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Seed yield and quality of soybean (*Glycine max* L. Merril) as influenced by row spacing and phosphorus under mid hill conditions of Himachal Pradesh

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Abstract

An experiment was conducted during the rainy (*Kharif*) seasons of 2002 and 2003 at CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur to study the effect of row spacing (30, 45 and 60 cm) and phosphorus (0, 30, 60 and 90 kg P_2O_5/ha) on growth, yield and quality of soybean (*Glycine max* L. Merril) seed. Sowing at a normal row spacing of 45 cm resulted in significantly higher pods/plant, 1000-seed weight, seedling length and vigour index than closer and wider row spacing of 30 and 60 cm. Significant increase of 10.2 and 7.2 percent in seed yield was recorded with row spacing of 45 cm over 30 and 60 cm, respectively. Plant height was significantly higher with wider row spacing of 60 cm. However, grains/pod and graded seed recovery remained unaffected by different row spacings. LAI, plant height, pods/plant, graded seed yield, 1000-seed weight, seed recovery percentage, seedling length and vigour index increased significantly by 90.5, 57.9, 106.3, 66.5, 14.8, 20.8, 65.5 and 65.1 percent, respectively with application of 90 kg P_2O_5/ha over control. Seed germination was not influenced by phosphorus application.

Introduction

Soybean is a potential crop of rainy season in mid hills of Himachal Pradesh. Seed viability in soybean is a critical factor in crop production. Agronomic requirements of soybean crop grown for seed are different from those recommended for grain production, rather needs higher inputs like water, nutrients, space, air and solar radiation for production of good quality seed. Manipulation of agronomic practices such as row spacing is considered to be foremost step to achieve proper and uniform distribution of plants over cultivated area thereby better availability of above and below ground resources towards increasing seed yield and decreasing competition among plants. Phosphorus availability to plants is low under acidic soils due to P fixation (Mujamdar et al. 2001 and Vara et al. 1994). Since the soils of the area, where soybean is grown in Himachal Pradesh are acidic in reaction, under such a situation there is a great scope to increase seed yield of soybean with higher phosphorus application. Keeping in view these factors the present investigation was carried out to study the effect of row spacing and phosphorus on growth, yield and quality of soybean seed.

Material and Methods

A field experiment was conducted during the rainy (*Kharif*) seasons of 2002 and 2003 at the research farm of Seed Production Unit, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur. The soil was silty clay loam in texture and acidic in reaction (pH 5.8) having 0.91% organic carbon, medium in available N (302 kg/ha) and P_2O_5 (16.6 kg/ha), and high in available K_2O (314 kg/ha). Twelve treatment combinations comprising of three row spacing viz. 30, 45 and 60 cm and four phosphorus levels viz. 0, 30, 60 and 90 kg P_2O_5/ha were laid out in randomized block design with three replications. Soybean variety PK 472 was sown by *kera* method on 14th and 20th June during 2002 and 2003, respectively with a seed rate of 100 kg/ha for uniform plant population. The crop was fertilized with 20 kg N and 40 kg K_2O/ha through urea and muriate of potash respectively and all the nutrients were applied at the time of sowing. Source of phosphorus was single super phosphate. Leaf area index (LAI) and plant height were recorded at flowering stage. The produce was graded using Agrosaw (Deluxe) seed grader. Graded seed yield, percentage of graded seed recovery and other quality parameters were recorded. The seedling length was

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measured on 8th day after soaking. Seed vigour index was worked out by multiplying seed germination percentage by the seedling length.

Results and Discussion

Growth and yield attributes

Higher LAI was recorded with wider row spacing of 60 cm, but it remained at par with normal spacing of 45 cm (Table 1). Significantly taller plants were observed with wider row spacing of 60 cm, but the plant height recorded under closer and normal spacings was at par with each other. Normal row spacing of 45 cm proved to be better in respect of pods/plant. Normal and wider row spacing did not show differences in 1000-seed weight (unprocessed/ raw seed) but were superior to close row spacing of 30 cm. These effects on growth and yield attributes on account of spacing could be attributed to uniform distribution of plants and less competition for water, nutrients, air and solar radiation under normal spacing than closer and wider spacings. Different spacings did not affect grains per pod.

Significant increase in LAI, plant height and pods per plant was observed with P application up to 90 kg P_2O_5/ha (Table 1). An increase of about 100% in LAI and pods per plant was recorded with the application of 90 kg P_2O_5/ha over control. The number of grains per pod did not show significant increase beyond 30 kg P_2O_5/ha. Similarly, unprocessed seed yield and 1000 seed weight did not increase significantly beyond 60 kg P_2O_5/ha. This may be due to the fact that P plays an important role in root development and translocation of photosynthates being constituent of nucleic acid, phytin and phospholipids, hence enhances the growth which resulted in more plant height and yield attributes. Similar results were reported by Pathak *et al.* (1986) and Mujamdar *et al.* (2001).

Yield

Effects of different row spacings on unprocessed/raw seed and processed/graded seed yield were similar. Significantly higher seed yield at 45 cm row spacing was recorded over 30 and 60 cm. Sowing at 30 cm row spacing resulted in the lowest yield. The higher yield at 45 cm row spacing was due to better yield parameters. These results are in conformity with Nimje (1996).

Effect of graded levels of phosphorus on raw and processed seed yield was different. The raw seed

Table 1. Effect of row spacing and phosphorus on growth, yield parameters and seed yield (q/ha) of soybean (Average of 2 years)

Treatment	Leaf area index	Plant height (cm)	Pods/plant	Grain/pod	1000-raw seed weight (g)	Unprocessed/ raw seed yield (q/ha)	Processed/ graded seed yield (q/ha)
Row spacing (cm)							
30	2.34	59.4	72.8	2.45	115.2	14.07	11.99
45	2.47	58.3	77.7	2.52	116.9	15.48	13.21
60	2.51	71.2	73.7	2.53	117.2	14.48	12.32
CD (P=0.05)	0.06	1.20	0.82	NS	1.03	0.21	0.17
P_2O_5 (kg/ha)							
0	1.68	47.8	44.5	1.70	111.8	12.04	9.14
30	1.96	57.1	72.3	2.70	115.5	13.55	11.14
60	2.93	70.4	90.2	2.80	118.6	16.53	14.52
90	3.20	75.5	91.8	2.79	119.8	16.59	15.22
CD (P=0.05)	0.07	1.16	0.95	0.98	1.20	0.24	0.19

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yield increased significantly up to 60 kg P_2O_5/ha, whereas graded seed yield showed response up to 90 kg P_2O_5/ha and the increase in raw seed with 60 kg P_2O_5/ha and graded seed yield with 90 kg P_2O_5/ha was recorded as 37.5 and 66.5 percent, respectively. The difference in response to phosphorus was due to higher number of bold seeds which resulted in significantly higher recovery percentage of seed with application of 90 kg P_2O_5/ha. Similar results were reported by Mujamdar *et al.* (2001) and Vara *et al.* (1994).

Response to P application at different row spacings on graded seed yield was significant (Figure 1). At 30 and 45 cm row spacing consistent and significant increase was recorded up to 90 kg P_2O_5/ha, whereas at 60 cm statistically it was significant up to 60 kg P_2O_5/ha. Highest seed yield of 16.35 q/ha was recorded with application of 90 kg P_2O_5/ha and row spacing of 45 cm.

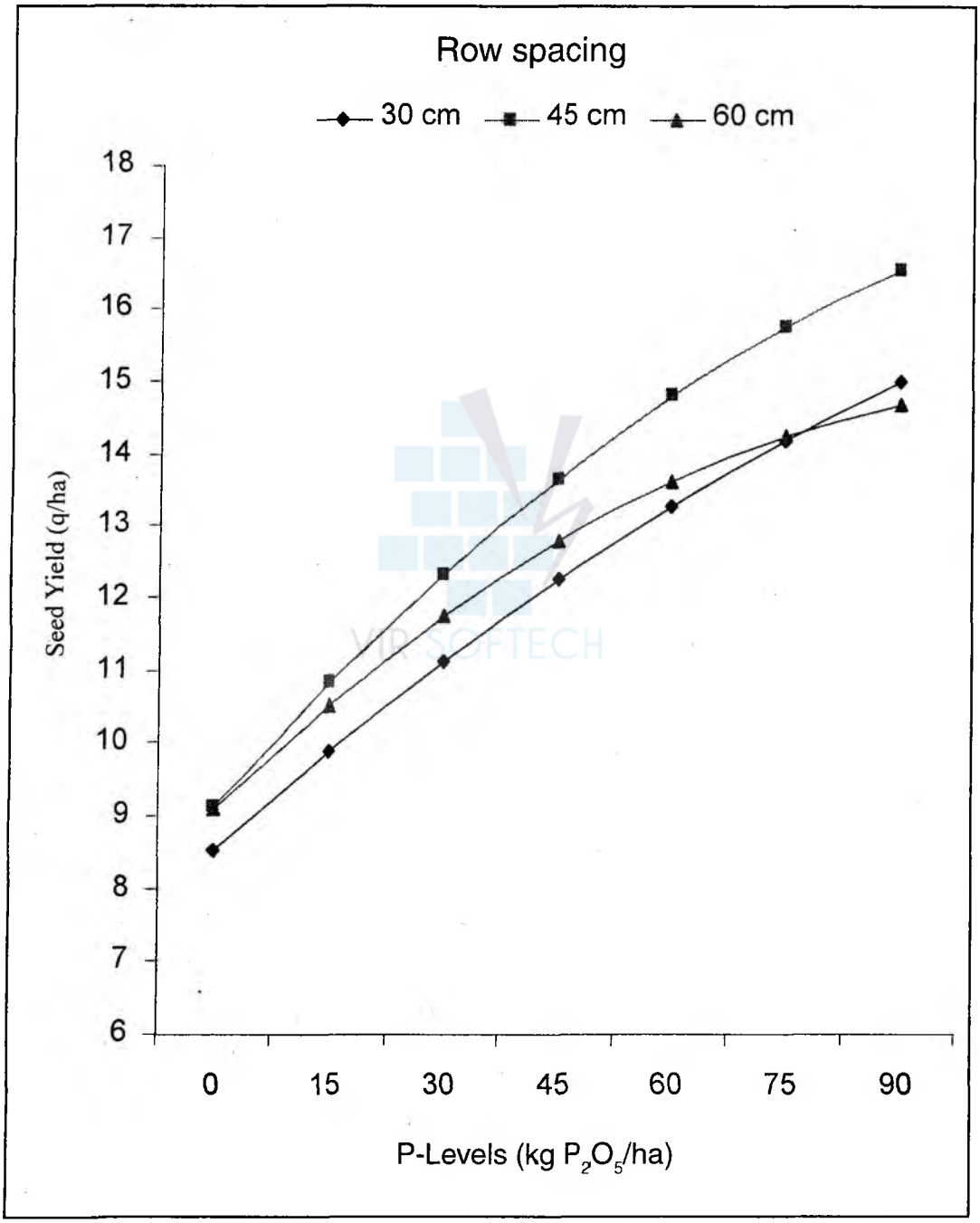


Figure 1. Response to phosphorus application at different row spacings

Seed quality parameters

Row spacing did not influence germination and recovery percentage of the seed (Table 2). However, 1000-seed weight, seedling length and vigour index were significantly higher with 45 cm row spacing while these parameters were significantly lower at 30 cm spacing. Further, increase in P levels significantly improved all the quality parameters of seed except the germination percentage. Significant increase of 14.8, 20.8, 65.5 and 65.1 percent was recorded for 1000-seed weight, seed recovery, seedling length and vigour index with application of 90 kg P_2O_5/ha over control.

It is concluded that sowing of soybean at row spacing of 45 cm and application of 90 kg P_2O_5/ha can be recommended for production of quality seed of soybean.

Table 2. Effect of row spacing and phosphorus on seed quality parameters (Average of 2 years)

Treatments	1000-graded seed weight (g)	Seed recovery (%)	Germination (%)	Seedling length (cm)	Vigour index
Row spacing (cm)					
30	144.1	84.4	98.0	14.5	1417.9
45	149.9	84.5	98.0	15.3	1501.6
60	145.4	84.4	98.1	14.7	1477.9
CD (P=0.05)	1.00	NS	NS	0.20	20.8
P_2O_5 (kg/ha)					
0	136.3	75.9	98.0	11.3	1107.6
30	142.2	82.2	98.1	13.4	1317.0
60	150.7	88.0	98.0	15.9	1556.4
90	156.5	91.7	98.0	18.7	1828.9
CD (P=0.05)	1.16	0.40	NS	0.22	24.0

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