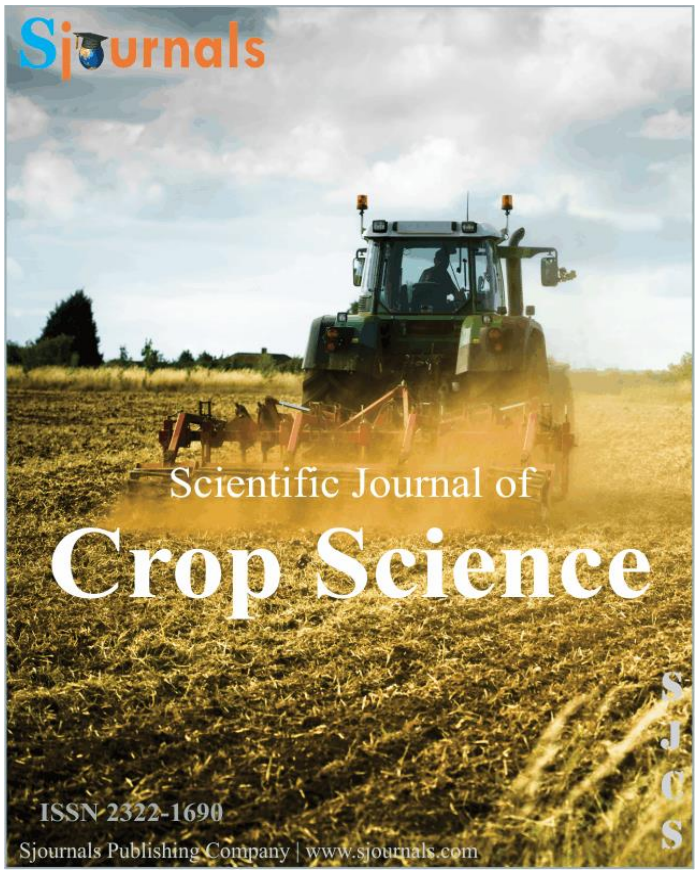

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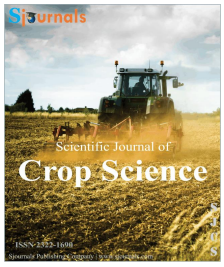

Original article

On farm demonstration of lentil technologies at highlands of Guji Zone, Southern Oromia, Ethiopia

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ABSTRACT

Highland areas of Guji zone is high potential for lentil production. However, farmers are not intensively engaged on lentil due to lack of improved varieties. Therefore, it is important to demonstrate lentil varieties on farmers land. This activity was done at Bore and Ana Sora districts to evaluate yield and profitability of improved lentil varieties, to assess farmers' preference and to create farmers' knowledge and skills on lentil production during 2019 year. From each district, three kebeles were selected based on suitability for lentil production. At each kebele 15 farmers were selected and grouped as one Farmers Research Group (FRG). At each FRG there were three experimental farmers. Alemaya and Derash varieties were demonstrated on plot size of 100 m^2 area by 20 cm space between rows and drilling seed in the row with recommended seed and fertilizer rates. Training, exchange visit between experimental farmers and field day was used to improve farmer-to-farmer learning on lentil production. Data was collected by observation, measurement and interview and analyzed by descriptive statistics and qualitative narration was used to analyze farmers' feedback. Profitability of lentil varieties were analyzed by net farm income. The result of demonstration revealed that Alemaya variety gave 10.02 qt/ha and 4.72 qt/ha was obtained from Derash variety. Even though both varieties susceptible to rust and pod borer during production year, Alemaya variety selected as first based on yield, farmers

preference and economic returns. With support of agro chemicals that control rust and pod borer Alemaya variety was recommended for pre scaling up in highlands of Guji zone and similar agro ecologies of the area.

1. Introduction

Lentil (*Lensculinaris* Medikus) is one of the most important cool season food legumes grown in many parts of the world as food crop (Erskine et al., 2011). In Ethiopia, lentil is produced under a wide range of altitude from 1600 to 2700 meter above sea level (Bedasa and Zewdie, 2019). Lentils one of the heavily consumed legumes crops in Ethiopia and is a popular ingredient of everyday diet in the majority of households. Besides being rich in protein, the ability of crop to use atmospheric nitrogen through biological nitrogen fixation (BNF) is economically appealing and environmentally friendly (Bezabeh and Belay, 2019). In addition, the crop is used as cash income, restore soil fertility for subsequent crop production, foreign currency earnings and the straw of lentil is used for livestock feeding (Bedasa and Zewdie, 2019; Matny, 2015; Daniel et al., 2015).

In Ethiopia lentil is used to make the local '*Nifro'* (boiled lentil), '*Sambusa'* (boiled whole lentil that is roasted in oil after wrapping with paste of wheat flour), and '*Shorba'* (soup) and wot (local soup for moistening and eating along with '*Injera'* (flat pancake) or bread) (Bedasa and Zewdie, 2019). The productivity of lentil remains low (1.4 tons ha^{-1}) (CSA, 2019) and still relatively low compared to its yield potential (3.6 tons ha^{-1}) with well managed production due to biotic and abiotic stresses (Kumar et al., 2017; Bedasa and Zewdie, 2019). High humidity with excessive rainfall during growing season promotes vegetative growth and caused lodging, which reduces later good yield and seed quality (Sorecha and Daba, 2019), use of local varieties also affect the yield performance of lentil (Yirga and Zinabu, 2018).

Despite nutritional, economic and environmental advantages of lentil the production of this crop is not known in highland of Guji zone due to lack of improved varieties. Highland parts of Guji are a potential for wheat and barley. Most farmers also use their land year to year for these cereal crops. But, naturally, cereal crops have ability of depleting soil fertility over years as sown repeatedly on the same land. Unless legume crops like lentils are supplemented with cereal crop farming the fertility of soil is in risk. Farmers of the study area did not know the production of lentil and its potential advantage. Thus, for further awareness creation and evaluate yield performance, the demonstration of lentil varieties was initiated to highland districts of Guji Zone.

1.1. Objectives of the study

- ✓ To evaluate yield performance and profitability of the improved lentil technologies under farmers' conditions
- ✓ To create knowledge and skills on lentil production in highland area
- ✓ Assess farmers' feedbacks for further development of lentil production

2. Materials and methods

2.1. Description of study areas

Bore is 385 km away from Addis Ababa to the South. The district is bordered by Hula district of SNNPR in the North, Ana Sora district in the South, Bona district of SNNPR in the East and Dama district in the West. The major agro-ecology of the district was highland (90%) and midland (10%). Annual average of temperature of the district is 16.05 ^{0}C. The mean annual rainfall is 1300mm while its altitude ranges from 1400 up to 2910 meter above sea level allowing a favorable opportunity for crop and livestock production. Root crops such as potato, carrot and onion and vegetable crop like cabbage could be grown in the area. At Bore district, cattle, horses, sheep and bee keeping are the dominant livestock. Selling of milk is one of income generating activity for rural women. Bore is also well known by its 'white honey' which is produced from different plants found in the district. Some rural youth and

male farmers of Bore district are migrants to extract minerals namely gold to maintain their income during off season (Basha et al., 2017).

Ana Sora was situated at a distance of 410km from Addis Ababa to the South. In the district crops such as bread wheat, food barley, horticultural crops (mostly potato, enset, garlic and head cabbage) and highland pulse crops (faba bean and field pea) were largely produced. The district has longer growing season for the production major crops except for potato which has relatively a short maturity crop. In the district, there is high potential of honey production (Basha and Dembi, 2017).

2.2. Site selection

The trail was implemented in two highlands of Guji Zone. Bore and Ana Sora districts were selected purposively based on lentil production. From each district, three representative *Kebeles* were selected based on their accessibility for follow up and suitable for production of the lentil. Accordingly, 15 (5 women) farmers were selected from each *Kebele.*

2.3. Experimental farmers' selection

Ownership of land, willingness to contribute the land, motive to implement the demonstration, and willingness to explain the technologies to others were criteria used to select experimental farmers. Three (3) experimental farmers were selected per kebeles. Therefore, 18 experimental farmers were used for this activity. But three experimental farmers trial was not used for analysis due to erosion effect on the trial.

2.4. Demonstration materials and field design

Two improved lentil varieties namely (Alemaya and Derash) were demonstrated on 100 m^2 plot size. Full packages were applied in which drilling of seed in the lines of 20 cm between rows, 100 kg/ha and 80 kg/ha seed rate of Alemaya and Derash were applied respectively, 121kg/ha NPS fertilizer per hectare was applied and twice hand weeding was done.

2.5. Data collection methods

Both qualitative and quantitative data were collected using direct field observation, measurements and face to face interview. The seed yield data were collected using data collection sheets while feedbacks were collected using checklist by conducting face to face interviews.

2.6. Methods of data analysis

Descriptive statistics were used to analysis the yield aspects while qualitative narration employed to analyze farmers' and other stakeholder feedback. Net farm income (NFI) was used to analyze the profitability of demonstrated lentil varieties.

3. Results and discussion

3.1. Capacity building on lentil production

To increase farmers' knowledge on lentil production trainings were given for selected Farmers Research Group members, Development Agents (DAs) and Subject Matter Specialists (SMSs). Exchange visit and field days were organized to enhance farmer to farmer learning and experience sharing on the production and management of lentil among and between FRGs members and other concerning body. Multidisciplinary teams; pulse and oil, agricultural extension and other stakeholders actively shared their experience and knowledge during training and field day organized. Table 1 shows the number of farmers, development agents, district office of agriculture experts and other participants who attended training, exchange visit and field day of lentil demonstration.

3.2. Yield performance of demonstrated varieties

Alemaya variety gave 10 qt/ha, which is greater than 4.7 qt/ha from Derash variety. Yield obtained from both varieties were lower than the previously conducted participatory variety selection (PVS) of lentil by Oil and Pulse research team which were 19.44 qt/ha and 13.24 qt/ha from Alemaya and Derash variety respectively (Afeta et al.,

2018). This yield gap was due to rust during flowering stage and infestation of pod borer during critical pod stage. Table 2 shows that mean grain yield performance of lentil demonstrated varieties.

Table 1
Number of participant on lentil capacity building.

Capacity building methods	Participants	Number of participant		
		Male	Female	Total
A. Training	Farmers	60	30	90
	DAs	6	3	9
	SMSs	6	-	6
B. Exchange Visit	Farmers	8	2	10
	DAs	3	-	3
	SMSs	3	1	4
	Others	3	1	4
C. Field day	Farmers	48	22	70
	DAs	8	2	10
	SMSs	10	-	10
	Others	30	8	38

DAs = development Agent, SMSs = subject matter specialist

Table 2
Mean seed yield of lentil variety demonstrated (qt/ha).

Varieties	N	Mean	Std. Deviation
Alemaya	15	10.0293	2.17393
Derash	15	4.7200	1.13701

Table 3
The result of independent t test

	Test for equality of variances		t-test for equality of means				
	F	Sig.	t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
No equal variances	6.351	.018	8.382	21.126	.001	5.30933	.63344

Table 3 show that the equality of yield performance of demonstrated lentil varieties were tested by independent sample t test. During lentil demonstration, the equal variances are assumed ($p = .018 < .05$). A significance value of .001 (less than .05) this indicates that there is statistically significant difference between the two means yield of both varieties which was 5.3 qt/ha of Alemaya variety over Derash variety.

3.3. Cost benefit analysis

During production season the farm get price was 40 ETB for one kilogram of both varieties. Total revenue was calculated by multiplying the price by the yield obtained (TR= Y x P). Total variable costs included were costs of land preparation, sowing, weeding, seed costs, fertilizers cost, harvesting and threshing costs. Total fixed cost is the cost of land used for lentil production. Growth margin was obtained by subtracting total variable costs from total revenue (GM = TR-TVC) and the final profitability was calculated by subtracting total fixed cost from total Gross margin (Profit = GM-TFC). The result of cost benefit analysis showed that 29,202 ETB/ha and 8515.46 ETB/ha was obtained from Alemaya and Derash varieties respectively during production season. Alemaya variety were profitable than Derash at the study area.

Table 4
Cost benefit analysis of lentil demonstrated varieties in ETB/ha

Parameters	N	Mean	Std. Deviation
Yield of Alemaya (qt/ha)	15	10.0293	2.17393
Yield of Derash (qt/ha)	15	4.7200	1.13701
Farm get price (P)	15	40	.00000
Total Fixed cost	15	2500.0000	.00000
Total variable costs	15	8415.3333	178.75229
Total cost	15	10915.3333	178.75229
Total revenue of Alemaya	15	40117.3333	8695.72593
Total revenue of Derash	15	18880.0000	4548.02940
Gross margin of Alemaya	15	31702.0000	8612.47501
Gross margin of Derash	15	11015.4667	6599.59862
Profitability of Alemaya	15	29202.0000	8612.47501
Profitability of Derash	15	8515.4667	6599.59862

3.4. Farmers' feedback on lentil varieties

In participatory research activities like sowing on farmers' field the farmers feedback is important for further research activities. During the demonstration of lentil experimental farmers provide constructive feedbacks which go back to research agenda for further research on lentil technologies for researchers. Even though both Alemaya and Derash lentil varieties were susceptible to rust and pod borer Alemaya variety tolerates both rust and pod borer than Derash variety and Alemaya variety gave higher yield and returns than Derash variety for farmers at the study area. Finally, farmers were preferred based on the tolerant to rust and pod borer, seed size, seed color, good crop stand and profitability of the varieties. Farmers preferred Alemaya variety as their first choice.

4. Conclusion

On farm demonstration of lentil varieties was carried out on fifteen (15) representative trial farmer's fields. Two Improved variety Alemaya and Derash varieties were demonstrated under farmer condition. Tolerate to rust and pod borer, grain yield and net return (profitability) were the most three priority traits of the farmers used to select and prefer the demonstrated lentil varieties. The demonstration result revealed that both varieties were not gave their maximum potential which was 10 qt/ha and 4.72 qt/ha from Alemaya and Derash varieties respectively. This is due to infestation of rust and pod borer during flowering and pod stage. However, profitability from Alemaya varieties was viable at the study area. Based on that tolerant to rust and pod borer, seed size, seed color, good crop stand Alemaya variety was selected by experimental farmers in the study area. In study area, most farmers use their land year to year for these cereal crops. But, naturally, cereal crops have ability of depleting soil fertility over years as sown repeatedly on the same land. Thus, lentil should be sown in rotation with cereals cropsin order to restore soil fertility. Even though, both lentil variety cannot give their maximum potential Alemaya variety had economically profitable at study area. Therefore, the succeeding pre-scaling up of Alemaya variety should be carried out with agro chemical application.

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