

COMPARATIVE PERFORMANCE OF SOYBEAN CULTIVARS UNDER RAINFED CONDITIONS

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(Received March 11, 1989; revised April 4, 1990)

Sixteen cultivars of soybean (*Glycine max* (L.) Merr) viz; Loppa, B-4, Bossier, Erton-2, SBL, S-73, Sue Hosine, Davis, Lee, Ford, Bragg, Celest, Braxton, Improved Pelican, Wayne and Monkey hair were planted on Silty clay loam soil under rainfed conditions at Barani Agricultural Research Institute, Chakwal, during the summer season of 1984 and 1985 to identify high yielding, early maturing cultivars and their agronomic performance. Loppa out yielded other cultivars, while improved Pelican produced the lowest yield. On an average, Loppa, B-4 and SBL had maximum number of pods per plant. Ford was the tallest among all cultivars. The highest harvest index (53%) was observed in Loppa and the minimum (15%) in Improved Pelican. Cultivars varied in days to mature from 84 to 105. Loppa was best suited as a summer soybean crop under rainfed conditions of Chakwal.

Key words: Soybean cultivars, Grain yield, Rainfed condition.

Introduction

Soybean (*Glycine max* (L.) Merr.) is an important source of plant protein and edible oil. Although soybean is a crop of temperature regions, it is well adapted to latitudes from 0 to more than 50 degrees [1]. Soybean was introduced in Pakistan as an oilseed crop in the mid 1960s from the United States of America and is being grown successfully under both irrigated and rainfed conditions.

During 1984-85, it was planted on 4537 ha, producing 1799 seed yield, an average of 397 kgs/ha [2]. It also fits well in the national cropping pattern (Table 1). In the Peshawar region during the mid 1960s, improved cultivars like Lee and Bragg (maturity group VII) were found to out yield the local cultivar (Mothi) both in grain and oil yield by about 30 percent [3]. These two cultivars are of long season taking 120-130 days to mature under normal sowing. However, soybean

cultivars for Barani areas should be of about 80-90 days maturity, so that they complete their life cycle during the monsoon season of late June to late September. Qureshi *et. al.* [4] reported that cultivars Woodworth (maturity group III) and Williams (maturity group III) yielded at par with Lee and Bragg but matured about three weeks earlier. Rana and Yousaf [5] reported that cultivars Bragg (maturity group III), Bossier (maturity group III) and Davis (maturity group VI) took 102 days to mature and formed a late maturity group while, Clark (maturity group IV) and Calland (maturity group II) matured in 84-86 days and formed an early maturing group under rainfed conditions of Islamabad.

The rainfed areas of the Potohar Plateau available for soybean production are abundant [6], after wheat harvesting, farmers often leave the land fallow during the Kharif season before planting wheat. If an early-maturity and high yielding cultivars is identified, it would not only increase the intensity of cropping but would also provide additional cash crop.

Investigations were conducted to identify high yielding, early-maturing cultivars to bring more area under soybean cultivation in the Barani areas and thus to ameliorate oil and protein shortages in Pakistan.

Materials and Methods

The performance of sixteen soybean strains/cultivars studies was determined at the Barani Agricultural Research Institute, Chakwal, during Kharif (Summer) season in 1984 and 1985 on silty clay loam soil. The cultivars were arranged in a randomized complete block design with four replications. Plot size was 5.0 x 1.8 m (4 rows 5 m long and spaced 45 cm apart). The crop was planted on July 26, 1984 and on July 21, 1985 with a hand drill using 100kg seed per hectare. The seeds were sown 4 to 5 cm deep and thinned (5 to 7 cm apart) later

TABLE 1. DIFFERENT CROPPING SEQUENCE FOR SOYBEAN CULTIVATION IN VARIOUS ECOLOGICAL ZONES OF PAKISTAN.

Irrigated cotton, wheat and rice area in Punjab & Sind		
Cotton	Soybean	Cotton
(June-Dec.)	(Feb.-May)	(June-Dec.)
Rice	Soybean	Rice
(June-Oct.)	(Feb.-May)	(June-Oct.)
Wheat	Soybean	Fodder
(Nov.-April)	(July-Oct.)	(Nov.-April)
		Rice
		(June-Oct.)
Rainfed Areas in the Punjab		
Wheat	Soybean	Wheat
(Nov.-May)	(July-Oct.)	(Nov.-May)
Wheat	Soybean	Groundnut
(Nov.-May)	(July-Oct.)	(March-Oct.)
Groundnut	Soybean	Groundnut
(March-Nov.)	(Feb.-May)	(June-Oct.)

*Central Cotton Research Institute, Multan.

on. Fertilizer was applied at the rate of 20 Kg N and 60 Kg P₂O₅ per ha at the time of seedbed preparation and was incorporated in the soil. Standard production practices were adopted to grow the crop.

Data on seed yield were obtained by harvesting the two centre rows of each plot on November 8, 1984 and on November 2, 1985. Grain yields were corrected to a moisture level of 11%. Data on plant height, number of pods per plant, biological yield (1988) and days to maturity (1985) were recorded. The number of pods per plant and plant height were the average for 10 plants per plot selected at random. Data were analysed by analysis of variance according to methods described by Gomes *et. al.* [7].

Results and Discussion

Seed yield. Soybean cultivars had highly significant differences in seed yield during both 1984 and 1985. The average yield of both seasons also differs significantly. As an average of two years, Loppa produced the maximum yield (530 kgs/ha) followed by Bossier (512 kgs/ha). Improved Pelican had the lowest yield (186 kgs/ha) under Chakwal barani conditions. The maximum yield produced by the cultivar Loppa was related to its high number of pods per plant, higher harvest index (Table 2), short stature (Table 3) and early maturity (Table 4). These results agree with those of [3-5]. This demonstrates that Loppa is suited to the rainfed conditions of Chakwal areas. Based on yield data, Loppa is not significantly better than B-4, Bossier, Erton, SBL and S-73 (Table 5).

TABLE 2. PLANT HEIGHT (CM) IN DIFFERENT SOYBEAN CULTIVARS AT MATURITY STAGE AT BARI, CHAKWAL DURING MONSOON 1984 AND 1985.

Cultivars	Plant height (cm)		Average
	1984	1985	
Loppa	69	71	70.0
Bossier	70	75	72.5
SBL	70	79	74.5
B-4	65	73	69.0
S-73	70	79	74.5
Ford	108	102	105.0
Sue Hosine	99	93	96.0
Erton-2	104	101	102.5
Lee	102	97	99.5
Davis	100	103	101.5
Celest	96	90	93.0
Bragg	104	100	102.0
Braxton	103	97	100.0
Monkey Hair	107	101	104.0
Wayne	105	100	102.5
Improved Pelican	107	101	104.0
LSD (P=0.05)	4.02	4.12	3.26
S.E. ±	1.97	12.01	1.60

Pods per plant. Cultivars differed significantly in number of pods per plant (Table 5). Maximum number of pods per plant were produced by Loppa, B-4 and SBL compared to Improved Pelican, Wayne and Monkey hair. Most cultivars had fewer pods in 1984 compared to 1985, probably because of excessive precipitation received during 1984 (Table 6). Other studies have also shown that number of

TABLE 3. SEED NUMBER PER POD AND 1000-GRAIN WEIGHT OF DIFFERENT SOYBEAN CULTIVARS GROWN AT BARI, CHAKWAL DURING MONSOON 1985.

Cultivars	Seed number per pod	1000-grain weight(g)
Loppa	3.3	358.5
B-4	2.8	316.8
Bossier	2.6	315.8
Erton-2	2.1	296.3
SBL	2.8	313.9
S-73	2.3	299.9
Sue Hosine	2.2	304.9
Davis	1.6	308.7
Lee	2.2	318.3
Ford	2.1	303.7
Bragg	2.0	310.0
Celest	2.2	300.3
Braxton	1.6	307.7
Improved Pelican	2.3	300.5
Wayne	2.3	202.9
Monkey Hair	2.2	281.3
LSD(P=0.05)	0.2099	1.9566
S.E. ±	0.1029	0.9591

TABLE 4. HARVEST INDEX IN DIFFERENT SOYBEAN CULTIVARS GROWN AT BARI, CHAKWAL DURING MONSOON 1985.

Cultivars	Economic* yield (gm/m ²)	Biological* yield (gm/m ²)	Harvest index (%)	Days to maturity
Loppa	53	100	53	84
Bossier	51	100	51	102
SBL	50	103	48	85
B-4	50	105	47	90
S-73	41	105	39	90
Ford	39	107	36	101
Sue Hosine	38	107	36	102
Erton-2	37	111	33	99
Lee	34	113	30	101
Davis	32	114	28	102
Celest	29	115	25	96
Bragg	29	115	25	104
Braxton	29	115	25	99
Monkey Hair	28	118	24	102
Wayne	24	121	20	102
Improved Pelican	19	125	15	101
LSD (P=0.05)	2.52	1.23	2.30	1.73
S.E.±	1.23	0.60	1.14	0.85

*One year data were available.

Pods per plant is a major contributor to increased seed yield in soybean. These results agree with those of [5]. Gautam and Singh [8] reported significant and positive correlation between seed yield and pods per plant and concluded that selection of cultivars for more number of pods per plant shall increase seed yield.

Plant height. The cultivars differed significantly in plant height (Table-2). Ford, Improved Pelican and Monkey hair were the tallest cultivars and attained an average height in excess of 1 m. Loppa, Bossier and SBL could be grouped as

TABLE 5. SEED YIELD OF DIFFERENT SOYBEAN CULTIVARS GROWN AT BARI, CHAKWAL DURING MONSOON 1984 AND 1985.

Cultivars	Yield (kg/ha)			No. of pods/plant		
	1984	1985	Average	1984	1985	Average
Loppa	400	660	530	16	18	17
B-4	397	594	496	14	17	16
Bossier	353	670	512	14	18	16
Erton-2	350	396	373	14	15	15
SBL	274	733	504	13	20	17
S-73	267	542	405	13	17	15
Sue Hosine	267	497	382	13	19	16
Davis	252	379	316	12	15	14
Lee	242	434	338	12	14	13
Ford	213	556	385	10	17	14
Bragg	213	365	289	10	15	13
Celest	208	372	290	10	15	13
Braxton	181	389	285	9	16	13
Improved Pelicon	181	191	186	9	10	10
Wayne	161	323	242	9	14	12
Monkey Hair	152	410	281	9	14	12
LSD(P=0.05)	140.6	157.5	139.7	2.08	1.67	1.79
S.E. ±	68.92	77.21	68.48	1.01	0.81	0.87

TABLE 6. METEOROLOGICAL DATA AT BARANI AGRICULTURAL RESEARCH INSTITUTE (MURID AIR BASE), CHAKWAL 1984 AND 1985.

Month	Rainfall (mm)		Temperature °C (Average)			
	1984	1985	1984		1985	
			Maximum	Minimum	Maximum	Minimum
July	158.4	61.7	33.2	23.2	36.4	24.1
August	128.9	38.7	35.1	22.8	35.0	25.3
September	61.7	13.8	33.6	18.5	35.1	23.1
October	01.0	17.2	30.6	10.0	30.6	13.2
November	11.5	01.0	24.3	06.8	26.0	07.1

short-statured cultivars. Excessive vegetative growth could result in lodging, delayed maturity and loss in yield as reported by Rana and Yousaf [5]. The relationship between height and seed yield can be described by an equation.

$$Y = 937.991 - 6.252 X \quad r = -0.85$$

where Y = seed yield; X = Plant height.

This relationship showed that short statured cultivars were high yielding compared to tall statured cultivars. These results are in agreement with those of [8].

Harvest index. The cultivars also differed significantly in harvest index (Table 4). The highest harvest index (53%) was achieved by Loppa and the least (15%) by Improved Pelican. These results agree with those of Nichiforovich [9], who reported that cultivars having high harvest index, were more efficient in translocating its photosynthate into reproductive growth. The relationship between harvest index and seed yield can be described by an equation.

$$Y = 62.189 + X 9.007 X \quad r = 0.997$$

The positive correlation indicated that seed yield increased with increase in harvest index. Similar results have been reported by Gautam and Singh [8].

Days to maturity. The cultivars tested under medium rainfed conditions differed significantly in their maturity time ranging from 85 to 104 days to maturity (Table 4). Loppa took 84 days compared to 104 for Bragg. Qureshi [5] reported that cultivar Bragg took 121-131 days to mature under conditions of rainfed sub-montaneous area of NWFP. This demonstrates that the time taken by different cultivars could be different in different ecological zones due to growth period and environmental factors. Boote [10] conducted field trial on response of soybean cultivars of 0 to VIII maturity group in Southern USA. He observed that soybean cultivars were very much affected by the day length. Cultivars in groups 0 to I were early maturing but low yielding and in groups II to VI, the cultivars were high yielding whereas those in group VII and VIII had prolonged flowering period and thus were very late. Parrini *et. al.* [11] reported that yields of soybean cultivars were affected by the prevailing environmental conditions. Other researchers [4,5] also reported similar results. The relationship between days to maturity and seed yield could be described by an equation.

$$Y = 1402.866 - 10.661 X \quad r = -0.667$$

where Y = seed cotton, X = maturity days.

The correlation between days to maturity and yield indicated that increase in growth period of plants decreased seed yield. These results show that number of days to maturity have high direct effect on the seed yield. This correlation goes in favour of the requirements of existing cropping system of the country in which early-maturing cultivars having high yielding potentials are needed. Similar results have reported

by Gautam and Singh [8].

Conclusion

The present study indicated that soybean cultivars Loppa, Bossier and SBL are most promising and could be cultivated successfully under rainfed conditions of Chakwal.

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