



# Evaluation of Garlic (*Allium sativum* L.) Varieties for Bulb Yield and Growth at Dabat, Northwestern Ethiopia

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## Abstract

A field experiment was conducted for two consecutive years (2013 and 2014) during the dry periods under irrigation at Dabat District, Northwestern Ethiopia to select the best adaptable and high yielder varieties. Five garlic varieties (BishoftuNech, Kuriftu, Tseday 92, MM-98 and the local) were planted on randomized complete block design with three replications. Data on days to emergence, days to maturity, pseudo stem height, number of leaves per plant, bulb diameter, number of cloves per bulb, fresh bulb weight, bulb yield, and bulb dry matter content were collected and subjected to analysis of variance (ANOVA) using SAS computer software version 9.0. Mean separation test was done by list significant difference (LSD) test at 5% probability level. The results revealed that varieties were significantly differed in all parameters. BishoftuNech was early maturing variety (135 days) followed by Kuriftu (143 days). MM-98 was matured lately at 176 days after planting. Significantly highest pseudo stem height and number of leaves per plant were recorded from the local variety. Similarly, significantly highest yield of  $16.56 \text{ t}\cdot\text{ha}^{-1}$  was recorded from the local variety. MM-98 and the local variety were with the highest bulb dry matter content of 25.83 and 23.86%, respectively. This research proved that the improved varieties were not compared with the local cultivar before they get released. Therefore, the result of this research can be used as good information for the future garlic variety development program at national level. Considering the most desirable yield and yield component parameters, the local variety is recommended to the producers at Dabat District. Further research on collection, characterization and evaluation of the local cultivars should be conducted for national use.

## Keywords

Garlic, Varieties, Bulb Yield

**Subject Areas:** Agricultural Science, Plant Science

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## 1. Introduction

Garlic (*Allium sativum* L.) belongs to the family Alliaceae and genus *Allium*, and is a shallow rooted vegetable crop [1]. It is an ancient crop that originated in Central Asia and it has been grown for culinary, medicinal, and religious purposes for several millennia [2] [3]. The alliums are distributed widely throughout the temperate, warm temperate and boreal zones of the northern hemisphere [2].

Garlic takes one of the top places among vegetables contributing to the maintenance of good health of humans. The species has been already grown and consumed in ancient Egypt and Rome [4]. According to Goldy [5], evidence of garlic cultivation can be found as far back as 3200 BC in Egypt and it continues to be an important part of Mediterranean, European and Asian diets as a food item, as well as a medicinal plant used to treat a variety of ailments. Garlic has been known for many hundreds of years and has many beneficial qualities. It is a natural antiseptic and was used as such in the First World War [6]. Not surprisingly, in view of its strength of flavor, it is used primarily as a condiment rather than a bulk foodstuff [7]. Garlic is grown for its edible bulbs, which are composed of a number of cloves. The bulbs can be eaten fresh, cooked in various ways, processed into a dehydrated product, or saved for seed to be planted later [3].

Garlic is produced in Ethiopia mainly as a spice crop for seasoning of foods and for its medicinal values. It is widely cultivated around home gardens in Ethiopia. But nowadays, its production is practiced in some large farms. Garlic is exported to Europe, Middle East and North America [8].

Despite the crop is a high value crop, its production and productivity are very low due to production and marketing constraints. According to CSA [1], the average area covered and total production of garlic in Ethiopia are 16411.19 ha and 159093.58 tons annually. This low yield of garlic is believed to be due to lack of improved agronomic practices, lack of improved and adaptable varieties, low soil fertility, diseases, insect pests and lack of improved post harvest technologies [8].

Dabat District has a great potential to produce garlic under irrigation. But there is no any improved variety under production in the woreda. Before the execution of this research, there are no any research efforts in relation to improved agronomic practices and variety adaptation trial to fully exploit the yield potential of garlic in this woreda. Farmers use only the local varieties with their own traditional production methods. As a result, the average yield of the crop is very low in this woreda—8 t·ha<sup>-1</sup> [9]. Even if the area is very suitable and the crop is very important commercially for the farmers for income generation, productivity is still unsatisfactory. Therefore, this research was executed to select adaptable and high yielder garlic varieties under irrigation for Dabat and similar districts.

## 2. Materials and Methods

### 2.1. Description of the Study Area

The study was conducted at Dabat District of North Gondar Administrative Zone. Dabat District is located at 814 km and 75 km north of Addis Ababa and Gondar City, respectively. Dabat Town is the main town of the district. The neighboring districts surrounding Dabat are Debark (in the north and north east), Tsegedie (in the west), Wogera (in the south and south east). The district has a total of 28,293 ha of cultivated land and a population of 176,795. The total garlic cultivation area in the woreda is 39 ha [9].

The altitude of the woreda ranges from 1500 to 3200 meters above sea level. Mean annual rainfall in the woreda ranges from 800 to 1400 mm. The main rainy season starts at the beginning of June and continues up to the end of September. The minimum and maximum temperature of the woreda is 18°C and 35°C, respectively [9]. The experimental plot was located at 13°05'N and 37°50'E and with an altitude of 2740 meters above sea level (GPS reading).

### 2.2. Material and Design

Five garlic varieties namely, BishoftuNech, Tseday 92, Kuriftu, MM-98 and the local were laid on Randomized Complete Block Design with four replications. The number of rows per plot was 8 for each treatment; each row containing 20 plants. Cloves of medium sized (2 - 2.5 g) were used as a planting material. The cloves were hand planted 10 cm apart on rows spaced by 25 cm at a depth of 3 cm.

Nitrogen was split applied in the form of Urea at the rate of 150 kg·ha<sup>-1</sup> half at planting and the other half at 30 days after planting. Phosphorus was applied in the form of DAP at a rate of 200 kg·ha<sup>-1</sup> [8]. Other cultural

practices were carried out as per the recommendations for the crop.

### 2.3. Data Collection

Data on plant height, number of leaves per plant, bulb diameter, number of cloves per bulb, bulb weight per plant and bulb dry matter content were recorded from a sample of 10 representative plants. Bulb yield was recorded from the middle 6 rows from each plot and converted into tons per hectare. Date of emergence was recorded when 50% of the plants per plot were emerged. Date of maturity was recorded when the plant was ready to harvest.

### 2.4. Data Analysis

For each treatment the mean value of the above-described parameters were computed and subjected to analysis of variance using SAS computer software version 9.0 with general linear model procedure [10]. Mean separation test was done by List Significant Difference (LSD) test at 5% probability level.

## 3. Result and Discussion

### 3.1. Days to 50% Emergence

Variety had a highly significant ( $p < 0.001$ ) effect on days to 50% emergence. Variety BishoftuNech achieved 50% emergence 10 days after planting where as the local variety and Kuriftu attained their 50% emergence 12 days after planting. MM-98 was the late variety to attain 50% emergence (**Table 1**).

### 3.2. Days to Maturity

Variety had a highly significant effect on date of maturity ( $p < 0.001$ ). BishoftuNech was early maturing variety followed by Kuriftu. MM-98 was matured lately at 176 days after planting (**Table 1**). The five varieties thus differed significantly in date of maturity. Similar result was reported by Yesigat (2008) on BishoftuNech and MM-98. This result is also in line with the work of Tadese [11] who reported that Tseday 92 and BishoftuNech were matured 137 and 131 days after planting, respectively. This result revealed that BishoftuNech is early maturing variety followed by Kuriftu. On the other hand MM-98 was the late maturing variety which required 176 days to mature. This extended growth period of this variety may incur additional cost and makes the land not to be ready for the next crop.

### 3.3. Pseudo Stem Height

The pseudo stem height was significantly affected by garlic varieties ( $p < 0.01$ ). Significantly highest pseudo stem length was recorded from the local variety (28.80 cm) followed by Kuriftu (24.53 cm) and MM-98 (24.43 cm). Significantly lowest pseudo stem height of 22.31 cm was recorded from BishoftuNech (**Table 2**). Therefore, this result indicated that the local variety is more vigorous than the rest of the garlic varieties.

### 3.4. Number of Leaves per Plant

Varieties had a significant effect on number of leaves per plant ( $p < 0.01$ ). Significantly highest number of leaves per plant was recorded from the local variety than Kuriftu, Tseday 92 and BishoftuNech (**Table 2**).

### 3.5. Bulb Diameter

Variety had a significant effect on bulb diameter ( $p < 0.01$ ). The local variety and Kuriftu scored the highest mean bulb diameter as compared to Tseday 92 and MM-98 (**Table 3**). As size is considered as a quality criterion for variety selection, the local variety and Kuriftu were selected by the farmers.

### 3.6. Number of Cloves per Bulb

Varieties were significantly differed in number of cloves per bulb ( $p < 0.01$ ). Significantly, highest number of cloves per bulb was recorded from the local variety (20.45) followed by Kuriftu (16.68). Tseday 92 scored

**Table 1.** Days to emergence and maturity of garlic varieties at Dabat, 2013-2014.

Variety	Days to 50% emergence	Days to maturity
Local	12.00c	145.00b
BishoftuNech	10.00d	135.00e
Tseday 92	13.00b	144.00c
Kuriftu	12.00c	143.00d
MM-98	35.00a	176.00a
LSD	0.01	0.84
CV (%)	0.05	0.03

Means followed by same letters in a column are not significantly different at  $p \leq 0.05$ .

**Table 2.** Mean pseudo stem height and number of leaves per plant of garlic varieties at Dabat (2013-2014).

Variety	Pseudo stem height (cm)	Number of leaves per plant
Local	28.80a	8.31a
BishoftuNech	22.31c	7.77c
Tseday 92	18.86d	7.07d
Kuriftu	24.53b	8.05b
MM-98	24.43b	8.21ab
LSD	1.23	0.76
CV (%)	4.28	1.76

Means followed by same letters in a column are not significantly different at  $p \leq 0.05$ .

**Table 3.** Yield and yield component of garlic varieties at Dabat (2013-2014)

Variety	Bulb diameter (cm)	Number of cloves per bulb	Fresh bulb weight per plant (g)	Bulb yield ( $t \cdot ha^{-1}$ )	Bulb dry matter content per plant (%)
Local	5.36a	20.45a	49.72a	16.56a	23.86ab
BishoftuNech	4.75ab	13.57dc	28.15bc	9.38bc	19.76c
Tseday 92	4.17b	12.70d	16.70d	5.57d	15.33d
Kuriftu	5.35a	16.68b	35.36b	11.78b	21.90bc
MM-98	4.17b	15.00bc	25.53c	8.52c	25.83a
LSD	0.75	1.95	7.47	2.50	2.36
CV (%)	13.08	10.25	19.81	19.91	9.12

Means followed by same letters in a column are not significantly different at  $p \leq 0.05$ .

significantly lowest number of cloves per bulb (**Table 3**). This result revealed that the local variety is superior to the rest of the varieties for this very important yield component parameter which is the edible part of garlic.

### 3.7. Fresh Bulb Weight per Plant and Yield Hectare

Varieties were significantly differed in their fresh bulb weight per plant and yield per hectare ( $p < 0.01$ ). Significantly highest fresh bulb weight (49.72 g per plant and  $16.56 t \cdot ha^{-1}$ ) was recorded from the local variety fol-

lowed by Kuriftu (35.36 g per plant and 11.78 t·ha<sup>-1</sup>). Significantly lowest bulb weight of 16.70 g per plant and 5.57 t·ha<sup>-1</sup> was recorded from Tseday 92 (**Table 3**). The mean fresh bulb yield of the local variety was 4.78, 8.04 and 10.99 t·ha<sup>-1</sup> higher than Kuriftu, MM-98 and Tseday 92, respectively. This result indicated that the local variety is superior to the nationally released varieties.

### 3.8. Bulb Dry Matter Content per Plant

Varieties were significantly differed in their bulb dry matter content per plant ( $p < 0.01$ ). Significantly, highest bulb dry matter of 25.83% was recorded from MM-98. In this parameter Tseday 92 was with the least bulb dry matter content of 15.33% (**Table 3**). The highest significant dry matter content of MM-98 may be confined with its long growth period by which it may uptake more essential minerals and accumulated more assimilates.

## 4. Conclusion and Recommendation

The local variety was superior in most of the desirable parameters for garlic. This research work proved that the improved and released varieties of garlic were not compared with the local cultivar which was under production in the study area before they get released. Therefore, the result of this research can be used as good information for the future garlic variety development program at national level. Finally, considering the most desirable yield and yield component parameters, the local variety should be recommended to the producers at Dabat District. Further research on collection, characterization and evaluation of the garlic cultivars which are under production in the study area and in the nearby districts with similar agro-ecologies should be conducted in order to make this variety to be registered and released at national level

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