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PLANTING PATTERN AND IRRIGATION LEVEL EFFECTS ON GROWTH, YIELD COMPONENTS AND SEED YIELD OF SOYBEAN *(GLYCINE MAX* (L.) MERR.)

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Field studies were conducted during 1990-92 at Agronomic experimental area, Agriculture Institute, Tandojam to determine the effect of planting patterns and irrigation regimes on growth and seed yield of soybean . Four interrow and intrarow spacings (45 x 5,45 x 10,60 x 5, and 60 x 10 cm) and four irrigation levels (3,4,5 and 6) were tested against soybean during each year. Spacings had significant influence on days to flowering, days to maturity, plant height, branches/plant, pods/plant, single plant weight and seed yieldlha. Closer interrow and wider intrarow spacing (45 x 10 cm) yielded significantly the maximum, while growth and yield components were superior at wider row and plant spacing (60 x 10 cm). Similarly, irrigation levels had significant effect on all the characters studied. Six irrigations applied at different growth stages (25 days after sowing, bud formation, flowering, pod initiation, seed formation, and complete pod filling stage) gave the maximum seed yield, which was associated with better growth and yield components.
Key words: irrigation levels, planting patterns, soybean, yield components

INTRODUCTION

Soybean *(Glycine max* (L.) Merr.) is a protein rich crop and its seed contains 37-40% high quality protein. The major use of soybean meal is in livestock and poultry feed; Besides oil and protein, it is rich in minerals and vitamins. A number of processed foods are marketed -in industrialized countries viz. artificial meat, milk, yogurt, cheese, soy protein concentrates, isolates etc. (Chaudhry et al., 1988). Soybean yield, at present, is low in Pakistan and it is mainly ascribed to improper agronomic practices, malnutrition and poor irrigation management. Proper irrigation and appropriate inter- and intrarow spacing play an important role in maximizing the yield of soybean. According to Pervez (1987, 1989), closer row and plant spacing (0.9 x 0.08 m) gave higher seed yield of soybean than the conventional one (0.30 x 0.18 m). Egli et al. (1987) tested three row spacings (25, 36 and 76 cm) and observed that closer spacing gave more seed yield. Agha et al. (1990) and Jadhav et al.:(1994) reported that though wider row and plant spacing gave significantly higher number of branches/plant, number of pods/plant and seed yield/plant, yet these depressed yield ha",

Kadhem et al, (1985) applied irrigation at seven different growth stages and reported that seed yield increased when irrigation was applied regularly up to pod filling stage. Ramseur et al. (1985) irrigated soybean up to flowering stage or during full season. Growth parameters, yield components and yield increased more with irrigation applied during full season than up to flowering. However, Gungor and Yurtsever (1993) reported that seed and its related characters are affected significantly by proper irrigation. Likewise Mahmoud and El-Far (1994) reported that irrigation until the end of pod filling improved .plant height, number of branches, pods/plant and seed yield. Similarly, Aruna et al. (1995) reported that increasing irrigation (60 mm panevaporation) significantly increased seed yield of soybean. The present study was performed for three consecutive seasons to determine the effect of different irrigation levels and inter- and intrarow spacings on the growth and yield of soybean.

MATERIALS AND METHODS

Field experiments were conducted during 1990-1992 growing seasons at Agronomic experimental area, Agriculture Research Institute, Tandojam. Homogeneous seed of an exotic soybean variety Hampton was sown at the rate of 50 kg/ha in a four times replicated split plot design keeping irrigation as main plot and spacings as subplots measuring 4 x 3.2m. Four irrigation levels comprised TI = 3 irrigations (25 days after sowing, bud formation and flowering), T_2 = 4 irrigations (25 days after sowing, bud formation, flowering and pod initiation), Ta = 5 irrigations (25 days after sowing, bud formation, flowering, pod initiation and bud formation) and T_4 = 6 irrigations (25 days after sowing, bud formation, flowering, pod initiation, bud formation and pod filling). The four interrow and intrarow spacings were 45 x 5, 45 x 10, 60 x 5 and 60 x 10 cm. A standard fertilizer dose of 75-100-50 kg NPKlha was applied in the form of urea, SSP and SOP, respectively. Full dose of P and K with a half dose of N were applied at the time of sowing, while remaining dose of N was top-dressed. The required cultural operations were normal and uniform for all the treatments. For recording observations on days to flowering, days to maturity, plant height, number of branches/plant, number of pods/plant, seed weight/plant, normal five plants were selected at random from each subplot. The collected data were subjected to analysis of variance and to discriminate the superiority of mean values, LSD test was applied at alpha 0.05 following Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Significant differences in days to flowering, plant height, branches/plant, pods/plant, seed weight/plant and seed yieldlha were observed among planting patterns (Table 2). Increased space between rows and plants produced taller plants with greater pod bearing branches, more pods and seed weight/plant and with more days to flowering and maturity. This tendency was due to greater space within the row and between the plants which provided chance to improve vegetative growth, but reduced yield, while the decrease within row space increased seed yield (Table 2). These results are supported by some earlier workers (Pervez, 1989; Agha et al., 1990). Narrow rows have several advantages, most of which are related to early canopy closure. These include: increased radiation, reduction in moisture evaporation, decrease in the use of herbicides, equalized density throughout the planting area, lower levels of soil erosion, and pod positioning for mechanical harvesting.

The data (Table 1) indicated that days to maturity, plant height, branches/plant, pods/plant, seed weight/plant, and seed yield ha'! changed due to irrigation levels. Irrigation applied at all growth

Table 1. Mean squares corresponding to various sources of variation for growth, yield components and seed yield of soybean under different irrigation levels, and inter- and intrarow spacings and seasons

Source of variation	Degrees of freedom	Mean squares						
		Days to flowering	Days to maturity	Plant height (cm)	No. of branches! plant	No. of pods! plant	Seed weight! plant	Seed yield/ha (kg)
Seasons(S)	2	73.068" *	6103.560" *	11.527*'	3.099" *	123.343" *	110.731**	0.218**
Replications within season	9	3.063NS	5140.744NS	0.487NS	0.215NS	O.269NS	0.012NS	0.218" *
Irrigation (l)	3	15.853" *	10392.684**	820.525" *	41.450" *	622.330" *	1813.038" *	17865" *
SxI	6	15.480"	5246.027NS	0.467NS	0.386'	19.447**	21.554NS	O.003NS
Pooled error (I)	27	1.695	5160.361	0.421	0.097	1.865	7.977	0.007
Spacing(Sp)	3	443.550" *	9257.370" *	131.5130" *	15.417" *	469.043" *	1098.712" *	1.402**
SxSp	6	9.636**	5218.665" *	0.245NS	O.229NS	1.355NS	14.848NS	0.004NS
I x Sp	9	1.153NS	5201.742NS	3.437" *	0.356'	13.411" *	32.806'	0.122" *
S x I x Sp	18	1.417NS	5210.097NS	0.287NS	0.219NS	1.256NS	13.534NS	0.004NS
Pooled error (II)	99	4.196	5204.306	0.516	0.116	1.873	10.731	0.008
Total	191							

* Significant at P = 0.05; ** Significant at P = 0.01; NS = Non-significant.

Table 2. Mean growth, yield components and seed yield of soybean under different levels of irrigation, spacing and season

Traits	Days to flowering	Days to maturity	Plant height (cm)	No. of branches/ plant	No. of pods/ plant	Seed weight/ plant	Seed yield/ha (kg)
Seasons							
1990	49.472 a	113.222 a	39.071 a	7.358 b	35.612 b	40.127 b	1,967 b
1991	48.716 c	112.291 a	38.568 b	7.115 c	34.864 c	40.034 b	1,911 c
1992	50.825 a	129.652 a	39.412 a	7.554 a	37.554 a	42.357 a	2.027 a
S.E.	0.163	8.980	0.081	0.039	0.171	0.357	0.010
P< 0.05	0.232	-	0.160	0.77	0.339	0.699	0.020
P< 0.01	0.529	-	0.213	0.103	0,450	0.928	0.026
Irrigation levels							
T_1 = 3 irrigations	48.813b	102.956 c	34.195 d	6.336 d	32.007 d	33.359 d	1,243 d
T_2 = 4 irrigations	50.012 a	111.227 be	37.130 c	6.842 c	34.070 c	38,480 c	1.686 c
T_3 = 5 irrigations	49.884 a	122.412 ab	41,380 b	7.783 b	38.129 b	44,462 b	2,444 b
T_4 = 6 irrigations	49.975 a	136.944 a	43.363 a	8,408 a	39.833 a	47.057 a	2.501 a
S.E.	0.325	17.959	0.076	0.342	0.342	0.706	0.020
P< 0.05	0.644	35.559	0.321	0.154	0.677	0.398	0.040
P< 0.01	0,429	-	0,426	0.205	0.899	1.857	1,053
Planting spaces							
S1 45 x 5 cm	46.523 d	107.538 a	36.894 d	6.645 d	32.990 d	35,410 d	1.973 b
S2 45 x 10 cm	48.294 c	111.752.a	38.683 c	7.217 c	34.059 c	39.059 c	2.973 a
S3 60 x 5 cm	50.247 b	115.664 a	39.705 b	7.504 b	39.915 a	42.260 b	1,880 c
S4 60 x 10 cm	53.619 a	136.619 a	40.785 a	8.002 a	39.915 a	46.661 a	1,814 d
S.E.	0.188	10.959	0.094	0.045	0.197	0.404	0.012
P< 0.05	0.385	-	0.193	0.092	0,404	0.836	0.025
P< 0.01	0.521	-	0.260	0.125	0.546	1,230	0.033

Values followed by similar letters are not significantly different at $P < 0.05$.

stages caused more number of days to flowering and crop maturity and produced higher seed yield (Table 2). It was observed that flowering days were statistically similar in plots receiving 4,5 and 6 irrigations, whereas plots treated with three irrigations caused early flowering and crop maturity and resulted in suppressed vegetative growth and yield. These findings are in agreement with those reported earlier by Chaudhry et al. (1988). The present results suggest that irrigation is necessary especially during pod filling period (Dharmasena, 1983).

Significant seasonal differences were found in respect of days to flowering, plant height, branches/plant, pods/plant, seed weight/plant and seed yield/ha (Table 1). Soybean planted during 1992 yielded significantly more than that obtained in 1990 or 1991, while maturity days were more or less similar during all the three seasons (Table 2). The significant effect of season was due to environmental change over the seasons. Warm temperature hindered the photosynthesis activity and resulted in poor vegetative growth and yield (Summerfield et al., 1983).

Season and irrigation interaction was significant for days to maturity, branches and pods per plant, while season and spacing interaction was significant for flowering and maturity days. However, irrigation and spacing interaction was pronounced for plant height, branches, pods, seed weightJplant and yield ha' (Table 1). Significant interaction between season and irrigation and similarly between season and spacing indicated that in 1990 and 1991, the growth and yield were less as compared to 1992 due to warm weather which hindered the photosynthesis activity and resulted in poor growth and yield (Summerfied et al., 1983).

It may be concluded that for obtaining better soybean seed yield, six irrigations at all growth stages are essential under the agro-ecological conditions of South Sindh.

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