38.6b	2.6b	3.67b	3.40c	12.9c	45.0b
V_3	1.31b	1.45b	103.0b	51.1c	36.9b	1.6c	3.72a	3.68a	15.0b	46.8b
CV (%)	5.83	6.72	2.3	5.4	7.5	5.0	1.21	7.00	16.8	5.7
Effect of inoculums										
I_0	1.38b	1.7 b	104.1b	51.4b	37.7b	2.9a	3.67b	3.72b	7.6b	45.8b
I_1	1.67a	1.75a	111.6a	60.0a	40.6a	2.6b	3.71a	4.10a	24.1a	51.4a
CV (%)	5.32	7.73	3.4	5.4	8.8	9.6	4.38	10.67	10.1	6.0
Effect of phosphorus										
$P_{60}$and	1.37c	1.61b	103.9c	52.5c	37.2	3.1a	3.63c	3.65b	14.0b	46.0c
P_{72}	1.54b	1.66ab	107.8b	55.7b	39.9	2.6b	3.68b	3.95a	15.2b	48.0b
P_{84}	1.65a	1.71a	111.8a	59.2a	40.3	2.5b	3.70a	4.13a	18.4a	51.7a
CV (%)	5.32	7.73	3.4	5.4	8.8	9.6	4.38	10.67	10.1	6.0

Means in a column followed by the same letter(s) are not significantly different at 5% level of significant by DMRT

Table 2: Combined effect of variety and inoculums; variety and phosphorus; and inoculums and phosphorus on the yield, yield attributes and other characters of soybean

Interaction	Seed yield (t ha^{-1})	Stover yield (t ha^{-1})	1000 seed wt. (g)	Seed plant^{-1} (No.)	Effective pod plant^{-1} (No.)	Empty pod plant^{-1} (No.)	Pod length (cm)	Branch plant^{-1} (No.)	Nodules plant^{-1} (No.)	Plant height (cm)
Variety X Inoculum										
V_1I_0	1.77b	1.96	119.07	56.10c	39.63	4.25a	3.64	3.22d	8.78d	51.01
V_1I_1	2.13a	2.07	124.86	66.70a	44.23	3.67b	3.72	4.08c	30.65a	56.91
V_2I_0	1.19d	1.43	93.74	50.20d	37.83	2.75c	3.67	3.45d	6.87e	42.69
V_2I_1	1.40c	1.60	103.29	59.20b	39.33	2.48d	3.68	3.35d	18.92c	47.35
V_3I_0	1.17d	1.32	99.52	48.00d	35.66	1.62e	3.70	4.50b	7.25de	43.63
V_3I_1	1.47c	1.59	106.49	54.20c	38.21	1.63e	3.74	4.87a	22.78b	49.98
CV (%)	5.32	7.73	3.42	5.41	8.89	9.66	4.38	10.67	10.13	6.01
Variety X Phosphorus										
V_1P_{60}	1.74c	2.02	118.63	58.00	39.03	4.48a	3.60	3.58	17.35c*	50.99
V_1P_{72}	2.01b	1.99	121.32	61.06	43.54	3.68b	3.67	3.68	19.65b	52.96
V_1P_{84}	2.10a	2.02	125.95	65.13	43.23	3.73b	3.78	3.70	22.15a	57.93
V_2P_{60}	1.18f	1.42	94.45	51.15	36.64	2.85c	3.62	3.16	11.98d	42.71
V_2P_{72}	1.31e	1.54	99.16	55.38	38.70	2.70c	3.67	3.43	10.60d	44.39
V_2P_{84}	1.40d	1.58	101.94	57.55	40.39	2.30d	3.73	3.61	16.10c	47.96
V_3P_{60}	1.19f	1.38	98.48	48.19	36.01	1.85e	3.68	4.23	12.78d	44.43
V_3P_{72}	1.31e	1.45	102.82	50.73	37.46	1.53f	3.71	4.75	15.25c	46.65
V_3P_{84}	1.45d	1.54	107.73	54.38	37.33	1.50f	3.78	5.08	17.03c	49.34
CV (%)	5.32	7.73	3.42	5.41	8.89	9.66	4.38	10.67	10.13	6.01
Inoculum X Phosphorus										
I_0P_{60}	1.25	1.51	99.98	48.48	35.38	3.25a	3.63	3.38	7.08d	43.24
I_0P_{72}	1.38	1.55	103.61	50.94	37.85	2.83b	3.66	3.75	7.32d	44.91
I_0P_{84}	1.50	1.65	108.75	54.83	39.88	2.53c	3.72	4.04	8.50d	49.18
I_1P_{60}	1.49	1.70	107.73	56.41	39.07	2.87b	3.64	3.93	20.98c	48.84
I_1P_{72}	1.71	1.77	111.93	60.50	41.95	2.43c	3.70	4.15	23.02b	51.09
I_1P_{84}	1.80	1.78	115.00	63.21	40.74	2.48c	3.80	4.22	28.35a	54.30
CV (%)	5.32	7.73	3.42	5.41	8.89	9.66	4.38	10.67	10.13	6.01

Means in a column followed by the same letter(s) are not significantly different at 5% level of significant by DMRT

Table 3: Interaction effect of variety, inoculums and phosphorus on the yield, yield attributes and other characters of soybean

V X I X P	Seed yield (t ha^{-1})	Stover yield (t ha^{-1})	1000 Seed wt. (g)	Seed plant^{-1} (No.)	Effective pod plant^{-1} (No.)	Empty pod plant^{-1} (No.)	Pod length (cm)	Branch plant^{-1} (No.)	Nodules plant^{-1} (No.)	Plant height (cm)
$V_1I_0P_{60}$	1.60	1.94	115.13	53.23	37.05	4.90a	3.61	3.15	7.75fg	47.23
$V_1I_0P_{72}$	1.81	1.93	117.70	55.16	39.35	3.95b	3.62	3.25	8.05fg	49.93
$V_1I_0P_{84}$	1.91	2.00	124.38	59.90	42.50	3.90bc	3.70	3.25	10.55f	55.88
$V_1I_1P_{60}$	1.89	2.10	122.13	62.78	41.00	4.05b	3.59	4.00	26.95b	54.75
$V_1I_1P_{72}$	2.22	2.06	124.93	67.00	47.73	3.40d	3.73	4.10	31.25a	56.00
$V_1I_1P_{84}$	2.29	2.04	127.52	70.35	43.95	3.55cd	3.85	4.15	33.75a	59.98
$V_2I_0P_{60}$	1.09	1.33	91.09	47.13	34.45	2.75f	3.61	3.18	6.70g	40.58
$V_2I_0P_{72}$	1.19	1.41	94.46	50.38	38.20	3.20de	3.69	3.45	6.80g	42.33
$V_2I_0P_{84}$	1.30	1.53	95.69	52.98	40.83	2.30g	3.71	3.73	7.10g	45.18
$V_2I_1P_{60}$	1.26	1.51	97.82	55.18	38.83	2.95ef	3.62	3.15	17.25de	44.85
$V_2I_1P_{72}$	1.43	1.66	103.87	60.38	39.20	2.20g	3.65	3.40	14.40e	46.45
$V_2I_1P_{84}$	1.51	1.62	108.20	62.13	39.95	2.30g	3.76	3.50	25.10bc	50.75
$V_3I_0P_{60}$	1.07	1.26	93.72	45.10	34.65	2.10g	3.66	3.80	6.80g	41.93
$V_3I_0P_{72}$	1.15	1.30	98.66	47.33	36.00	1.35h	3.69	4.55	7.10g	42.48
$V_3I_0P_{84}$	1.29	1.42	106.17	51.60	36.33	1.40h	3.76	5.15	7.85fg	46.50
$V_3I_1P_{60}$	1.32	1.50	103.22	51.28	37.38	1.60h	3.70	4.65	18.75d	46.93
$V_3I_1P_{72}$	1.47	1.60	106.98	54.13	38.93	1.70h	3.73	4.95	23.40c	50.83
$V_3I_1P_{84}$	1.61	1.66	109.28	57.15	38.33	1.60h	3.79	5.00	26.20bc	52.18
CV (%)	5.32	7.73	3.42	5.41	8.89	9.66	4.38	10.67	10.13	6.01

Means in a column followed by the same letter(s) are not significantly different at 5% level of significant by DMRT

number of effective pods plant^{-1}, number of seeds plant^{-1}, 1000-seed weight, stover yield with higher dosage of phosphorus in all varieties. But number of empty pods plant^{-1} decreased in all varieties with the increased dose of phosphorus.

Among the varieties, Shohag succeeded to produce significantly the highest seed yield (2.10 t ha^{-1}) with its highest number of nodules plant^{-1} using the highest dose of P_2O_5 (84 kg ha^{-1}). The second highest seed yields (2.01 t ha^{-1}) was recorded from the same variety with use of 74 kg P_2O_5. The seed yields (1.40 and 1.45 t ha^{-1}) of BS 60 and BS 16 were statistically identical using the highest dose of P_2O_5 (84 kg ha^{-1}). Numerically the highest stover yield (2.02 t ha^{-1}) was also harvested from Shohag using the highest dose of phosphorus. Cumulative favourable effects of the number of effective pods plant^{-1}, seeds plant^{-1} and 1000-seed weight possibly caused the highest seed yield (Table 2).

Combined effect of inoculum and phosphorus: The combined effect of inoculum and phosphorus was significant only on number of nodules plant^{-1} and number of empty pods plant^{-1} but other parameters were not statistically varied. The plots having inoculum with phosphorus produced the significantly higher number of nodules plant^{-1} and lower number of empty pod plant^{-1} than that of the plots having only phosphorus. The number of nodules plant^{-1} increased significantly up to 28.35 with increase of the dose of phosphorus along with inoculum but no difference was observed due to application of different dosage of phosphorus alone. This result indicated that 84 kg P_2O_5 ha^{-1} alone failed to produce higher number of nodules. But higher dose of P_2O_5 alone enhanced to reduce the number of empty pods and along with inoculum. The unit of other studied characters was also numerically higher due to use of inoculum along with phosphorus and increased with increase of the dose of phosphorus. However, application of 84 kg P_2O_5 ha^{-1} along with inoculum produced numerically the highest seed yield (1.80 t ha^{-1}) and it was 21, 20, 30 and 44% higher than that of 60 kg P_2O_5 ha^{-1} with inoculum, 84 kg P_2O_5 ha^{-1} alone, 72 kg P_2O_5 ha^{-1} alone and 60 kg P_2O_5 ha^{-1} alone, respectively (Table 2).

Combined effect of variety, inoculum and phosphorus: No significant variation was observed in respect of all the studied parameters except number of nodules plant^{-1} and number of empty pods plant^{-1} due to combined effect of variety, inoculum and phosphorus. Significantly the highest number of nodules plant^{-1} (33.75) was recorded from the variety, Shohag using inoculum along with the highest dose of phosphorus (84 kg P_2O_5 ha^{-1}) and it was statistically identical to the numbers of nodules of the same variety with inoculum and 72 kg P_2O_5 ha^{-1}. On the other hand the maximum and minimum number of empty pods plant^{-1} were produced from the combinations of Shohag x No inoculum x 60 kg P_2O_5 ha^{-1}) and BS 16 x No inoculum x 72 kg P_2O_5 ha^{-1}. Though there was no significant variation due to combined effects the variety Shohag produced numerically the highest seed yield using inoculum along with 84 kg P_2O_5 ha^{-1} (Table 3).

The overall results of the experiment indicated that higher dosage of phosphorus along with inoculum produced higher yield in all the three tested varieties of which Shohag gave the maximum yield. Therefore, it can be concluded that in August planting the variety, Shohag can be grown using inoculum along with 84 kg P_2O_5 ha^{-1} for higher seed yield of soybean.

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