

Participatory Variety Selection and Promotion of Improved Soybean (*Glycine max* L.) Variety in Northwestern Ethiopia

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Abstract

A participatory variety selection (PVS) approach was used to evaluate the varieties when selecting new soybean varieties. Farmers were requested to state the most important traits when deciding which soybean varieties to adopt. The study aimed to identify a high-yielding variety that fulfills farmers' preferences, creates wider demand, and strengthens linkage among the possible actors in improved soybean varieties. The study was conducted at Jawe, Guangua, and North Achefer locations in the Awi and West Gojam zones during the 2018 and 2019 cropping seasons. Eight improved soybean varieties were considered in the experiment. Farmers identified seven biological attributes as their selection criteria and considered social factors when deciding which variety to grow. High grain yields of 1830 kg.ha⁻¹ and 1680 kg.ha⁻¹ were recorded for varieties "Pawe-02" and "Wegayen," respectively, whereas the lowest grain yield of 1430 kg.ha⁻¹ was recorded for the variety "Ethio-Yugoslavia." "Pawe-02" variety was ranked 1st by farmers' selection in two districts among the eight varieties. The average performance of the "Pawe-02" variety in the pre-scale-up activity was 2580 kg.ha⁻¹ with a yield advantage of 48.87%. Likert-scale analysis indicated that farmers positively perceived the important traits "Pawe-02" against the existing soya bean variety. Therefore, the "Pawe-02" variety should be recommended to farmers on a large scale to benefit them in this study area and similar agroecology.

Keywords: improved soybean varieties, varietal preference analysis

Introduction

Soybean (*Glycine max* L.) production is considered a low-cost quality protein for animal feed. Most (76%) soybean production is used as animal feed, 20% is

consumed as edible oils and human food products, including tofu, soy milk, and tempeh, and 4% is used for industrial purposes, primarily in the form of biodiesel (Ritchie, 2021). Soybean has relatively wide adaptability to many geographies and are industrially very popular due to their oil and protein-rich seeds, which are processed or synthesized for different uses and high productivity per unit area (Tehulie et al., 2021).

Food insecurity and malnutrition are among the urgent challenges developing countries face today (Atif, 2023). The soybean seed contains 41.50% protein and 24.5% oil from "Pawe-01", "Pawe-02", and "Pawe-03" varieties, which determine the economic worth of seeds around the globe (Agegn et al., 2022). The crop is amenable to agronomic as well as genetic improvements and has a high yield potential under good conditions and performs better in different cropping systems. There is a gap in soybean yield in research stations (2000-3600 kg.ha⁻¹) and that of on-farm fields (1200-1900 kg.ha⁻¹) in Ethiopia (Mekonnen et al., 2022). The theoretical limit of soybean productivity was suggested to be 8000 kg.ha⁻¹ based on the energy available in the field. However, soybean production grew to 353 million tons in 2020 from about 231 tons in 2008 from cultivating 126 million hectares of soybeans (FAO, 2020). The major reasons for low productivity are limited varietal stability and narrow genetic bases, insect pests and diseases, limited access to improved varieties, and poor agronomic practices.

According to Begna (2022), participatory variety selection (PVS) is a breeding approach that provides a wide choice of varieties for farmers to evaluate in their environment using their resources for increasing production. This approach assumes that varieties that are better than those currently grown exist, but farmers have not had the opportunity to test or adopt them. This approach brings breeders, social scientists, farmers, and agricultural extension officers

together in a field setting to prioritize and target the important traits. In developing and selecting new varieties, breeders may discard many lines due to traits they consider undesirable, even though these traits may be of interest to farmers. Since farmers are the ultimate beneficiaries of the varieties, it is essential to involve them in evaluating suitable options under their socioeconomic and agroecological conditions, whether at early or advanced stages of the breeding process. Understanding farmers' selection criteria provides valuable information that helps improve focus in developing varieties that meet their preferences, thereby increasing chances of acceptance and adoption.

Generally, any participatory research methodology should consider the importance of gender by including participants who play different roles within households, such as men, women, children, and female heads of households (Lokot et al., 2023). Selection allows farmers to choose the varieties that better suit their needs and conditions.

Even though soybeans have numerous potential uses, their productivity in Ethiopia is far below potential due to the use of low-yielding varieties, poor agronomic practices, the prevalence of insect pests and diseases, and declining soil fertility in northwestern Ethiopia. No studies have been conducted in this area to address these gaps. This study aimed to identify a high-yielding variety that fulfills farmers' preferences, creates wider demand, and strengthens linkage among the possible actors.

Materials and Methods

Description of The Study Area

The study was conducted in the North Achefer district of the West Gojam zone and the Guangua and Jawe districts of the Awi zone of the Amhara region during the 2018 and 2019 cropping seasons. Table 1 describes the districts' geographical coordinates, climate, and soil types.

Experimental Materials and Trial Management

Eight improved soybean varieties (Table 2) were included in the participatory variety selection (PVS) study.

The participatory variety selection was conducted in a mother-baby trial approach, a trial designed to conduct on-farm participatory action research, following the Amhara Regional Agricultural Research Institute's (ARARI's) PVS guideline (Alemayehu

et al., 2021). The mother trial was laid out in three replications in a randomized complete block design (RCBD) and executed at a research or farmer training center site in each district. In contrast, the baby trial was conducted on farmers' farms, and the farmer was considered as a replication. The mother trial was used for biological data collection, while the baby trial was used for farmers' varietal evaluation and selection. Each experimental plot had four rows of 4 m length and 2.4 m width. The gross and harvestable plot sizes were 4 m x 2.4 m (9.6 m²) and 4 m x 1.2 m (4.8 m²). The spacing between rows, plants, plots, and blocks was 60 cm, 5 cm, 1 m, and 1.5 m, respectively. NPS Fertilizer was applied at a rate of 121 kg.ha⁻¹ at the planting time. All agronomic data were taken from the four central rows. Weeding and other agronomic practices were done as required.

Agronomic Data Collection and Analysis

Agronomic data were collected on a plant and plot basis. Data on plant height (cm), number of pods per plant, number of seeds per pod, and hundred seed weight (g) were collected from five randomly selected plants. Data on days to flowering, days to maturity and seed yield were collected on a plot basis. The collected data was subjected to analysis of variance using SAS 9.4 version statistical software (SAS, 2013).

Farmers' Participation in Variety Evaluation and Selection

Farmers' varietal evaluation and selection were done on baby trials. In consultation with kebele development agents, 13 male and nine female representative farmers were invited to participate in various evaluations and selections from each district. Before the actual review and selection session in the field, the participants were oriented about the objective of the PVS and their role during varietal evaluation and selection sessions. They were made to set their varietal selection criteria. The selection criteria were given a 1 to 5 score, where one refers to excellent, two to very good, three to good, four to medium, and five to fairly important in soybean varietal selection. Then, the selection criteria were ranked following De Boef and Thijssen (2007), and the rank of each criterion was considered as the weight of the criterion. The pair-wise ranking method done by individual farmers was compiled into a matrix to give the overall ranking by the participants.

Varietal Preference Analysis

The varietal preference analysis was done by determining the preference value of each variety. To

determine the preference value of each variety, the values of two factors were considered. The first one was the performance score of each variety for each selection criterion using a 1-5 scale (1=excellent, 2=very good, 3=good, 4=fair, 5=poor), and the second one was the rank of each selection criterion considered as the weight of the criterion. Hence, the product of the performance score and weight determined the preference value of the varieties at each selection criterion. The summation of the preference value of each variety at each selection criterion gave the total preference value of each variety. Hence, the rank of acceptability of the varieties was done based on the total preference value of each variety. The lower the total preference value of a given variety, the higher the rank of acceptability.

Pre-Scaling-Up of Selected Improved Soybean Varieties

Following identifying an adaptable and preferred variety, a pre-scaling-up activity was conducted in the study districts during the 2020 main season. Host farmers were selected and supplied with seeds of variety. Because the success of the technology promotion program depends on appropriate prior orientation given to participants on technologies and the stepwise implementation of subsequent activities, training was given to the host farmers, kebele development agents, and district level agricultural office experts on recommended soybean seed production and management package by a team of researchers. A multi-disciplinary team of researchers

Table 1. Description of the study areas

District	Altitude (masl)	Longitude	Latitude	Soil type	Soil pH	Temperature (°C)	Rainfall (mm)
North Achefer	2000	10°35'37"N	36°57'50"E	Red loam	5.20	27	1800
Guangua	2024	10°32'10"N	37°21'28"E	Red loam	5.30	18	1800
Jawe	1200	12°18'59"N	30°85'39"E	Nitisol	5.23	28	1700

Source: Ethiopian Meteorological Station; masl= above sea level.

Table 2. Description of improved soybean varieties in the PVS study in 2018-2019

Variety names	Year of release	Maturity type	Suitable agro-ecology		Productivity (t.ha ⁻¹)	Resistance
			Altitude (masl)	Rainfall (mm)		
"Gizo" (TGX-1885-33F)	2010	Medium	520-1800	700-1000	2.006	Bacterial purple, blight, viral diseases
"AFGAT" (TGX-1892-10F)	2007	Medium	750-1600	700-1000	1.480	Anthraxnose
"Gishama" (PR-143-(26))	2010	Medium	520-1800	700-1000	1.796	Bacterial purple, blight, viral diseases
"ETHIO-YUGOSLAVIA"	2007	Late	520-1900	>1000	1.7-3.5	
"Belesa-95" (PR-149)	2003	Late	520-1900	>1000	1.7-3.0	Bacterial purple blight
"Pawe-01" (PARC-2013-2)	2015	NA	520-1900	>1000	2.440	Soy-mosaic virus, leaf blotch
"Pawe-02" (PARC-2013-3)	2015	NA	460-1900	>1000	2.550	Soy-mosaic virus, leaf blotch (medium)
"Wegayen" (TGX-1998-29F)	2010	late	520-1800	700-1000	1.8-3.6	Bacterial purple, blight, viral diseases

Source: Ethiopian Agriculture Authority (EAA) (2022), NA=not available; m.a.s.l.= meter above sea level; mm = millimeter.

and agricultural experts made regular field visits to observe progress, fix problems, and advise on proper field and crop management practices, from land selection to harvesting. Field days were organized at the physiological maturity stage of the crop to capture the reaction of host farmers and other field day participants on the performance of the improved soybean variety being scaled up. Grain yield ($\text{kg}\cdot\text{ha}^{-1}$) data of the new variety was collected from 15 host farmers' farms, and for comparison purposes, grain yield data of the local cultivar was collected from 6 farms. The grain yield data was analyzed using simple descriptive statistics. Data on farmers' perceptions of the new technology was collected and analyzed using the Likert scale analysis method (Likert, 1932).

Results and Discussion

Agronomic Performances

The analysis of variance for days to flowering, days to maturity, plant height, pods per plant, seed per pod, hundred seed weight, and grain yield showed significant differences among the tested soybean varieties. This study's results agree with the research findings of Deresse and Gezahegn (2018), who evaluated soybean varieties and found significant differences. Varieties "Pawe-02" and "Wegayen" showed higher grain yields across the two districts. Farmers' variety preference ranking was similar to researchers' biological data at two locations (Guangua and Jawe); "Pawe-02" was ranked 1st. However, researchers who were ranked 1st "Wegayen" were ranked 3rd by farmers (North Achefer).

The grain yield ($\text{kg}\cdot\text{ha}^{-1}$) performances of each tested variety in each testing district are indicated in Table 6. Various grain yield performance variations were observed among the tested varieties within and across the test districts. For instance, the grain yield ($\text{kg}\cdot\text{ha}^{-1}$) performance of the varieties ranged from 1060 to 1470, 1300 to 1840, and 1250 to 1870 in North Achefer, Guangua, and Jawe districts, respectively. The grain yield performance variation of the varieties ranged from 1060 (in the North Achefer district) to 1870 (in the Jawe district) (Table 6). Similarly, the overall mean grain yield ($1430\text{-}1830\text{ kg}\cdot\text{ha}^{-1}$) variation was detected from the performance of the varieties. The highest grain yield ($1830\text{ kg}\cdot\text{ha}^{-1}$) was recorded for "Pawe-02" followed by "Wegayen" ($1680\text{ kg}\cdot\text{ha}^{-1}$), while the lowest ($1430\text{ kg}\cdot\text{ha}^{-1}$) was for "ETHIO-YUGOSLAVIA" (Table 6). "Pawe-02" and "ETHIO-YUGOSLAVIA" varieties show significant statistical differences compared to the other tested varieties. Therefore, the possible reason for the observed yield difference might be due to dissimilarity in genetic

composition among them; for that fact, characters may differ in their genetic properties. Moreover, environmental influences might be the cause of their significant differences. Generally, soybean varieties show low seed yield performance during the execution of the experiment due to high rainfall.

Ranking of Farmers' Varietal Preference Criteria

The PVS participant farmers set six varietal selection criteria, including the number of pods (NP), Uniformity (UN), disease resistance (DR), Seed yield (Sy), early maturity (EM), and plant height (PH). Among them, disease resistance, seed yield, early maturity, number of pods, uniformity, and plant height ranked as 1st, 2nd, 3rd, 4th, 5th, and 6th, respectively (Table 7), and the rank of each criterion was considered as weight of the criterion and used in varietal preferences in each district. The criteria for variety selection and ranking of varieties by farmers did not differ across locations and gender groups (Buah et al., 2020).

Farmers' Varietal Preferences

Farmers' variety preferences ranking was made in North Achefer, Guangua, and Jawe Districts as indicated in Tables 8, 9, and 10, respectively. Farmers ranked varietal preference using the varietal selection criteria as shown in Table 7. "Pawe-02" variety was ranked 1st by researchers and farmers (Tables 8 and 10). Among the eight varieties, "Pawe-02" was ranked highest by most farmers, followed by "Gashima," "Gizo," "Pawe-01," "Belesa-95," "Afgate," "Wogayaen," and "Ethio Yigozlava" in that order at Guangua (Table 8). However, varieties ranked differently based on seed yield (Table 6). Also, farmers ranked "Gizo" first, but this variety was ranked 4th by researchers based on its seed yield in the North Achefer District (Table 9).

Pre-Scaling Up of Farmers' Preferred Improved Soybean Variety

One of the major components of participatory variety selection was to scale up the variety/varieties that were most preferred by farmers and show the best biological performance to harvest their advantages. Based on the results of agronomic data and farmers' varietal preference analysis, "Pawe-02" was selected and recommended for pre-scaling up. Accordingly, it was pre-scaled up in the Awi Zone in the Guangua district in 2020. The seed was given to 33 farmers, and a total of 6.25 hectares was covered in a cluster form. A cluster approach has become more successful than a scattered one (Lilja and Ashby, 2001). The cluster approach allows farmers to compete to produce high quantities and better-quality yields by applying

Table 3. Mean grain yield and other agronomic characteristics of soybean varieties at Guangua District (2018)

Soybean varieties	Days to flowering	Days to maturity	Plant height	Pods per plant	Seeds per pod	100-seed weight (g)	Grain yield (kg.ha ⁻¹)
“AFGAT”	45	134	84.7	55.7	2.5	11.7	1630
“Belesa-95”	42	128	72.4	34.1	2.8	10.7	1460
“ETHIO-YUGOSLAVIA”	44	125	77.7	49.1	2.7	11.3	1630
“Gizo”	46	134	87.8	44.1	2.7	10.3	1850
“Gishama”	44	132	73.7	40.7	2.9	11.4	1540
“Pawe-01”	43	123	87.4	37.3	2.9	11.2	1300
“Pawe-02”	42	132	83.3	37.3	2.7	9.6	1840
“Wegayen”	43	129	76.3	44.3	2.9	10.4	1440
Mean	44	130	80.4	42.8	2.8	10.8	1590
CV	5	4	7.9	11.0	8.5	9.1	6.4
LSD	4	8	11.1	8.2	0.4	1.7	180

Notes: CV= Coefficient of variation; LSD= Least significance differences.

Table 4. Combined mean seed yield and other agronomic characteristics of soybean varieties at North Achefer during the 2018 and 2019 main seasons

Soybean varieties	Days to flowering	Days to maturity	Plant height	Pods per plant	Seeds per pod	100-seed weight (g)	Grain yield (kg.ha ⁻¹)
“AFGAT”	53.0	143.0	56.0	30.0	2.5	15.3	1180
“Belesa-95”	51.2	141.8	56.1	53.2	2.5	12.6	1160
“ETHIO-YUGOSLAVIA”	53.5	148.8	56.5	57.2	2.6	13.2	1060
“Gizo”	52.2	143.3	58.5	51.2	2.4	11.9	1230
“Gishama”	53.7	146.7	57.3	53.5	2.7	12.7	1360
“Pawe-01”	52.2	146.2	61.5	42.8	2.5	12.7	1150
“Pawe-02”	53.2	148.3	66.0	57.8	2.6	12.5	1420
“Wegayen”	54.8	151.2	69.2	55.3	2.6	13.6	1470
Mean	52.7	146.2	61.4	53.3	2.6	12.5	1220
CV	5.5	4.0	7.8	11.3	6.9	8.8	13.9
LSD	3.3	6.7	5.6	7.4	0.2	1.3	270

Notes: CV= Coefficient of variation; LSD= Least significance differences.

Table 5. Combined mean seed yield and other agronomic characteristics of soybean varieties at Jawe during the 2018 and 2019 main seasons

Soybean varieties	Days to flowering	Days to maturity	Plant height	Pods per plant	Seeds per pod	100-seed weight (g)	Grain yield (kg.ha ⁻¹)
“AFGAT”	49.0	106.7	62.1	61.3	2.8	13.6	1270
“Belesa-95”	50.7	105.8	71.5	74.6	2.6	13.0	1520
“ETHIO-YUGOSLAVIA”	45.5	97.8	54.4	69.6	2.6	13.7	1390
“Gizo”	51.8	110.3	64.9	63.4	2.6	12.2	1250
“Gishama”	49.0	113.7	69.5	66.1	2.4	13.5	1610
“Pawe-01”	48.0	108.0	66.0	83.0	3.0	14.0	1700
“Pawe-02”	51.0	112.2	68.7	77.5	2.8	13.0	1870
“Wegayen”	47.0	102.7	63.7	88.4	2.6	14.0	1690
Mean	49.0	107.1	65.7	73.0	2.6	13.3	1520
CV	6.1	8.2	12.9	11.3	9.0	9.7	13.3
LSD	3.4	10.1	9.6	10.5	0.7	1.5	240

Notes: CV= Coefficient of variation; LSD= Least significance differences.

the recommended agronomic practices. Moreover, it helps control pests and stimulates them to ask, observe, and adopt the technology. The average grain yield of “Pawe-02” was about 2580 kg.ha⁻¹, about 48.87% over the local cultivar.

Field Day

A field day was organized at the physiological maturity stage of the crop. It was used to address many farmers and other stakeholders to create massive awareness. A total of 169 participants attended the field day, of which 124 were farmers and 37 were other stakeholders. During the events, experiences and knowledge were shared among farmers and other stakeholders. About 150 leaflets were distributed to the participants, which describe the production, agronomic practices, and overall management of improved soybean varieties. Finally, group discussion was conducted to grasp field day participants’ feedback on the strengths and weaknesses of the variety. Accordingly, all field participants acknowledged the host farmers who did the seed production following the seed production guidelines and its performance. All participants agreed and recommended variety (Figure.1) for

further scaling. Male and female participant farmers were especially inspired by the best performance of the variety, which meets their traits of interest. The farmers then agreed with host farmers to have seeds of the varieties for further scaling up in their respective kebeles.

Farmers’ Perception of Important Attributes of “Pawe-02”

The most important attributes of “Pawe-02”, which farmers preferred in the intervention area, were good germination capacity, disease resistance, early maturity, high yield, better number of branches, better number of pods, extended plant height, uniform maturity, and shattering problem (Table 11). Regarding the assessment of farmers’ perception of the soybean variety attributes, an index of a five-point Likert scale, which indicates how well specific attributes meet farmers’ preferences over the other varieties, was used (Likert, 1932). The rating used to measure the respondents’ perception of the technology attributes was 1 to 5: 1 - strongly disagree, 2 = disagree, 3 = undecided, 4= agree, and 5 = strongly agree. In the list of technology attributes, a value of less than three indicates that farmers perceived the attribute

Table 6. Mean values of grain yield (kg.ha⁻¹) across districts in 2018-2019

Varieties	North Achefer	Guangua	Jawe	Mean
“AFGAT”	1180	1630	1270	1450
“Belesa-95”	1160	1460	1520	1540
“ETHIO-YUGOSLAVIA”	1060	1630	1390	1430
“Gizo”	1230	1850	1250	1650
“Gishama”	1360	1540	1610	1500
“Pawe-01”	1150	1300	1700	1520
“Pawe-02”	1420	1840	1870	1830
“Wegayen”	1470	1440	1690	1680
Mean	1220	1590	1520	1570
CV	13.9	6.4	13.3	12.6
LSD	270	180	240	140

Notes: CV= Coefficient variation; LSD= Least significance differences.

Table 7. Farmers’ varietal selection criteria and pair-wise ranking of the criteria

Criteria	Uniformity	Plant height	Number of pods	Early maturity	Disease resistance	Seed yield	Total	Rank
Uniformity	X	UN	NP	EM	DR	Sy	1	5 th
Plant height		X	NP	EM	DR	Sy	0	6 th
Number of pods			X	EM	DR	Sy	2	4 th
Early maturity				X	DR	Sy	3	3 rd
Disease resistance					X	DR	5	1 st
Seed yield						X	4	2 nd

Table 8. The preference value of each soybean variety and final acceptability rank in Guangua district (n= 22)

Variety	Preference value (Score * rank)						Total	Rank
	Disease resistance (1)	Seed yield (2)	Early maturity (3)	Number of pods (4)	Uniformity (5)	Plant height (6)		
"Gizo"	5	8	15	4	30	18	80	3 rd
"Wegayen"	6	14	24	24	40	6	114	7 th
"Belesa-95"	7	10	18	20	25	24	104	5 th
"Powe-02"	1	2	3	4	5	12	27	1 st
"Gishama"	2	4	6	12	10	30	64	2 nd
"AFGAT"	4	12	10	16	35	36	113	6 th
"Powe-01"	3	6	9	28	15	42	103	4 th
"ETHIO-YUGOSLAVIA"	8	16	12	32	20	48	136	8 th

Notes: The number within brackets refers to the rank of the selection criterion.

Table 9. Preference value of each soybean variety and final acceptability rank in North Achefer district (n= 22)

Variety	Preference value (Score * rank)						Total	Rank
	Disease resistance (1)	Seed yield (2)	Early maturity (3)	Number of pods (4)	Uniformity (5)	Plant height (6)		
"Gizo"	12	8	15	8	10	18	61	1 st
"Wegayen"	4	6	12	24	25	30	101	3 rd
"Belesa-95"	7	20	36	20	30	24	137	7 th
"Powe-02"	1	6	9	16	35	36	103	5 th
"Gishama"	5	12	28	18	20	42	125	6 th
"AFGAT"	4	16	24	16	45	48	153	8 th
"Powe-01"	3	8	9	24	15	42	101	3 rd
"ETHIO-YUGOSLAVIA"	8	16	12	16	20	12	84	2 nd

Notes: The number within brackets refers to the rank of the selection criterion.

Table 10. Preference value of each variety and final acceptability rank in Jawe district (n= 22)

Variety	Preference value (Score * rank)						Total	Rank
	Disease resistance (1)	Seed yield (2)	Early maturity (3)	Number of pods (4)	Uniformity (5)	Plant height (6)		
"Gizo"	7	4	9	12	20	18	70	3 rd
"Wegayen"	1	2	9	28	15	42	97	6 th
"Belesa-95"	1	2	9	20	25	42	99	7 th
"Powe-02"	12	8	3	12	5	12	52	1 st
"Gishama"	1	2	3	16	35	48	104	8 th
"AFGAT"	6	8	6	12	10	30	70	3 rd
"Powe-01"	2	4	3	16	35	36	96	5 th
"ETHIO-YUGOSLAVIA"	10	2	12	12	10	6	52	1 st

Notes: The number within brackets refers to the rank of the selection criterion.

as poor or negative (Likert, 1932). Accordingly, most sample households perceived the listed attributes of the variety (“Pawe-02”) positively (Table 11). The attributes’ relative importance index (RII) ranged from 0.41 to 0.93 (Table 11), indicating the variation in performance for different attributes.

On-farm Grain Yield Performance of the Pre-Scaled-Up Improved Soybean Variety

The mean grain yield of the pre-scaled-up variety (“Pawe-02”) and the local cultivar as a comparison in the Guangua district are indicated in Table 12. The average grain yield obtained from “Pawe-02” was 2580 kg.ha⁻¹ and ranged from 2298 kg.ha⁻¹ to 2910 kg.ha⁻¹. This variation within the variety stemmed from soil fertility differences among host farmers’

farms, crop management differences among the host farmers, and some uncontrollable factors in some host farmers’ farms. “Pawe-02” showed a 48.87 % grain yield advantage over the local cultivar in the Guangua district.

Conclusions

Participatory variety selection showed that farmers selected “Pawe-02” based on its disease resistance, yield, early maturity, number of pods, uniformity, and plant height at Jawe and Guangua. Farmers scaled up the “Pawe-02” variety with improved agronomic traits, and a higher yield was recorded. Farmers’ preferred variety selection criteria and ranking of varieties did not differ across locations and gender groups. The



Figure 1. Performance of “Pawe-02” variety and a field day with the soybean farmers

Table 11. Farmers’ perception of important attributes towards soybean “Pawe-02” variety

Attribute	SA	A	UD	DA	SD	T weight	RII	Rank	Mean
Very good germination	40	16	0	0	0	56	0.93	1	4.66
Disease resistant	25	0	15	4	0	44	0.73	7	3.66
Early mature	10	16	9	4	1	50	0.66	8	3.33
High yielder	25	28	0	0	0	53	0.88	2	4.41
Has a greater number of pods	45	4	6	0	0	49	0.81	3	4.08
A high number of branches	15	20	6	4	0	45	0.75	6	3.75
Long plant height	20	16	12	0	0	48	0.80	4	4.00
Uniform maturity	15	24	3	4	0	46	0.76	5	3.83
No shattering problem	0	0	9	14	2	25	0.41	8	1.78

Notes: SD = strongly disagree, DA = disagree, UD = undecided, A = agree, SA = strongly agree, and RII = relative importance index.

Table 12. Grain yield (kg.ha⁻¹) of “Pawe-02” soybean vs the local cultivar in Guangua district in 2020

Grain yield	Minimum	Maximum	Range	Mean	Std. dev	Yield advantage
“Pawe-02”	2298	2910	612	2580	230	48.87
Local	1645	1955	310	1733	177	

pre-scaling-up results confirmed that the “Pawe-02” soybean variety provided better benefits to farmers than the locally cultivated variety. So, greater demand has been created for most farmers and stakeholders across the tested areas. The improved soybean technology should be reached to farmers on a large scale to benefit them in the study area and similar agroecology. To increase the probability of adoption, technology promotion should concentrate on the options selected by the farmers, and all actors should be considered during the development of various activities.

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