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Effects of Row Space and Fertilizer Nitrogen Level on the Yield and Quality of Short Duration Garden Pea Grown on a Clay Terrace Soil of Bangladesh

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A field experiment was conducted in the rabi (dry) season of 1997–98 to determine the optimum requirement of row space and fertilizer N level for achieving the highest yield potential of garden pea on a clay terrace soil of Bangladesh. The experiment was executed in the split–plot design comprising the combination of three intensities of row spacing (30, 40, and 50 cm) assigned to main plots and six levels of N application (0, 20, 40, 60, and 80 kg N ha^{-1}, and 20 kg N ha^{-1} plus inoculation of seeds with *Rhizobium leguminosarum*) distributed to subplots. Garden pea was harvested at the green pod and matured seed stages. As an interaction effect, the highest yields of green pods (2.75 Mg ha^{-1}) and matured seeds (1.86 Mg ha^{-1}) were obtained with the application of N at the levels of 40 and 80 kg ha^{-1}, respectively, under the row space of 30 cm. However, the main effect of N level indicated that the yields were not significantly different among the N levels of 40 through 80 kg ha^{-1} and of 20 kg ha^{-1} with inoculation of seeds with *Rhizobium leguminosarum.* Concerning the impact of row space, the yield of green pods was significantly higher under the space of 30 cm. The yield of matured seeds was not significantly affected by the row space.

The row space and the N level affected independently the N content in seeds, and the higher row space along with the medium level of N application favored increase in the seed N content. The N harvested through plant biomass was remarkably increased by reducing the row space and increasing the N level. The combination of the row space of 30 cm and the N application at the level of 40 kg ha^{-1} was judged to be best with respect to yield and quality of garden pea on the clay terrace soil of Bangladesh. Pea harvest at the green pod stage is advantageous in terms of yield and cropping duration.

INTRODUCTION

Garden pea (*Pisum sativum* L.) is a widely spread legume vegetable that is grown for green pods and matured seeds in Bangladesh. Cultivation of garden pea is highly profitable to farmers for its short durability. It takes about 45 to 50 days from sowing to green pod harvest and 55 to 60 days to matured seed harvest, thus making the crop accessible to fit in the cropping pattern. The crop has the capacity of fixing a

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considerable amount of atmospheric N and hence favors increase in the soil fertility for subsequent crops (Rana and Sharma, 1993). Garden pea is highly nutritious and may be used as a source of protein for the farmers and poor people.

It is evident that keeping an optimum plant density and N status in soil is a prerequisite for obtaining higher yield of garden pea. Both excessive and reduced densities of the plant stand lead to a reduction in the numbers of pods per plant and seeds per pod (Valdes *et al.*, 1988). Optimum plant density and row space are essential for obtaining desired yields (Mackenezie *et al.*, 1975; Nangju and Anjorin-ohu, 1975).

The climate of Bangladesh is dominated by tropical to subtropical monsoon. The period from November to March called the rabi cropping season (the pea growing season) is dry and enjoys only 1 to 11% of the mean annual rainfall of 2200 mm. The mean monthly air temperature in the rabi season, ranging from 18 to 31 °C, is favorable for a wide variety of crops including vegetables. The terraces occupy 8 % of the total land area. Madhupur and Barind Tracts are the major terraces (5–25 m above MSL) located at the central and western parts of the country, respectively. Bangladesh comprises 30 agro-ecological zones which are separated mainly based on the soil and climatic characteristics (FAO-UNDP, 1988). Detailed soil management studies are undertaken for the suitable crops of the specific agro-ecological zone of the country for improving the yield performance.

Pea research has been neglected in Bangladesh (Kaul and Gowda, 1982). The present study was carried out to determine the optimum row space and level of N application for approaching the highest yield potential of garden pea in the agro-ecological zone of Madhupur Tract and to find the relationship of the seed and biomass N contents with application of different levels of N.

MATERIALS AND METHODS

Location and soil

The experiment was conducted at the research farm of Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU) (24°05' N latitude and 90°16' E longitude), Salna, Gazipur, Bangladesh, located at the center of Madhupur Tract at an elevation of 8.4 m above MSL, during November 11, 1997 to January 14, 1998.

The farm soil belongs to Salna series of Shallow Red-Brown Terrace Soil in the Bangladesh soil classification system (Brammer, 1971; Saheed, 1984) and is equivalent to Ochrepts in Soil Taxonomy. The soil is silty clay loam in texture having a pH of 5.3. The organic C and total N contents are 8.9 and 0.8 g kg^{-1}, respectively. Available P by the Olsen method is 13.5 mg kg^{-1} and cation-exchange capacity is 11.4 $cmol_c$ kg^{-1}. High bulk densities between 1.35 and 1.61 Mg m^{-3} at the subsurface layers indicate the high soil compaction which has caused impeded internal drainage condition.

Climate

The rabi season in Bangladesh is the cool-dry winter season with low humidity and bright sunlight. Rainfall is scarce, unpredictable, and unevenly distributed in this season and can not meet the evapotranspiration demand of crops (Karim and Egashira, 1994). In the 1997-98 rabi season, the mean monthly air temperature for the months of November, December, and January was 25, 20, and 18°C, respectively, indicating the optimum temperature for pea cultivation. There was no rainfall during November that has increased the necessity of irrigating the crop at the early growing stage, but 23 and 16 mm of rainfall in December and January have met the irrigation demand of pea for the period.

Experimental design and treatments

The experiment was laid out in the split-plot design with three replications. The size of a unit plot was 2.4 m × 2.0 m having a plot-to-plot and a block-to-block spacing of 0.75 and 1.0 m, respectively. Half portion (1.2 m × 2.0 m) of each plot was used for green pod harvest and the rest half was for matured seed harvest.

The treatment of row spacing was assigned to main plots, while the N treatment was distributed as subplots. The three different row spaces were 30, 40, and 50 cm. The six N levels were 0, 20, 40, 60, and 80 kg N ha^{-1}, and 20 kg N ha^{-1} plus inoculation of seeds with *Rhizobium leguminosarum*. Urea was used as the source of N, and the half was applied during final land preparation and the remaining half was top-dressed at the pre-flowering stage.

Triple super phosphate, muriate of potash, gypsum, zinc oxide, ammonium molybdate, and borax were applied to the plots to supply 80 kg P_2O_5, 60 kg K_2O, 20 kg S, 4 kg Zn, 1 kg Mo, and 1 kg B per ha, respectively, during final land preparation.

Test crop

The test crop of garden pea was the variety 'IPSA motor shuti-1' which was developed and released by Department of Genetics and Plant Breeding of BSMRAU. It is a short duration variety having the cropping period of 45 to 50 days for green pod harvest and 55 to 60 days for matured seed harvest.

Cultural and management practices

Seeds of garden pea were sown on November 11, 1997 by maintaining a plant-to-plant distance of 5 cm under each prescribed row space as per treatment. Seedlings emerged at 4-5 days after sowing (DAS). Excess seedlings were uprooted to maintain the desired population.

Two times of light irrigation were needed; the first irrigation was given immediately after sowing and the second one was provided at 21 DAS. There was a sufficient amount of rainfall during the latter half of December and in January that fulfilled the need of irrigation of pea for the period. Weeding was done twice at 11 and 43 DAS to keep the crop free of weeds. At the early stage of growth the seedlings were severely attacked by *Sclerocium rolfsii*. The disease was controlled by applying Diathane M-45 at the rate of 4.5 g L^{-1} of water.

Harvest of pea

The pods of garden pea were harvested at two different stages. The first harvest was done on January 1, 1998 at the green pod stage (51 DAS) from the half portion of each plot. The green pods are the green seeds with pod cover which are used for human consumption after the removal of pod cover. The pod cover is not eaten by people but used as animal feed or preparation of manures. The rest half of the plot was kept as it was to allow the pods to get matured. The matured pods were harvested on January 14, 1998 (64 DAS). The matured seeds are taken by the people by removing the husk. The matured husk is used for preparing manures. The two forms of garden pea are sold in market.

The yield-constituting characters of garden pea considered are number of primary branches per plant, number of pods per plant, number of seeds per pod, and weight of 100 seeds. These data were taken just after the harvest. Ten plant samples were taken randomly from each plot to record the yield component data.

Nirogen content in seed and biomass

The total N content of pea seeds and the biomass (pod cover and the plant) was determined by the Kjeldahl method. The N harvested through biomass was calculated from the weight of biomass and the biomass N content.

Satistical analysis

Duncan's multiple range test was applied to the statistical analyses of grain yield and other characters of garden pea.

RESULTS AND DISCUSSION

Yield of garden pea

The yields of garden pea are shown in Tables 1 and 2. The main effect of row space was significant on the green pod yield but not on the matured seed yield (Table 1). It suggests that the row space between 30 and 50 cm had no significant impact on the yield

Table 1. Main effects of (a) row space and (b) nitrogen level on the yield and yeild-constituting characters of garden pea.

	Yield (Mg ha^{-1})		Number of primary branches plant^{-1}	Number of pods plant^{-1}	Number of seeds pod^{-1}	Weight of 100 seeds (g)	
	Green pod	Matured seed				Green	Matured
a) Row space (cm)							
30	2.42 a	1.56	10.25	4.47	3.67	45.80	34.20 b
40	2.18 ab	1.15	9.98	4.44	3.37	45.72	33.94 b
50	1.71 b	1.09	10.14	4.54	3.66	46.07	35.12 a
LSD(0.05)	0.53	NS	NS	NS	NS	NS	0.89
b) N level (kg ha^{-1})							
0	1.40 c	1.04 b	9.04 d	3.53 c	3.39 c	43.61 c	32.66 c
20	1.87 b	1.20 ab	10.02 c	4.29 b	3.63 b	45.67 ab	34.04 b
20+inoc[a]	2.32 a	1.27 ab	10.76 a	4.75 ab	3.78 ab	47.48 a	35.22 ab
40	2.47 a	1.25 ab	10.14 bc	4.26 b	3.72 ab	45.25 bc	34.32 b
60	2.29 a	1.42 a	10.13 bc	5.16 a	3.92 a	46.74 ab	35.77 a
80	2.26 a	1.41 a	10.63 ab	4.90 a	3.66 b	46.44 ab	34.49 b
LSD (0.05)	0.34	0.22	0.61	0.61	0.21	1.25	1.27

[a] Inoculation of seeds with *Rhizobium leguminosarum*.

Treatments having a common letter in a column are not significantly different at 5% level.

NS: not significant.

Table 2. Interaction effect of row space and nitrogen level on the yield and yield-constituting characters of garden pea.

Row space (cm)	N level (kg ha^{-1})	Yield (Mg ha^{-1})		Number of primary branches plant^{-1}	Number of pods plant^{-1}	Number of seeds pod^{-1}	Weight of 100 seeds (g)	
		Green pod	Matured seed				Green	Matured
30	0	1.92	1.21	8.90	3.70	3.37	43.01	32.54
	20	2.28	1.40	9.97	3.90	3.60	46.18	33.29
	20+inoc[a]	2.25	1.44	10.05	4.70	3.80	48.04	34.18
	40	2.75	1.58	10.77	4.77	3.67	45.26	34.04
	60	2.52	1.74	10.40	5.20	4.00	46.59	35.73
	80	2.57	1.86	10.97	4.53	3.57	45.77	35.41
40	0	1.25	0.85	8.83	3.43	3.56	43.86	32.17
	20	1.76	1.11	9.97	4.37	3.67	46.11	33.88
	20+inoc[a]	2.47	1.25	11.00	5.00	3.90	46.98	35.19
	40	2.69	1.07	9.87	3.67	3.70	45.36	33.49
	60	2.70	1.44	10.07	5.25	3.90	46.03	34.74
	80	2.16	1.20	10.33	4.93	3.63	45.97	34.16
50	0	1.05	1.08	9.40	3.47	3.23	43.96	33.28
	20	1.59	1.21	10.33	4.60	3.63	44.71	34.96
	20+inoc[a]	1.94	1.13	10.77	4.55	3.63	47.43	36.29
	40	2.03	1.14	9.80	4.33	3.80	45.12	35.44
	60	1.60	1.08	9.93	5.03	3.87	47.60	36.83
	80	2.05	1.18	10.60	5.23	3.77	47.59	33.89
LSD(0.05)		NS	NS	NS	NS	NS	NS	NS

[a] Inoculation of seeds with *Rhizobium leguminosarum*.
Treatments having a common letter in a column are not significantly different at 5% level.
NS: not significant.

of matured seeds. The highest yield of green pods was found under the row space of 30 cm, indicating that maintenance of the higher plant density by adoption of the minimum row space favored the yield increase. The lowest yield was noted under the maximum row space (50 cm). White and Anderson (1974) reported that the yield of green peas rose with decreasing the row width and was highest with the closest spacing. Naik (1989) also stated the increased pod yield with the closer spacing.

The main effect of the N level on the yield of green pods was significant and positive up to a certain N level (Table 1). The significantly lowest yield in the plot having no N application corresponds with the poor N fertility of the soil at the research farm of BSMRAU, common to the terrace soils of Madhupur Tract (Karim *et al.*, 1994). The application of N at the level of 40 kg ha^{-1} has led to the production of the highest green pod yield, similar to the results of Naik (1989) and Bhopal and Singh (1990) who reported that the pod yield was increased substantially by increasing the N level up to 40 kg ha^{-1}. However, the yield of green pods was not significantly different among the N levels of 40, 60, and 80 kg ha^{-1}. The yield in the plot receiving 20 kg N ha^{-1} plus inoculation by *Rhizobium* strain was also in the statistically same level as them, suggesting the positive effect of the inoculation of seeds on the yield of green pods.

The main effect of the N level on the yield of matured seeds was significant but less distinct, as shown in Table 1. The yield was not significantly different among the N applied plots, and the yield of the plot having no N application was statistically in the same level as that of the plots receiving N below 40 kg ha^{-1}. This less distinct effect of the N level on the matured seed yield is probably due to the increasing decrease in the weight of seeds during the green pod and matured seed stages with increasing the N level or to the increased variation of the weight of seeds at the matured seed stage from plot to plot, leading to the poor correspondence of the matured seed yield to the managements such as row spacing and N fertilization.

The interaction effect of row space and the N level on the yields of green pods and matured seeds was not significant (Table 2). It suggests that the row space and the N level affected them independently.

Based on the above results, it is concluded that maintaining higher plant densities by adopting the row space of 30 cm together with the application of N at the level of 40 kg ha^{-1} is suitable for approaching the highest yield of green pods of garden pea in Shallow Red-Brown Terrace Soil of Madhupur Tract. The row space of 30 cm and the application of 20 kg N ha^{-1} plus inoculation of seeds with *Rhizobium leguminosarum* is possibly another combination. Application of 20 or 40 kg more N ha^{-1} leads to the insignificant yield increase but increases the cost of production and will contribute to water pollution by nitrate. It is also indicated that the harvest at the green pod stage is preferable due to not only its higher yield but also minimizing the cultivation period by 13 days.

Yield–constituting characters of garden pea

The results are shown in Tables 1 and 2. The main effect of row space was significant only on the weight of 100 matured seeds (Table 1). It is difficult to relate the yield differences in green pods and matured seeds due to row space to the differences in yield–constituting characters.

The main effect of the N level on the different yield–constituting characters of garden pea was significant (Table 1). The significantly lowest values of all yield–constituting characters in the plot having no N application well explain its lowest yields of green pods and matured seeds. In general, the higher level of N application up to a certain extent has improved the yield–constituting characters of garden pea. However, none of the yield–constituting characters could not be related to the yields of green pods and matured seeds, because the significant differences in the yield–constituting characters were observed among the N levels of 40 through 80 kg ha^{-1} and of 20 kg ha^{-1} plus inoculation by *Rhizobium* strain. This may indicate that the yield–constituting characters, which are mainly controlled by the N level applied, contribute combinedly to the yields of green pods and matured seeds of garden pea.

The interaction effect of row space and the N level on the yield–constituting characters was all insignificant (Table 2). This suggests that the yield–constituting characters of garden pea are affected independently by both managements.

Quality of garden pea

Quality of garden pea was evaluated by determining the N contents of seeds and plants which reflect the amount of seed protein for human consumption and the extent of N addition to soil through incorporation of the plants. The results are shown in Tables 3

Table 3. Main effects of (a) row space and (b) nitrogen level on the nitrogen content in seed and the nitrogen harvested through biomass of garden pea.

	N content in seed (g kg^{-1})		N harvested through biomass (kg ha^{-1})	
	Green	Matured	Green	Matured
a) Row space (cm)				
30	35.4	33.3 c	21.4	20.1
40	35.9	37.0 a	19.6	16.0
50	36.2	36.2 b	15.3	14.4
LSD(0.05)	NS	0.71		
b) N level (kg ha^{-1})				
0	33.6 d	31.9 d	12.3	10.8
20	34.9 c	34.4 c	16.0	15.8
20+inoc[a]	36.6 b	40.8 a	17.9	17.5
40	39.0 a	36.5 b	21.5	18.9
60	36.4 b	34.8 c	19.7	18.7
80	36.6 b	34.9 c	22.7	19.2
LSD (0.05)	1.1	1.3		

[a] Inoculation of seeds with *Rhizobium leguminosarum*.
Treatments having a common letter in a column are not significantly different at 5% level.
NS: not significant.

Table 4. Interaction effect of row space and nitrogen level on the nitrogen content in seed and the nitrogen harvested through biomass of garden pea.

Row space (cm)	N level (kg ha^{-1})	N content in seed (g kg^{-1})		N harvested through biomass (kg ha^{-1})	
		Green	Matured	Green	Matured
30	0	33.5	32.5	12.1	14.1
	20	35.0	34.1	16.4	17.1
	20+inoc[a]	36.2	40.0	18.4	19.2
	40	38.3	37.1	24.3	21.7
	60	33.4	30.8	26.4	22.8
	80	35.8	35.5	30.9	25.5
40	0	34.1	32.2	14.0	8.5
	20	34.4	34.3	17.4	15.7
	20+inoc[a]	36.7	41.6	18.8	19.8
	40	37.4	35.5	23.1	18.8
	60	34.7	35.7	23.6	17.0
	80	38.2	33.0	20.6	16.1
50	0	33.2	31.2	10.7	9.7
	20	35.3	36.0	14.3	14.7
	20+inoc[a]	36.7	40.7	16.5	13.6
	40	41.1	36.8	17.0	16.1
	60	37.4	36.7	16.7	16.2
	80	35.8	36.1	16.5	16.0
LSD(0.05)		NS	NS		

[a] Inoculation of seeds with *Rhizobium leguminosarum*.
Treatments having a common letter in a column are not significantly different at 5% level.
NS: not significant.

and 4, and the N content of plants is expressed as the N harvested through biomass.

The main effect of row space was significant on the N content of matured seeds only (Table 3). The N content in matured seeds was highest for the row space of 40 cm followed by the 50 cm space. It can be assumed that the plants under higher spacing have enjoyed more room to extract more N from the soil to show the higher seed N contents.

Different levels of N application have led to a significant variation in the N contents of green and matured seeds (Table 3). The N content in green seeds varied between 39.0 and 33.6 g kg^{-1} under the application of 40 and 0 kg N ha^{-1}, respectively. In case of matured seeds the values varied between 40.8 and 31.9 g kg^{-1} under 20 kg N ha^{-1} plus inoculation by *Rhizobium* strain and 0 kg N ha^{-1}, respectively. These findings reveal that the N application up to a certain level is necessary to increase the seed N content of garden pea but that the highest level of N application (80 kg ha^{-1}) is not required.

The interaction effect of row space and the N level on the N contents of green and matured seeds was not significant (Table 4), indicating the independent effects of the row space and the N level on the N contents of green and matured seeds of garden pea. Apart from the interaction effect, the N content in seeds indicated the general decreasing tendency from the green pod to matured seed harvest stages, except for the plot having 20 kg N ha^{-1} plus inoculation by *Rhizobium* strain in which the seed N content was highest and equal to or over 40 kg ha^{-1} at the matured seed harvest stage in all the row spaces.

Estimation of the N harvested by pea plants (biomass) was done to evaluate the quality of biomass to be incorporated to the soil for predicting the intensity of N addition through biomass for succeeding crops. The individual effects of row space and the N level on the N harvested through biomass was remarkable (statistical analysis was not done on the calculated values), as shown in Table 3. The amount of N harvested was greatly influenced by plant population and plant vigor which were dominated by row space and the N level. The highest N harvest of 21.4 kg ha^{-1} from green biomass was noted under the row space of 30 cm which was higher by 9.3 and 40.2% than the values for the 40 and 50 cm row spaces, respectively. The N of matured biomass followed the same sequence, but its values were comparatively low.

Nitrogen application has favored increase in the N harvested through biomass at both stages (Table 3). The highest values of 22.7 and 19.2 kg ha^{-1} were recorded at the green pod and matured seed harvest stages, respectively, under the highest level of N application. The values decreased with the decreasing N level and came down to the minimum under no application of N.

The interaction effect of row space and the N level on the N harvested through biomass is shown in Table 4. The amount of N harvested was dominated primarily by the amount of biomass produced. As a result comparatively high values were recorded under higher plant densities coupled with the higher N content. At the green pod harvest stage the highest N harvest of 30.9 kg ha^{-1} was found under the minimum row space of 30 cm (maximum plant density) along with the maximum level of N application (80 kg ha^{-1}). The second and the third highest values of 26.4 and 24.3 kg ha^{-1} were noted by the application of 60 and 40 kg N ha^{-1}, respectively, under the row space of 30 cm. The similar trend was observed in case of matured biomass, with values somewhat lower than those of green biomass in most cases.

Table 5. Net benefit analysis for different treatments of row space and nitrogen level in garden pea production.

Row space (cm)	N level (kg ha^{-1})	Net benefit (Tk. ha^{-1})	
		Green pod	Matured seed
30	0	40,320	28,620
	20	48,972	33,972
	20+inoc[a]	55,472	34,922
	40	60,374	39,024
	60	54,276	43,476
	80	55,178	46,728
40	0	23,570	17,820
	20	35,972	25,272
	20+inoc[a]	53,472	29,222
	40	58,874	23,724
	60	58,776	34,476
	80	44,928	26,928
50	0	18,570	24,720
	20	31,722	28,272
	20+inoc[a]	40,222	25,622
	40	42,374	27,924
	60	31,276	23,676
	80	42,178	26,328

[a] Inoculation of seeds with *Rhizobium leguminosarum.*
Rates used: green pod, Tk. 25.00 kg^{-1}; matured seed, Tk. 30.00 kg^{-1}; urea, Tk. 8.00 kg^{-1}; triple super phosphate, Tk. 15.00 kg^{-1}; muriate of potash, Tk. 14.00 kg^{-1}; gypsum, Tk. 10.00 kg^{-1}; irrigation, Tk. 40 h^{-1} (discharge=10 L s^{-1}); labor, Tk. 70 day^{-1} $person^{-1}$.

The above information reveals that cultivation of garden pea not only produces a considerable amount of vegetables for supplementing a significant amount of protein for human consumption but also allows to harvest a good amount N through plant biomass for improving the quality of soil. The N content in seeds was as high as 40 g kg^{-1}, and the N harvested through biomass amounted to the nearly half of the quantity of fertilizer N required to achieve the highest yield potential of garden pea.

Economic aspect

The economic evaluation of each treatment was done to select the best treatment acceptable to the farmers (Table 5). This was done by determining the net benefit from the difference between gross return (output) and the variable costs (inputs). The highest net benefit of Tk. 60,374 ha^{-1} (Tk. is a unit of Bangladesh currency and one US dollar is nearly equivalent to Tk. 50) was recorded for the green pod harvest under the row space of 30 cm along with the application of N at the level of 40 kg ha^{-1}, signifying the economic viability of this combination for cultivation of garden pea in Shallow Red-Brown Terrace Soil of Madhupur Tract. The second and third highest values were recorded under the 40 cm space with the application of N at the levels of 40 and 60 kg ha^{-1}, respectively, at the green pod harvest. The fourth highest value (Tk. 55,472 being 6% below the second highest value), under the 30 cm row space with the N application at the level of 20 kg ha^{-1}

plus inoculation by *Rhizobium* strain may be considered to be satisfactory from the viewpoint of minimum application of N to make the soil less liable to be polluted by nitrate. The matured seed harvest was found to be uneconomic in each treatment with comparison to the pea harvest at the green pod stage.

CONCLUSIONS

From the present findings it may be concluded that N application is indispensable in the terrace soil of Madhupur Tract and that the application of 40 kg N ha^{-1} along with the maintenance of the 30 cm plant row is required for achieving the highest yield potential of better quality of garden pea and as well as the maximum net benefit from the crop production. The application of 20 kg N ha^{-1} plus inoculation of seeds with *Rhizobium leguminosarum* is a reasonable alternative from the viewpoint of the high yield and the high N content in seeds. The high row space and the medium level of N application favor the N increase in seeds, but the N harvest by plant biomass increases with increased plant population (reduced row space) and increasing the level of N application. Pea harvest at the green pod stage is the best time for getting the maximum benefit from the crop production.

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