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RESPONSE OF OKRA (*ABELMOSCHUS ESCULENTUS* L. MOENCH) TO VARIOUS DOSES OF N & P AND DIFFERENT PLANT SPACINGS

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Abstract: Seeds of okra cv. Sabz Pari were planted on both sides of raised beds prepared at a distance of 90 cm. Plant to plant distance was maintained as 15, 30 or 45 cm. N and P were applied @ 78 kg N + 92 kg P_2O_5, 112 kg N + 168 kg P_2O_5, 140 kg N + 200 kg P_2O_5 or 180 kg N + 240 kg P_2O_5 ha^{-1}. Potassium was applied at a constant rate of 120 kg K_2O ha^{-1}. The entire amount of phosphorus and potash and half dose of nitrogen were applied at the time of sowing, while other half dose of nitrogen was applied at the time of flower initiation. Seed germination, growth and green pod yield were not affected by the fertilizer application. However, seed number per pod and seed yields were affected significantly and were highest at the higher doses of fertilizer. Plant spacing had no significant influence on seed germination, days taken to flowering and number of seeds per pod. However, length of green pod, number of green pods per plant, average weight per green pod, green pod yield per plant, number of mature pods per plant, 1000 seed weight and seed yield per plant were highest at the widest spacing. While, plant height at the time of flowering, green pod and seed yields per hectare were highest at the closest spacing. Regarding combined effect of the two factors, the highest green pod and seed yields per plant were recorded at all the fertilizer doses with the widest plant spacing. However, the highest green pod and seed yields per hectare were obtained at the higher fertilizer doses with the closest plant spacing.

Keywords: Fertilizer application, green pod yield, growth, lady's finger, planting distance, seed yield.

INTRODUCTION

Okra (*Abelmoschus esculentus* L. Moench) is one of the important summer vegetables grown through out the tropical world including Pakistan. The crop is grown through seed, quality of which deteriorates if not stored properly. The use of fresh good quality seed is very important to get higher yield. This necessitates the production of good quality seed every year. The average green pod yield per unit area in the country is quite low as compared with some other countries. The major factors, which contribute to the crop yield include; genetic factors, nutritional factors and space available to the plants. If the crop is managed properly, okra produces green pods continuously for several months. Application of NPK increases vegetative growth, yield and quality attributes [Faraq and Damrany 1994]. Dwivedi *et al.* [1993] applied N @ 80, 120 or 160 kg and P @ 60, 80 or 100 kg ha^{-1} to okra cv. Pusa Sawani. The highest seed yield was obtained with 120 kg N and 100 kg P ha^{-1}. Anjum and Amjad [1999] applied N @ 50, 75, 100 or 125 kg, P_2O_5 @ 60, 80 or 100 kg and

K_2O @ 60 or 80 kg ha^{-1} in different combinations to okra cv. Pusa Sawani and found that number of pods per plant, pod length and green pod yield were affected significantly and were highest at the highest dose of fertilizers. Crop yield also depends upon population size. With increasing plant population, yield per unit area increases till certain limit, beyond which resources for plant become limited and yield decreases [Weiner 1990]. So optimum population size is required for higher yields in okra as plant growth and yield are affected by intra and inter row spacing. Singh [1990] planted okra at plant spacing of 40 x 20, 50 x 20, 40 x 30, 50 x 30, 40 x 40 or 50 x 40 cm. The highest seed yield per hectare was recorded with the closest spacing. The greatest average weight of single fruit and fruit length were recorded at widest spacing. Ali [1999] also recorded the maximum fruit length, fruit weight and number and fruit yield per plant with the widest spacing. However, highest fruit and seed yields per hectare were at closest spacing. Thus, nutrition and plant density are two important factors, which need to be studied to get higher yields of quality green pods and seeds. Therefore, in the present study effect of various doses of N and P fertilizers and planting geometry was assessed on the green pod and seed yields of okra cv. Sabz Pari.

Table 1: Physico-chemical characteristics of the soil used for the experiment.

Characteristics	Unit	Quantity
Sand	%	52.3
Silt	%	20.6
Clay	%	27.1
Textural class	-	Sandy clay loam
pH	-	7.8
TSS	%	0.22
Organic matter	%	0.65
Total nitrogen	%	0.045
Available phosphorus	ppm	5.5
Available potassium	ppm	175

MATERIALS AND METHODS

The present studies were carried out at Vegetable Research Area, Department of Horticulture, University of Agriculture, Faisalabad during the year 2000. Seed of okra cv. Sabz Pari (a high yielding local cultivar) was obtained from the Ayub Agricultural Research Institute, Faisalabad. The physico-chemical characteristics of the soil used for the experiment are given in Table 1, as determined using the method of U.S. Salinity Laboratory Staff [1954]. The experiment was laid out according to split plot design with three replications. The main plots comprises of four doses of fertilizers and the subplots three levels of plant spacings. The fertilizer doses applied were: 78 kg N + 92 kg P_2O_5 ha^{-1} (F_1), 112 kg N + 168 kg P_2O_5 ha^{-1} (F_2), 140 kg N + 200 kg P_2O_5 ha^{-1} (F_3) and 180 kg N + 240 kg P_2O_5 ha^{-1} (F_4). Potassium was applied at a constant rate of 120 kg K_2O ha^{-1}. The fertilizers used were urea, DAP (Di-ammonium phosphate) and MOP (Murate of potash). The required amounts of these fertilizers

were applied in each main plot in each replication. Full dose of phosphorus and potash and half dose of nitrogen were applied at the time of sowing. The remaining half dose of nitrogen was applied at the time of flower initiation. The crop was sown on 7th of April 2000 on both sides of raised beds prepared 90 cm apart. The seeds were planted at a distance of 15 cm (S_1), 30 cm (S_2) and 45 cm (S_3). The sizes of main plots and subplots were 7 x 14 m and 7 x 4.67 m, respectively. All the cultural practices like watering, weeding etc. were standard and uniform for all the subplots.

After recording the seed germination percentage, ten plants were selected randomly from each subplot in each replication and following observations were recorded using standard procedures; days to first flowering, height at the time of flowering (cm), number of green pods per plant, length of green pod (cm), average weight per green pod (g), yield of green pods per plant (g) and pod yield per hectare (tons). Except these ten plants, all other plants were left for seed production. Among those, further ten plants were selected randomly and following observations were recorded; number of mature pods per plant, number of seeds per pod, 1000 seed weight, seed yield per plant (g) and seed yield per hectare (kg). The data collected were analyzed statistically using Fisher's analysis of variance technique and Duncan's multiple range test was employed at 5% level of probability to compare differences among the treatment means [Petersen 1994].

RESULTS AND DISCUSSION

SEED GERMINATION

The data reveal non-significant differences among various doses of fertilizers, different plant spacings and the interaction between fertilizer doses and plant spacings for seed germination percentage (Tables 2 – 4). It indicates that fertilizer doses, planting distance and combined effect of these two factors have no significant effect on seed germination. The reason might be that the seeds contain enough food reserves for germination and external source of nutrients has no role to play. Therefore, seed germination was not affected by various doses of fertilizer and also by different plant spacings. Similar results have been reported by several workers, who stated that seed germination percentage remains unaffected by different levels of fertilizers [Zanin and Kimoto 1980, Rastogi *et al*. 1987, Singh 1995, Ali 1999, Anjum and Amjad 1999] and plant spacings [Zanin and Kimoto 1980, Rastogi *et al.* 1987, Ali 1999].

DAYS TAKEN TO FIRST FLOWERING

The data reveal that effect of fertilizer doses, plant spacings and their interaction remained non-significant for number of days required to flower (Tables 2-4). It demonstrates that the fertilizer doses applied, plant

spacings followed and their interaction did not affect the time of flowering. Birbal *et al*. [1995] has already reported that plant spacing had non-significant effect on number of days to flower in okra, while Ali [1999] reported that fertilizer treatments were also ineffective. Therefore, the results of the present study are in accordance with previous workers [Birbal *et al.* 1995, Ali 1999].

Table 2: Effect of various doses of N and P on the growth, green pod and seed yields of okra cv. Sabz Pari.

Characteristics	F_1	F_2	F_3	F_4
Seed germination (%)	70.00 a*	71.00 a	70.44 a	71.22 a
Days taken to first flowering	43.88 a	44.38 a	45.49 a	44.50 a
Plant height at flowering (cm)	35.72 a	36.48 a	31.94 a	32.89 a
Length of green pod (cm)	12.06 a	13.06 a	12.11 a	12.16 a
Number of green pods/plant	15.28 a	14.55 a	15.94 a	16.22 a
Average weight/green pod (g)	13.46 a	13.98 a	13.76 a	13.78 a
Green pod yield/plant (g)	208.2 a	205.3 a	220.1 a	224.0 a
Green pod yield/hectare (t)	16.38 a	16.56 a	18.39 a	18.81 a
Number of mature pods/plant	13.19 a	12.45 a	13.44 a	13.58 a
Number of seeds/pod	39.25 b	44.93 a	46.35 a	46.42 a
1000 seed weight (g)	52.03 a	52.72 a	53.07 a	52.65 a
Seed yield/plant (g)	27.06 b	29.81 b	33.22 a	33.24 a
Seed yield/hectare (kg)	2180 b	2372 b	2684 a	2727 a

*Means in each row sharing same letter (s) are non-significant at 5% probability (DMR test).

Table 3: Effect of different plant spacings on the growth, green pods and seed yield of okra cv. Sabz Pari.

Characteristics	S_1	S_2	S_3
Seed germination (%)	71.25 a*	70.50 a	70.25 a
Days taken to first flowering	46.16 a	44.00 a	43.54 a
Plant height at flowering (cm)	37.58 a	33.11 b	32.08 b
Length of green pod (cm)	12.38 ab	11.88 b	12.79 a
Number of green pods/plant	14.08 c	15.71 b	16.70 a
Average weight/green pod (g)	12.36 c	13.27 b	15.61 a
Green pod yield/plant (g)	174.2 c	208.4 b	260.7 a
Green pod yield/hectare (t)	25.09 a	15.00 b	12.51 c
Number of mature pods/plant	11.53 c	13.32 b	14.64 a
Number of seeds/pod	45.11 a	45.22 a	42.39 a
1000 seed weight (g)	45.58 c	51.92 b	60.37 a
Seed yield/plant (g)	23.77 c	31.24 b	37.48 a
Seed yield/hectare (kg)	3423 a	2249 b	1799 c

*Means in each row sharing same letter (s) are non-significant at 5% probability (DMR test).

PLANT HEIGHT AT FLOWERING

The fertilizer doses did not differ significantly for the plant height at flowering. However, the parameter was significantly affected by the plant spacings and the interaction between fertilizers doses and plant spacings. It is interesting to record that the increase in fertilizer dose did not affect the plant height (Table 2). The possible reason could be that as phosphorus and potash were also used in combination with nitrogen, therefore nitrogen could not show its dominating effect. Furthermore, application of additional fertilizer beyond a specific dose may not be effective rather at some stage has negative effects. It is obvious from the Table 3 that the maximum plant height was recorded in closest spacing

(S_1), which significantly differed from other spacings. The possible reason could be that in closest spacing plants compete for light and become taller. The results of the present study are in good conformity with Raghav [1996] who reported that plant height at flowering increased in closer spacing and at wider spacing the plant height was reduced. As far as interaction between fertilizer doses and plant spacings is concerned, maximum plant height at flowering was recorded when fertilizer was applied @ 112 kg N + 168 kg P_2O_5 ha^{-1} (F_2) and plants were spaced at 15 cm (S_1). This was followed by F_1 x S_1 combination and stood at par with the former combination. All other combinations behaved statistically alike with minimum plant height at flowering (Table 4). This difference in plant height was probably due to the significant effect of plant spacings.

LENGTH OF GREEN POD

The fertilizer doses applied had non-significant effect on length of green pod. The different plant spacings adopted differed significantly for length of green pod, while the interaction between the fertilizer doses and plant spacings also had significant effect. Comparison of fertilizer doses reveals that the fertilizer application could not increase the length of green pod significantly (Table 2). However, the plant spacing had a significant effect on pod length and was the maximum at the widest spacing (S_3) (Table 3). The results of the present study are in accordance with Singh [1990] who reported that maximum pod length was obtained with widest spacing. In case of interaction, the maximum length of green pods was recorded in combination F_2 x S_3 (Table 4), indicating that F_2 was the optimum fertilizer dose and S_3 was proper spacing to get longest pods in the present study.

NUMBER OF GREEN PODS PER PLANT

Results indicate that the different plant spacings and their interaction with fertilizer doses had significant effect on number of green pods per plant. However, fertilizer doses had no significant influence on the parameter. Comparison of plant spacings reveals that the number of green pods per plant increased with increase in plant to plant distance. It is obvious from the Table 3 that the maximum number of green pods per plant was recorded in the widest spacing (S_3), which significantly differed from other plant spacings. The minimum number of green pods was harvested from the plants in the closest spacing (S_1). With wider spacing plant receives more nutrients and lateral growth takes place, as a result number of fruits per plant increases. These findings are in close conformity with the results of previous workers [Bisen *et al*. 1994, Birbal *et al.* 1995, Ali 1999] who reported that with the increase in plant spacing, number of green pods per plant increased. In case of interaction between fertilizer doses and plant spacings, all the combinations were at same level of significance except F_2 x S_1 and F_1 x S_1, which resulted in minimum

number of green pods. Both these treatments also behaved statistically alike and stood at par (Table 4). This was probably because the plants received low fertilizer doses and had competition for nutrients, water and light in closest spacing, thus resulting in less number of green pods per plant.

AVERAGE WEIGHT PER GREEN POD

Results reveal that non-significant differences occurred for various fertilizer doses and significant for the plant spacings and interaction between fertilizer doses and plant spacings. Comparison of the plant spacings indicates that all the spacings differed significantly from each other. The heaviest green pods were produced from the plants in widest spacing (S_3), while the minimum green pod weight was attained in those from the closest spacing (S_1) (Table 3). Similar findings have been reported by previous workers [Singh 1990, Birbal *et al.* 1995, Ali 1999] they found that wider spacing leads to heavier individual pod weight in okra. Comparison of interaction means indicates that the highest green pod weight was recorded in the combinations $F_2 \times S_3$, $F_4 \times S_3$, $F_3 \times S_3$ and $F_1 \times S_3$ (Table 4), indicating the clear-cut supremacy of the widest plant to plant distance (S_3 i.e. 45 cm).

GREEN POD YIELD PER PLANT

Yield of green pods per plant was not influenced by the fertilizer doses but affected significantly by plant spacings and interaction of fertilizer doses and plant spacings. Comparison of means for fertilizer doses indicates that the fertilizer doses used in the present study proved ineffective to increase the green pod yield per plant (Table 2). Non-significant differences among the fertilizer doses reveal that the addition of more fertilizer beyond a specific limit may not be productive and further indicating that the fertilizer doses used in the present study were high. However, yield of green pods per plant significantly increased with increase in planting distance. With wider spacing, green pod yield per plant increased and maximum pod yield was obtained with the widest spacing (S_3) (Table 3). The yield of green pods increases with increase in number of green pods harvested, pod length and pod weight. As these were highest in wider spacings, therefore, green pod yield per plant was also highest in wider spacings. Similar results have already been reported by Birbal *et al*. [1995] and Raghav [1996], who in separate studies observed that green pod yield per plant was highest in case of widest spacing. In case of interaction between fertilizer doses and plant spacings, the highest green pod yield per plant was achieved in all combinations of widest spacing (F_3), irrespective of fertilizer doses (Table 4). This indicates that the significant differences among the means of combined effect were due to the plant spacings.

Table 4a: Effect of various levels of N and P and different plant spacings on growth, green pod and seed yields of okra cv. Sabz Pari.

Characteristics	F_1			F_2			F_3			F_4		
	S_1	S_2	S_3	S_1	S_2	S_3	S_1	S_2	S_3	S_1	S_2	S_3
Seed germination (%)	70.67 a*	68.67 a	70.67 a	71.67 a	71.67 a	69.67 a	71.33 a	71.00 a	69.00 a	71.33 a	70.67 a	71.67a
Days taken to first flowering	46.83 a	42.33 a	42.50 a	47.33 a	43.00 a	42.83 a	45.80 a	45.50 a	45.17 a	44.67 a	45.17 a	43.67 a
Plant height at flowering (cm)	40.00 ab	32.67 bc	34.50 bc	42.33 a	34.27 bc	32.83 bc	34.00 bc	31.50 c	30.33 c	34.00 bc	34.00 bc	30.67 c
Length of green pod (cm)	11.67 cd	11.50 d	13.00 b	12.17bcd	12.50bcd	14.50 a	12.83 bc	11.67cd	11.83bcd	12.83 bc	11.83bcd	11.83 bcd
Number of green pods/plant	12.33 b	16.67 a	16.83 a	12.50 b	14.83 a	16.33 a	15.50 a	15.50 a	16.83 a	16.00 a	15.83 a	16.83 a
Average weight/green pod (g)	11.74 c	13.18 b	15.46 a	12.81 b	13.29 b	15.85 a	12.46 bc	13.26 b	15.55 a	12.43 bc	13.34 b	15.57 a
Green pod yield/plant (g)	144.8 c	219.7 b	260.2 a	160.1 c	197.1 b	258.8 a	193.1 b	205.5 b	261.7 a	198.9 b	211.2 b	262.0 a
Green pod yield/hectare (t)	20.84 b	15.82 c	12.49 c	23.06 b	14.19 c	12.42 c	27.81 a	14.80 c	12.56 c	28.64 a	15.20 c	12.58 c
Number of mature pods/plant	11.07 c	13.83 ab	14.67 a	10.95 c	12.35 bc	14.05 ab	11.93 c	13.43ab	14.95 a	12.17 bc	13.67 ab	14.89 a
Number of seeds/pod	41.24 ab	38.54 b	37.98 b	45.01 ab	45.82 ab	43.95 ab	46.57 a	48.56 a	43.91 ab	47.61 a	47.94 a	43.72 ab
1000 seed weight (g)	45.00 c	52.46 b	58.64 a	45.10 c	50.77 bc	62.30 a	45.87 bc	52.44 b	60.89 a	46.33 bc	51.99 b	59.63 a
Seed yield/plant (g)	20.54 e	27.96 cd	32.67 b	22.23 e	28.73 c	38.47 a	25.48 d	34.20 b	39.97 a	26.84 cd	34.07 b	38.82 a
Seed yield/hectare (kg)	2958 b	2013 d	1568 e	3201 b	2068 d	1846 de	3670 a	2462 c	1919 d	3865 a	2453 c	1863 de

*Means in each row sharing same letter (s) are non-significant at 5% probability (DMR test).

GREEN POD YIELD PER HECTARE

Data concerning this parameter also reveal that there were non-significant differences among the fertilizer doses and significant among the plant spacings as well as the interaction of fertilizer doses and plant spacings. It can be concluded that green pod yield per hectare, like green pod yield per plant was not affected by the fertilizer doses (Table 2). Comparison of plant spacings indicates the highest green pod yield per hectare was obtained from closest spacing (S_1) and the lowest from the widest spacing (S_3) (Table 3). Pod yield per hectare depends upon the yield per plant and plant population. So closer spacing up to a certain limit results in higher pod yield per hectare due to more number of plants and wider spacing leads to less number of plants per hectare and ultimately low yield. The highest green pod yield per hectare with closest spacing had already been reported by previous workers [Singh 1990, Ali 1999]. Comparison of means of interaction between the two factors indicates that the combinations F_4 x S_1 and F_3 x S_1 resulted in the highest green pod yield per hectare and both these combinations were statistically at par. This was followed by the combinations, F_2 x S_1 and F_1 x S_1 and both these combinations also behaved alike. While all other combinations were at bottom with statistically same level of significance (Table 4). The higher yields in these combinations were probably due to closest spacing or more number of plants.

NUMBER OF MATURE PODS PER PLANT

Data on number of mature pods per plant indicate that different plant spacings differed significantly, while the fertilizer doses had non-significant effect on the parameter. However, the interaction of fertilizer doses and plant spacings was also found significant. Comparison of fertilizer doses indicates that the number of mature pods harvested was not affected by the fertilizer doses applied (Table 2). However, in case of plant spacings, the maximum number of green pods per plant was harvested in the widest spacing (S_3), which significantly differed from other plant spacings (Table 3). The minimum number of green pods was harvested from the plants in the closest spacing (S_1). It indicates that the number of green pods per plant increased with increase in plant-to-plant distance. In wider spacings, plant receives more nutrients and lateral growth takes place resulting in increased number of fruits per plant. Similar results have been reported by Bisen *et al.* [1994] and Birbal *et al.* [1995] who found that with the increase in plant spacing, number of green pods per plant increased. The means of interaction between fertilizer doses and plant spacings indicate that all the combinations with wider spacings were better with more number of pods than those with closest spacing (Table 4). This was probably because of the plant spacing rather than the fertilizer dose. This is interesting to record that the number of mature pods obtained per plant was lower than the number of green pods

harvested for vegetable purpose. This demonstrates that when green pods were harvested, new pods were produced. The results of the present study are also in accordance with Jordan-Molero [1986] who has already reported that the number of pods decreased significantly when harvested for seed purpose.

NUMBER OF SEEDS PER POD

Data reveal that fertilizer doses and interaction of fertilizer doses and plant spacings had significant effect on the number of seeds per pod. However, plant spacings have no significant influence on the parameter. The maximum number of seeds per pod was recorded in heavier doses of fertilizer (i.e. F_4, F_3 and F_2). It is evident from the data that the number of seeds per pod increased with the increase in fertilizer dose to a certain limit (Table 2). Similar results have already been reported by Anjum and Amjad [1999] who observed that pod length increases with increase in fertilizer dose and ultimately the number of seeds per pod increases. Comparison of interaction means indicate that all the combinations had statistically same number of seeds per pod except F_1 x S_2 and F_1 x S_3, which had the minimum number of pods per pod (Table 4), possibly due to low dose of fertilizer.

1000 SEED WEIGHT

The fertilizer doses had no significant effect on the weight of 1000 seeds (Table 2). However, plant spacings and their interaction with fertilizer doses had significant influence on seed weight. As the plant spacing increased, the weight of 1000 seeds also increased. The highest seed weight was recorded in the widest spacing (S_3), while the lowest in the closest one (S_1) (Table 3). This was probably because in widest spacing plants had less competition and better chances to grow. Similarly, in case of interaction between the fertilizer doses and plant spacings, maximum seed weight was recorded in all the combinations of fertilizers with widest spacing (Table 4), also indicating the supremacy of widest spacing.

SEED YIELD PER PLANT

Seed yield per plant was affected significantly by fertilizer doses, plant spacings as well as by interaction between fertilizer doses and plant spacings. The heavier doses of fertilizer (i.e. F_3 and F_4) resulted in significantly higher seed yield per plant than the lower fertilizer doses (i.e. F_1 and F_2). It indicates that in the present study, though increased fertilizer doses failed to affect the green pod yield but resulted in increased seed yield (Table 2). Seed yield per plant also differed significantly for different plant spacings. The highest seed yield per plant was obtained at the widest spacing (S_3) and lowest from the closest spacing (S_1) (Table 3). Seed yield per plant is a measure of number of pods per plant, number of seeds per pod and seed weight, which become

higher at wider spacing. The results of the present study are in accordance with previous workers [Bisen *et al.* 1994, Ali 1999] who after separate studies reported that the highest seed yield per plant was obtained at a wider spacing. Regarding the interaction between fertilizer doses and plant spacings, the highest seed yield per plant was obtained from all the combinations of widest spacing (S_3) with higher doses of fertilizer (i.e. F_2, F_3 and F_4). The results are in close conformity with Abdul and Aarf [1986] who reported that with increasing the plant spacing, number of fruits per plant increases under optimum dose of fertilizer.

SEED YIELD PER HECTARE

The results indicate that the fertilizer doses, plant spacings and also their interaction (fertilizer doses x plant spacings) had significant effect on the seed yield per hectare. Comparison of fertilizer doses indicates that the higher doses of fertilizers (i.e. F_3 and F_4) resulted in higher seed yield per hectare than the lower fertilizer doses (i.e. F_1 and F_2). These results are in line with the results on seed yield per plant (Table 2). Regarding the effect of plant spacing on seed yield, the highest seed yield per hectare was obtained from the closest spacing (S_1) and the minimum at the widest spacing (S_3) (Table 3). Seed yield per hectare depends upon the number of plants per unit area and seed yield per plant. The highest yield in closest spacing might be due to more number of plants per unit area. These results are in close conformity with the findings of previous workers [Singh 1990, Baruah 1995, Kadam *et al.* 1995, Ali 1999] In case of interaction, the combinations of higher fertilizer doses with the closest spacing (i.e. F_4 x S_1 and F_3 x S_1) ousted all other combinations. These were followed by the combinations of lower fertilizer doses with the closest spacing (i.e. F_2 x S_1 and F_1 x S_1). All other combinations were inferior for seed yield per hectare. The results obtained are in accordance with Abdul and Aarf [1986] who reported that the highest seed yield per unit area was obtained with closest spacing and a higher dose of fertilizer.

CONCLUSIONS

The Fertilizer doses applied had no significant effect on green pod yield indicating that the doses used were high. However, seed yield was highest at the higher doses (140 kg N + 200 kg P_2O_5 and 180 kg N + 240 kg P_2O_5 ha^{-1}) and these did not differ significantly. Therefore, it is concluded that the doses 78 kg N + 92 kg P_2O_5 and 140 kg N + 200 kg P_2O_5 proved optimum for green pod yield and seed yield, respectively in the present study. The closest plant spacing of 15 cm resulted in the highest green pod and seed yields per hectare.

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