Genetic variability and heritability studies on soybean landraces

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Abstract- Genetic variability is an essential feature for selection among the genotypes for breeding programs. The current study was conducted in 2019 using a Randomized Complete Block Design with two replications to identify genetic variation among soybean landraces. Data were recorded on a set of 38 genotypes for, days to flowering, days to pod initiation, pods plant^{-1}, plant height, primary branches plant^{-1}, days to maturity, 100-seed weight and seed yield plant^{-1}. Significant differences were observed among all the landraces for all the traits. Among the landraces early flowers initiated (44.0 days) for K2uk54, whereas K2p84 was late in flowering (54.5 days). Early pods were initiated (86.5 days) in K2uk61 and late (101.5) was observed for K2w23. Short stature plants (53.1 cm) were observed in K2p20, while K219 were taller ones (91.5 cm). Line K2p28 was recorded minimum number of pods plant^{-1} (31.7), while line K2uk45 had maximum number of pods (67.0). Lines K2p99, K2p28 and K2p84 had minimum primary branches plant^{-1} (5.0), while line K2uk54 had maximum primary branches plant^{-1} (13.0). Line K2uk44 and K2p87 were earliest in maturity (180.5 days), while line K2p75 was late in maturity (196.5 days). Minimum 100-seed weight (6.0 g) was recorded in K2p75, while maximum (12.8 g) was recorded for K2w30. Minimum seed yield plant^{-1} (7.32 g) was observed in K2pa3, while maximum seed yield plant^{-1} (14.52 g) was recorded for K2uk45. Analysis revealed low, moderate and high heritability for the studied traits. High heritability was recorded for days to maturity (86%) and 100-seed weight (65%). Moderate heritability was noted for days to flowering (30%), plant height (34%), pods per plant (46%) and seed yield per plant (45%), while low heritability was recorded for days to pod initiation (29%) and primary branches per plant (13%). The current study revealed that the landraces K2uk45, K2p133 and K2uk154 could be used in future breeding programs to produce high yielding soybean cultivars in Peshawar region.

Index Terms- Genetic variability, Heritability, Genotypes, Landraces, Soybean

I. INTRODUCTION

Soybean (*Glycine* max L.) is an annual legume belongs to family *Fabaceae* grown for edible beans. The diploid chromosomes number of soybean is 40. China has been reported to be the place of origin of soybean (Chang, 1980). In the first century AD, soybean was introduced, and landrace varieties were created in China, India, Korea, and other regions of Asia. Globally, the soy crop is very important economically since it provides millions of people with vegetable protein and is a key component of hundreds of chemical products (Fageria *et al*., 1997). One of the most significant oilseed crops in the world is soybean. It is highly desirable for the diet, comprises 18 to 22 percent oil, and has 40 to 42 percent high-quality protein. As a result, it genuinely holds the distinction of "meat oil that grows on plants" and is the best source of both protein and oil (Chang *et al*., 1980).

A total of 358.77 million metric tonnes of soybeans were produced globally on an area of 125.14 million hectares, with an average yield of 2.87 metric tonnes per hectare (FAS/Office of Global Analysis USDA 24 October 2019). In Pakistan (2016-17) soybean was grown in Swat and Malakand region on an area of 5 hectare with total production of 7 tonnes. In Pakistan, 120 tonnes of soybeans were produced in 2013 on 135 ha of land; with an average yield of 8889 kg/ha (FAO STAT, 2013). In Asia the farmers grown soybean landraces generation after generation for food, feed and for other medicinal purposes.

These landraces are the major source of genetic diversity in soybean germplasm collection. The fundamental steps for crop improvement programs are genetic heterogeneity among the germplasm. Since yield is a complex trait, it is influenced by a variety of yield-contributing polygene-controlled traits as well as by the environment. Variability in the soybean genotypes is due to the sum total of heredity effects of concerned genes and their environmental influence. Heritability and genetic progress are helpful biometrical methods for determining genetic diversity in the genome (Adityaer *et al.,* 2011). The degree to which the characters are passed down from one generation to the next is determined by their heritability. Studies on heritability estimates may also be useful to understand how parents perform in landraces. Heritability helps the plant breeders for effective selection of the desired traits in a short possible time (Patil *et al.,* 2015). Researchers have found that traits compared with lower heritabilities, those with higher heritabilities are more amenable to selection and breeding. The current research was carried out to achieve the following objectives to; (i) Assess genetic variability in different soybean landraces introduced from different areas of Chitral. (ii) Estimate heritability for yield and yield related traits. (iii) Select best performing and high yielding landraces for the local environment of Peshawar. Use of sand culture – A novel approach for boosting the germination of soybean under room temperature.

II. IDENTIFY, RESEARCH AND COLLECT IDEA

The research was carried out at The University of Agriculture, Peshawar, during 2019. A set of 38 genotypes were sown in disposable cups having sand (only) at laboratory on 20th March 2019 and were kept under room temperature for one week. Sand was used as a culture medium to check its effect on the germination of soybean landraces. Soybean seedlings were moved to the screen house after one week and remained there for four to five days so, they could get used to the sunlight. On April 3rd, 2019, after nine days, seedlings were transplanted to the field using a Randomized Complete Block Design with two replications. The seedling were transplanted in a ridges with row length of 2 m, row to row distance were kept 75 cm and with plant to plant distance of 30 cm. Field was well irrigated immediately after transplantation. Data were recorded on five randomly selected plants in each genotype for days to flowering, days to pod initiation, plant height (cm), pods per plant^{-1}, primary branches plant^{-1}, days to maturity, 100-seed weight (g) and seed yield per plant (g).

List of Landraces used in the experiment.

S.No	Landraces	S.No	Landraces
1	K2uk54	20	Kuk53
2	Parachinar	21	K2p74

3	K2w30	22	K2p16
4	K2uk8	23	K2uk62
5	K2p75	24	K2p87
6	K2p53	25	K2p106
7	K2pa3	26	K1uk24
8	K1w9	27	K219
9	K2p99	28	K2p28
10	K2p131	29	K2uk57
11	K2w23	30	K2p12
12	K2uk61	31	K2p100
13	K2uk44	32	wBag02
14	K2p105	33	K2uk60
15	K2p198	34	K2p20
16	K2p67	35	K2p133
17	K2p10	36	Kiuk22
18	K2p84	37	K2uk45
19	Uk53	38	K2p149

III. WRITE DOWN YOUR STUDIES AND FINDINGS

Results and discussion

Days to flowering

Significant differences among the soybean landraces were observed for days to flower initiation (Table 1). Baraskar *et al.* (2014) also found similar results among soybean genotypes for days to flowering. Mean values for days to flower initiation ranged from 44.0 to 54.5 days (Table 2). Line K2uk54 was earlier in flowering (44.0 days), while K2p84 was late in flowering (54.5 days). Moderate broad sense heritability (30%) was observed for flower initiation (Table 3). Jain *et al.* (2018) also noted moderate heritability foe days to flowering among soybean genotypes. Similar finding were also supported by Khan *et al*. (2011) and Dilnesaw *et al.* (2013).

Days to pod initiation

The results showed significant differences among the landraces of soybean for days to pod initiation (Table 1). Mean values for days to pod initiation ranged from 86.50 to 101.5 days (Table 2). Line K2uk61 was earlier in pod initiation (86.50 days), while late pod initiation was observed for K2w23 (101.5 days) (Table 2). Low broad sense heritability (29%) was observed for days to pod initiation (Table 3). These findings were also supported by Khan *et al*. (2011) and Dilnesaw *et al.* (2013).

Plant height (cm)

The analysis revealed significant differences among the soybean landraces for Plant height (Table 1). Neelima *et al*. (2018) also found significant variability among soybean genotypes for plant height. Mean values for plant height ranged from 53.1 to 91.5 cm. Line K2p20 was shortest (53.1 cm), while line K219 was the tallest (91 cm). Moderate broad sense heritability (34.0%) was observed for plant height (Table 3). Jain et al. (2018) also reported moderate heritability among soybean genotypes for plant height. Our results were also in the line of those of Khan *et al*. (2011).

Pods plant^{-1}

The differences among the soybean landraces were highly significant for number of pods plant^{-1} (Table 1). Guleria *et al.* (2019) also justified similar result among soybean genotypes for pods per plant. Mean value for pods plant^{-1} ranged from 31.7 to 67.0 (Table 2). K2p28 recorded minimum number of pods plant^{-1} (31.7), while K2uk45 showed maximum number of pods (67.0) (Table 2). Moderate broad sense heritability value (46%) was observed for number of pods plant^{-1} (Table 3). Our result for moderate heritability was also supported by (Mesfin, 2018). The results were also similar to that of Baraskar *et al*. (2014) and Iqbal *et al.* (2010).

Primary branches plant^{-1}

Analysis of variance showed significant variations among the landraces of soybean for number of primary branches plant^{-1} (Table 1). Similar results for primary branches per plant were also recorded by Neelima *et al.* (2018) among soybean genotypes. Mean values ranged from 5.0 to 13.0. Landraces K2p99, K2p28 and K2p84 showed minimum primary branches plant^{-1} (5.0), while K2uk54 recorded maximum primary branches plant^{-1} (13.0). Low broad sense heritability (13%) was observed for primary branches plant^{-1} (Table 6). Desissa, (2017) also reported low heritability among soybean genotypes for number of branches per plant. These findings were supported by the results of Baraskar *et al*. (2014) and Iqbal *et al*. (2010).

Days to maturity

All the soybean lines differentiated significantly for days to maturity (Table2). Baraskar *et al.* (2014) and Guleria *et al*. (2019) were also found similar results among soybean genotypes for days to maturity. Mean values for maturity ranged from 180.5 to 196.5 days (Table 2). K2uk44 and K2p87 were earliest in maturity (180.5 days), while K2p75 was late in maturity (196.5 days) (Table 2). High broad sense heritably (86%) was observed for days to maturity (Table 3). Gohil *et al*. (2006) also justified high heritability for days to maturity among soybean genotypes. Hakim *et al*. (2014) also reported same results for days to maturity.

100-seed weight (g)

Highly significant differences among the soybean landraces were observed for 100 seed weight (Table 1). Kuswantoro, (2019) also reported similar results among soybean genotypes for 100-seed weight. Mean values for 100-seed weight range from 6.0 to 12.8 g (Table 2). Minimum 100-seed weight (6.0 g) was recorded for K2p75, while maximum (12.8 g) was noted for K2w30 (Table 2). High broad sense heritability (65%) was observed for 100-seed weight (Table 3). Aditya *et al.* (2011) also noted high heritability for 100-seed weight. Khan *et al.* (2011) and Hakim *et al*. (2014) also reported similar results for 100 seed weight.

Seed yield plant^{-1} (g)

The ANOVA showed highly significant differences among the soybean landraces for seed yield plant^{-1} (Table 1). Mesfin, (2018) also found significant diversity among soybean genotypes for seed yield per plant. Mean values for seed yield plant^{-1} ranged from 7.32 to 14.52 g (Table 2). Minimum seed yield plant^{-1} (7.32 g) was observed for K2pa3, while maximum seed yield plant^{-1} (14.52 g) was recorded for K2uk45 (Table 2). Moderate broad sense heritability (45%) was observed for seed yield plant^{-1} (Table 3). Kuswantoro, (2019) also reported moderate heritability for seed yield per plant. These results were also supported by the findings of Baraskar *et al.* (2014) and Iqbal *et al*. (2014).

Table 1. Mean square values and coefficient of variation (CV) for various traits of 38 soybean landraces.

Traits	Genotype	Error	CV (%)
Days to flowering	15.44*	8.23	5.86
Days to pod initiation	43.09*	23.74	5.22
Plant height (cm)	203.92*	99.78	13.41
Pods plant^{-1}	194.12**	71.68	18.08
Primary branches plant^{-1}	6.09*	4.67	27.52
Days to maturity	39.67**	3.01	0.92
100-seed weight (g)	5.69**	1.2	11.53
Seed yield plant^{-1} (g)	8.52**	3.22	16.28

****,* Significant at 1% and 5% levels of probability, respectively**

Table 2. Ranges and mean values for various traits of 38 soybean landraces, evaluated at The University of Agriculture Peshawar during 2019.

Trait	Range	Mean	LSD 5%	Best Genotypes
Days to flowering	44.0-54.5	48.93	5.81	K2uk54, K2p149, K2p20
Days to pods initiation	86.5-101.5	93.42	9.87	K2uk61, K2uk8, K2uk54
Plant height (cm)	53.1-91.5	74.50	20.24	wBag02, K2p20, K2uk45
Pods/plant	31.7-67	46.84	17.16	K2uk45, K2p131, K219
Primary branches/plant	5.0-13.0	7.85	3.96	K2uk54, K2p53, K2w30
Days to maturity	180.5-196.5	189.03	3.52	K2uk44, K2p87, K2p133
100-seed weight (g)	6-12.8	9.50	2.22	K2w30, K2uk54, K2p133
Seeds yield/plant (g)	7.32-14.52	11.04	3.64	K2uk45, K2p133, K2uk54

Table 3. Genetic variance, Environmental variance, Phenotypic variance and Heritability of 38 soybean landraces.

Traits	Vg	Ve	Vp	h^2 (%)
Days to flowering	3.61	8.23	11.83	30
Days to pods initiation	9.675	23.74	33.42	29
Plant height (cm)	52.07	99.78	151.85	34
Pods/plant	61.22	71.68	132.90	46
Primary branches/plant	0.71	4.67	5.38	13
Days to maturity	18.33	3.01	21.34	86
100-seed weight (g)	2.25	1.2	3.44	65
Seeds yield/plant (g)	2.65	3.22	5.87	45

IV. CONCLUSION

Significant variability among the soybean landraces for all the parameters revealed the presence of sufficient diversity among the landraces for improvement. By using the sand as a culture medium the germination of soybean was reduced from 15 days (in clay soil) to two to three days. High heritability was observed for days to maturity and 100-seed weight, while moderate heritability was observed for days to flowering, plant height, number of pods per plant and seed yield per plant and low heritability was recorded for days to pod initiation and primary branches per plant. The current study revealed that the landraces K2uk45, K2p133 and K2uk154 could be used in future breeding programs to produce high yielding soybean cultivars at Peshawar.

APPENDIX

Appendixes, if needed, appear before the acknowledgment.

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