



# PERFORMANCE EVALUATION AND ADAPTATION OF LENTIL VARIETIES IN LEMU, GUMUR AND DAMOT GALE DISTRICTS OF SOUTHERN ETHIOPIA

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## ABSTRACT

*This study was conducted on stations and on farm in three districts of South region, Ethiopia, to evaluate the lentil varieties for yield and adaptation, assess farmer's preferences during 2004/05 Meher Season. Data on plant height, hundred seed weight, pod per plant, days to flowering, days to maturity and grain yield were collected. Six lentil varieties which included five released and one local check of respective locations were planted on 3.2m<sup>2</sup> plots at spacing of 20cm\* 2cm. The plots consisted of four rows which were four meters long for on-centre and on farm trials. The trials were laid in randomized complete block design with four replications. Twelve farmers from three districts of four farmers at each village were participated in executing on farm trials. Each farmer was a replicate for on farm component. There were significant differences among varieties for grain yield and some of traits. The results for the on-centre and on farm trials indicated that there were significant yield differences between the local check and the released varieties at two stations and three districts. The varieties Teshale and Alemaya were superior yielded overall to the local check across three villages and on stations. Thus, Alemaya and Teshale out yielded other varieties and had average yields of 1239.1 kg/ha and 1193.8 kg/ha at on station and 1165.1 kg/ha and 1202kg/ha at on farm trials, respectively. Combined statistical analysis and farmers assessments identified two genotypes (Teshale and Alemaya) as potential varieties for production in south Ethiopia. Therefore, based on researchers and farmers' preference, varieties Teshale and Alemaya are recommended for production in Lemu, Gumur and Damot Gale districts and similar agro ecologies of south Ethiopia.*

**Keywords:** Adaptation, Lentil, On centre and on farm evaluation, Release variety, Grain yield.

## 1. INTRODUCTION

Lentil (*Lens culinaris* Medik) is dominantly produced in Canada, India and Nepal, which contributing 1043200, 810000 and 161147 metric tons, respectively, to the world's total production. USA, Ethiopia, Bangladesh, Australia, Iran, Syrian Arab Republic and China are also

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important lentil producing countries. Lentil is one of the high land crops widely grows in Ethiopia. It is largely produced in the high land and semi-highland regions of the country mainly on clay soil. In Ethiopia, out of the total area under cultivation, 97,110 hectares of land is covered with lentil and about 81,049.4 tons are produced currently [1]. This crop is widely used for food because of its protein content. Apart from this, due to its ability to fix nitrogen, it is used in the crop rotation with the nationally important crops.

Lentil is grown in various zones, some special woredas and pocket areas in the Southern Nations, Nationalities and Peoples Regional State (SNNPRS), south Ethiopia. In general, in this region lentil occupies about 1,987.5 hectares of land annually with estimated production of 8,900.48 quintals [1]. The average yield of lentil in the region is 0.448 tons/ha, which is low, compared to the 0.835 tones/ ha of the national average yield [1]. The low productivity in the region could be attributed to lack of adapted high yielding cultivars, susceptibleness to disease, insect pests and inadequate agronomic management. Some researches' in the country and abroad indicated that lentil varieties produce significantly different yields at locations emphasizing to test lentil varieties in various agro ecological zones for their adaptation, yield potential and disease reaction so as to identify appropriate varieties for promotion on farmers' field. Geletu and Yadeta [2] evaluated 44 entries at Akaki and Mekele and suggested that among those genotypes 4 entries that had good stand and high yield were selected for further yield tests. One entry, a large black seeded type was recommended for further testing and seed increase. Similarly two entries and entry in Syrian lentil observation nursery of 30 entries are both large seeded and may be useful in a breeding program. Although there were some research efforts to fill the gap between actual and potential yield, suboptimal yield in the lentil is mainly due to lack of adoption of improved production packages.

Therefore, the objectives of this study were to evaluate lentil varieties with a vision of selecting and identifying the variety (ies) that will best adapt to the conditions and assess farmer's preferences in the southern parts of Ethiopia.

## 2. MATERIALS AND METHODS

The experiment was conducted both at on centre and on farm in Lemu, Gumur and Damot Gale districts

**On-Station.** The study was conducted at the South Agricultural Research Institute's of Areka Research Centre at Hossana and Freeze stations. The altitudes, rain fall, soil type, mean temperature, latitude and longitude of the study sites are 2290masl, 1592.1mm, Profondic Luvisols, 17.02°C, 7° 5' N and 37° 5' E for Hossana station and 2884 masl, 1860.1mm, Profondic Luvisols, 17.02°C, 7° 5' N and 37° 5' E for Freeze. The study included evaluation of five released and local check for adaptation and yield, assesses farmer's preferences. The six varieties were: Alemaya, Checkol, Ada, Teshale, Alemtena and Local checks. The trial was planted in randomized complete block design with four replications. The trial was planted at Hossana and Freeze stations at four rows with plot area of 3.2m<sup>2</sup> of 4m\*0.8m during the Meher season of 2004/05.

Spacing was 20cm between rows and about 2cm between plants in a row. The crop was planted in mid to late July at a spacing of 20cm \*2cm. Local checks of respective locations were used as checks at both sites. Hand weeding was used to control weeds as per recommendation. Observations were recorded on the days to flowering, days to maturity, pod/plant, plant height, 100 seed weight and seed yield. At harvest seed yield was determined from the two central rows, whereas 100 seed weight was determined from 100 seeds that were randomly selected. Data on grain yield in gm per plot were recorded and converted into kg/ha.

On-farm. The trial was carried out on-farm in three clusters, one in Gurage Zone of Gumur District, one in Wolayta Zone of Damot Gale district and Hadiya Zone of Lemu District. The respective agro- ecological zones were Gumur (high land), Wandara (mid highland) and Bobicho (mid highland) groups. The altitude, rainfall and soil texture ranged from, 2000 masl to 2884 masl and 1592mm to 1900 mm and sandy-loam-clay loam ,respectively . The trial comprised of all the five released and one local check. A total of 12 farms at three districts; 4 farmers at each villages were participated. Planting started in mid July and continued until Early August, 2004/05. Each plot comprised of four rows which were four meters long. The spacing was 20 x 2 cm. Each farm was treated as a replicate. Experiments were run with close supervision of Researchers according to recommended agronomic practices.

The farmers used matrix ranking to assess the most suitable varieties for their areas. To validate farmers preferences focus group interviews' were held with group of farmers to obtain their perceptions on lentil varieties under evaluation. Therefore, a total of 90 farmers at three districts; 30 farmers at each village were invited to visit the trial site twice and farmers were asked for their perceptions on the lentil varieties under evaluation. The characters scored included; yield, pod setting, maturity, seed size, seed color, seed market demand, seed number, pod number per plant and taste. A scale of 1-5 was used to assess these characters and farmers were asked to place the above scales for variety ranking representing a given trait and variety. The Researchers were prepared lentil varieties rating sheet indicating these criteria and farmers were asked by Researchers to give their preference by ranking the six varieties under evaluation. Farmers' responses were counted to get totals for each trait per variety; the smallest total count was assigned first rank. Besides to technical support, researcher also provided seeds to the farmers. Farmers provided land and other resources for crop management. Data was collected for days to flowering, maturity, plant height number of pods per plant, hundred seed weight and grain yield per hectare. Data recorded were subjected to analysis of variance (ANOVA) using the general linear model (GLM) procedures of statistical Analysis System package [3].

### 3. RESULTS AND DISCUSSION

Analysis indicated that the checkol was found the earliest variety to mature with mean of 96 days, Alemaya with mean of 113.5 days was found the latest variety among others (Table 1). All genotypes were matured between 96 day and 113.5 days. This also disagrees with the findings of Edossa, et al. [4]who reported that varieties Alemaya, Alemtena, and Teshale were early

maturing varieties and hence could be recommended for areas with short rainy season whereas checkol was intermediate maturing varieties. Opposite our findings, Sarker, et al. [5], and L'azaro, et al. [6] reported that maturation has taken 132 and 226.7 days, respectively, for these lentil lines. This variation may also be due to the genetic and climatic factors. The result of this finding revealed that all the improved lentil varieties except checkol are late maturing as a result of which they need to be planted earlier to escape frost attack at Freeze areas and terminal drought at moisture stress areas to realize their potential.

The mean days to flowering ranged from 43.5 days to 48.5 days for Hossana and Freeze stations. Our findings disagree with Erksine [7] who found days to flowering ranged from 118 to 162 days. Significant variations were observed among cultivars for plant height. Plant height was varied from 30 to 35.25 cm. It was determined that local variety was the shortest, and Ada was the tallest among lentil varieties (Table 1). Piergiovanni [8] reported that plant height varied from 28 to 41 cm in their material. Sarker, et al. [5] stated that plant height was record in 31cm. The mean number of pods per plant ranged from 36.8 to 44.3. The genotypes local check, Alemaya, and Alematena had higher number of pods per plant than the other test varieties (Table 1). This finding is in line with Stoilova and Pereira [9] who reported that number of pods per plant was showed remarkable variation in their lentil lines. The results of on station trials revealed that differences among varieties were significant for yield, plant height, number of pods and hundred seed weight (Table 1 &2). This finding agrees with the result reported by Edossa, et al. [10] in Ethiopian lentil landraces for number of pods, number of secondary branches, plant height, and seed yield except for hundred seed weight. Average grain yield for on- center and on farm trials range from 943.6 to 1239 kg/ha, and 921.4 to 1202 kg/ha, respectively (Table 2). Alemaya and Teshale had maximum mean grain yield (Table 2). In line with this findings Erksine [7] reported that grain yield had a wide variation (from 10 to 3257 kg/ha) in his lentil materials. This result pointed out that seed yield potential in lentil may be varied from cultivar to cultivar. On farm: - Analysis of variance revealed that differences among varieties were significant ( $P < 0.05$ ) to highly significant ( $p < 0.01$ ) for grain yield (Table 2). The grain yield was significantly different in varieties tested in this experiment and the maximum grain yield (1239 kg/ha) was recorded in variety Alemaya, while Teshale produced average grain yield of 1193.8 kg/ ha (Table 2). The local check and Alematena gave lower yield 943.6 kg/ha and 958.6 kg/ha. The results of on station and on-farm managed trials revealed the outshining and farmers preferred varieties Alemaya and Teshale showed chance of wider acceptance to the farmers in the study area. The superior yielding varieties Alemaya and Teshale produced 1165.1 kg/ha, 1202 kg/ha of grain yield, (26.4%) and (30.5%) more than the local check, respectively at on farm trials (Table 2). Similarly over two stations 31.3 % and 26.5 % more than local check was recorded by these top yielding varieties. The average grain yield from the three on farm sites ranged 921.4 kg/ha for local check to 1202 kg/ha for variety Teshale (Table 2). Alemaya and Teshale performed relatively better than others in all the villages exchangeably. All the test varieties showed

relatively lower performance in Freeze station than Hossana. This might be due to poor soil fertility status particularly Freeze on station and poor management for on farm trials.

At Bobicho on farm, varieties Teshale and Alemaya yielded significantly higher than local checks. The local check yielded significantly lower (1029.7 kg/ha). The yield range from 1029.7 to 1352.7 kg/ha for this site. At wandara Boloso, varieties Teshale, Ada and Alemaya out yielded the local check whereas the differences among them were statistically at par. Similar, in Idiget village, significant yield difference was observed among varieties Alemaya, Teshale, Ada and the rest of varieties. However; the differences among them were not statistically significant. These yields indicate with proper choices of varieties it is possible for farmers to achieve superior yields and improved production packages. Farmers' perception on the preference of the new lentil varieties depend on the significance of the crop in the farming system and benefits. The ranking of lentil varieties based on the perception of the farmers are presented in Table 3. As per the selection criteria set farmers ranked Alemaya, Teshale and checkol at the first, second and third position across all three districts of three villages (Table 3). The overall preference ranking of varieties based on nine criteria was in the order Teshale, Alemaya, checkol, Ada, Local check and Alemtena, respectively. Farmers prefer cultivars that meet several objectives; as per farmers' preference Teshale and Alemaya newer improved cultivars could easily be disseminated in the farming systems. Farmers preferred the variety checkol thirdly as its earlier maturity, whereas Alemtena and local check were ranked the lowest.

#### 4. CONCLUSION

This research was done on two centres and on farm in three districts of Gurage, Wolayta and Hadiya Zones, south region, Ethiopia, to identify potentially high yielding and farmers' preferred genotypes for improved production of Lentil during 2004/05 Meher Season. The analysis of variance revealed that varieties are significant for grain yield and some yield components. The mean values of on station trials of varieties for grain yield ranged from local check (943.6 kg/ha) to Alemaya (1239.1 kg/ha). Varieties Alemaya, Teshale and Ada had a grain yield advantage of 31.3%, 26.5% and 16.9 % over the local check, respectively. Similarly at on farm trials varieties Alemaya and Teshale had a grain yield advantage of 26.4% and 30.5 % over the local check, respectively. Checkol was found to be the earliest maturing variety with moderate grain yield. Farmers' main selection criteria were grain yield, maturity date, pod setting, seed size, seed color, seed market demand, seed number, pod per plant and taste of boiled dry grain. Combination of yield and farmers' preference identified two genotypes (Teshale and Alemaya) as potential varieties for production in south Ethiopia. Therefore, based on Researchers and farmers' preference, varieties Teshale and Alemaya are recommended for production in the selected districts and similar agro ecologies of south Ethiopia.

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**Table-1.** Mean number of pod per plant, hundred seed weight (gm), plant height (cm), days to flowering and days to maturity per Lentil varieties at Hossana and Freeze on station in 2004/05 meher season

Lentil varieties	HSW (gm)			PH (cm)			PP			FD			MD		
	H	F	X	H	F	X	H	F	X	H	F	X	H	F	X
Alemaya	3.2ab	2.9a	3.1	38.3bc	27.5b	32.9	44.ab	37.5ab	40.8	44.5a	50.5a	47.5	110a	117a	113.5
Chekol	2.2c	2.6b	2.4	41.3a	27.3bc	34.3	45ab	35.5bcd	40.3	44a	51.5a	47.8	93.5c	98.5b	96
Ada	2.2c	1.8c	2.0	40.3ab	30.3a	35.3	40.8b	32.75cd	36.8	44.3a	50.3a	47.3	106.8ab	111.75a	109.3
Teshale	3.4a	2.9a	3.2	39.5abc	30.3a	34.9	41.5b	32d	36.8	45.5a	51.5a	48.4	111a	114a	112.5
Alem Tena	3.0b	1.8c	2.4	37.3cd	31.3a	34.3	43.5ab	37abc	40.3	45.5a	50a	47.8	108.3a	113.25a	110.8
Local	2.2c	1.8c	2.0	35d	25c	30	48.25a	40.25a	44.3	40.5a	46.5b	43.5	99.5bc	104.5b	102
GM	2.7	2.3		38.6	28.6		43.83	35.83		44.04	50.04		104.8	109.83	
Cv	6.7	8.3		4.7	5.74		7.32	8.15		8.69	4.61		5.03	4.19	
LSD (5%)	0.27	0.28		2.7	2.48		4.84	4.4		5.77	3.48		7.94	6.93	

Means within each column followed by the same letter are not significantly different at 5% as determined by Duncan's Multiple Range Test  
 NB:-H=Hossana,F=Freeze,X=Mean ,GM=Grand mean, Ph=plant height ,pp=pod per plant, HSW=Hundred seed weight, FD=Days to Flowering & MD=Days to maturity

**Table-2.** Mean grain yield (kg/ha) per Lentil varieties at Hossana and Freeze on station and at Wandara Boloso, Bobicho and Idiget villages on farm in 2004 /05 meher season

Lentil varieties	Yield(kg/ha) of on station trials				Yield(kg/ha) of on farm trials			Mean	Y.A
	Hossana	Freeze	Mean	Y.A	Wandara	Idiget	Bobicho		
Alemaya	1392.2a	1085.9a	1239.1	31.3%	1173.4ab	1010.94a	1310.94a	1165.1	26.4%
Chekol	1214.1ab	857.8abc	1036.0		996.96b	756.25bc	1093.75b	949.0	
Ada	1298.4ab	907.8abc	1103.1	16.9%	1232.8ab	851.56abc	1198.44ab	1094.3	
Teshale	1420.3a	967.2ab	1193.8	26.5%	1351.6a	901.56ab	1352.69a	1202.0	30.5%
Alem Tena	1232.81ab	684.4c	958.6		1170.3ab	842.19abc	1195.3ab	1069.3	
Local check	1131.25b	756bc	943.6		1068.8b	665.63	1029.69b	921.4	
Grand mean	1281.5	876.6	1079.01		1165.6	838.0	1196.8	1066.8	
Cv	12.1	18.52			12.29	16.65	11.01		
LSD (5%)	233.6	244.7			216.1	1973.7	198.62		

Note:- Y.A=Yield advantage

**Table-3.** Matrix ranking of six Lentil varieties based on farmers perception on various characters during 2004/05 meher season

Lentil varieties	HY	PS	EM	SZ	SC	SD	SN	PN	TS	Total	Rank
Alemaya	1	2	3	2	1	2	4	2	1	18	2 <sup>nd</sup>
Chekol	4	1	1	3	3	3	3	3	4	25	3 <sup>rd</sup>
Ada	3	3	2	3	2	2	5	4	2	26	4 <sup>th</sup>
Teshale	2	2	4	1	3	1	2	1	1	17	1 <sup>st</sup>
Alem Tena	4	3	5	3	5	2	3	2	2	29	6 <sup>th</sup>
Local check	5	3	3	2	2	2	4	3	4	28	5 <sup>th</sup>

Key: HY=high yielding, PS=pod setting, EM=early maturity, SZ= seed size, SC=seed color, SD=seed market demand, SN= seed number, PN= pod number per plant and TS=taste -preference scale 1-5, Higher preferences=1, to lower preference=5

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