

Research Article

Pre-Extension Demonstration of Black Cumin Technologies in Goro and Ginnir Districts of Bale and East Bale Zones Southeastern Oromia

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Abstract

Pre-extension demonstration of improved black cumin technologies was carried out in Goro and Ginnir districts. The new variety Urgessa was demonstrated and evaluated against the standard check Gemechis where plot size of 10*10 m was used for each variety. Row planting was applied using seed rate of 12 kg /ha and fertilizer (NPS) rate of 100 kg/ha. Yield data, number of farmers participated on training and mini field days, production costs and farmers' feedback were collected using field observation, check list, and focus group discussion. Descriptive statistics was used to analyze quantitative data. Cost-benefit analysis was used for profitability analysis. Awareness creation activities like training and mini field days were arranged for target beneficiaries and other stakeholders. Combined yield evaluation was carried out in which Urgessa gave higher seed yield of 13.84 qt/ha while Gemechis gave 11.73 qt/ha. Direct matrix ranking was used to rank black cumin varieties. Consequently, farmers gave the higher score for Urgessa variety. The result of pair wise ranking indicated that farmers gave high attention for traits of yield, number of branch per plant and number of capsule per plant. The result of profitability analysis also revealed that the farmer who prefers to produce Urgessa variety could get an extra net benefit of 24,360.00 ETB/ha than who prefers to produce Gemechis variety in single production season. Therefore, based on farmers' preference and profitability analysis, Urgessa variety is recommended for pre-scaling up.

Keywords

Awareness Creation, Black Cumin, Farmers' Feedback Farmers' Preference, Urgessa Variety

1. Introduction

Spices have an immense potential for countries economic development through improving smallholder farmers' income creation and expansion of employment opportunities and distribution of income and foreign exchange earnings. Ethiopia is homeland to many spices, such as korarima (*Aframomum korarima*), long red pepper, black cumin, white cumin (bishops weed), coriander, fenugreek, turmeric, sage,

cinnamon, and ginger [1].

Black cumin (*Nigella sativa* L.) is belongs to the family Ranunculaceae and it is the most revered medicinal seeds in history [2]. The crop is a short-lived annual flowering plant which used predominantly to flavor food, either as whole grain or in powdered form or as an oleoresin extracts [3]. The crop originated from South and Southwest Asia, North

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Africa, and the Mediterranean region [4]. It is widely grown for its black seeds in the countries bordering the Mediterranean Sea, Middle East, Southern areas of Europe, Pakistan, Iran, India, and Egypt due to its nutritional, medicinal, and industrial properties [5]. Black cumin seed oil was used traditionally in different countries for many medical complaints [6]. In Ethiopia, black cumin is an important spice crop cultivated as cash crop and medicinal plant [7]. The seeds are used for culinary purposes, medicinal treatment and also used as food additives [8]. Black cumin is mainly produced within an altitudinal range of 1750–2200 m a s l. It can grow in well drained black vertisols with residual moisture. A rainfall of 120–400 mm during its growing season could be enough for its optimum production. It grew in temperature ranges of 5–25°C, with 12–14°C is being the optimum [3]. An increasing demand of black cumin seed and oil in local, national and international market for medicinal, consumption and commercial purpose makes the best alternative crop for smallholder farmers in Ethiopia [6]. It is produced in most parts of Ethiopia and its uses are diverse from spices and medicinal aspects. Black cumin is second Ethiopian export spice crop next to ginger [9]. The country generated 1.55 million USD in 2009/10 crop season from export of 801 MT cumin seeds in addition to huge domestic consumption [10].

Even though black cumin has the aforementioned economic and social advantages, the production of this spices crop has been characterized by low output per unit of land allocated arising from lack of high yielding improved varieties. The main reasons for the low productivity are mainly attributed to the lack of improved variety, lack of fertilizer management, lack of knowledge on cultural practices, and diseases and insect pest management, poor extension system, postharvest handling problems, as well as marketing problems [11, 12]. Cognizant of this, Sinana Agricultural Research Center had released a few improved black cumin varieties in the recent past years. Among these black cumin varieties, Urgessa variety was released in 2021 with yield potential of 18–24.5 qtha⁻¹. As a result, this pre-extension demonstration of Urgessa variety with its associated full packages was initiated to create demand and build confidence about black cumin technologies for further promotion and dissemination of this spices crop in Goro and Ginnir districts of East Bale zone.

Objectives

The current study was initiated to achieve the following specific objectives.

- (1) To evaluate the yield performance of improved black cumin technologies under farmers' condition.

- (2) To create awareness on the importance of improved black cumin technologies among farmers and other participant stakeholders.
- (3) To collect farmers' feedbacks on improved black cumin technologies for further variety development of black cumin production.

2. Materials and Methods

2.1. Site and Farmer Selection

The study was carried out in Goro and Ginnir districts of Bale and East Bale zones. These districts were purposively selected due to there are a niche to spices production. Similarly, two kebeles were selected from each district purposively based on road accessibility for trial management and supervision. Accordingly, the trial was implemented in four kebeles which have a good potential for black cumin production and easily accessible. Trial farmer selection was carried out with consultation of FRG members and experts of respective district and DAs of each kebele. While nominating farmers for hosting replicative trial, status of the field (fertility, slope), and accessibility for crop management and supervision was considered. Hence, the trial was executed by selecting two trial farmers from each kebele. Thus, it was implemented on eight (8) farmers' field.

2.2. Materials and Field Design

The study was employed a simple plot design of 10 m*10 m in which one improved variety of black cumin (Urgessa) and one standard check (Gemechis) were planted side by side. The recommended seed rate of 12 kg ha⁻¹ was used for both varieties. Row planting was applied with the spacing of 30 cm between rows. Fertilizer was applied with the recommended rate of 100 kg NPS per hectare. Moreover, other recommended agronomic and management packages were applied per the recommendations.

2.3. Technology Demonstration and Evaluation Approaches

FRG approach was employed to carry out black cumin pre-extension demonstration activity. One FRG was established in each kebele which consists of 19–21 members (Table 1). Field visit and mini filed days were also arranged to demonstrate and evaluate the new variety of black cumin.

Table 1. List of FRG members by gender.

| District | Kebele | Adult men | Adult Women | Young men | Young women | Total |
|----------|-------------|-----------|-------------|-----------|-------------|-------|
| Goro | Woltei Gobu | 13 | 3 | 4 | 1 | 21 |

| District | Kebele | Adult men | Adult Women | Young men | Young women | Total |
|----------|------------|-----------|-------------|-----------|-------------|-------|
| Adaba | Bale Anole | 15 | 2 | 3 | - | 20 |
| Ginnir | Loboca | 16 | 3 | 2 | - | 20 |
| | Kebena | 14 | 2 | 3 | - | 19 |
| Total | | 58 | 10 | 12 | 1 | 80 |

2.4. Type of Data and Methods of Data Collection

Both quantitative and qualitative data were collected to address the objectives of the study. Both primary and secondary sources of data were also used. Types of data includes: number of farmers participated in training, mini-field day and field visits, and yield data. Besides, input costs (fertilizers, seeds, Labor, fungicides, herbicides, transportation and harvesting costs), local market price of the out puts at harvesting time gained were recorded. Farmers' feedback about the technology (farmers' preferences and farmers' variety selection criteria) was identified. Simple interview schedule, field observation and focus group discussion (FGD) were employed as methods of data collection for this study.

2.5. Methods of Data Analysis

Quantitative data were analyzed using descriptive statistics like mean and standard deviation. Independent t-test was used to test yield difference between the two black cumin varieties. Furthermore, cost-benefit analysis was used to calculate the economic return. Matrix ranking was used to

summarize the demonstrated black cumin varietal preferences of farmers. The score was given for each varietal traits on 1 to 5 scale; 1 for least score and 5 for highest score following the work of [13]. Farmers' feedback towards the demonstrated black cumin varieties were summarized using pairwise ranking method.

3. Result and Discussion

3.1. Yield Performance of Black Cumin Varieties

Yield evaluation for demonstrated black cumin varieties was carried out over location in which the new variety, urgessa, gave high seed yield of 13.84 quintals per hectare with standard deviation of 3.13. The result is in line with the result of [14] in which the new variety (Soressa) gave higher yield than Gemechis in the same study location. Similarly, the standard check (Gemechis) also gave 11.73 quintals per hectare with standard deviation of 2.86. However, the yield difference between the varieties is not statistically significant at α level of significance (Table 2).

Table 2. Yield performance of black cumin varieties.

| Potato varieties | N | Yield/ha (Qt) | Std. Deviation | t-value |
|------------------|---|---------------|----------------|---------|
| Gemechis | 8 | 11.73 | 2.86 | - 1.407 |
| Urgessa | 8 | 13.84 | 3.13 | |

3.2. Awareness Creation

Awareness toward the demonstrated new black cumin variety was created through training and mini filed days. Training was provided for FRG members, DAs and SMS.

Training was mainly focused on agronomic packages recommended for black cumin production starting from land preparation to output marketing, principles and approaches of FRG in participatory research system. The following table shows participants involved during theoretical training.

Table 3. Stakeholders participated on training given on black cumin production in Goro and Ginnir districts.

| District | Farmers | | | DAs | | | SMS | | |
|----------|---------|--------|-------|------|--------|-------|------|--------|-------|
| | Male | Female | Total | Male | Female | Total | Male | Female | Total |
| Goro | 45 | 6 | 51 | 9 | 3 | 12 | 4 | 1 | 5 |
| Ginnir | 36 | 4 | 40 | 4 | 2 | 6 | 6 | 2 | 8 |
| Total | 81 | 10 | 91 | 13 | 5 | 18 | 10 | 3 | 13 |

Mini-field days were also organized to improve awareness of farmers towards the new variety and to enhance variety selection in Goro and Ginnir districts. On this extension event, 30 farmers and 6 agricultural experts were participated to evaluate and select the varieties.

Table 4. Stakeholders participated on Mini field day in Goro and Ginnir districts.

| District | Farmers | | | DAs | | | SMS | | |
|----------|---------|--------|-------|------|--------|-------|------|--------|-------|
| | Male | Female | Total | Male | Female | Total | Male | Female | Total |
| Goro | 20 | 2 | 22 | 2 | 1 | 3 | 1 | 0 | 1 |
| Ginnir | 18 | 2 | 20 | 2 | 0 | 2 | 1 | 0 | 1 |
| Total | 38 | 4 | 42 | 4 | 1 | 5 | 2 | 0 | 2 |

Finally, farmers were enhanced to evaluate the field evaluation of black cumin varieties by grouping farmers in small manageable group in which farmers had listed different variety evaluation criteria and selected their variety of interest.

3.3. Farmers' Preference Towards Demonstrated Black Cumin Varieties

After field visit, farmers were encouraged to discuss what they had observed while comparing field performance of black cumin varieties by selecting a group leader who finally reported the result of their discussion in evaluating black

cumin varieties. Direct matrix scoring was carried out to rank demonstrated varieties based on the criteria identified by farmers during group discussion. Direct matrix ranking is used to list black cumin varieties to be compared along horizontal line and criteria on the vertical line to rank choices from most important to least important (i.e. 1st and 2nd). The score was given on the scale of 1 to 5 where 1 stands for the lowest score and 5 indicates the highest score.

Accordingly, they selected Urgessa variety of black cumin in the first stage due to its relative advantages than Gemmchis (Table 5).

Table 5. Direct matrix score ranking of black cumin varieties.

| Varietal Traits | Score given for Black cumin varieties | |
|-------------------------|---------------------------------------|---------|
| | Gemmchis | Urgessa |
| Early maturing | 4 | 3 |
| Number of branch/plant | 3 | 4 |
| Number of capsule/plant | 3 | 5 |
| Number of seed/capsule | 4 | 4 |

| Varietal Traits | Score given for Black cumin varieties | |
|-------------------|---------------------------------------|-----------------|
| | Gemechis | Urgessa |
| Plant height | 3 | 4 |
| Seed size | 4 | 5 |
| Disease tolerance | 3 | 4 |
| Uniformity | 4 | 5 |
| Total Score | 28 | 34 |
| Rank | 2 nd | 1 st |

3.4. Farmers' Feedback Assessment

Farmers' feedback assessment is important to prioritize their criteria and incorporate their interest in the breeding program in order to develop demand driven technologies for sustainable development of black cumin technologies. Farm-

ers are curious in setting varietal traits evaluation criteria to select any new technology which can fit their need and the local circumstances which will be considered in the future breeding program [15]. Accordingly, farmers' feedback about black cumin varieties was assessed and prioritized using pair wise ranking method (Table 5).

Table 6. Pairwise ranking of demonstrated black cumin varieties.

| Code | Varietal Traits | Code of Varietal Traits | | | | | | | | | Frequency | Rank |
|------|-----------------|-------------------------|---|---|---|---|---|---|---|---|-----------|-----------------|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | | |
| 1 | EM | | 2 | 3 | 4 | 1 | 1 | 7 | 1 | 9 | 3 | 6 th |
| 2 | NBPP | | | 2 | 2 | 2 | 2 | 2 | 2 | 9 | 7 | 2 nd |
| 3 | NCPP | | | | 3 | 3 | 3 | 3 | 3 | 9 | 6 | 3 rd |
| 4 | NSPC | | | | | 4 | 4 | 4 | 4 | 9 | 5 | 4 th |
| 5 | Plant height | | | | | | 6 | 7 | 5 | 9 | 1 | 8 th |
| 6 | Seed Size | | | | | | | 7 | 6 | 9 | 2 | 7 th |
| 7 | DT | | | | | | | | 7 | 9 | 4 | 5 th |
| 8 | Uniformity | | | | | | | | | 9 | 0 | 9 th |
| 9 | Yield | | | | | | | | | | 8 | 1 st |

Note: EM= Early maturing,
NBPP= Number of branch per plant,
NCPP= Number of capsule per plant,
NSPC= Number of seed per capsule,
DT=disease tolerance

3.5. Profitability Analysis

The result of financial analysis illustrated in the Table 7 below shows that the farmer who decided to produce Urgessa and Gemechis black cumin varieties could earn the net profit

of 98,810.00 (ETB) and 74,450.00 (ETB) per hectare, respectively in Meher (Bona) production season (Table 7). Similarly, the farmer who prefers to produce the new variety, Urgessa, could get extra net benefit of 24,360.00 (ETB) than the farmer who prefers to produce Gemechis variety.

Table 7. Financial analysis of the demonstrated black cumin varieties.

| Variables | Varieties | |
|---|------------|------------|
| | Urgessa | Gemeshis |
| Yield obtained (qtha ⁻¹) | 13.84 | 11.73 |
| Sale price (ETB/qt) | 12,000.00 | 12,000.00 |
| Total Revenue (Price * Qt) | 166,080.00 | 140,760.00 |
| Variable Costs | | |
| Land preparation (tractor rent) | 3200 | 3200 |
| Seed purchase | 3600 | 2700 |
| Fertilizers purchase (NPS) | 4350 | 4350 |
| Cost of Insecticide | 2500 | 2500 |
| Cost of labor for weeding | 6000 | 6000 |
| Labor cost for insecticide spray | 2450 | 2450 |
| Cost of Labor for harvesting | 3250 | 3250 |
| Cost of labor for threshing | 5500 | 5500 |
| Store (bag purchase) | 420 | 360 |
| Total Variable Costs (ETB/ha) | 31,270.00 | 30,310.00 |
| Fixed costs | | |
| Cost of Land | 36,000 | 36,000 |
| Total cost (TVC + TF C) | 67,270 | 66,310 |
| Gross Margin (GM)=TR-TVC | 134,810.00 | 110,450.00 |
| Net Profit=TR-TC or GM-TFC | 98,810.00 | 74,450.00 |
| Benefit-cost Ratio=Total Revenue/Total Cost | 2.47 | 2.12 |

4. Conclusion and Recommendations

The new variety of black cumin (Urgessa) which was released in 2021 was demonstrated against the standard check Gemechis variety on plot size of 10 m*10 on eight (8) farmers' field in which similar agronomic and management practices were applied. Based on the result of t-test the new variety (Kenedi) gave higher yield of 13.94 qt/ha while the standard check, Gemechis, gave 11.73 quintals per hectare. The yield difference between Urgessa and Gemechis varieties is not statistically significant. However, the result of profitability analysis indicated that the farmer who prefers to produce the new variety, Urgessa, could get an additional net benefit of 24,360.00 (ETB) than the farmer who prefers to produce Gemechis variety. Direct matrix ranking was carried out to identify the variety of their interest. Accordingly, farmers gave the highest score for Urgessa variety based on the varietal traits set during focus group discussion. Therefore, based on farmers' preference and profitability analysis,

Urgessa variety is recommended for pre-scaling up.

Abbreviations

| | |
|-----|--|
| DAs | Development Agents |
| ETB | Ethiopian Birr |
| FRG | Farmers' Research Group |
| Ha | Hectare (Equivalent to 10,000 m ²) |
| Qt. | Quintal (Equivalent to 100 kg) |
| SMS | Subject Matter Specialist |

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Author Contributions

Ayalew Sida: Conceptualization, Formal Analysis, Investigation, Methodology, Software, Validation, Writing – original draft, Writing – review & editing

Bayeta Gadissa: Conceptualization, Formal Analysis, Investigation, Methodology, Software, Validation, Visualization, Writing – original draft, Writing – review & editing

Conflicts of Interest

The authors declare no conflicts of interest.

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Research Fields

Ayalew Sida: Participatory Research, Agricultural Commercialization, Business and financial management, Stakeholders' Linkage Analysis, Perception Analysis, Adoption study.

Bayeta Gadissa: Extension Research, Agricultural Commercialization, Gender Analysis, Communication, Social and humanity.