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Adaptation Assessment of Introduced Soybean Varieties in Kabul Climatic Conditions

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Abstract: ***Seven soybean varieties evaluated for adaptation in Kabul climatic conditions in research farm of agriculture faculty, Kabul University. The soil of this research farm has silty loam texture with pH of 8.01 and EC of 0.17. The NPK levels of this soil are 8.3, 9.3 and 68.2 %, respectively. This research was conducted in Randomized Complete Block Design (RCBD) with three replications. The size of each plot was 6 m^2, the space between each rows and plants was considered 40 cm and 20 cm, respectively. Germination percentage, days to flowering, days to maturity, plant height, number of pods per plant, number of seeds per pod, yield per unit area and morphological characters were targeted to measure. The concentration of leaf nitrogen was also measured using SPAD made in Japan and the result was significant. The highest yield performed in LD 11-2170 variety (2156.11 kg ha^{-1}) but the lowest yield recognized in Kanpong 5 variety (1270 kg ha^{-1}). The result of ANOVA was also significant. LSD was applied to compare varieties and LD 11-2170 and Daewon 3 were different from the others. The objective of this research was also yield performance. Based on the cluster, varieties classified into two main groups.***

Keywords: SPAD, Variety, Soybean, Adaptation, Yield

1. Introduction

The Leguminosae is one of the most important and largest plant families and is composed of about 750 genera containing 16,000–19,000 species distributed worldwide. Leguminosae has major impacts on agriculture, environment, animal/human nutrition, and health. Soybean [Glycine max L.),is one of the world's most important and miraculous pulse crops. It accounts for 29.7% of the world's processed vegetable oil and is rich in dietary protein both for human food and animal feed [9] Soybean is grown on 104 million hectares of land on five continents with annual total production of 241 million tons and productivity of 2.0 ton ha^{-1}[8].

Introduction of new cultivars with a high yields is one of the fast ways for plant breeding. Soybean is the most important commercial species among the grain legume and oil seed crops. It represents the most important plant source of vegetable oil and protein in the world. For example, 40% of the world's edible vegetable oil comes from soybeans. A group of researcher found soybean accessions to range from 24.3 to 53.80% in protein content with a mean of 40.7% and oil content ranges from 8.2 to 27% oil with a mean of 21.2%[10].Roundup Ready cultivars averaged 3.293 t ha^{-1} and the top cultivar was Deltapine DP 5915RR, which yielded 3.965 t ha^{-1} [14], [15]. [19]. Above normal precipitation continued across the state for most of July, August, and September. Above average environmental growing conditions for most of 2018 led to a projected statewide average soybean yield of 49 Bu A^{-1} to 2.6 t ha^{-1}[18]. The large amount of seed yield 84 Bu A^{-1} equal to 4.7 t $ha^{-1}$and the lowest seed yield 67 Bu A^{-1} equal to 3.64 t ha^{-1} as well as The longest plan height 41 inches equal to 104.1 cm and the shortest 31 inches equal to 78.8 cm reported [7].Soybea variety PSC-60 showed best performance as it gave significantly higher seed yield 0.6973 t ha-1as well as plant height 27.43 cm [1]. The newly recommended improved verities of soybean have a wide range of maturity and divers morphology[17], [2].Grain yield in soybean is influenced by environmental factors in growing conditions during the grain filling period [16]. Plant height, number of leaves per plant, number of pods per plant and seeds per podto be the most important plant traits contributing to improved economic yield in soybean crop and hence suggested that these traits should be given more importance while selecting superior soybean genotypes[3].100 seed weight and harvest index had a direct effect on final seed yield of soybean [5]. Planting date has also played role on yield of soybean [4].In a six-state study (North Dakota, Iowa, Minnesota, Wisconsin, Michigan, and Pennsylvania) of organic grain production, the no-till treatment (cover crops roll-crimped ahead of corn and soybean) enhanced microbial biomass, PMN, POM, extractable K, and macro-aggregation compared to tilled organic grain production, with each parameter statistically significant at one or more [6].The objective of this research was to compare the yield and yield components of different soybean varieties.

2. Material and Methods

2.1 Materials

New introduced soybean verities such as LD10-10198, LD11-2170, LD11-7311,) Mangpong5, Kangpongla, Daewon3, Stine – 1, obtained from Nutrition Educational International.

2.2 Methods

Field trials were conducted at Kabul University- Agriculture Faculty's research farm(34 `N 69`E). The soil physical and chemical properties were also tested (Table1). Experiments were arranged in a randomized complete block design with three replications. The area for each plot was 6 m^2 (3 X 2), the space between each row and plants considered 40 cm and 20 cm, respectively.

Seeds of the mentioned varietieswere planted directly to the soil. DAP as fertilize was applied during cultivation and Urea was used three times (during cultivation, vegetative stage and flowering stage). The seeds were also inoculated by Brady rhizobia.Data sheet were constructed to record the data.

Vernier clipper instrument was used to measure the length of pod and seed. SPAD (Soil Plant Analysis Development) Mad in Japan were used to measure the amount of N and chlorophyll in the leaves.

Statistical Tool for Agricultural Research (STAR), Version 2.0.1, January 2014 was used to analyse the data.

Table 1: Soil Composition a Kabul University- Agriculture Faculty's research farm

Elements description											
Year	N	P	K	Ca	S	Mg	Mo	Texture	pH	EC	Bulk density
2016	8.3	9.3	68.2	14.1	6.4	10.1	0.6	Silty Loam	8.01	0.17	0.7

3. Results and Discussion

Yield and Yield Components Analysis

Based on the results, Manpong 5 variety performed longer pod (47.50 mm) than the others and the shortest pod was from LD 11-2170 variety (39.29 mm). This length had correlation with 100 grain weight but did not have coincidence with the other yield components. Analysis of variance (ANOVA) showed a significant difference among varieties (Tab 1).

Stine-1, LD 10-10198 and LD 11-7311 exhibited more number of seeds per pod (3.00) and the lowest number recorded from Kangpongla and Manpong 5 (2). Based on ANOVA there was not significant difference among varieties in this character (Tab 1).

According to the data, the heaviest 100 seeds weight recorded from manpong 5 and the lightest 100 seeds weight recognized from LD 10-10198. Statistically analysis results showed significant difference among cultivars and least significant different test (LSD) has also been applied to compare varieties. Based on this test, Manpong 5 was different from the others, Daewon 3, Stine-1 and LD 11-2170 was categorized in the same group and LD 10-1019811 and LD 11 7311 came in the same group (Tab 1).

The highest yield was performed in LD 11-2170 (2156.11 kg ha^{-1}) but the lowest yield was recognized in Kanpong 5 variety (1270 kg ha^{-1}). The result of ANOVA performed a significant difference among varieties, LSD was applied to compare verities and LD 11-2170 and Daewon 3 were different from the others in yield performance (Tab 1). We can conclude that LD 11-2170 and Daewon 3 was well adapted in Kabul climatic conditions. Hence, these two varieties are recommendable in Kabul and the same agro-climatic zones as well.

The greatest pods per plant (PPP) detected in variety of LD 10-10198 (106.75) and the smallest number of pod per plant counted in variety of Kangpongla (72.17). The result of ANOVA was also non-significant (Tab 1).

The goal of all researchers and farmers is to plant, certified, adaptable, healthy and high yielding varieties. Therefore, we decided to apply variety trial to 7 introduced varieties in Kabul climatic conditions and through the results of this trial, two adaptable elite varieties were detected in Kabul climatic conditions and we recommend farmers to cultivate these two varieties for getting high yield from their fields. The other importance of this research on soybean varieties is that this crop can be a good replacement or alternative for poppy.

Table 2: Analysis of yield and yield components of soybean varieties

Variety	PL (mm)	SPP	100 GW (g)	GY (kg/ha)	PPP
Daewon3	44.61 b	2.67	13.50 bc	1646.11 b	85.42
Kangpongla	43.10 bc	2.33	14.60 b	1270 c	72.17
Stine-1	42.22 bc	3.00	12.37 cd	1445 bc	88.92
LD 10-10198	39.41 d	3.00	11.93 d	1145.56 c	106.75
LD 11-7311	40.87 cd	3.00	12.07 d	1421.67 bc	83.42
LD 11-2170	39.29 d	2.67	12.83 cd	2156.11 a	83.67
Manpong 5	47.50 a	2.33	16.23 a	1448.33 bc	88.00
Mean	42.43	2.71	13.36	1504.68	86.90
SEM	0.89	0.22	0.42	121.41	13.58
SED	1.25	0.32	0.60	171.69	19.21
F-test	**	NS	**	**	NS
LSD (p= 0.05)	2.73	0.69	1.29	374.09	41.86
C.V	3.62	14.31	5.46	13.98	27.07

Pod Length (PL), Seed per Pod (SPP), 100 Grain Weight (100 GW), grain yield (GY), Pod per Plant (PPP), Means in a column with the same letter are not significantly different *, ** at P< 0.05 and P< 0.001, respectively; NS= Not significant.

Agronomic Traits Analysis

Shifting the seasonal timing of reproduction is a major goal of plant breeding efforts to produce novel varieties that are better adapted to local environments and changing climatic conditions [13]. In this study the flowering time (anthesis) of varieties was also recorded to recognize the exact flowering time of each variety. Based on the result, the shortest days to flowering recorded in Daewon 3 (45) and the longest days to

flowering detected in Stine -1 (69). Analysis of variance result revealed that there is a significant difference in days to flowering among varieties at 1% level (Tab 2). Least significant different test showed that Stine-1, LD 11- 7311 and manpong 5 are the same group, Daewon 3 and LD 11-2170 fell under the similar category, and Kangpongla and LD 10-10198 came to the same group (Tab 2).

The SPAD 502 Plus Chlorophyll Meter instantly measures chlorophyll content or "greenness" of your plants to reduce the risk of yield-limiting deficiencies or costly over fertilization. The SPAD 502 Plus quantifies subtle changes or trends in plant health long before they're visible to the human eye.

Chlorophyll meters are widely used to guide nitrogen (N) management by monitoring leaf N status in agricultural systems, but the effects of environmental factors and leaf characteristics on leaf N estimations are still unclear. In a study, the relationships estimated among SPAD readings, chlorophyll content and leaf N content per leaf area for seven species grown in various environments. There were similar relationships between SPAD readings and chlorophyll content per leaf area for the species groups, but the relationship between chlorophyll content and leaf N content per leaf area, and the relationship between SPAD readings and leaf N content per leaf area varied widely among the species groups [20].

In this research, the SPAD 502 Plus was used to measure chlorophyll contents of soybean varieties. The largest chlorophyll content recorded in LD 11-7311 and the lowest chlorophyll content recorded in Daewon 3 and Kangpongla. The result of ANOVA showed a significant difference among cultivars in chlorophyll content at 1 % level. Based on LSD result, Daewon3 and Kangpongla, LD 10-10198, LD 11-7311 and Manpong 5, and LD 11-2170 categorized in the similar group, respectively (Tab 2).

Brushing reduces plant height, increases stem and petiole strength, improves insect resistance in the greenhouse, tends to improve stress tolerance and enhance stand establishment in the field, and has no effect on crop yield [12]. Focus on plant height for obtaining high yield is very important. In this study, plant height of 7 varieties was recorded and the result showed that LD 10-10198 exhibited the shortest height and Daewon 3 the highest plant height. Analysis of variance (ANOVA) was conducted to find the differences of height among varieties. The result showed that there is a significant difference in plant height among varieties at 1% level (Tab 2). Least Significant Different Test applied to compare varieties and according to this test, Daewon 3, Kangpongla and LD 11-2170 classified in to the same group. Stine -1 and LD 11-7311 and Mangpong 5 fell in the same category. LD 10-10198 with 17. 67 cm height was different from the others (Tab 2). We can conclude that plant height can play an important role in increasing yield and it is one of the causes of lodging in plant. Therefore, finding the varieties with short column can help breeder to reduce the plant height.

Branching has also role in increasing of yield, especially in pulse crops. Branching of soybean varieties under study was counted, the largest branching (6.42) branches detected in Kangpongla and the lowest branching (4.92) branches recognized in LD 11-7311. The result of ANOVA was non-significant, it meant that there is no differences in branching of soybean varieties (Tab 2)

Table 3: Analysis of agronomic traits of soybean varieties

Vareity	DTF	SPAD	PHT (cm)	BPP
Daewon3	45 d	33.33 d	89 a	6.25
Kangpongla	63.67 c	33.43 d	85 ab	6.42
Stine - 1	69 a	38.43 b	58.33 c	6.33
LD 10-10198	65 bc	40.67 a	17.67 d	5.92
LD 11-7311	66.67 ab	41.10 a	65 bc	4.92
LD 11-2170	47 d	36 c	79.67 ab	6.17
Manpong 5	67.67 ab	40.37 ab	58.33 c	5.50
Mean	60.57	37.62	64.71	5.93
SEM	0.95	0.63	6.57	0.54
SED	1.35	0.89	9.29	0.76
F-test	**	**	**	NS
LSD (p= 0.05)	2.93	1.94	20.24	1.66
C.V	2.72	2.90	17.58	15.75

Pod Lenght (PL),Seed Per Pod(SPP),100 Grain Weight (100 GW) , grain yield (GY),Days to Flowering (DTF),SPAD and plant height (PHT),Pod per Plant (PPP),Branch Per plant (BPP) ,Means in a column with the same letter are not significantly different *, ** at P< 0.05 and P< 0.001, respectively ;NS= Not significant.

Unweighted pair-group average Euclidean distance was conducted to find genetic relationship of soybean varieties. Based on the tree diagram, soybean varieties classified into two main groups, group one was consisted of LD 11-2170, LD 11-73 and LD 10-10198 and group two was consisted of Cangpongla, Stine-1, Mangpong 5 and Daewon 3. Group-I divided into two sub-groups, sub-group-I consisted of LD 11-2170 and LD 11-73 and sub-group-II consisted of LD 10-10198. Group-II divided into three Sub-groups such as sub-group-I-II, which consisted of Cangpongla, sub-group-II-II that was consisted of Stine-1 and Mangpong 5 and finally sub-group II-III, which was consisted of Daewon 3 (Fig 1).

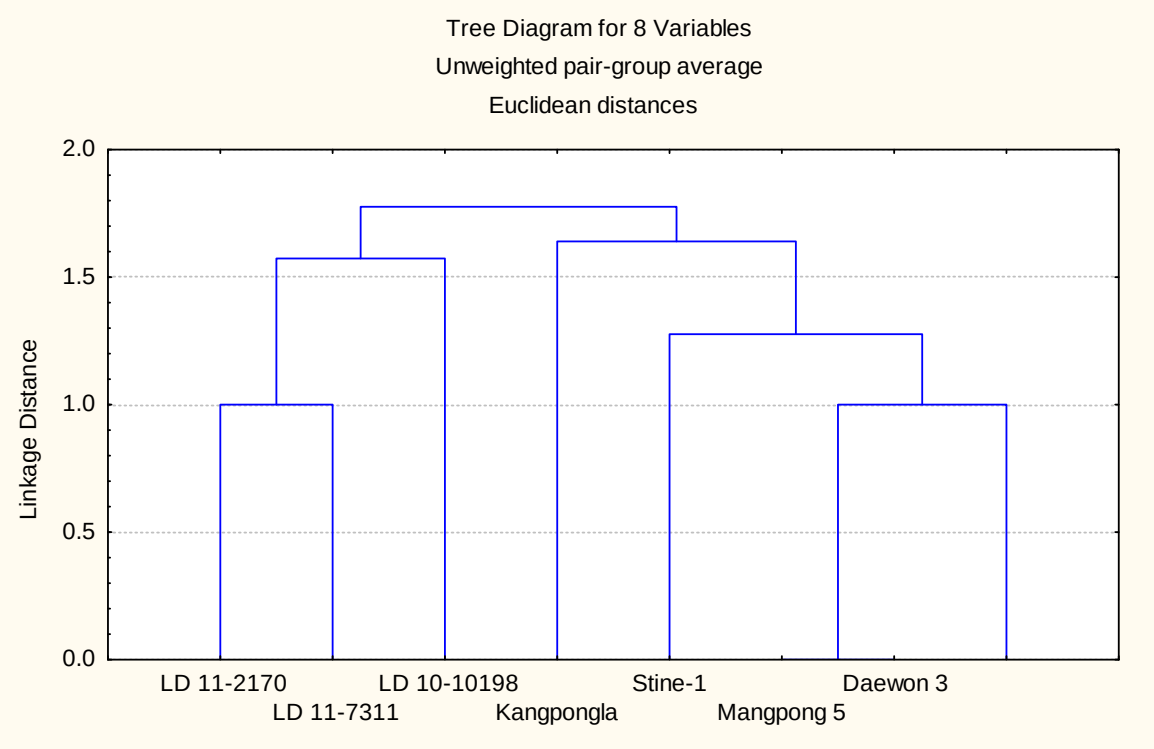

Figure 1: Tree diagram of soybean varieties for genetic relationships

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Author Profile

Prof. Dr. Wakil Ahmad Sarhadis/o Hi Mohammad was born in Andarab district of Baghlan province in 1347. He completed Qasan-e- Andarab elementary school and received his baccalaureate from Agriculture High School in Baghlan province. After passing the entrance exam, and due to high interest and enthusiasm in agriculture field, he got admission to agriculture faculty of Kabul University. After the completion of four-year study and receiving BSc degree in excellent grade, he has been accepted as an assistant professor in the Department of Agronomy of Agriculture Faculty at Kabul University. In addition, he was farm research manager in the research farm of Agriculture Faculty from 1372 to 1376. He was selected as the head of agronomy department in an open selection in 1382. For further education up to Master and PhD degrees, he went to Japan and successfully completed the mentioned programs in 1387. He returned to his home country after obtaining of Master and PhD degrees and continued the sacred profession of being a professor at Kabul University. Prof. Dr. Sarhadi has membership of Society of Plant Breeding Science, Society of Agronomists, and Crop Science Society. Prof. Dr. Sarhadi has more than 50 scientific publications in national and international languages in national and international journals. He has been appointed as the dean of Agriculture Faculty in 1392. Currently, he is the dean of the faculty and an active professor of agronomy department in Agriculture Faculty of Kabul University. Prof. Dr. Sarhadi speaks in five different languages Dari, Pashto, English, Japanese, and Arabic