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Research Article

Performance of Lentil Varieties at Bule Hora, Southern Ethiopia

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Abstract

Lentil (Lens culinaris Medik) is one of the most important highland food legumes grown in many parts of the world as food crops. It is among dominated legume crops produced in southern Ethiopia including Bule hora districts of West Guji zone. However, shortage of improved lentil varieties that suitable to the existing environment is one of the major production constraints. Consequently, this experiment was conducted to evaluate nine Lentil varieties and recommend suitable lentil varieties for the study areas and similar agro ecologies. Moreover, the field experiment was conducted for three years at Bule hora in 2018, 2019 and 2020 and the varieties were planted in Randomized Complete Block Design (RCBD) with three replications. All necessary data were collected on yield and yield related traits and summarized on Microsoft excel sprit shit. Combined analysis of variance over three years revealed significant variations among varieties for grain yield, flowering dates, maturity dates and number of seeds per plants. Moreover, Varieties showed a grain yield as high as 1104kg/ha with pooled mean of 894.84kg/ha. Derash (1104kg/ha) variety is relatively high yielding variety followed by Chackol (1099.999kg/ha) with yield advantage of 18.95% and 18.65% over variety mean respectively. Therefore, those two varieties are suggested for commercial production all over the place of the study area and locations with similar agro climate until new high yielder varieties will be developed through breeding program.

Keywords

Adaptability, Grain Yield, Yield Related Traits

1. Introduction

Production of lentil is mostly dominated by highland agro ecologies of the world as important source of food for household for over 8,000 years ago [2] and [12]. It is one of the most important highland food legumes grown in many parts of the world as food crop [14]. It is among the top ten legume crops produced worldwide after dry bean, pea, chickpea, faba bean and cow pea. Ethiopia, it is widely grown in highland and semi midland agro ecologies [9, 3, 8] mainly preferring variable soil from sand to clay loam and high amount of rainfall [8]. Know days in Ethiopia, the production of Lentil is increasing from year to year (Figure 1). In Ethiopia, the total land area and the total volume of lentil production has increased at a compound growth rate of 4% and 9% respectively, while the productivity of the crop has shown a 5% compounded growth [4]. The area coverage, production and productivity were simultaneously increasing from year to year. The national average yield was also increased by more than double from 0.556 tons in 1993 to 1.365 tons in 2020.

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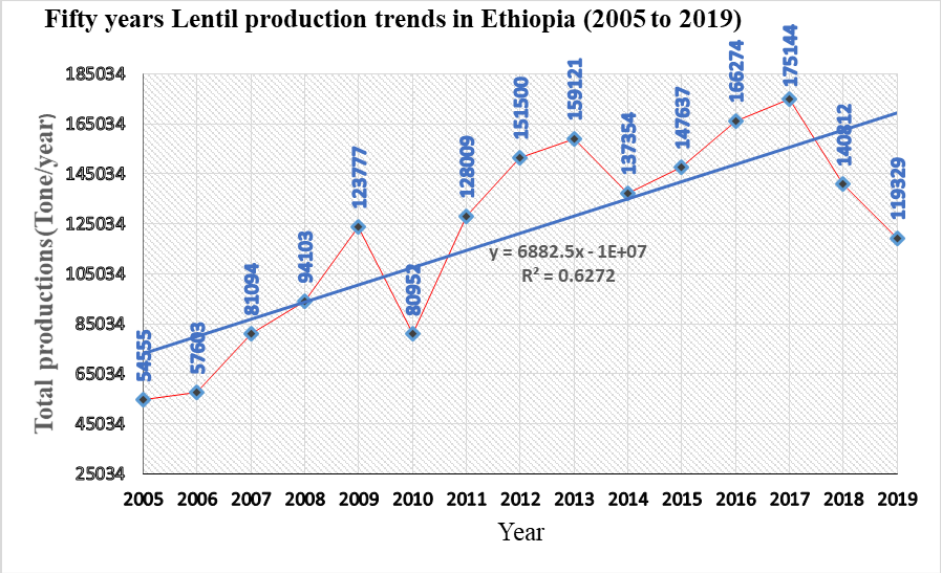
From this, it is expected that Lentil production is increasing rapidly in the future due to its demand for consumption and other purposes.

In southern part of Oromia, the production of Lentil is still very low. Moreover, there is a need for selecting high yielding and adaptable varieties and capacitating farmers and agricultural investors in the study areas. This experiment was therefore conducted with the following objective.

Objective: To select and recommend adaptable Lentil varieties for the study areas.



Source: [5]

Figure 1. *Fifteen Years Production Trends of Lentil Productions in Ethiopia.*

2. Materials and Methods

2.1. Descriptions of the Study Area

The experiment was conducted at Bule hora during 2018, 2019 and 2020 cropping season. The experimental areas are located in the Southern part of the country in the Oromia Regional State, West Guji zone, Bule hora district (Garba). The area is located at 447 km far from Addis Ababa city.

2.2. Experimental Materials

A total of 9 Lentil varieties were collected from Debre zeyit Agriculture research Center and evaluated at Bule hora for three consecutive years (2018, 2019 and 2020).

Table 1. *List of Lentil Varieties Used in this Experiment.*

S. No	Variety	Year of release	Breeder/ Maitainer
1	Chalew (NEL 358)	1984	DZARC /EIAR
2	Alemtena (FLIP 96-49L)	2004	DZARC /EIAR
3	Gudo (FLIP 84-78L)	1995	DZARC /EIAR
4	Denbie (El-142xr-186-3)	2013	DZARC /EIAR
5	Teshale (FLIP 96-46L)	2004	DZARC /EIAR
6	Derash	-	-
7	Alemeya	-	-
8	EL		

S. No	Variety	Year of release	Breeder/ Maitainer
9	Chekol (ENAL-2704)	1984	DZARC /EIAR

2.3. Experimental Design and Managements

The experiment was laid out in Randomized Complete Block Design. Each variety was planted in a plot having 6 rows of 2 meter length. Four rows were harvested and two border rows were left to exclude border effect. Individual plot size was 1.8 m x 2m=3.6 m^2 and 1m between each block. All other agronomic managements were applied uniformly in all experimental plots as per national recommendation for the lentil varieties.

2.4. Data Collection

1) Plant height at harvest (cm): Height of five randomly taken plants during harvest period from each experimental plot was measured in centimeter from the ground level to top of the plants and the average height was recorded.
2) Number of primary branches: Number of productive branches extending from the main stem was recorded from five randomly selected plants and average branch number was taken.
3) Data recorded on plot basis.
4) Days to Flowering: The numbers of days from the date of emergence to the date on which about 50% of the plants in each plot produce flowers.
5) Days to maturity: The number of days from planting to maturity period.
6) Stand count at harvest: This was recorded by counting the total number of plants from the four middle rows of each plot at harvest.
7) Grain yield (g/plot): Grain yield in grams obtained from the central four harvestable rows of each plot was harvested, threshed and weighted by using sensitive balance.
8) Grain yield (kg/ha): Grain yield obtained from each plot was used to estimate grain yield (kg) per hectare.
9) Number of pods per plant: this was recorded as average total number of pods of five randomly selected plants from each experimental plot at harvest.
10) Number of seeds per plant: This was recorded as average total number of seeds of five randomly selected plants from each experimental plot.

2.5. Data Analysis

Analysis of Variance

Analysis of variance (ANOVA) was computed for grain yield and other traits as per the methods described by [7] using R and R-Studio for Randomized complete block design. Comparison of treatment means was made by using Duncan multiple range test (DMRT) at 5% level of significance test. Analyses of variance (ANOVA) were computed using the following mathematical model:

$$Yijk = \mu + Gi + yj + Bk + Gyij + \varepsilon ijk$$

Where: $Yijk$ = is the observed mean of the i^{th} variety (G_i) in the j^{th} year (y_j), in the k^{th} block (B_k)

μ= General mean of trait Y

Gi = Effect of the i^{th} variety

yj= Effect of the j^{th} year

Bk = Block effect of the i^{th} variety in the j^{th} year

Gyij = The interaction effects of the i^{th} variety and the j^{th} year

εijk= The error term

3. Results and Discussions

3.1. Analysis of Variance

The combined over three years Analysis of variance (ANOVA) computed shown that variation among varieties were highly significant (P<0.01) for all traits except plant height, number of primary branch and pod per plant (Table 2). The presence of variations among varieties under experiment for traits studied indicated the presence of sufficient variability among Lentil varieties. Significant variation among grain yield, days to flowering, days to maturity and seeds per plant were also reported by [6, 12] and [10]. Other author [11] also reported the existence of variation in grain yield and maturity date for lentil varieties.

Table 2. *Analyses of Variance (ANOVA) for 8 Traits of Lentil Varieties Grown at Bule Hora for Three Consecutive Years in 2018, 2019 and 2020.*

Source of var.	df	GY (kg/ha)	FD	MD	Pht	NPB	PPP	SPP
Year (Y)	2	101168	258.235***	161.370***	499.10***	22.312***	8621.6***	562964.0***
Variety (V)	8	222461**	13.559***	66.111**	25.65	1.408	1597.4	17543.0***
Rep (Y)	6	173471*	2.111	15.432	27.47	3.149	279.5	935.0
V*Y	16	90804	11.235***	30.606	7.50	1.265	574.0	11416***
Pooled error	48	74678.39	2.417	17.168	15.50	1.391	316.9	1258.600
CV		30.54	2.69	3.38	12.05	24.36	26.57	21.27

ns,*,**&***, non-significant, significant and highly significant at P<0.05, P<0.01 and P<0.001, respectively. DF= degree of freedom, FD= days to flowering, MD= days to maturity, PH (cm) = plant height in centimeter, NPB= number of primary branch, GY (kg/ha) = Grain yield in kilogram per hectare, PPP=Pods per plants, SPP=Seeds per plant.

Very highly significant variation of year effect (P<0.01) for all traits except grain yield were observed indicating the presence of variability in all years for those traits. On the other hand, performance of Lentil varieties for grain yield was not significantly influenced by year effect. The interaction effect of variety by year was not significant for all traits except flowering date and grain yield indicating similar performance of varieties in different year for those traits. Similar findings were also reported by [7].

3.2. Mean Performance of Varieties

3.2.1. Crop Phenology

Flowering duration of 9 Lentil varieties ranges from 55.77-59 days while the maturity duration of varieties ranges from 117.44-126.33 days. The pooled mean performances of these traits are presented in Table 3. The earliest flowering variety was chakol (55.77 days) followed by EL (56 days) and Alemaya (56.55 days) while the late flowering varieties were Chalew (59 days) followed by Alamtena and Gudo (58.667 days each). The top three early maturing varieties are Chekol (117.44 days), EL (120.11 days) and Alemaya (121.778 days) while the three top late maturing varieties are Gudo (126.33 days), Chalew (126), Alemtena and Dembie (122.667 days each. This research finding is agree with the findings of [4] and contradict with the findings of [15, 16] who reported lowest flowering date range as to 43.5 to 48.5.

3.2.2. Growth Traits, Yield and Yield Components

The combined over year analyses indicated that there are no significant variation among 9 Lentil varieties for number of primary branches, plant height and number of pods per plants. Mean performances of varieties for plant height ranged from 30.58cm to 35.89cm. About 55.55% of varieties were taller than the grand mean (32.676). [6] also reported variation of lentil varieties ranged from 26.3cm to 36.4 which is in line with this finding. Other author [11] reported variation from 35cm to 40.49cm. Varieties showed considerable variations for number of seeds per plants that ranged from 99.867 to 219.62 (Table 3). Similar result was also reported by [6] for number of seeds per plants, seeds per pods and thousand seeds weight in lentil varieties.

Table 3. *Mean Value of Yield and Yield Related Traits of 9 Varieties of Lentil Tested at Bule Hora in 2018, 2019 and 2020 Cropping Season.*

var. name	FD	MD	Pht	NPB	PPP	SPP	GY (kg/ha
Chalew	59a	126a	32.689a	3.311a	80.11a	209.111ab	726.62cd
Alemtena	58.667ab	122.667ab	30.933a	5.133a	60.267a	126.422cd	815.277bcd
Gudo	58.667ab	126.333a	35.889a	4.711a	57.733a	99.867d	737.963bcd
Denbie	58.222ab	122.667ab	33.267a	4.600a	80.111a	204.822ab	976.621abc
Teshale	58.22ab	122.556ab	32.978a	4.356a	51.244a	124.089cd	893.751a-d
Derash	57.333bc	122.444b	34.289a	4.733a	82.289a	219.622a	1104.398a

var. name	FD	MD	Pht	NPB	PPP	SPP	GY (kg/ha
Alemeya	56.556cd	121.778ab	31.4a	5.422a	87.911a	184.133b	993.867ab
EL	56cd	120.111c	32.067a	4.322a	54.739a	192.222ab	705.093d
Chekol	55.778d	117.444bc	30.578a	4.967a	65.756a	140.6c	1099.999a
mean	57.61	122.44	32.676	4.84	69.99	166.76	894.84
Range	55.778-59	117.44-126.33	30.58-35.89	3.31-5.13	51.24-87.91	99.867-219.62	705-1104

Means with the same letters in the same columns are not significantly different.
FD= flowering date, MD= Maturity date, PH= plant height in centimeter, NPB= number of primary branch, GY= Grain yield per hectare, PPP=Pods per plants, SPP=Seeds per plant.
Highest mean grain yield was recorded from Derash (1104.4kg ha^{-1}) followed by Chakol (1099.99kg ha^{-1}) and Alemaya (993.87kg/ha). But, the lowest mean grain yield were recorded from EL (705.09kg ha^{-1}) followed by Chalew (726.62kg ha^{-1}) and Gudo (737.96kg ha^{-1}). Variation of mean grain yield ranged from 650kg ha^{-1} to 1590/ha in lentil varieties were previously reported by [6, 13, 1].

4. Conclusions and Recommendations

From the experiment conducted at Bule hora for three consecutive years (2018, 2019 and 2020), the variation among lentil varieties for grain yield, flowering date, maturity date and seed per plants were observed. The existence of significant variation among varieties for grain yield and other yield related traits indicated the possibility of selecting varieties for the study areas. The mean of flowering and maturity date in this experiment ranged from 55.778-59 days and 117.44-126.33 days respectively. The early flowering and maturing varieties was Chekol with 55.7 and 117.4 days respectively while the late maturing varieties are Gudo and Chalew with 126.33 and 126 days respectively. The mean grain yield ranged from 705kg to 1104kg. The highest mean grain yield were exhibited by Derash (1104.4kg ha^{-1}) followed by Chekol (1099.99 kg ha^{-1}) and Alemaya (993.87kg ha^{-1}). The high yielding capacity of these varieties may be due to the presence of high number of seeds per plants and pods per plants. Therefore, farmers and Lentil producers around the study area and similar agro ecologies can alternatively use those varieties until new high yielder varieties will be recommended for the study areas.

Abbreviations

ANOVA	Analysis of Variance
DMRT	Duncan Multiple Range Test
FAOSTAT	Food and Agricultural Organization Statistics
Ha	Hectare

Conflicts of Interest

The authors declare no conflicts of interest.

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