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Pre-Extension Demonstration of Improved Banana Varieties in Kaffa Zone, Southwestern, Ethiopia

Maregn Alemu
Ethiopia agricultural research institute
Wondimu Yonas
wondimuyonas17@gmail.com
Ethiopia agricultural research institute
Tamrat Tadewos
Ethiopia agricultural research institute

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Abstract

Banana is a widely grown fruit crop in southwestern Ethiopia and plays a key role in food supply and household income. It produces high yields within a short time and provides food throughout the year, making it important for smallholder farmers. However, the productivity of banana in the area is still lower than its potential due to limited use of improved varieties and insufficient field-level demonstration of better production practices. This study aimed to demonstrate improved banana technologies under farmers' conditions and to assess farmers' preferences for selected varieties and management practices.The study was conducted during the 2022 and 2024 main rainy seasons in Gimbo District, Kaffa Zone. Two kebeles were purposively selected based on their production potential, and twenty farmers participated in the demonstration. Two improved banana varieties (Poyo and Williams-1) were evaluated alongside a local variety using 100 m² plots with spacing of 2.5 m × 2.5 m. Capacity-building activities, including training, exchange visits, and field days, were organized to strengthen farmer-to-farmer learning. Data were collected through field observations, yield measurements, and face-to-face interviews. Quantitative data were analyzed using descriptive statistics, while farmers' preferences were assessed qualitatively.The findings showed that the improved varieties performed better than the local variety, with mean yields of 28.0 t ha^{-1} for Poyo, 27.75 t ha^{-1} for Williams-1, and 9.20 t ha^{-1} for the local variety. Farmers preferred the improved varieties due to their higher yield and better overall performance.Based on yield advantage and farmers' preference, the improved varieties (Poyo and Williams-1) are recommended for wider dissemination and scaling up in similar agro-ecological zones.

1. Introduction

Banana (*Musa* spp.) is an important fruit crop in tropical and subtropical regions and serves as a major source of food, nutrition, and income for millions of people worldwide. The crop is valued for its high productivity, short production cycle, and adaptability to diverse agroecological conditions. Global banana production exceeds 114 million tons annually, with average yields of 20–40 t ha^{-1} under improved management practices (FAO, 2021). However, banana productivity in many African countries remains low, often below 10–15 t ha^{-1}, because of declining soil fertility, limited use of improved cultivars, pests, diseases, and poor crop management practices (Robinson and Galán Saúco, 2010).

In Africa, banana is an important staple and cash crop, particularly in East and Central Africa, where it contributes significantly to food security and rural livelihoods. Ethiopia is among the major banana-producing countries in the region, and banana ranks first among fruit crops in area coverage and total production. The crop is mainly produced in the southern and southwestern parts of the country, where environmental conditions favor its cultivation (Bezuneh, 1973). Although banana contributes more than two-thirds of Ethiopia's total fruit production, yields under smallholder farming systems remain far below the potential yields obtained under research conditions (Ambisa et al., 2019).

In southwestern Ethiopia, especially in Kaffa Zone, banana production is dominated by local cultivars with low yield potential, poor fruit quality, and susceptibility to diseases. Previous studies reported that

improved cultivars such as Williams-1 and Poyo showed better adaptability, higher bunch weight, and improved fruit quality under tropical conditions (Silva et al., 2002; Teixeira et al., 2002). Robinson and Nel (1988) also showed that the use of improved varieties together with proper management practices can significantly increase banana productivity.

Despite the evaluation of several improved banana varieties in Ethiopia, most studies have been conducted under research station conditions, with limited validation under farmers' field conditions. As a result, information on farmers' preferences and the field performance of improved varieties under smallholder production systems remains limited. Fikre et al. (2022) evaluated improved banana varieties in Kaffa Zone, southwestern Ethiopia, and identified Williams-1 and Poyo as superior cultivars based on yield performance and adaptability. The authors recommended these varieties for wider production in the area.

Following these recommendations, improved banana varieties were demonstrated on farmers' fields in Kaffa Zone under local management conditions. The demonstration assessed varietal performance and farmers' preferences and promoted the dissemination of adaptable and high-yielding banana cultivars. The results confirmed the suitability of Williams-1 and Poyo for banana production in southwestern Ethiopia and their potential to improve productivity and household income among smallholder farmers.

2. Materials and Methods

A field demonstration of banana varieties was conducted in Gimbo Woreda, Kaffa Zone, during the 2023–2024 main cropping seasons. Two kebeles, namely Beyemo and Shomba Sheka, along with their respective Farmers' Training Centers (FTCs), were purposively selected based on their suitability and agroecological potential for banana production.

A total of 20 beneficiary farmers were selected from the two kebeles based on their willingness to participate in the demonstration and the availability of adequate farmland. Prior to the commencement of the activity, training was provided to participating farmers and agricultural experts on banana production and field management practices.

The banana varieties evaluated in the demonstration included Poyo, William-1, and a local variety used as a check. Each variety was planted at a spacing of 2.5 m × 2.5 m. All recommended agronomic and field management practices were applied uniformly across the demonstration plots to ensure consistency in management conditions.

3. Result and discussion

Yield Performance of Banana Varieties.

The demonstrated banana varieties showed clear differences in fruit yield under farmers' field conditions in Gimbo Woreda. Among the tested varieties, Poyo produced the highest average fruit yield (28 t ha^{-1}),

followed closely by William-1 with 27.75 t ha⁻¹, while the local variety gave only 9.25 t ha⁻¹ (Table 1). The minimum and maximum yields also confirmed the superior and stable performance of the improved varieties across demonstration sites.

Table 1: Yield of the varieties.

Varieties	Fruit Yield t/ ha		
	Min	Max	Average
Poyo	25.25	32.5	28
William-1	24.75	31.5	27.75
Local	8.5	11.5	9.25

The result clearly indicates that improved banana varieties had nearly three times higher yield than the local cultivar. The better performance of Poyo and William-1 may be associated with their improved genetic potential, better adaptation to the agroecology, vigorous growth, and higher bunch weight. Similar findings were reported by Eshbel et al. (2023), who found that William-1 produced about 28.4 t ha⁻¹ in Southern Ethiopia, showing strong adaptability and high marketable yield. Likewise, a study conducted in southwestern Ethiopia reported that Poyo and William-1 were among the best-performing varieties, producing 38.14 t ha⁻¹ and 33.37 t ha⁻¹, respectively, compared with local cultivars.

The present finding is also supported by Yoseph, T.*et al*, (2014), who observed that improved banana cultivars significantly outperformed local varieties in fruit yield due to better bunch formation and finger number. However, the current yield level was slightly lower than yields reported in research stations and irrigated production systems. This variation may be due to differences in soil fertility, rainfall distribution, management practices, disease pressure, and farmers' management capacity.

In contrast, Cibsa (2021) reported that some improved varieties such as Giant Cavendish and Dwarf Cavendish performed better than Poyo under small-scale irrigation systems. This difference may arise from environmental variation, irrigation access, and genotype-by-environment interaction. Banana varieties respond differently to local climatic conditions, soil moisture, and management intensity. Therefore, the strong performance of Poyo and William-1 in the present study confirms their suitability specifically for the agroecological conditions of Gimbo Woreda.

The farmers also preferred Poyo and William-1 mainly because of their high yield potential and market attractiveness. Higher productivity directly increases household income and improves food security, which makes these varieties more acceptable to smallholder farmers.

Incidence (%) of Major Banana Diseases

Table 2 presents the incidence of the two major banana diseases, namely Fusarium wilt (FW) and bacterial wilt (BW), across three banana varieties. The results indicate substantial variation in disease

occurrence among the tested varieties (Table 2).

The highest incidence of Fusarium wilt was recorded in the local banana variety, where all assessed plants were affected, resulting in a disease incidence of 100% (Table 2). Similarly, the Williams-1 variety showed a high level of susceptibility, with an FW incidence of 82%. In contrast, the Poyo variety exhibited a considerably lower incidence of Fusarium wilt (18.7%), suggesting a comparatively higher level of tolerance or resistance to the disease (Table 2).

Regarding bacterial wilt incidence,Williams-1 recorded the highest value (30.7%), indicating that this variety is also highly vulnerable to bacterial wilt infection (Table 2). The Poyo variety showed a moderate bacterial wilt incidence of 14.7%, whereas no bacterial wilt infection was observed in the local variety (Table 2). The absence of bacterial wilt in the local variety may indicate possible resistance or could be associated with environmental or management factors that limited disease development during the study period.

Overall, the findings demonstrate clear differences in disease susceptibility among banana varieties. Poyo appeared to be less affected by both diseases compared to Williams-1 and the local variety, highlighting its potential suitability for cultivation in areas where these diseases are prevalent. The high incidence of Fusarium wilt observed in Williams-1 and the local variety emphasizes the need for effective disease management strategies and the selection of resistant cultivars to minimize production losses.

Table 2: Incidence (%) of Major Banana Diseases.

Variety	Fusarium Wilt (FW) Incidence %	Bacterial Wilt (BW) Incidence %
Poyo	18.7%	14.7%
Williams-1	82 %	30.7%
Local	100 %	0%

Participation in Field Day Evaluation

Field days were organized at farmers' fields and Farmers Training Centers (FTCs) to evaluate varietal performance and share practical experiences among stakeholders. A total of 31 participants attended the field visit, including farmers, development agents, and woreda experts (Table 3).

Table 3: Number of field day participants

Participant	Male	Female	Total
Farmers	14	6	20
Woreda experts	3	-	3
Development agents	5	3	8
Total	22	9	31

The participation of farmers, extension personnel, and local experts created an opportunity for knowledge exchange and practical learning. Farmers directly observed varietal differences in yield, maturity, disease tolerance, and fruit quality. Such participatory demonstrations improve technology adoption because farmers gain confidence through field observation and experience sharing.

The involvement of women participants is also important because women play a significant role in fruit production, postharvest handling, and marketing activities in rural households. Previous studies have shown that participatory field demonstrations enhance farmers' awareness and accelerate technology dissemination among farming communities. Eshbel et al. (2023) similarly reported that training and field demonstrations significantly improved farmers' interest in improved banana technologies in Southern Ethiopia.

Although female participation was lower than male participation, the inclusion of women in the demonstration activities is encouraging. Increasing women's participation in future scaling-up programs could further strengthen technology adoption and household nutrition improvement.

Farmers' Preference Ranking of Banana Varieties

Farmers evaluated the demonstrated varieties using their own selection criteria through pairwise ranking. The major criteria identified by farmers were fruit yield (FY), disease resistance (DR), early maturity (EM), taste of fruit (TF), and sucker number (SN). Based on these criteria, Poyo ranked first, William-1 second, and the local variety third (Table 4).

Table 4: Preference Ranking

Varieties	Farmers preference ranking							
	TF	EM	SN	DR	FY	Overall	Mean	Rank
Poyo	4	4	5	4	4	21	4.2	1st
William-1	4	4	4	4	4	20	4	2nd
Local	3	3	3	3	2	14	2.8	3rd

EM= Early Maturity, TF= Taste of Fruit, DR= Disease Resistances, SN= Sucker Number, FY= fruit Yield

Scores: 1= very poor, 2= Poor, 3= Good, 4= Very Good 5 =Excellent

The preference ranking result indicates that farmers did not evaluate varieties based only on yield. Traits such as disease resistance, fruit taste, and sucker production were also important during selection. Poyo received the highest score because farmers perceived it as high yielding, vigorous, and adaptable. Its higher sucker production is particularly important because it provides additional planting materials for future expansion.

William-1 also received high scores in all evaluation criteria, showing that farmers appreciated its balanced performance. The local variety ranked lowest mainly due to low yield and poor market preference.

The current result agrees with participatory evaluation studies conducted in Ethiopia, where farmers preferred improved banana varieties because of their superior yield, better fruit quality, and tolerance to production constraints. Wasihun Alemnew and Temesgen Gizaw (2025) similarly reported that farmers ranked improved banana varieties above local cultivars due to better fruit number and marketability.

Some studies, however, reported that farmers may still prefer local cultivars because of traditional taste, local market demand, or better adaptation to stress conditions. Such contrasting findings are scientifically reasonable because farmers' varietal preference often depends on cultural food habits, market orientation, and environmental conditions. In the present study area, yield and disease resistance were more important to farmers than traditional preferences, which explains the strong acceptance of Poyo and William-1.

Beneficiary Farmers

A total of 60 farmers benefited directly and indirectly from the demonstration program conducted in Gimbo Woreda. The activity improved farmers' awareness regarding improved banana production technologies, varietal selection, and management practices. The demonstration also strengthened collaboration among researchers, extension workers, and farming communities, which is essential for successful technology dissemination.

4. Conclusion and Recommendations

The demonstration of improved banana varieties in Gimbo Woreda showed that improved cultivars significantly outperformed the local variety under farmers' conditions. Among the tested varieties, Poyo produced the highest average fruit yield (28 t ha^{-1}), followed closely by William-1 (27.75 t ha^{-1}), whereas

the local variety produced only 9.25 t ha^{-1}. Farmers also ranked Poyo and William-1 as their first and second choices based on yield, disease resistance, fruit taste, sucker number, and early maturity.

The superior performance and high farmer preference indicate that Poyo and William-1 are well adapted to the agroecological conditions of the study area. Therefore, these varieties should be promoted and scaled up widely with recommended management practices. Future interventions should focus on strengthening access to quality planting materials, farmer training, irrigation management, and disease control practices to maximize productivity and adoption.

Declarations

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Conflicts of Interest/Competing interests

The authors declare that they have no competing interests.

Human Ethics and Consent to Participate

Human Ethics and Consent to Participate declarations: not applicable.

Consent to Publish

Consent to Publish declaration: not applicable.

Data availability

The collected data and analyzed in this study can be obtained from the corresponding author upon reasonable request.

Autor contribution

All authors contributed equally to all aspects of this research. They have reviewed and approved the final manuscript, accept responsibility for its content, and confirm that it is original and not under consideration elsewhere.

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