Journal of Agricultural Research Advances
ISSN: 2582-7227

Research Article
Open Access

Evaluation of early and medium maturity released soybean varieties for agronomic performance and adaptation at Meiso District of West Harerghea zone, Eastern Ethiopia

Tariku A, Begna T, Asrat Z and Gojam M
Ethiopian Institutes of Agricultural Research,
Chiro National Sorghum Research and Training center, Chiro, Ethiopia

Corresponding author: abdulfetah02@gmail.com

Received on: 18/03/2023 Accepted on: 19/06/2023 Published on: 23/06/2023

ABSTRACT

Aim: The objective of the study to evaluate improved, adaptable and high yielding soybean variety/ies for West Harerghea Zone and similar agro ecologies.
Materials and Methods: Eleven released soybean varieties were used as a planting material. The experimental design used was RCBD with three replications. Data of varieties for all of the traits were evaluated using statistical analysis.
Results: The statistical analysis showed significant difference at (P <0.01) among the varietiesfor all of the traits. The year by varieties interactions showed significant effect for days to maturity, days to flowering and plant height, while number of pods per plant, seeds per plant, number of hundred seed weight and grain yield had non-significant effect. Mean grain yield ranged from 1.49 t/ha to 2.79 t/ha. The four high yielding varieties were Gozella (2.79 t/ha), Coker-240(2.63t/ha), Nyala(2.36t/ha) and Afgat (2.33t/ha).
Conclusion: It was concluded that the early-maturing varieties are suitable for short rainfall areas and may also suit for double cropping in long rainfall areas. These varieties; Gozella, Coker-240, Nyala and Afgat, are recommended for growers in the study area (Meiso) and its similar agroecology in Western Harerghea zone Ethiopia.

Keywords: Adaptation, Agronomic Performance, Grain yield, Soybean.

How to cite this article: Tariku A, Begna T, Asrat Z and Gojam M (2023). Evaluation of early and medium maturity released soybean varieties for agronomic performance and adaptation at Meiso District of West Harerghea zone, Eastern Ethiopia. J. Agri. Res. Adv., 05(02): 31-35.

Introduction

Soybean (*Glycine max* L., 2n=40) belongs to the genus Glyicine in the family Leguminasae (Bermard and Weiss, 1973). The cultivated soybean is self-fertilized crop and it was derived from China from wild type (Dupare *et al*, 2008). It is a medium-altitude crop and is well adapted to areas located in altitudes ranging from 1300 to 1800masl and receiving rainfall of 900 to 1300mm (Hammer and Haraldson, 1975). It is an important source of edible vegetable oil and protein for both humans and animals; and it improves soil fertility by fixing atmospheric nitrogen (Worku and Astatkie, 2011). It is one of the versatile crops throughout the world.Soybeans represented 59% of the world's vegetable oilseed production (USDA, 2022).

It is a good source of protein content (40%) for most developing countries faced with extensive malnutrition and food insecurity, high oil content (20%), best ingredient for industrial food complexes (Singh *et al*., 2008).

The major producing and supplying countries in the world are Brazil, USA, Argentina and China, accounting for more than 90% of the world production. African producers contribute less than 1% of the world soybeans. South Africa, Nigeria and Zambia are the top soybean producers; While, Ethiopia is the sixth producer on the continent (Cornelius and Goldsmith, 2019).

In Ethiopia, Soybeanis becoming a high potential promising crop identified in the framework of the strategy for the development of agricultural sectors. Soybean is becoming a high potential crop in Ethiopia. Increasing soybean production to meet the required quantities can best be achieved through an increase in yield per

unit area, which can partly be achieved by the cultivation of high-yielding improved varieties.

Even though Western Harerghea zone has potential for soybean production, farmers in the study area had no access for improved soybean varieties. Hence, evaluating the performance of the released soybean varieties has critical advantages and promoting high yielder soybean varieties are a paramount importance. To date more than twenty-seven improved soybean varieties have been released at national and regional levels in Ethiopia for different agro ecology for production by different research center (MOANR, 2017). However, the performance of the released varieties could not find in the past and recommended for the study area. Therefore, the objective of this study was to evaluate improved soya bean varieties that give best yield for the study area and similar agro ecology.

Materials and Methods

Description of the Study Area:

The study was conducted at Chiro National Sorghum Research and Training Center of Meiso Research Station. Meiso is located in Oromia region, west Harerghea zone of Eastern Ethiopia. The Mieso district is located at about 300 km from Addis Ababa and 25 km to the west of Chiro town. The district receives a bimodal rainfall where the short rain season is between March and April, while the main rain season is between July and September. Mixed agriculture is the economic foundation of the population, which is the production of crops and livestock. Geographically, the district is located between 40°9″30.1′ W and 40°56″44′E; and: 9°19″52′N and 8°48″12 N. The mean annual temperature is around 21^{0}C, while average annual rainfall is between 635 and 945 mmwith an altitude of the 1300m above sea level (WHZAO.2016).

Experimental Treatments and Design

A total of 11 released soybean varieties in Ethiopia (Table 1) were evaluated in randomized completed block design with three replications.There were four rows in each plot of 4 m x 2.4 m with a total plot size of 9.6m^2, and the middle two rows were harvested for collection of post-harvest data such as grain yield and 100-seed weight. Planting was done in rows of four meter long and 60 cm wide, and the recommended 5 cm spacing was maintained between plants. The distance between two plots was 1 m, while 1.5 m was maintained between blocks. Three times hand weeding was done to create a weed-free experimental plot till maturity. 100kg DAP fertilizer (46% P_2O_5 and 18% N) were applied during planting.3-4 hand weeding were practiced to control weeds. Harvesting and threshing is made manually.

Data Collection:

Data were collected both at plot and plant basis. Days to flowering, days to maturity and hundred seed weight, disease severity and yield were collected on plot base. Five plants from the central rows were randomly selected for data collection on plant basis and the averages of the five plants in each experimental plot were used for statistical analysis for traits such as plant height, number of pods/plant and number of seeds/plant.

Data Analysis:

The collected data were subjected to analysis of variance using R-Software after testing the ANOVA assumptions and treatment means were separated with the Least Significant Difference (LSD) at 5% probability level.

Table 1. Description of the soybean varieties, maturity type, altitude, year of release and ecology of adaptation soybean varieties used for the study.

No.	Variety	Maturity Type	Altitude (m.a.s.l.)	Year of Release/ Register
1	Coker-240	Medium	700-1700	1981/2
2	Clarck-63k	Medium	100-1700	1981/2
3	Afgat	Medium	1200-1900	2007
4	Gishama	Medium	520-1800	2010
5	Nova	Early	1200-1700	2012
6	Hawassa 04	Medium	NA	2012
7	Nyala	Medium	1200-1800	2014
8	Gozela	Early	800-1700	2015
9	Pawe-01	Medium	520-1800	2015
10	Pawe-0 2	Medium	460-1600	2015
11	Pawe-0 3	Medium		2012

Source: MOANR (2017), NA=Not available

Results and Discussion

Analysis of variance:

The combined analysis of variance for all varieties across the two years for grain yield and yield related traits were presented (Table 2). Results from the analysis of variance for all studied traits demonstrated that differences among mean values for varietiesand growing years were highly significant (P≤0.01). Year by varieties interactions showed significant effect for days to maturity, days to flowering, plant height, number of pods per plantand seeds per plant.

While number of hundred seed weight and grain yield had non-significant effect for year by variety and season affected the response of varieties on some of studied parametres. Year had significant effect only on days to maturity, number of pods per plant, number of seeds per plant and grain yield. However, non-significant effect for year showed on days to flowering, plant height and hundred seed weight. The presence of significant differences among the tested varieties might be due to the existence of dissimilarity in genetic composition among them, for that fact characters may be differ in their genetic properties. The highly significant differences observed among varieties for some of the studied characters revealed the presence of substantial variability among varieties. Similarly, Deresse and Gezahegn (2018) also advocated significant variation among soybean varieties for most of the measured characters.

Mean Performance of soybean varieties for Yield and Yield related traits:

The combined mean values over the two yearsfor all the varieties for grain yield and yield related traits were observed (Table 3). The average grain yield over the year ranged from the lowest of Gishama varieties 1.49 t/ha to the highest of 2.79 t/ha for Gozella varieties. This large portion of variation might be due to the genetic potential of the varieties. The maximum yield was recorded on Gozella, Coker-240, Nyala and AFGAT varieties. However, Pawe - 03 and Gishama varieties had the lowest yield potential through the tested locationovertwo years.Therefore, traits which obtained highest ranges were played important role in the total variability of soybean varieties. Indicating, the scope for selection of these traits for further breeding works. Similar to the current finding, the result wide range of variation for number of pod, grain yield, plant height, number of seed and hundred seed weight was reported by (Abush *et al*., 2017 and Neelima *et al*., 2018; Yechalew *et al.,* 2020).

Days to maturity was ranged from 107.33 to 79.33 with mean value of 94.8 days. The highest days to physiological maturity were recorded in Gishama (107.33) and Pawe-03 (104.33) varieties. While the lowest days to maturity were recorded for the varieties Nova (79.33) and Nyala (84.33). Gishama and Pawe-03 were the late matured with mean value of 68.5 day to flowering. Nyala variety matured 23 and 20 days earlier than Gishama and Pawe - 03 varieties, respectively. The highly significant effect of variety on days to physiological maturity might be due to different maturity group of varieties with early maturing variety Nyala having earliest days to maturity. This result was in agreement with the report of Deresse and Gezahegn (2018) who reported that days to maturity were significantly affected by soybean varieties. Moreover, this finding was in agreement with Yechalew *et al., (*2020) who founded that, days to maturity were significantly affected by soybean varieties.

In this study, out of the total tested released soybean varieties four varieties shows plant height below the mean value (65.59). The tallest plant height was recorded from Pawe-03 (72.5) followed by Pawe-01 (71.33) and Gishama (71.17) variety while the shortest plant height were recorded from variety Clarck-63k (55.67) and Nyala (56.67).The maximum hundred seed weight was recorded from the variety Pawe-02 (15.77g) and Gozella (15.32g), while the minimum from the varieties Pawe - 03 (9.58g) and Nova (8.7g). These findings were in line with Yechalew *et al*. (2020) who reported that plant height significantly difference among soybean genotypes. Similarly, Deresse and Gezahegn (2018) also evaluated soybean varieties resulted a significantly difference at plant height in soybean varieties.

Table 2. Combined analysis of Soya bean varieties at Meiso district tested for two years (2020 & 2021).

Source	Df	DM (days)	DF (days)	NOP	NOS	PH (Cm)	HSW (gm)	Yield(t/ha)
Year	1	9528.0***	120.02ns	104.37*	417.52*	0.015ns	11.626ns	1.36**
Variety	10	549.2***	275.83**	82.57**	330.28**	191.912**	31.748***	1.13***
Year*Variety	10	120.9***	410.28***	41.279ns	165.12ns	254.015***	4.839ns	0.36 ns
MSE	33	8.1	78.09	23.568	94.27	61.157	3.263	0.18

Table 3: Combined mean yield and other parameters of Soybean varieties over two year at Meiso district

Variety name	DM (days)	DF (days)	NOP	NOS	PH (cm)	HSW (gm)	Yield (t/ha)	Rank (by Yield)
Gozela	107.33	73.33	45.6	93.33	64	15.32	2.79	1
Coker-240	96	73.83	38.33	78.67	66.5	14.47	2.63	2
Nyala	84.33	61	44.67	91.33	56.67	15.1	2.36	3
Afgat	88	63.5	35.33	72.67	65.67	12.35	2.33	4
Hawassa-04	86	62.83	37.5	77	68	13.57	2.21	5
Pawe-02	104.83	69.83	38.67	79.33	68.17	15.77	2.09	6
Nova	79.33	61.17	43	88	61.83	8.77	1.85	7
Pawe-01	103.33	69.33	37.17	76.33	71.33	14.88	1.79	8
Clarck-63k	92.17	63.33	34.83	67.67	55.67	13.83	1.64	9
Pawe-03	104	73	38	78	72.5	9.58	1.6	10
Gishama	97.33	82.33	36.33	74.67	71.17	13.08	1.49	11
Min	***79.33***	***61***	***34.83***	***67.67***	***55.67***	***8.77***	***1.49***	
Max	***107.33***	***82.33***	***45.6***	***93.33***	***72.5***	***15.77***	***2.79***	
LSD(5%)	***3.34***	***10.38***	***5.7***	***11.4***	***9.18***	***2.12***	***0.49***	
CV(%)	***3.02***	***12.9***	***12.43***	***12.12***	***11.92***	***13.54***	***20.37***	

Remark: ns= non-significant, *= significant, **= highly significant,***= Very highly significant, Df= Degree of freedom; PH=Plant height (cm); NoP=number of pods/plant; DF=Days to flowering ;DM=Days to Physiological Maturity ;NoS= number of seeds/plant; HSW= Hundred seed weight; t/ha=ton per hectar

The highest mean number of pods per plant (45.6) was recorded for variety Gozella and the lowest was recorded for variety Clark-63k (34.83). The largest number of seed per plant (93.33) for variety Gozellafor variety Gozella, while variety Clark-63k showed the lowest number of seed per plant (67.67) with a mean value of 79.33 (Table 3). Yechalew *et al. (*2020) also corroborated significant difference of pods per plant and number of seed per plant among soybean varieties.

Conclusions

It was concluded that presence of genetic variability is one of the pre-request to perform selection in any breeding program. Form the current investigation, the tested soybean genotypes were found genetically diverse in terms of different morphological traits.

From the combined results of the study made for two year with released varieties, Gozella (2.79 t/ha), Coker-240 (2.63t/ha),Nyala (2.36t/ha) and Afgat (2.33t/ha) were found the four high yielding varieties as well as number of days required to reach physiological maturity is short. The early-maturing varieties are suitable for short rainfall areas, and may also suit for double cropping in long rainfall areas. These varieties are recommended for growers in the study area (Meiso) and its similar agroecology in Western Harerghea zone Ethiopia. Thus, it may augment the productivity of the nation as well as farmers and soybean breeding program in the country may lead the development of early and medium maturing varieties, as a short term strategy.

References

Cornelius M and Goldsmith P (2019). The State of Soybean in Africa: Soybean Yield in Africa, Department of Agricultural and Consumer Economics, University of Illinois at Urbana Champaign. farmdoc daily , 9: 221.

Dupare BU, Billore SD, Joshi OP and Husain SM (2008). Origin, domestication, introduction and success of soybean in India. Asian agri. history, 12(3): 179-195.

Hammer O and Haraldson LG (1975). Introduction of soybean in Ethiopia.pp.1-120.In: Hammer, O.and L.G. Haraldson (eds). Soybean Production, Protection and utilization in Ethiopia, Proceeding of Conference, Oct 14-17, 1975. Addis Ababa, Ethiopia.

Hunde D and Tefera G (2018). Participatory Varietal Selection and Evaluation of twelve Soybeans [Glycine max (L.) Merrill] varieties for Lowland areas of North Western Ethiopia.International Journal of Plant Breeding and Crop Science, 5(2): 403-407.

MOANR (Ministry of Agriculture and Natural Resources) (2017). Plant variety release, protection and seed quality control directorate. Addis Abeba, Ethiopia.

Neelima G, Mehtre SP and Narkhede GW (2018). Genetic Variability, Heritability and Genetic Advance in Soybean. Int. J. Pure App. Biosci., 6: 1011-1017.

Singh P, Kumar R, Sabapathy SN and Bawa AS (2008). Functional and edible uses of soya protein products. Reviews in Food Science and Food Safety, 7: 14–28

Tesfaye A, Githiri M, Derera J and Debele T (2017). Genetic Variability in Soybean (Glycine max L.) for Low Soil Phosphorus Tolerance. Ethiop. J. Agric. Sci., 27(2): 1-15

United States Department of Agriculture (USDA), (2020). Oilseeds: World Markets and Trade, USDA foreign Agricultural Service report.

West Hararghe Zone of Agricultural Office (WHZAO) (2017). West Hararghe Zone Agricultural Office Report of Cultivated and Planted Land in 2016/2017 Crop Year, Unpublished Document, West Hararghe Zone of Agricultural Office (WHZAO), Chiro, Ethiopia, 2017.

Worku M and Astatkie T (2011). Row and plant spacing effects on yield and yield components of soya bean varieties under hot humid tropical environment of Ethiopia. Journal of Agronomy and Crop Science, 197 (1): 67-74

Yechalew S, Masresha Y, Mesfin H and Bahailu A (2020). Performance of Released Soybean Varieties at Jimma, South Western Ethiopia. Journal of Biology, Agriculture and Healthcare, 10(4): 12-15.

****