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Participatory demonstration and evaluation of improved onion variety in East Shewa zone of Oromia regional state, Ethiopia

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Abstract

The study was carried out in selected districts of East Shewa zone Oromia regional state to compare the performance of a recently released onion variety (Nafis) with their recommended agronomic recommendations to a control (Bombay red) through an on-farm demonstration. The demonstration was implemented on 9.3 hectares of 37 farmers' farmland. The Nafis variety outperformed the control, with a mean yield of 293.2 qt/ha. The mean technology gap was 106.8 qt/ha and the technology index recorded was observed to be 26.7%. Farmers' preferences were used to evaluate onion varieties with criteria of yield, disease, bulb size, bulb color (deep red preferred), pungency, storability, and market preference. Nafis variety is preferred over the Bombay red variety. In addition, lack of improved seeds, high chemical costs, and insect and disease infestations are among the major constraints limiting onion production and productivity in the study area. Trips and fungi (Purple Bloch) have also been identified by farmers as a major disease affecting onion production in the districts. In general, the demonstrated variety (Nafis) was found to be feasible and preferred by the farmers to cultivate in the East Shewa zone as compared to the check (Bombay red). Therefore, onion yield in farmers' fields can be improved largely by cultivating the Nafis variety in the study area and similar environments.

Keywords: Demonstration, Extension gap, East-Shewa, Onion, Technology gap, Technology index.

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Contents

Contribution of this paper to the literature

This paper contributes to the existing literature in several ways. First, unlike most other studies, it focuses on the traits growers consider for sustainable onion production rather than evaluating the technology in yield performance only. Second, the study is unique in that the technology is new and contributes significantly to the farming community's production and productivity.

1. Introduction

In Ethiopia, onion is an important cash crop that is widely used to enhance the flavor of various foods. It is grown under both irrigation and rainfed conditions, by smallholder farmers and commercial growers, with, irrigation covering the majority of the land [1]. The study area has a high potential for onion production because of the abundance of irrigated farmland and the presence of relatively better market access [2].

According to a report from the Central Statistics Agency [3], the area covered by onions in 2019/20 was approximately 28,185.11 hectares, with a total production of 2,624,782.85 quintals. There was a 29% increase in area coverage and a 20% increase in production when comparing the 2019/20 onion cropping season to the 2012/2013., Crop productivity, however, is decreasing year after year. There was a 25 qt/ha yield difference between the 2012/13 (100.24 qt/ha) and the 2019/20 (75.29 qt/ha) cropping season Table 1.

These low yield results indicate the presence of a large productivity gap, which is attributed to several constraints, the most significant of which are the lack of an authorized body that produces and distributes improved onion seed varieties and the use of inappropriate agronomic practices [2, 4]. With this in mind, the purpose of the study was to compare the performance of a recently released onion variety (Nafis) with the check (Bombay red) through on-farm demonstration and to analyze farmers' preferences for the demonstrated varieties.

Table 1. Area coverage, production, and productivity of onion in Ethiopia.

Production year	Area coverage (ha)	Production (qt)	Productivity (qt/ha)	Productivity change (qt/ha)
2012/13	21,865.37	2,191,886.02	100.24	
2013/14	24,375.70	2,197,352.67	90.15	-10.09
2014/15	22,771.88	2,307,451.89	101.35	11.2
2015/16	29,517.01	2,648,493.54	89.73	-11.62
2016/17	33,603.39	3,274,752.45	97.45	7.72
2017/18	31,673.21	2,938,875.85	92.79	-4.66
2019/20	28,185.11	2,624,782.85	75.29	-17.5

Source: CSA (2012/13 – 2019/20).

2. Materials and Methods

2.1. Description of the Study Area

The research was carried out in three districts of the East Shewa Zone (Adama, Lume, and Adamitulu Jido Kombolcha) of the Oromia regional state. The zone has ten districts and is divided into 17.2% slight, 41.3% moderate, and 41.5% severe agricultural drought risk subzones. The zone economy is characterized by a mixed farming system that relies on a large rain-fed farm [5]. East Shewa Zone has three agroecologies namely highland, midland, and lowland. This Zone received an annual temperature range of 12-39°C. The Zone has a total land area of 971,159.21 hectares [6]. Figure 1 shows the distribution of the study areas.

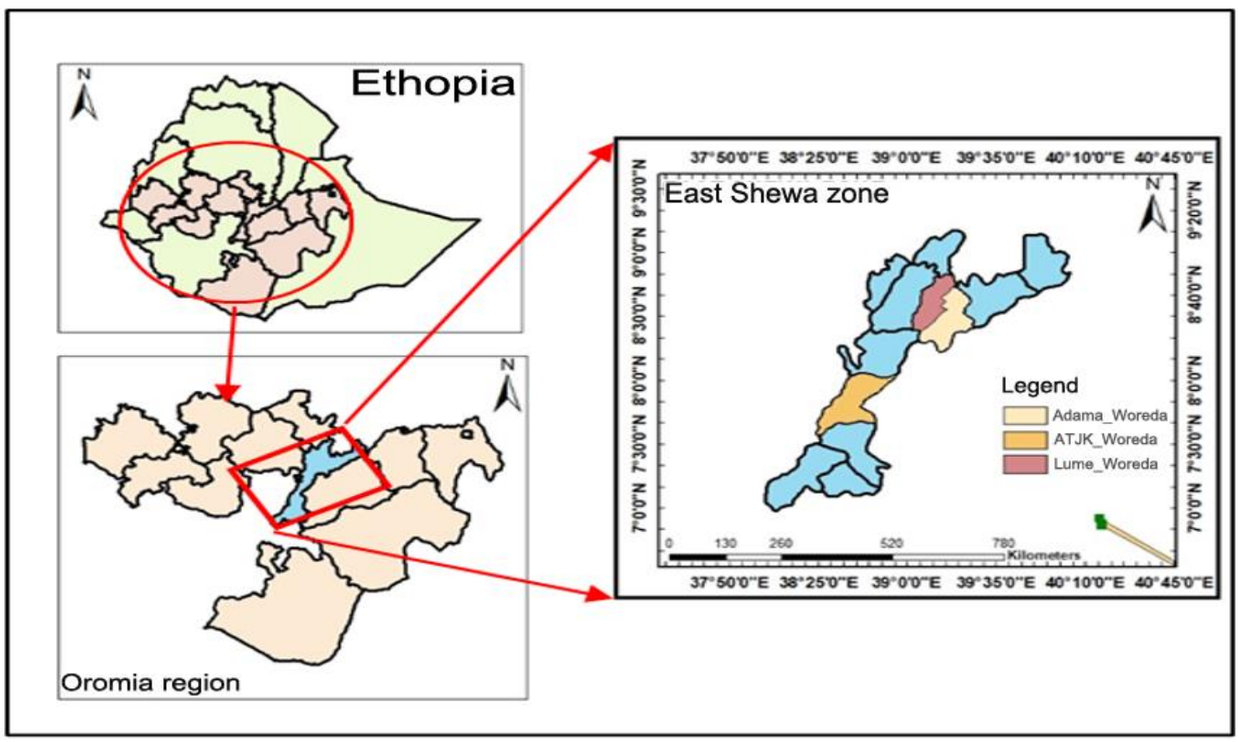

Figure 1. Map of the study area.

2.2. Farmer's Selection and Field Establishment

As Adama, Lume, and Adamitulu Jido Kombolcha (ATJK) districts are potential areas in onion production, farmers who have access to irrigation, interest in the technology, a willingness to allocate and manage fields of the demonstration, and a willingness to collaborate with researchers and extension agents were chosen to host the demonstration. The newly released variety (Nafis) was demonstrated side by side with a locally popular variety (Bombay red). A plot size of 0.25 hectares was used for each demonstration. In onion production, all recommended packages reported by MoA [7] applied for instance, using 40 cm water furrows with 20 cm rows on beds and 5 cm between plants in the demonstration plots are employed in farmers' fields. All varieties were planted on the same day. Follow-ups and critical advice from respective researchers and agricultural experts have been provided to demonstration host farmers. The Melkassa Research Center provided complete onion technology packages for the demonstration.

2.3. Training of Farmers

Since training is one of the extension methods playing a significant role in increasing the awareness of the farming community on a particular technology, host farmers (37) and development agents (10) in the study were given training on onion production and management practices. The training consists of both theoretical and practical training. Researchers discovered gaps during their regular visits. To fill the observed gap, field-level training was provided to the farmers by grouping them into small groups and discussing issues raised by farmers.

2.4. Data Collection and Analysis

Both qualitative and quantitative data were collected and analyzed through supervision and follow-up of the activity with the participation of all stakeholders. A data record sheet was created to collect all necessary data. Thus, field observation and contact with the target farmer during the field visit were used to collect data. Farmers' yield data and preferences for the variety were collected. Finally, the collected data was analyzed using simple statistical tools. The following equation was used to calculate the gaps between the potential yield and the demonstration yield, the extension gap, and the technology index [8].

- Technology gap = Potential yield – demonstration yield (1)
- Extension gap = Demonstration yield – Yield under existing practice (2)
- Technology index = (Potential yield - demonstration yield / potential yield) x 100 (3)

3. Result and Discussion

3.1. Yield Performance

The mean yield of the Nafis variety obtained under the demonstration was 271.19, 322.09, and 286.16 q/ha in the Adama, Lume, and ATJK districts respectively. The highest yield (346 qt/ha) was in the Adama district during 2018/19 whereas the smallest yield (196.38 qt/ha) was in the same district during 2019/20 for the Nafis variety. The difference in yield amount over location and demonstration year was observed, which might be due to management differences in climatic deviations, as well as the change in the location of the demonstration in each year. The result of the demonstration revealed that the recently released varieties (Nafis) performed extremely well when compared with the check (Bombay red) during all the years of demonstration Table 2.

Accordingly, a mean yield advantage of 33.9, 127.3, and 48.9% of Nafis variety was recorded over the check-in Adama, Lume, and ATJK districts respectively. The pooled mean shows also a 41.4% yield advantage of the Nafis variety over the check-in of all demonstrated districts. The yield improvement in onion and other crops under demonstration has adequately been documented by Abady, et al. [9] and Kinfe and Tesfaye [10].

Table 2. Yield performances of Nafis variety.

Location	Year	No. of demo.	Area	Nafis yield (qt/ha)	Check (qt/ha)	Yield increment (%)
Adama	2018/19	8	2	346.00	232.37	48.90
	2019/20	5	1.25	196.38	164.97	19.04
Mean		13	3.25	271.19	198.67	33.97
Lume	2018/19	8	2	311.27	101.34	207.14
	2019/20	5	1.25	332.90	225.83	47.41
Mean		13	3.25	322.09	163.59	127.28
ATJK	2018/19	6	1.5	241.23	233.03	3.52
	2019/20	5	1.25	331.08	286.86	15.41
Mean		11	2.75	286.16	259.95	48.90
Pooled mean		37	9.25	293.15	207.40	41.35

3.2. Technology Gap, Extension Gap, and Technology Index

The newly released onion variety (Nafis) outperformed the control (Bombay red). Table 3 shows that the percentage increase in yield over check is 36.5 in the Adama district, 97 in the Lume district, and 10 in the ATJK district. The technology gap in Adama, Lume, and ATJK districts was 128.8, 77.9, and 113.8 qt/ha, respectively. This may be attributed to differences in soil fertility status and weather conditions. As a result, it appears that location-specific recommendations are required to close the yield gap between different varieties.

Regarding the extension gap, the Lume and Adama districts had the greatest extension gap (158.5 qt/ha). The extension gap highlighted the importance of educating onion-producing farmers through various means for the adoption of improved high-yielding varieties with the recommended packages. By using the Nafis variety, Farmers can change the trend of a wide extension gap.

The technology index in Table 3 indicates the viability of the variety (Nafis) in the farmers' field. The lower the value of the technology index, the higher the technology's feasibility [11, 12]. Across districts, the technology index ranges from 19.48 to 32.2 percent. The Nafis variety is found to be more feasible for farmers to produce in the study area than the Bombay Red variety (Check).

Table 3. Productivity of onion (Nafis variety), yield gaps, and technology index.

Location	Potential yield (qt/ha)	Demonstration (qt/ha)	Bombay red (qt/ha)	% increase over check	Technology gap	Extension gap	Technology index (%)
Adama	400	271.19	198.67	36.50	128.81	72.52	32.20
Lume	400	322.09	163.59	96.89	77.91	158.50	19.48
ATJK	400	286.16	259.95	10.08	113.84	26.21	28.46
Mean	400	293.15	207.40	47.82	106.85	85.74	26.71

3.3. Farmers Feedback

Farmers' preferences were used to evaluate onion varieties with criteria of yield, disease and insect resistance, bulb size, bulb color (deep red preferred), pungency, storability, and market preference. According to the ranking of onion varieties based on farmers' criteria, farmers preferred the Nafis variety over the Bombay red variety. Table 4 presents below the onion producer farmers preference of onion variety based on their own criteria. As a result Nafis variety was preferred by all listed criteria for production. The focus group discussion participants mentioned that a lack of improved seeds, high chemical costs, and insect and disease infestations are among the major constraints limiting onion production and productivity in the study areas as shown in Table 5. Trips and fungi (Purple Bloch) have also been reported by farmers as a major disease affecting onion production in the districts.

Table 4. Preference ranking of onion varieties based on farmers' preference criteria.

Varieties	Market preference	Better yield	Good bulb color	Average bulb size	Resistance to insect	Pungency	Resistance to disease	Storability
Nafis	1st	1st	1st	1st	1st	1st	1st	1st
Bombay red	2nd	2nd	2nd	2nd	2nd	2nd	2nd	2nd

Table 5. Major challenges of onion production.

Major challenges	Disease	Insect	Cost of pesticides	Unstable price	UIS*	Total scores	Rank
Disease		Disease	Disease	Disease	UIS	3	2nd
Insect			Insect	Insect	UIS	2	3rd
Cost of pesticides				Cost of pesticides	UIS	1	4th
Unstable price					UIS	0	5th
UIS*						4	1st

Note: *UIS (Unavailability of improved seed).

4. Conclusion and Recommendations

The demonstration yielded an encouraging result and allowed stakeholders to demonstrate the new variety's productivity potential by comparing it to local variety on farmers' fields. This could alleviate some of the barriers to technology transfer and adoption. According to the findings of the study, conducting demonstrations of the improved variety (Nafis) increased onion yield potential significantly. The crop's yield potential can be increased to a greater extent by cultivating the Nafis variety of onions in the East Shewa Zone. As a result, the farming community's income and livelihood will improve. The study also emphasized the importance of educating farmers to improve their use of improved varieties. The demonstration also raised awareness and encouraged farmers to plant the newly demonstrated onion variety (Nafis). As a result, a strategy to address the wide farming community should be developed to increase onion production and productivity.

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