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Evaluation of Improved Soybean Varieties *(Glycine max)* Under Rain Fed Condition for Traits of Yield and Yield component at Ari Zone, South Ethiopia

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Abstract

The soybean crop as one of the valuable economically the most important oil and pulse crop. Ethiopia having this importance, the grain yield of the crop is limited and low because of improved varity and promotion of highyielder varieties of soybeans. Evaluating the recently released varieties for their good yield potential and recommending them to the study area is the major important for increasing the yield production and productivity of soybeans crop in Ari Zone, Debube Ari District . The trial was done in Ari Zone at Jinka Agricultural Research Center research station for two consecutive years from 2022 to 2023. The experiment was inaiated for the objective of identify high yielder soybean varieties and recommend for the target area .Twelve (12) recently released varieties were evaluated using appropriate application of arandomized complete block design (RCBD) on (3) three replications. The major important research data were collected from the four centeral rows on: - crop plant height, pod number per plant, number of seed number per pod, yield, weight of and hundred seed and analyzed using the SAS software program. The research experiment results show that, amoung the tested varieties , the hight yield were obtained for varieties Gazelle (2963.8kg ha),Gishama (2853.6 kg/ha), and Pawe-2 (2652.9 kg/ ha) (Table-4). While Hawassa-95 (1331.4 kg/ha) had a minimum grain yield (Table -4). Therefore from the research result, it was concluded that, Gazeale, Gishama, and Pawe-2 varieties were well performed and adapted varieties and could be recommended for the growers in the area of Ari Zone and other similar agroecologies.

Keywords: *Grain yield, evaluation, parameters, soybean varieties*

INTRODUCTION

The soybean crop as one of the valuable economically the most important oil and pulse crop Ethiopia and in the world due to its lot of different purpose advantages as a source of livestock, aquaculture feed, protein, oil for the human diet, and biofuel besides producing grain yield [1]). The soyabean crop has the character of a primary low-cost source of protein for animal feed and most pre packaged meals, soy-vegetable oil is another valuable product of the processing.Soybeans can produce at least twice as much protein per acre than many other major vegetable or grain crops [2]. Soybean is the most important crops as a source of protein (40%),35% carbohydrate, and 5% ash on a dry matter basis. Most developing countries are faced with extensive malnutrition and food insecurity, high oil content (20%), the best ingredient for industrial food complexes, and It also has a superior amino acid profile compared to other legumes [3]. Soybean crop is well known as to in improving and amending soil properties through nitrogen fixation and enhanced moisture retention [4]. In Ethiopia food processing plc company has imported and used soybeans to prepare balanced food for infants and adults[5] knowdays the factory has been trying to improve the food values of other food types by mixing them with soybean flour, which indicates the importance of soybeans and its increment on the market[6].Soybean in Ethiopia, are cultivated over wider agroecologies that have moderate annual rainfall (500-1500mm [7] and the crop grows well in between 1300 and 1800 m.a.s.l. and it requires temperature ranging from 23- 25oC and medium relative humidity for optimum yield production[8] ,[9] and grows best on well-drained loamy soils that are high in fertility. The crop does well in slightly acidic to neutral soils having a pH of about 5.7 to 6.2. The crop is a short-day plant and most varieties require about 12 hours of light, although some are less sensitive [10]. The crop production and productivity in Sub-Saharan Africa counter results increasing trends in the past ten years ago and are expected to increase in the later [11]. In our countery Ethiopia, soyabean crop has a total land coverage of 36,635.79 ha and 812,346.59 quintals of production in yield , and 22.17 quintals per hectare of production. In SNNPR a total of 209.28 ha of land was covered, 2,684.09 quintals of production, and 12.83 quintals per hectare of production were recorded [12]. Know days soybean crop is important and supported by government and non governmental organizations. At regional level, the yield of soyabean was limited in production than the average potential yield (12.83 quintals per hectare) under optimium crop management practice . [12]. In the South Ethiopia and Central Ethiopia Regionis, the yield was limited because of none adaptation and promotion of relased varieties, lack of crop management rainful distribution problem soil fertility problem , different diseases and insect pests [13]. Know days approximately 34 soybean varieties have been registerd for production by different national and regional research centers in Ethiopian [14].

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However, improved soyabean evaluation and its performance was not done and recommended in the past in the Ari Zone . Soybean is potential crop in production in the area of South Ethiopia and Ari Zone araeas. Therefore the experiment was done to evaluating the performance of recentely released varieties that have high yielder and recommend for production and productivity in Ari Zone of South Ethiopia and other similar areas .

MATERIALS AND METHODS

Reseach Area Description

The research trial was conducted at the Jinka Agricultural Research Center, located in Ari Zone, during the 2021/22 and 2022/23 main cropping seasons. Ari Zone is situated in the southern part of Ethiopia, with its administrative center, Jinka city, located approximately 729 km south of Addis Ababa. The geographical coordinates of Jinka are 36°33'–37°67"E and 5°46'–6°57"N, at an altitude of 1,450 meters above sea level (m.a.s.l.).

The study area receives an average annual rainfall of 1,307.3 mm, distributed over two distinct seasons, and experiences average temperatures ranging from 21.0°C to 28.0°C. The soil at the experimental site is classified as sandy loam with a pH of 6.41, making it suitable for various agricultural practices [15].

Treatments and Experimental Procedures

Twelve (12) improved soybean varieties such as:- Nyala, Hawasa -95, Hawasa-04, Clark 63K, Melko bonsa, Gishama, Gazelle, Nova, Pawe-3, Afgat, Pawe-2, Coker-240 were evaluated in appropriate mothod of randomized complete block design (RCBD) on (3) three replications. The trial had aplot area of 4m x 5m (20 m^2) separated by a distance of 1meter between plots within a block and 1.5 meter between blocks within the experiment. 40 centimeter between rows and 10 centimeter between plants was maintained in spacing and a seed rate of 60-70 kg/ ha was used according to the seed size of the crop. Cultivation, leveling, weeding, and other agronomic activities were applied equally to all the entry treatments at their proper time of application.

Data Collection and Data Analysis

Data collection was performed on both a plant and plot basis. Grain yield and hundred seed weight were recorded at the plot level, while key plant-based data were collected from selected plants within the middle rows of each plot. For parameters such as plant height, the number of pods per plant, and the number of seeds per pod, the average values of five randomly selected plants per experimental plot were used for statistical analysis.

Grain yield data were measured from the five central rows of each plot and subsequently converted to a per-hectare basis. Hundred seed weights were determined by randomly selecting 100 seeds harvested from the five central rows of each plot and weighing them using a sensitive balance.

For data analysis, the collected data were subjected to analysis of variance (ANOVA) using SAS software after verifying the assumptions of ANOVA. Treatment means were separated using the least significant difference (LSD) test at a 5% probability level.

RESULT AND DISCUSSIONS

Results of Analysis of Variance

Combined analysis of variance was done to identify the effects of varieties, year, and their interaction (year * varieties).

Combined analysis of variance is presented in table 3. The combine mean square due to varieties shows significant ($P < 0.05$) differences for all of the studied parametrs except the number of pods per plant which was a non-significant difference ($P > 0.05$). The mean squares due to years' results show significant differences ($P < 0.05$) for plant height, grain yield, and hundred seed weight while non-significant differences for pod number per plant and number of seeds per plant. The result of interactions (year* varieties) shows non-significant differences for all of the traits except plant height.

The combined Result Data For the Two-Year

Plant height: In this current study, the result of combined analysis of variance as shown in table 3, shows the main effects of varieties and year, as well as their interactions had significant effect ($P<0.05$) on plant height. The longest combined plant height (74.1 cm) was recorded to variety Gishama followed by variety pawe-3 (57.36cm), while the shortest (31.53cm) plant height was recorded to variety Clark 63K (Table 4). This variation shows the differences in environment factories , climatic conditions, genetic makeup of the varieties and other factors. This result is in line with [16] who recorded height of plant showed that, significantly difference among the evaluated varieties. Similarly [13] experimented with soybean variety evaluation and he observed a significant difference in plant height of different varieties of soybean.

Pod numbers per plant: The results of analysis of variance indicates that, the main effects of varieties , year and their interaction had no effects on the pod numbers per plant ($P>0.05$). From the result, the maximum pods per plant (58) was collected to pawe 3 ,while minimum pods number per plant (28.40) was recorded to variety Hawsa-04 (Table 3). The difference in the pod numbers per plant might be because the pod numbers per plant is regulated by the varieties of soybeans. This current result was similar to the research finding of [13], who reported that there was a significant difference in numbers per plant among different soybean varieties.

Seed numbers per pod: The result of analysis of variance indicaties , the main effects of varieties were significant effects on the seeds numbers per pod but effects of years were no effects on seed numbers per pod. The interaction of varieties and year effect shows none significant effects on seeds numbers per pod ($P>0.05$). Maximum seed numbers per pod (3) is recorded to Gishama variety and the other varieties have statically similar values (Table 4).

Yield (kg/ ha): The main effect of variety and year had significant effect ($P<0.05$) and their interactions had none effects on yield. From the result, the maximum yield results (2963.8kg/ ha), (2853.6kg/ ha), and (2652.9kg/ ha) were recorded for varieties, Gazele, Gishama, and Pawe-2 respectively and the minimum yield result (1331.4 kg/ ha) was recorded to Hawassa-95. The current research finding is similar to the finding of [13], who observed and reported a significant difference among soybean varieties based on their yield potentials. Similarly, [17] studied one evaluation of soybean varieties and reported that, there was resulted as a significant difference in grain yield in soybean varieties based on performance. Hundred seed weight.The combined analysis of variance of the current study shows. the main effects of variety and year had significant effect ($P<0.05$) while their interactions

had none significant effects on grain yield. The maximum wight of hundred seed yield (20 g) was recorded for the variety Gazelle and the minimum hundred weight of seedt yield (12 g) was recorded for the variety Nova.

Table 1. The Mean values of Yield and Yield Related Traits of Soybean Varieties in 2022

Treatements	PH (cm)	NPPP	NSPP	YD(kg/ha)	HSW (g)
Neyala	42.80^{efg}	50.06^{abc}	2.86^{ab}	2208.3^{abcd}	19.00^{abc}
Hawsa-95	43.53^{defg}	35.40^{abc}	2.60^{b}	1115.7^{d}	14.83^{def}
Hawsa-04	53.53^{cde}	28.40^{c}	2.86^{ab}	2939.8^{abc}	13.54^{def}
Clark63K	34.06^{g}	44.93^{abc}	2.60^{b}	1685.2^{cd}	15.66^{bcdef}
Melkobonsa	50.13^{cdef}	30.00^{c}	2.86^{ab}	2384.3^{abcd}	17.66^{abcd}
Gishama	81.53^{a}	37.73^{abc}	3.0^{a}	3129.6^{ab}	16.00^{bcde}
Gazelle	55.00^{cd}	34.66^{abc}	2.73^{ab}	3291.7^{a}	20.50^{a}
Nova	38.46^{fg}	46.80^{abc}	2.86^{ab}	1841.7^{bcd}	12.50^{f}
Pawe-3	44.06^{b}	58.00^{a}	2.80^{ab}	2078.7^{abcd}	13.00^{ef}
Afgat	52.13^{d}	56.13^{ab}	2.73^{ab}	3111.1^{ab}	19.33^{ab}
Pawe-2	58.53^{bc}	32.33^{bc}	2.93^{ab}	3203.7^{a}	15.33^{cdef}
Coker-240	53.06^{cde}	36.13^{abc}	2.66^{ab}	2449.1^{abcd}	18.16^{abcd}
LSD(0.05	11.68	25.10	0.37	1341.2	3.83
CV (%)	13.62	8.63	8.08	32.78	13.74

N.B e: mean values having the same letters within the columns are not significantly different at p<0.05., PH=plant height , NPPP= number of pod per plant, NSPP= number of seed per pod, YD=Grain yield, HSW, and wight of hundred seeds

Table2. The Mean values of Yield and Yield Related Traits of Soybean Varieties in 2023

Treatements	PH (cm)	NPPP	NSPP	YD (kg/ha)	HSW (g)
Neyala	29.10^{e}	60.80^{a}	2.80^{ab}	1111.3^{g}	20.56^{a}
Hawsa-95	29.26^{e}	49.86^{bc}	2.66^{bc}	1380.3^{fg}	16.40^{e}
Hawsa-04	52.53^{b}	53.60^{b}	2.93^{ab}	2222.0^{bc}	20.50^{a}
Clark63	29.33^{e}	48.80^{bcd}	2.86^{ab}	1830.3^{de}	18.00^{cd}
Melkobonsa	52.73^{b}	65.60^{a}	2.86^{ab}	2238.7^{bc}	20.66^{a}
Gishama	66.66^{a}	45.80^{cde}	3.0^{a}	2577.7^{a}	16.83^{de}
Gazelle	39.00^{d}	39.93^{ef}	2.46^{c}	2636.0^{a}	20.66^{a}
Nova	38.46^{d}	46.80^{bcde}	2.86^{ab}	1775.0^{de}	12.00^{g}
Pawe-3	44.06^{C}	42.40^{def}	2.80^{ab}	2194.7^{c}	13.83^{f}
Afgat	37.66^{d}	49.33^{bcd}	2.93^{ab}	2083.7^{bc}	16.33^{e}
Pawe-2	46.40^{c}	35.33^{f}	2.80^{ab}	2519.7^{ab}	19.66^{ab}
Coker-240	37.40^{d}	47.13^{bcd}	2.66^{bc}	1564.0^{ef}	19.00^{bc}
LSD(0.05	4.05	7.09	0.28	310.99	1.42
CV (%)	5.95	8.63	5.73	9.65	4.75

Note: Mean values having the same letters within the columns are not significantly different at p<0.05., PH=plant height, NPPP= number of pod per plant, NSPP= number of seed per pod, YD= yield, HSW and weight of hundred seeds

Table 3 . Mean square values values of Yield and Yield Related Traits of Soybean Varieties in over the two year during 2022 and 2023

SV	DF	PH	NPPP	NSPP	YD	HSW
Rep	2	218.67ns	10.56ns	0.035ns	952266ns	23.6318ns
Varieties	11	810.44 *	214.44ns	0.084*	1439676*	39.7959*
Year	1	2211.13*	914.49ns	0.0022ns	2175930*	25.56*
Var*Year	11	96.22*	338.84ns	0.028ns	409210ns	5.6903ns
Mean square of Errors (MES)						
Year -1	-	7.588	19.749	0.0489	327396	5.1319
Year -2	-	5.747	17.546	0.02778	233731	2.7114
F= max	-	1.320	1.1255	1.760	1.400	1.892

Note: SV =source of variation, DF =degree of freedom, PH=plant height, NPPP=number of pod per plant, NSPP= number of seed per pod , YD= grain yield, HSW and wight of hundred seeds

Table 4. Combined Mean Values of Growth Parameters, Gield Components, and Grain yield of Soybean Varieties in 2022 and 2023

Treatements	PH (cm)	NPPP	NSPP	YD (kg/ha)	HSW (g)
Neyala	35.20^{g}	54.76^{a}	2.83^{abc}	1909.8^{cdef}	19.78^{ab}
Hawsa-95	36.40^{fg}	40.96^{abc}	2.63^{de}	1331.4^{f}	15.61^{cd}
Hawsa-04	53.03^{bc}	41.50^{abc}	2.9^{ab}	2580.9^{abcd}	19.16^{ab}
Clark63K	31.53^{g}	46.20^{abc}	2.86^{ab}	1791.1^{ef}	16.83^{c}
Melkobonsa	51.43^{bcd}	49.46^{abc}	2.86^{abc}	2311.5^{abcd}	19.16^{ab}
Gishama	74.1^{a}	41.76^{abc}	3.0^{a}	2853.6^{ab}	16.41^{c}
Gazelle	47.00^{cd}	37.30^{bc}	2.60^{e}	2963.8^{a}	20.000^{a}
Nova	38.46^{efg}	46.80^{abc}	2.86^{abc}	1841.7def	12.00^{d}
Pawe-3	57.36^{b}	50.20^{ab}	2.80^{ab}	2299.2^{abcde}	13.41^{de}
Afgat	44.40d^{ef}	48.93^{abc}	2.83^{abc}	2643.7^{abc}	17.83^{abc}
Pawe-2	50.80^{bcd}	33.83^{c}	2.86^{abc}	2652.9^{abc}	17.50^{bc}
Coker-240	45.23^{cde}	41.63^{abc}	2.66^{cde}	2173.2^{bcde}	19.58^{ab}
LSD(0.05	8	16.18	0.22	785.05	2.31
CV (%)	14.63	11.33	7.06	19.64	11.55

Note: Means values having the same letters within the columns are not significantly different at p<0.05., PH=plant height,N PPP= number of pod per plant, NSPP= number of seed per pod, YD=Grain yield and HSW= weight of hundred seeds

CONCLUSION AND RECOMMENDATIONS

In this present research study, twelve soybean varieties were evaluated in 2022 and 2023 for two consecutive main cropping years to select high yielder varieties for Ari Zon areas . From the research finding results, the maximum grain yield were (2963.8 kg /ha), (2853.6 kg /ha) and (2652.9 kg /ha) was obtained to the varieties, Gazele, Gishama, and Pawe-2 than the other evaluated and tested varieties. Therefore, these three varieties, Gazele, Gishama, and Pawe-2 recommended for Ari Zone area and areas with similar agroecologies .

CONFLICTS OF INTEREST

No conflicts

availability of data

The data supporting of this research finding are available with in the reseach article and its supplementary materials.

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Fig. 1. performance Staus of the experiment in both year

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