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On-farm Demonstration and Evaluation of Improved Variety of Black Cumin in Gemechis, Habro and Tulo Districts of West Hararghe Zone

*Mideksa Babu Asfaw Zewdu Fekede Gemechu
Oromia Agricultural Research Institute, Mechara Agricultural Research Center,
P.O.BOX 19, Mechara, Ethiopia

Abstract
The experiment was carried out in Habro, Gemechis and Tulo districts of West Hararghe Zone with the objectives of evaluating improved varieties of black cumin under farmers` field condition and to create awareness and skill of production and management of the improved black cumin variety. Four kebeles were selected purposively based on black cumin production potential, two kebeles from Gemechis and the other two were selected from Habro and Tullo districst. Seven farmers and two Farmers Training Centre were included depending on their interest to the technology, managing the experiment, have appropriate land for the experiment and taking the risk at the time of failures. Two improved varieties Eden and Dirshaye with local check were demonstrated and evaluated. The experiment was demonstrated on 50m^2 demonstration plots and NPS 40kg/ha -with Urea (50kg at the time of sowing and at growing stage) were applied to one demonstration plot. Both quantitative and qualitative data were collected through observation, feedback from farmers and data recording sheet. Descriptive statistics, gross margin analysis and ANOVAs -test was used to analyze collected data. While qualitative data were analysed through simple ranking and summarization. The result of the study indicated that Dirshaye was ranked first in terms of high branch, high plant height, large pod size, high pod per plant, high yield, drought tolerant and insect resistance. Dirshaye variety has more economic advantage than local variety at the study area. Thus, Dirshaye were recommended for further popularization and scaling up in study area and similar agro ecology.
Keywords: Black cumin, Varieties**,** demonstration, insect resistance, yield
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INTRODUCTION

Black Cumin (*Nigella sativa* L.) is a member of Apiaceae (Umbelliferae). This species is originated in Egypt and East Mediterranean, but is widely cultivated in Iran, Japan, China and Turkey (Shewaye, 2011). Black cumin grows on a wide range of soils. Sandy loam soil rich in microbial activity is the most suitable for its cultivation. The sloppy soils of heavy rainfall areas and leveled and well drained soils of moderate rainfall areas are quite suitable for its cultivation. Soil pH of 7.0 to 7.5 is favorable for its production (Ermias et.al as cited in Orgut, 2007).

Nigella sativa has been used as a food preservative and to enhance flavour in many countries of the world for thousands of years and has also been used as a spice, and Nigella sativa seed and oil has been consumed for the treatment of many diseases in the world for many years. Today, it is believed to have antihypertensive, antihyperlipidemic, antidiabetic, anticancer, antioxidant, antimicrobial, antitumour, antibacterial, anti-inflammtory and immune-system effects through its components (Merve and Nevin, 2017). Nigella sativa is used to decrease asthenia and depression, and to increase body resistance (Razavi & Hosseinzadeh, 2014).

It is used principally to flavor food, either as whole grain, in powdered form or as an oleoresin extract. It is also used in gripe water and other herbal medicines. Within Ethiopia its main use is as a spice, which is typically ground and mixed with other spices. There is also some use in traditional medicine. The vast majority of Ethiopia's black cumin exports go to Arabic countries, which, together with other predominantly Muslim countries, accounted in 2008 for some 98% of national exports. Sudan overtook Saudi Arabia as the main export destination in 2007 and by 2008 it accounted for almost one half of all official exports. It is uncertain how reliable this market is and whether exports can be maintained at current levels. Value-adding to cumin in Ethiopia is low, with all exports being made in the form of whole grain (Orgut, 2007).

Recently, many medicinal properties have been attributed to black cumin seeds and its oil. The crude fixed oil extracted from black cumin seeds has powerful antibacterial properties against diverse genera of some pathogenic bacteria (Samah et al., 2014). Increased demand of black cumin oil for medicinal purposes, its potential in crop diversification, income generation and its importance to reduce the risk of crop failure makes black cumin as a best alternative crop under smaller land holdings (Adam et .al, 2006). Even though the uses of black cumin and its demand are very high, the society of West Hararghe has no access of this improved variety. However; Mechara Agricultural Research Center has conducted adaptation trial on improved variety of black cumin which are developed by Kulumsa Agricultural Research Center. Dirshaye, Eden, Darbera & local variety were adapted varieties of black cumin in 2014 cropping season at McARC.

From the study result Dirshaye and Eden has the highest mean of total yield with 587 kg ha-[1] and 547 kg/ha-[1] respectively among the adapted varieties. But, local has the minimum yield of 346 kg/ha-[1]. Thus, Mechara Agricultural Research Center recommended two variety of black cumin named as: Dirshaye and Eden by selecting with all parameters for further promotion and demonstration on farmers' field. Thus, the study was initiated with the objectives of evaluating improved varieties of black cumin under farmers` field condition and to create awareness on the improved black cumin production & management in the study area.

METHODOLOGY

Description of the Study Area

The activity was done in Habro, Gemechis and Tulo districts of West Hararghe Zone. Habro is one of the West Hararghe zone districts which is found at 404 Km from Addis Abeba. The district is situated at the coordinate between 40^0 30' 32.08'' E and $8^0$47'19.81''N. The district has an altitude range from 1600-2400 m.a.s.l. and annual rainfall of 650 mm and 1000 mm while the average temperature of the district is 18°C. Most of the soils found were sandy clay loam in textural class. Habro district consists of *Weynadega* (mid-highland) (57%), *Kola* (lowland) (25%) and *Dega* (highland) (18%) agro climatic zones. It occupies a total area of 725 km^2 i.e. about 4.2% of the zonal total area. The rainfall pattern in the area is uni-modal with high amount of rainfall occurring during the main rainy season between June to September (*Kiremt)* and the short rainy season stretching from March to June (*Belg*). The highest rainfall is received in August. The mean annual temperature was 20 ^{0}C with the hottest months being March, April and July (Dereje D, 2013).

Gemechis district is one of the 17 districts in West Hararghe zone and located at 343 km East of Addis Ababa and about 17 km South of Chiro, which is the capital town of the zone. The district is situated at the coordinate between 8^0 49'10.28"N and 41^0 0'24.77"E. The soil of the study area was dominantly loamy soil (Desalegn et al., 2016). Gemechis town is located on the top of a hill and its climate is 70% cold and cloudy.

Tulo district has 45,670 hectares of land area and located 370km southeast of Addis Ababa. The altitude of the district is 1750 meters above sea level with mean annual rainfall of 1850ml and mean annual temperature of 23°C. It is found at the coordinate between 41^0 7' 11.05''E and 9^0 12' 14.31'' N. The production system is mixed type in which extensive husbandry management of livestock have been practiced (Tulu D and Lelisa K, 2016).

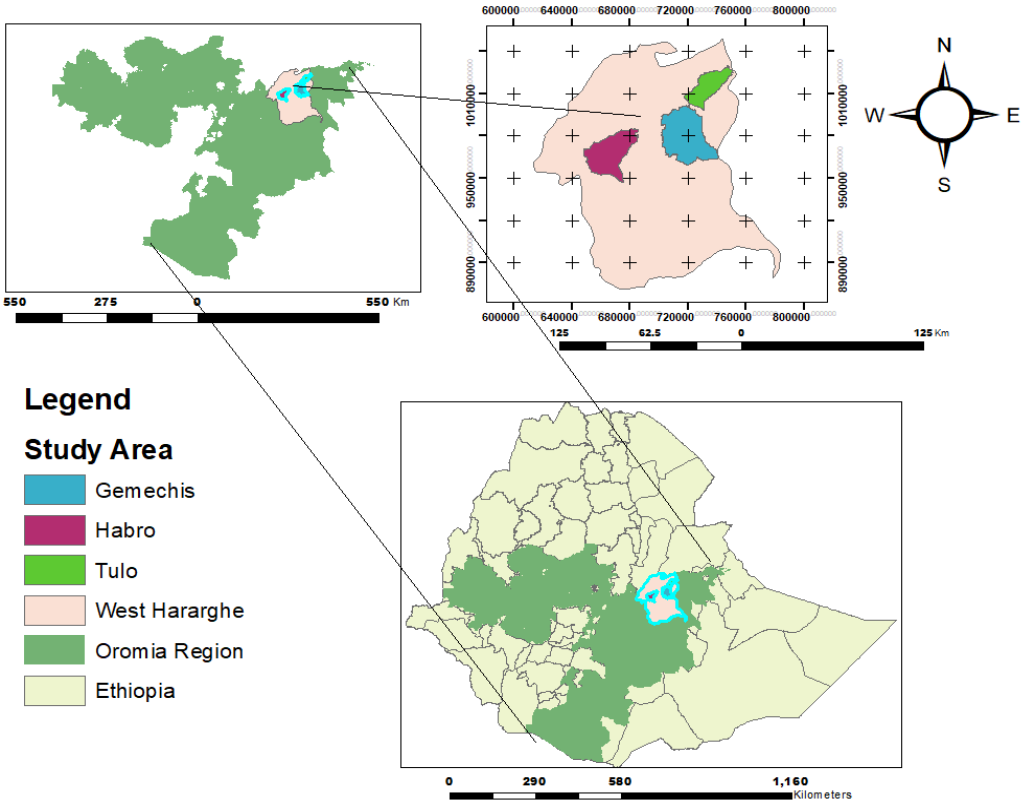

Figure 1: Map of study area Source: Own Design, 2018

Farmers and Site Selection

Representative sites/locations (Districts, PAs and villages) were selected based on objectives of the research and recommendation domain of the technology. Accordingly, Habro, Gemechis and Tulo districts were the selected

districts of West Hararghe zone for the experiment. Bareda *kebele* from Habro district, Medariya Lega Lafto and Welargi kebele from Gemechis district and Kira Kufis *kebele* from Tulo district were purposively selected depending on their black cumin production potential. As the study location is selected, representative farms/fields were selected based on appropriateness of the field for conducting the trial. Thus, seven (7) farmers were selected based on their interest to the technology, model farmers, managing the experiment and have appropriate land for the experiment. During choosing experimental fields/farms, researchers have considered uniformity of the field, drainage, soil types, topography, and bordering influences such as trees, runoff from neighbouring fields and accessibility for visiting and data collection. Two Farmers' training centres (FTCs) were also used as one experimental site.

Research Design

Two improved black cumin varieties namely Eden and Dirshaye were demonstrated and evaluated with local variety. The experiment was demonstrated on 5m by10m ($50m^2$) by using simple plot design with 0.5m gap between plot to plot. Fertilizer NPS 50kg/ha and 40 kg/ha of Urea were applied to each demonstration plot with recommended seed rate.

Experimental Procedure and Field Management

After site and farmers selection were undertaken the field were ploughed three times before sowing. During sowing the seed of black cumin were properly putted by drilling in the row with fertilizer. On the field proper supervision and management like weeding were undertaken in good manner. When the experiment were reach the maturity stage field day were organized to evaluate the improved varieties with local check.

Data Collection Methods

Both quantitative and qualitative data were collected through observation, group discussion on field day and data recording sheet. Data like farmer preference on high branch; high plant height, large pod size, and high pod per plant, high yield, drought tolerant and insect resistance were collected through the prepared data collection sheet/record sheet by organizing mini field day and observation on farmer's field.

Methods Data Analysis

Descriptive statistics like mean and tabulation were used to analyse the crop performance concerning yield and yield components of the experiment harvested from demonstration plot. Improved varieties along with local variety were also analysed through ANOVA-tests. While qualitative data were analysed by Garret Ranking methods and summarization. Partial budget analysis was also used to analyse the economic benefit gained from the experiment.

RESULTS AND DISCUSSIONS

Performance of the Crop on field

The performance of the crop/experiment was evaluated from germination stage to threshing and yield collection through observation and measurements. Accordingly, Dirshaye variety has good performance from its germination to harvesting and threshing stage. From the results, Dirshaye variety give more mean yield than Eden and local variety. Thus, the mean yield gained from Dirshaye, Eden and Local varieties were 2.68, 2.25 and 2.27 Qt/ha respectively (Table 1). From the table, maximum yield 5.38 Qt/ha and 1.90 standard deviation were recorded from Dirshaye variety. But, the yield gained from the study is not its potential yield. Yield decrease may be occurred due effect of insect pest found on field during its maturity, water stress on growing stage and other biotic & an biotic factor. Kara, 2015 reported that, shortage of rain has great influence on growth and yield of black cumin.

Table1: Yield summary of black cumin collected from four locations

Varieties	Summary of yield harvested in Qt/ha from nine farmers			
	Min	Max	Mean	Std. Dev.
Eden	0.21	4.57	2.25	1.65
Dirshaye	0.45	5.38	2.68	1.90
Local	0.21	4.93	2.27	1.65

Yield advantage of improved variety over local check

Yield enhancement due to technology intervention is the primary objective of this study. Thus, it is calculated as:

$$\% \text{ of yield advantage} = \frac{(\text{Mean yield of improved variety-mean yield of local check})\times 100}{\text{Mean yield of local check}}$$

$$\% \text{ of yield advantage of Dirshaye} = \frac{(2.68-2.27)\times 100}{2.27} = 18.06\%$$

% of yield advantage of Eden = $\frac{(2.25-2.27)x100}{2.27}$ = -0.88%

Even though the variety did not gave its potential yield, the yield difference and percentage of yield enhancement by Dirshaye variety over local check were 0.41Qt/ha and 18.06% respectively (Table 2). Similar yield enhancement in different crop due to technology intervention has been reported by (Dhaka *et al*., 2010). There is no statistical difference between improved varieties (Eden and Dirshaye) with local check at 5% level of significance (Table 2). In line with this study Ermias *et al*, 2015 shows that there is no significance difference among improved varieties of Eden, Dirshaye and local check at 5%. From the table 2 we can conclude that Dirshaye variety has more yield advantage than Eden and local varieties.

Table 2: Yield enhancement and mean comparison among varieties

Varieties	**Yield difference**	**% of yield enhancement over local check**	**F-value**	**Sig**
Eden	-0.02	-0.88	0.173	0.842
Dirshaye	0.41	18.06		
Local	-	-		

Capacity Building and Experiment Evaluation

Field day was organized on evaluation of three treatments of black cumin demonstration at Bareda PA of Habro district and Kira Kufis PA of Tulo district. On field day different stakeholders like Zonal Head of Agricultural and Natural Resource Office, NGOs, Unions, University, experts from district Agricultural and Natural Resource Office, DAs and farmers were participated. To evaluate the experiment farmers, DAs, and SMS were organized in to groups for selecting best performed variety by using different selection criteria. Thus, farmers were given its own value to each trait by observing the crop on field for ranking the varieties. The value given for treatments were summarized and ranked by Garret Ranking methods (Table 3).

Table 3: Garret Ranking Methods for ranking traits on three treatments

Criteria's	Variety	1*69	2*50	3*31	Total	Avge score=Total/100	Rank
	Eden	276	450	992	1718	17.18	III
	Dirshaye	2967	100	0	3067	30.67	I
HB	Local	621	1350	279	2250	22.5	II
	Eden	69	550	1023	1642	16.42	III
	Dirshaye	2553	350	31	2934	29.34	I
HPH	Local	897	1300	186	2383	23.83	II
	Eden	276	450	992	1718	17.18	III
	Dirshaye	2760	250	0	3010	30.1	I
LPS	Local	345	1500	310	2155	21.55	II
	Eden	276	800	775	1851	18.51	III
	Dirshaye	2346	500	31	2877	28.77	I
HPP	Local	828	1050	372	2250	22.5	II
	Eden	552	850	620	2022	20.22	II
	Dirshaye	2691	300	0	2991	29.91	I
HY	Local	276	1150	558	1984	19.84	III
	Eden	1380	750	310	2440	24.4	I
	Dirshaye	1518	500	403	2421	24.21	II
EM	Local	138	1350	496	1984	19.84	III
	Eden	828	350	806	1984	19.84	III
	Dirshaye	2208	500	93	2801	28.01	I
DT	Local	552	1250	372	2174s	21.74	II
	Eden	1173	350	620	2143	21.43	III
	Dirshaye	2001	200	310	2511	25.11	I
IR	Local	1380	750	310	2440	24.4	II
	Eden	621	550	434	1605	16.05	III
	Dirshaye	1587	200	31	1818	18.18	II
DiR	Local	690	600	713	2003	20.03	I

Note: high branch (HB), high plant height (HPH), early maturity (EM), large pod size (LPS), high pod per plant (HPP), high yield (HY), drought tolerant (DT), insect resistance (IR) and Disease insect resistance .

From Table 3, Dirshaye was ranked first in terms of high branch (with average score of 30.67), high plant height (with average score of 29.34), large pod size (with average score of 30.1), high pod per plant (with average

score of 28.77), high yield (with average score of 29.91), drought tolerant (with average score of 28.01) and insect resistance (with average score of 25.11). From table we can conclude that Dirshaye variety has selected and accepted well by farmers than Eden and local varieties with the mentioned criteria's.

Economical Advantage of the crops

The profitability of on-farm trial of black cumin is presented in Table 3. The result shows that, Dirshaye variety gave the highest profit of seven thousand, five hundred and forty five birr (7,545) and high returns to investment of 35%. Thus, Dirshaye variety was selected by its profitability and percents of benefits among two varieties (Eden and Local varieties). The results from Table 3 shows that, enomically one farmer can benefit 35% from a hectare of Dirshaye variety. Similar study conducted by Mishra *et al*, 2009 shown that improved variety application was more economical than local landraces.

Table 4: Profitability of black cumin experiment from four locations

Variety	Yield (Qt/ha)	Price (Qt/Birr)	Fertilizer cost in birr	Seed cost in birr	Labor cost in birr	Insecticide cost	TVC*	TR*	GM*	% of benefit
Eden	2.25	8000	1025	1100	11520	250	13895	18000	4105	22.81
Dirshaye	2.68	8000	1025	1100	11520	250	13895	21440	7545	35.19
local	2.27	8000	1025	800	11520	250	13595	18160	4565	25.14

Note: TVC*, TR* and GM*, shows total variable cost, total revenue and gross margin respectively.

CONCLUSION AND RECOMMENDATIONS

Conclusions

Eden and Dirshaye varieties of improved black cumin were evaluated with local check on eight experimental farmers land. From the evaluated treatments Dirshaye variety has more mean yield (2.68qt/ha) than Eden (2.25qt/ha) and local check (2.27qt/ha). Even though the experiment did not record its potential yield due to insect problem, Dirshaye variety has more yield advantage and economic profit than both varieties at the study areas. Farmer has also selected dirshaye variety by different traits (was ranked first in terms of high branch, high plant height, large pod size, high pod per plant, high yield, drought tolerant and insect resistance) on field during field day program organized on it. Besides observation on field; the importance of the crop towards its medicinal purpose and income motivated the farmer to accept the technology and expand & disseminate the seed on its own land for the future.

Recommendations

Thus, based on its great importance of the crop and yield potential obtained from the result, Dirshaye variety was recommended for further scaling up to reach huge farmers and cover wide areas. Therefore, concerning bodies like research centers, district agricultural office, NGOs and other development institutions should have multiply and disseminate the crop in study areas and similar agro-ecology.

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