Research Article

Evaluation of Soybean genotypes for yield and other economically important traits under rainfed condition

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Abstract

A study having 14 genotypes of Soybean was conducted during years 2013 and 2014 to select suitable high yielding and early maturing genotypes. The data were recorded for plant height, pods per plant, days to flowering, days to maturity, hundred seed weight, oil content and seed yield (kg/ha). The results revealed significant differences for all the traits studied. The genotype Callend produced the tallest plant (78 cm) during 2013. In year 2014, genotype No. 6 (77 cm) and Aust 94-1 (77 cm) produced the tallest plants with maximum height. Genotype SS-129 produced maximum number of pods per plant during 2013. In 2013 Callend, SS-129 and Lochlon produced flower earlier whereas in 2014 the NARC-2 showed earliest flowering. In 2013, maximum days to maturity were taken by No. 6 and minimum days were taken by NARC-2. In 2014 NARC-2 and HM-8468 proved to be the earliest in maturity among the entries. In 2013 maximum hundred seed weight was recorded in Ajmeri followed by Callend. However, in 2014 highest hundred seed weight was produced by genotype 2429-3130. HM-8468 gave the highest oil content both in 2013 and 2014. The maximum seed yield was recorded in Ajmeri followed by Callend during 2013. In 2014, the highest yield was produced by variety NARC-2 followed by Ajmeri. We recommend wide scale germplasm characterization for selecting parental lines to develop climate smart, disease resistant and high yielding varieties.

Keywords: Genetic diversity; Rainfed; Soybean; Varietal evaluation; Yield components

Introduction

Soybean (*Glycine max* (L.) Merr.) is one of the important oilseed crop and grown all over the world. It contained maximum amount of protein and other important essentials vitamins that play important role in our daily life. It is also an important cash crop for our industry and also used as a biofuels [1]. For

continuous improvement of this crop, it is important to develop new plant species against biotic and abiotic stress resistant lines through efficient genetic diversity methods [2-5]. The genetic variability among different germplasm can be studied though by measuring the differences/similarity among different quantitative traits of Soybean

genotypes [6, 7]. Therefore, genetic diversity study plays a key role to study variability among different germplasm and to select improved genotypes [8-14].

Some researchers have characterized different Soybean genotypes with aim to study agro-morphological based variations. For example Khan *et al.* [15] evaluated full duration cultivars of Soybean for sowing in the orchards and irrigated lands of Malakand. They found that Epps and 76-2109 gave significantly higher yields than that of Bragg (commercial check). Both varieties matured 5-15 days earlier, with better quality seed and good germination percentage. However, it was also observed that plant population directly affected plant height and inversely affected pod number/plant. Khan *et al.* [16] studied grain yield potential of eight mid duration varieties of Soybean. Differences among the average values for days to flowering, days to maturity, plant height, pods/plant, 100-grain weight and grain yield were statistically significant. Days to flowering ranged from a minimum of 31.3 days (Century) to a maximum of 39.0 days (Ajmeri). Maximum days to maturity (100.3) were taken by Ajmeri followed by Malakand-96 with 97.7 days, while the minimum of 84 days were taken by Calland and Century. Tallest plants were produced by variety Malakand-96 (82 cm). Jin *et al.* [17] studied a new sprout-Soybean cultivar, "Wonhwang" at the Honam Agricultural Research Institute (HARI) in 2005. The preliminary, advanced, and regional yield trials for evaluation and selection of Iksan45 were carried. This cultivar has a determinate growth habit with purple flower, grayish brown pubescence, grayish brown hilum, and small seed size (10.0 grams per 100 seeds). The maturity date of Wonhwang is 7 days earlier than that of the check variety, Pungsan. It has good seed quality for Soybean-sprout, and resistance to lodging. The average yield of "Wonhwang" was 2.80MT/ha, which was higher by 4%

than "Pungsannamulkong" at the regional yield trials. Various morph-biochemical methods were tested by other researchers to screen best plant genotypes [18-23]. In present study we have evaluated fourteen diverged elite Soybean genotypes for two year experiments, in order to find out the suitable high yielding and early maturing genotypes. The resulted novel genotypes will be useful for further breeding program of this important plant species.

Materials and methods

The experiment comprised 14 Soybean promising advance lines viz. Callend, SS-129, E-1092, Lochlan, E-1531, No-3702, Amcor, Aust 94-1, TN-81-124, HM-8468, 2429-3130, No-6, NARC-2 and Ajmeri. Experimental material was planted in Randomized Complete Block design with three replications at NARC, Islamabad in year 2013 and 2014. A Plot size of 9.6m² was used. The entries were planted keeping row to row and plant to plant distance of 45 cm and 5 cm, respectively. Seed rate of 100kg /ha was used. Crop was planted during 3rd week of July during both years. All other agronomic practices including ploughing, irrigation, fertilizer, insecticides etc. were performed as recommended. The crop was protected from insect pest and weeds through application of pesticides and mechanical weeding. Crop was harvested, sundried and threshed in the end of November. Agronomic data for plant height, number of plants per plot, number of pods per plant, days to flowering, days to maturity, 100 seed weight, oil content, and seed yield were collected and analyzed. Also, oil content was quantified by Soxhlet apparatus extraction using hexane as extraction solvent (boiling point 68°C) by using method of Arif *et al.* [24]. Seeds were dried at 103±2°C until water content was reduced to 10% (w/w). Three extraction cycles (4+2+2 hrs) were carried out to completely recover oil from seeds. Seeds were carefully grounded after each extraction

cycle and percentage of the collected oil in the seeds was determined gravimetrically and expressed as a weight% relative to initial weight of the raw castor bean seeds. Data was subjected to analysis of variance [25] to assess the effect of genotypes on various parameters studies.

Results and discussion

Plant Height

Plant height recorded on 14 entries revealed significant difference in both years. In 2013, plant height ranged from 30 to 81 cm (Table 1). Maximum plant height was recorded in E.1092 (81 cm) followed by callend, TM81.142, E-1531 and No. 3702 with 78, 77, 73 and 71cm, respectively. Minimum plant height was recorded in NARC-2 (30cm). In year 2014, the Soybean genotypes did not differ significantly from each other (Table 2) for plant height. In the year 2014 the plant height was ranged from 77 to 62cm (Table 2). Maximum Plant height was recorded in Aust 94-1 (77 cm) followed SS-129, NO 3702, HM-8468 with plant height of 76, 76 and 76 respectively. Minimum plant height was recorded in NARC-2(62 cm). Akande *et al.* [19] and Iqbal *et al.* [6] also claimed significant differences among Soybean genotypes for plant height.

Pods per plant

Number of pods per plant has significant role in Soybean yield. In our experiment number of pods per plant was significant in both years (Table 1 & 2). In 2013 maximum number of pods per plant was recorded in Ajmeri (116 pods) followed by SS-129 (111 pods), E.1092, Callend, 2429-3130 and Iochlon with 111, 105, 101, 101, and 95 pods per plant respectively, while minimum Pods per plant were recorded in HM 8468 (55) (Table 1). In 2014 range of number pods per plant was 72 to 119 (Table 2). The genotypes HM-8468 and Ajmeri produced maximum pods (119) followed by TN-81-124 (109) while minimum Pods per plant were recorded in NARC-2 (72). The results of this study also

in line the previous studies Khan *et al.* [16] and Burli *et al.* [26]. In these studies they also observed significant variations among Soybean genotypes for number of pods per plant.

Days to flowering

In 2013 (Table 1) the data recorded on days to flowering on 14 entries of Soybean revealed significant difference, the maximum days taken to flowering recorded in TN.81.142 (49 days) followed by No .6, (48days) while minimum days to flowering was taken by Callend (43days). In 2014 effect of genotypes on 50% flowering was also significant. The maximum days taken to flowering recorded in TN-81-124(54 days) followed by E 1092,(51days) and Callend, SS-192(49days) while minimum days taken to flowering recorded in NARC-2(40 days) (Table 2). These results suggests different genetic background among the 65 Soybean lines studied for days to flowering, Veni *et al.* [27] also claimed that the plant genotypes significant role on days to flowering.

Days to maturity

Maturity had also significant role in any crop. However, short duration and high yielding varieties are preferred in all field crops. Days to maturity recorded on 14 entries of Soybean revealed significant difference and ranged from 94 to 103 days in 2013 (Table 1). Maximum days taken to maturity were recorded in three varieties viz. Callend, SS-129, and TN -81. 124 (103 days) followed by No.3702 (102 days) and NARC-2 (101 days). The genotype E-1531 taken minimum days to maturity (94 days) was taken to maturity by. In 2014 maximum days taken to maturity was recorded in No-6(101 days) followed by E-1092 (99 days). Minimum days taken to maturity were recorded in NARC-2 (90 days). Our results are similar to those reported by the findings of Arshad *et al.* [28] and Ashraf *et al.* [29] who observed significant difference among the genotype for days to maturity.

Table 1. Mean values of different parameters of Soybean genotypes during 2013 at NARC

Entry No.	Plant Height (cm)	Plant/ Plot (No.)	Pods/ Plant (No.)	Days to Flowering (Days)	Days to Maturity (Days)	Seed Yield (kg/ha)	100 Seed Weight (g)	Oil Content (%)
Callend	78	124	101	43	103	2249	11.07	18.3
SS-129	65	78	111	44	103	831	9.53	18.4
E-1092	81	136	105	47	103	1161	8.10	17.4
Lochlun	62	95	95	45	97	928	8.57	17.9
E-1531	73	134	72	45	94	2160	11.03	18.9
No.3702	71	103	72	46	102	1015	8.93	16.2
Amcor	61	106	72	46	99	576	7.70	16.8
Aust 94-1	57	87	63	45	98	802	9.57	18.2
TN-81-124	77	106	87	49	103	850	8.33	15.8
HM -8468	50	74	55	44	96	843	9.30	18.9
2429-3130	68	88	101	46	100	1171	10.77	18.1
No-6	62	97	82	48	98	904	9.20	17.6
NARC-2	30	21	77	48	101	262	10.97	18.7
Ajmeri	52	91	80	46	100	2256	11.5	18.0
CV%	6.85	43.43	26.46	5.43	2.50	30.96	7.82	5.97

Table 2. Mean values of different parameters Soybean genotypes during 2014 at NARC

Entry No.	Plant Height (cm)	Plant/ Plot (No.)	Pods/ Plant (No.)	Days to Flowering (Days)	Days of Maturity (Days)	100 Seed Weight (g)	Seed Yield (kg/ha)	Oil Content (%)
Callend	70	144	90	49	95	10.92	2109	17.5
SS-129	76	105	96	47	96	10.89	2493	17.4
E-1092	70	122	78	51	99	8.78	1805	16.4
Lochlun	74	148	93	47	94	11.2	2264	18.7
E-1531	68	107	104	46	97	10.82	2207	12.6
No.3702	76	155	94	46	92	10.96	2289	17.6
Amcor	63	129	106	46	96	10.2	2294	16.7
Aust 94-1	77	160	100	46	95	11.9	2215	18.4
TN-81-124	73	149	109	54	95	9.65	2247	17.1
HM -8468	76	99	119	46	91	11.76	2335	19.8
2429-3130	72	133	104	45	96	13.76	2044	16.9
No-6	77	98	99	44	101	10.84	2106	17.8
NARC-2	62	118	72	40	90	10.47	2591	17.8
Ajmeri	65	145	75	46	96	12.0	2502	18.2
CV%	10.52	63.48	35.74	5.99	46.37	9.71	24.79	7.89

Hundred seed weight

A significant effect of genotypes was observed on hundred seed weight in both the years. In 2013 hundred seed weight was ranged from 7.70 to 11.07g (Table 1).

Maximum hundred seed weight was recorded in Ajmeri (11.5g), followed by Callend , E-15-13, NARC-2 and 2429-3130 with hundred seed weight of 11.07, 11.03, 10.97 and 10.77g respectively. Minimum seed weight

was recorded in Amcor (7.7g). In 2014 the genotype 2429-3130 produced maximum hundred seed weight (13.7g) followed by Ajmeri (12g) and HM-8468 (11.9g) whereas minimum seed weight was recorded in E-1092 (8.7g) (Table 2). Our results are also similar to those of Ashraf *et al.* [29] who found significant effect of genotype on hundred seed weight.

Oil contents

The significant effect of genotype was also observed on oil content in both years. In 2013 the oil content ranged from 15.8 to 18.9% (Table 1). Maximum oil content recorded in HM.8468 and E-15-13 (18.9%) followed by NARC-2 (18.7%) and S-129 (18.4%) whereas minimum oil content was determined in TN-81-124 with oil content of 15.8%. The effect of genotypes on oil content was also significant in 2014. Maximum oil content was recorded in HM.8468 (19.8 %) and minimum oil content was determined in E-1092 (16.1%). The results of this study also in line with previous studies Iqbal *et al.* [6]. In these studies they also observed significant variation among Soybean genotypes for oil content.

Seed yield

Seed yield is the ultimate goal and end product of all field crops. The data recorded on 14 entries of Soybean revealed significant difference for yield in both years. In 2013 the maximum seed yield was recorded in Ajmeri (2256 Kg/ha) followed by Callend (2249 Kg/ha) and E-1531, (2160 Kg/ha). Minimum seed yield was recorded in Amcor (576Kg/ha). In 2014, maximum seed yield was recorded in NARC-2 (2591 Kg/ha) followed by Ajmeri (2502 Kg/ha), SS-129 (2493 Kg/ha) and HM-8468 (2335 Kg/ha) (Table 2). These findings are in accordance with those of [6, 15, 16, 19, 30] who found significant differences among cultivars of Soybean.

Conclusions

Estimating genetic diversity among crops is pre-requisite for breeding program. In Pakistan, Soybean crop has negligible production and grown only in marginal fields for domestic consumption. Major hindrance for low adoption of the crop is due to absence of new elite Soybean varieties as traditional Soybean varieties imported in 1980s have low grain yield. Therefore, in the present study Soybean genotypes were evaluated to select high yielding early maturing lines for further utilization in Soybean crop improvement program. It is imperative to localize the crop which is one of the leading import commodities due to demand from poultry and feed industry and local edible oil production. We recommend wide scale germplasm characterization for selecting parental lines to develop climate smart, disease resistant and high yielding varieties. These high yielding and adaptable Soybean varieties will offer new opportunities to small farmers whose land remain non-cultivated after wheat crop in Kharif season.

Authors' contributions

Conceived and designed the experiments: D Baig, M Arshad & N Nawaz, Performed the experiments: D Baig, MA Khan & N Nawaz, Contributed to reagents/ materials/ analysis tools: SA Jan, H Khurshid & D Baig, Analyzed the data and wrote the manuscript: SA Jan & H Khurshid.

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