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Influence of Seed Size on phenology, Yield and Quality of three Soybean (*Glycine max* (L.) Merr.) Genotypes

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Abstract

A field experiment was conducted to determine the effect of seed size on soybean performance. Amongst the three genotypes under study, 95-1 gave highest average seed yield of 2065 kg ha^{-1} followed by FS-85 which produced 1820 kg ha^{-1}. Williams-82 produced the lowest average seed yield of 1282 kg ha^{-1}, among the seed size categories, maximum average seed yield of 1991 kg ha^{-1} was produced by medium (4.9 mm-6.2 mm) seed followed by an average produce of 1976 kg ha^{-1} by large sized seed. Lowest produce (1171 kg ha^{-1}) was obtained from small size seed. Besides seed yield, the yield components like number of pods per plant, number of seeds per pod and number of seeds per plant were significantly affected both by genotypes and seed size. Similarly photo biomass producing contributors (number of plant, plant height, biological yield and harvest index) were also found responsive to genotypes and seed size categories. Genotypes also showed significant results regarding phenology but less pronounced results on phenology were shown by seed size. Quality of oil, however, was increased by large seed size which remained 22.40 percent.

Introduction

Soybean is one of the most important protein and oil crop of the world. Its seed contains 18-22 percent cholesterol free oil having 85 percent unsaturated fatty acids and 40 percent proteins (Hatim and Abbasi, 1994). It is a universal food, feed and industrial crop which is used in the preparation of more than 400 products. Due to its diversified use soybean is truly called as miracle crop or gold crop.

Adopted mainly to temperate regions with fairly humid growing seasons, soybean plant also thrives good in tropical and subtropical climates, provided essential requirements are met. Pakistan's annual production of soybean is 7311 tones with an average yield of 538 kg ha^{-1} (Anonymous, 1997) which is far below than soybean growing countries. There are many reasons for this low output for example poor seed germination, poor seedling vigour, photoperiod sensitivity and low varietal performance based on different agro-ecological zones. Among these, germination and seedling vigour are greatly influenced by seed size. Similarly various soybean cultivars show varying sensitivity to seed size at their different development stages (Longer *et al.*, 1986).

However, there is paucity of information regarding growth, development and yield response of our domestic cultivars to varying seed sizes. Consequently present study was aimed at evaluating the effect of seed size on yield and yield components in three soybean genotypes under agro-ecological conditions of Faisalabad.

Materials and Methods

The experiment was conducted at the Agronomic Research Farm, University of Agriculture, Faisalabad during the year 1997 on a sandy clay loam soil. Experiment was laid out in randomized complete block design with split plot arrangement and four replications. The net plot size was 1.8 m x 5.0 m. Soil upto 30 cm layer was sampled before the start of the experiment and subjected to physicochemical analysis. The data showed 0.040 percent N, 8 ppm P_2O_5 and 174 ppm K_2O. The soil pH was 8.0. At the time of harvesting climatic data of crop growing season showed slight differences, however, the growing season remained normal. The soybean genotypes i.e. FS-85, Williams-82 and 95-1 were in the main-plots whereas seed grades of control (ungraded), small (<4.9 mm), medium (4.9 mm to 6.2 mm) and large >6.2 mm) were randomized in sub-plots. Crop was sown in single rows 30 cm apart with the help of a single row hand drill. Seed rate was 100 kg ha^{-1}. A basal dose of N and P_20_5 at the rate of 50 and 80 kg ha^{-1} in the farm of urea and single super phosphate respectively was applied. All other agronomic practices were kept normal and uniform for all treatments. Nitrogen percentage of soybean seed samples collected from each subplot was determined by micro Kjeldohl method (AOAC, 1980). Nitrogen percentage was multiplied by a constant factor (6.25) for calculating protein contents. Seed samples were randomly taken from each subplot and seed oil contents were determined by Soxhiet method as described by Low (1990). The data collected were statistically analyzed by the analysis of variance techniques (Steel and Torrie, 1984).

Results and Discussion

Yield: As regards seed size (Table 1) effects, medium sized seed produced maximum yield (1991 kg ha^{-1}). Both large and medium sized seed remained statistically at par with each other whereas minimum seed yield was obtained (1171 kg ha^{-1}) from small seed. Regression line showed a positive correlation between seed size and seed yield. Genotype 95-1 (Table 1) gave the highest seed yield (2063 kg ha^{-1}) than other genotypes. Statistically all

Table 1: Effect of different seed sizes on yield, yield components in three soybean genotypes

Treatments	Seed yield (Kg ha^{-1})	No. of pods per plant	No. of seeds per pod	Total No. of seeds per plant
(a) Seed size				
Ungraded	1747.0b	27.63b	2.59ab	71.39b
Small	1171.0c	24.96b	2.47b	60.43c
Medium	1991.0a	35.75a	2.66a	95.21a
Large	1976.0a	35.92a	2.56ab	91.99a
L.S.D.	120.0	2.849	0.135	8.205
(b) Genotypes				
FS-85	1820.0b	N.S.	2.45b	73.28b
William-82	1282.0c	N.S.	2.53b	75.20b
95-1	2063.0a	N.S.	2.69a	90.79a
L.S.D.	169.8		0.12	12.64

Any two means not sharing the same letter differ significantly at 5% probability, N.S. = Non significant

Table 2: Effect of different seed sizes on Photo biomass production, phenology and quality of three soybean genotypes

Treatments	No. of Plant (m^2)	Plant height (cm)	Biological yield kg ha^{-1}	Harvest index (%)	Days taken to germination	Days taken to flowering	Days taken to maturity	Oil contents (%)
(a) Seed size								
Ungraded	26.00b	33.32b	5594.0b	31.09b	6.83b	N.S.	N.S.	21.48b
Small	16.67c	35.53c	4179.0c	28.52b	8.33a	N.S.	N.S.	20.50c
Medium	33.92a	39.66a	6188.0a	31.62a	6.41b	N.S.	N.S.	22.01ab
Large	33.92a	39.80a	6146.0a	31.70a	6.41b	N.S.	N.S.	22.40a
L.S.D.	2.17	1.32	283.5	1.18	0.426	N.S.	N.S.	0.76
(b) Genotypes								
FS-85	24.88b	28.00c	5769.0b	31.14a	6.00c	31.18c	91.06c	N.S
William-82	24.00b	32.37b	4361.0c	29.62b	6.62b	34.50b	94.75b	N.S
95-1	34.00a	53.81a	6452.0a	8.37a	8.37a	41.44a	101.9a	N.S
L.S.D.	2.59	1.52	462.2	0.35	0.35	1.001	0.710	N.S

Any two means not sharing the same letter differ significantly at 5% probability, N.S. = Non significant

genotypes differ significantly. The interaction of genotypes and seed sizes also showed a significant trend and 95-1 x large seed interaction was significantly better than all combinations, however 95-1 x medium seed interaction being statistically at par with first combination. These results are in conformity with Longer *et al*. (1986) and Rana and Yousaf (1988).

Yield components: The relationship between the grain yield and its components is shown in Table 1. Number of pods per plant were not significantly affected by genotypes. However, pod number was significantly affected by different seed sizes. Medium and large sized seed produced maximum number of pods per plant. There was positive correlation value of 0.649 between number of pods per plant and yield. These results are in line with Kazmi *et al*. (1991). A perusal of the Table 1 indicate that genotype 95-1 produced significant number of seeds per pod. Medium sized seed was able to produce 2.66 number of seeds per pod which remained significantly better than other treatments. There was a positive correlation value of 0.568 between number of seeds per pod and yield. These results are in agreement with Kolak *et al*. (1992).

Significant maximum number of seeds (90.79) per plant was counted for genotype 95-1 followed by williams-82 and FS-85 which were statistically at par with each of (Table 1). As regards seed sizes maximum number of seed were produced by medium and large sized seed remained at par with each other. There was a position correlation of 0.715 between total number of seeds plant and yield. These results in agreement with Reddy *et al*. (1989).

The study showed that 100-grain weight was not affected by genotypes as well as seed sizes. The multiple regress equation showed that 61.2 percent of variation in was due to these four yield components. The important yield contributors were total number of seed: plant (R^2 51.2%), followed by number of pods per plant 42.1%) and number of seeds per pod (R^2 32.3%). From these results it may be concluded that for increasing soybean yield the priority area for research should be increase the number of seeds.

Photo biomass production: Economic yield, the indirectly, is the outcome of photo biomass production is determined by the following parameters. It is clear the data (Table 2) that plant population was significant among genotypes as well as seed sizes. Their interface was also found significant 95-1 x large and medium the highest plant population. The highest yield was also obtained by this combination as discussed earlier. These results are in agreement with Kazmi *et al*. (1991).

Genotype 95-1 attained maximum height. Similarly both large and medium seed sizes attained maximum height as compared to other seed sizes. Their interaction was also found significant. These results are in line with TeKrony *et al*. (1987). Genotype 95-1 gained maximum biological yield (Table 2). Similarly medium sized seed gained maximum production which is statistically at par with large sized seed. However, their interaction was found to be non-significant. Similar results were obtained by Reddy *et al*. (1989). The efficiency of a crop is reflected by its harvest index value. Harvest index of all genotypes as well as all seed sizes was significant (Table 2).

Bhardwaj and Bhagsari (1990) have already reported that seed yield was positively correlated with harvest index in large and small seeded genotypes.

Phenology: Data in Table 2 suggest that genotypes have shown significant responses in case of days to germination, flowering and maturity. Genotype 95-1 has late emergence, late flowering and late maturity, whereas FS-85 was found to be early maturing. Seed sizes showed a non-significant response except that large and medium seed emerged early (Table 2). Late field emergence of small seed may be related to lower emergence force expressed on a unit cross sectional area of the cotyledon pair. Similar findings were drawn by Sung (1992).

Quality: Genotypes as well as seed sizes has non-significant effect on protein contents. Oil contents was one of the major factor to be affected by varying seed sizes (Table 2). Large sized seed produced 22.40 per cent oil and remained significantly better than ungraded and small seeds. Similar findings were observed by Shukla *et al*. (1987).

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