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Evaluation of improved onion (*Allium Cepa* L.) varieties for growth and bulb yield under irrigated condition in lowland area of South Omo Zone, Southern Ethiopia

Tadesse A*[1]and Bekele Y[2]
Southern Agricultural Research Institute,
Jinka Agricultural Research Center, Crop Research Directorate, Jinka, Ethiopia

Corresponding author: awoketadese3@gmail.com

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ABSTRACT

Aim: The main objective of the study was to identify high-yielding improved variety/ies for bulb production.
Materials and Methods: Six varieties namely Local, Nafis, DZSHT-91-2B, DZSHT-157-1B, Adama and Nasick Red were laid down in randomized complete block design with three replications. Data were collected on number of leaves per plant, plant height, bulb diameter and bulb yieldand subjected to analysis of variance using SAS software program.
Results: The result of the study revealed that there was significant difference among varieties in all traits except number leaves per plant and plant height at Omorate while plant height at Weyito. The highest (27.2t ha^{-1}) and (23.7t ha^{-1}) bulb yields were recorded fromDZSHT-91-2B variety at Weyito and Omorate, respectively.
Conclusion: It was concluded that use of DZSHT- 91-2B variety can be recommended for onion producing farmers/agro-pictorial at Weyito, Omorate and its vicinity.

Keywords: Bulb yield, evaluation, growth, onion varieties.

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Introduction

Onion *(Allium Cepa* L.*)* belongs to family Liliaceae, an important group of crops worldwide (Best, 2000). Onions exhibit particular diversity in the eastern Mediterranean countries, through Turkmenistan, Tajikistan to Pakistan and India, which are most important sources of genetic diversity and believed to be center of origin (Brewster, 2008). Onion is one of oldest bulb vegetables in continuous cultivation dating back to at least 4000 BC (Ahmad *et al.*, 2008). Onions are grown mainly as food materials however; it has medicinal properties and has been used for treatment of various ailments such as skin diseases, ear pain, heart attack and strokes. Bulbs are boiled and used in soups and stews, fried or eaten raw in salads. Although, its main role in cooking is to provide flavor as a significant source of vitamin C and potassium, contains about 60 calories in a medium-sized bulb and has very low sodium content (Ado, 2001).

It also contains vitamins; thiamine, riboflavin and niacin and is used for its medicinal value especially in the case of heart problems (Mettananda and Fordham, 2001). It contains a phytochemical called quercetin which is effective in reducing the risk of cardiovascular disease, an anticancer, and has promise to be an antioxidant (Smith, 2003).

A cultivar crop performs differently under different agro-climatic conditions and various cultivars of the same species grown even in the same environment give different yields as the performance of a cultivar mainly depends on the interaction of genetic makeup and environment (Jilani & Ghafoor, 2003).The optimum altitude range for onion production is between 500 and 2200m.a.s.l and temperature ranged between 12.4 ^{o}C to 31.3 ^{o}C (Prasad and Kumar, 2005).

In Ethiopia, it has an economically important place among other vegetable crops due to ease of production, high profitability per unit area and increase in small-scale irrigation schemes, the area under production of the onion is increasing from time to time. Onion was grown on about

1,681.51ha in SNNP Region from which about 17,367.42tons onion yield was produced with the average zonal yields 10.3t ha^{-1} (CSA, 2017). However, this tuber yield is far less than the attainable yield (50-60 tha^{-1}) under good management conditions (MOANR, 2017).

There are a number of production problems which makes the farmers not to produce onion in advanced manner. Among production problems, the low yield because of lack of improved varieties, non-optimal agronomic practices, unavailability and high cost of seed, the prevalence of diseases and insect pests. Moreover, improved onion varieties are limited in South Omo Zone and farmer/agro-pastorals using their own local cultivars, which result produced low yield per hectare (Misgana *et al.*, 2017). Therefore, to alleviate the problem, the experiment was conducted to identify superior onion variety/ies in terms bulb yield and desirable agronomic traits for study area.

Materials and Methods

Description of study area

The experiment was conducted during 2018 cropping season at Omorate (lobet keberle) and 2019 at Weyito (Enchete kebele). Omorate which located South Omo Zone in Southern Nations, Nationalities and People's Regional State. Omorate which is located South Omo Zone in Southern Nations, Nationalities and People's Regional State. It is situated between 4°37′-4°58′ North latitude and 35°56′-36°20′ East longitude with altitude of 365 above sea level. The rainfall distribution of the area is bimodal, with a primary rainy season between March to May and secondary small rain between Septembers to December. The monthly average minimum and maximum temperature is 24.4°C-37.8 °C, respectively. Weyito also located South Omo Zone in Southern Nations, Nationalities and People's Regional State. It is situated between 5°01′-5°73′ North latitude and 36°38′ - 37°07′ East longitude with altitude of 588 meter above sea level. The rainfall distribution of the area is bimodal with main rainy season extends from January to May and the second cropping season, from July to October. It receives annual average rainfall of 876.3 mm and the monthly average minimum and maximum temperatures of 18.2 and 37.3 ° C, respectively. All the metrological data a given above for the two location are long term averages.

Experimental treatments and design

Five improved onion varieties namely: Nafis, DZSHT- 91-2B, DZSHT-157-1B, Adama Red, Nasick Red and one Local check were used for current study. These varieties were arranged in randomized complete block design (RCBD) with three replications.

Experimental procedures

Onion varieties were planted at recommended seeding rate of 4kg/ha. A randomized complete block design with three replications was used. Seeds were sown on seed bed and four leaves stage seedlings were transplanted in plot of 3m x3m. Row to row and plant to plant spacing was 40cm and 20cm respectively. As per recommended fertilizer rate of 100kg/ha of NPS was applied at transplanting and half of Urea which is 75kg/ha was applied at transplanting and the remaining half of urea (75kg/ha) was applied six weeks or 45 days after transplanting. The irrigation water was applied by using furrow irrigation method from 5 up to 10 days interval at according weather condition. All the recommended cultural practices in growing period of onion were applied.

Data Collection

Plant height was measured from the ground level up to the tip of the longest leaf using a measuring tape. It was measured using five randomly selected plants from the two central rows of each plot at physiological maturity of the crop and the average values competed. Number of leaves per plant was counted from five randomly taken plants from the middle rows at physiological maturity and the average was computed for each plant. Bulb diameter was measured at right angles to longitudinal axis at the widest circumstance of the bulb of five randomly taken plants in each plot by using veneer caliper (model 141). The harvested bulb of all varieties were left to dry in shade for four days then the leaves were removed to get the dry bulbs of onion. Thereafter, harvested onions were weighed using an electronic balance then expressed as kg per plot and converted into t ha^{-1}.

Data Analysis

The various collected data were subjected to analysis of variance appropriate to randomized complete block design (RCBD) using SAS software version 9.2 (SAS, 2008) with a generalized linear model (GLM) procedure. Means were separated using least significant differences (LSD) test at 5% level of significance.

Results and Discussion

Plant height (cm)

The mean result of onion varieties revealed non-significant (P<0.05) difference among tested varieties on plant height at two locations (Omorate and Weyito) presented (Table 1). Results were in agreement to the findings of Misgana and Awoke (2017) who reported that non-significant difference among onion varieties on plant height.

Number of leaves per plant

At Omorate, the analysis of variance revealed non-significant (P<0.05) difference among tested varieties on number of leaves per plant (Table 1). However at Weyito, there was significant (P<0.05) difference among tested varieties on number of leaves per plant (Table 1). The highest number of leaves per plant (21.7) was measured from variety DZSHT- 91-2B followed Nafis (17.3), while the lowest number of leaves per plant (11.6) was recorded from variety DZSHT-157-1B. The possible reason for significant and non-significant difference among varieties on plant height at Omorate and Weyito location might be due to the fact that environmental conditions and years. Result was in agreement with Demisie and Tolessa (2018) who obtained variation among onion varieties for number of leaves per plant. Similarly, Bindu and Bindu (2015) who studied on onion found that the significantly differ on number of leaf per plants.

Bulb diameter

Bulb diameter was highly significantly affected (P<0.01) by variety at both locations (Table 3). Variety DZSHT-91-2Bgave the highest (5.7cm) bulb diameter at Omorate location which, is did not significantly differ from Nafis, Nasik-Red and Adama Red varieties (Table 4), while the lowest (4.1) bulb diameter was gained from local variety in the same location. Similarly, significantly the highest (6.3cm) bulb diameter was recorded from Variety DZSHT-91-2Bat Weyito which did not significantly differ from Nafis, Nasik Red, Adama Red and DZSHT-57-1Bvarieties; whereas, the lowest bulb diameter (4.6) were recorded from variety Local (Table 3). This was due to the reality that varieties can have different genetic makeup that makes them different. Similarly, Jilani *et al*. (2009) and Yemane (2011) reported variation among onion varieties for bulb length.

Average bulb yield

The average fresh bulb of onion was influenced (P<0.01) by variety at both locations (Table 3). Variety DZ-SHT- 91-2B had significantly highest bulb weight (27.2 t ha^{-1}) followed by variety Nafis (22.8 t ha^{-1}), while the lowest (15.2 t $ha^{-1)}$ bulb yield was recorded from local variety at Weyito location. Similarly, significantly the highest (23.7cm)bulb yield was recorded from Variety DZ-SHT- 91-2B at Omorate; whereas, the lowest bulb diameter (12.1) was recorded from variety local which was not significantly differ from DZSHT-57-1B variety(Table3).Generally, DZSHT-91-2B variety produced more tuber yield and was superior to the others varieties at Omorate and Weyito location. The presence of significant differences among the tested varieties might be due to the existence dissimilarity in genetic composition among them, for that fact characters may be differ in their genetic properties. Besides, environmental or years influences might be the possible causes of their significant differences or both. The present study was in agreement with findings of Demisie and Tolessa (2018); Simon et al. (2014) who obtained significantly difference on bulb yield of onion varieties. Similarly, Neim et al. (2019) who studied on onion found that significantly difference among used test varieties.

Table 1: Mean square values for leaves per plant and plantheightof onion varieties at Weyito (Enchete kebele) and Omorate (lobet kebele) location

		Weyito(Enchete kebele)(2019)		Omorate (lobet kebele)(2018)	
Source	**Degree of freedom**	**Number of leaves per plant**	**'lant height**	**Number of leaves per plant**	**Plant height**
Replication	2	2.335 ^{ns}	40.88 ^{ns}	4.535 ^{ns}	44.515^{ns}
Varieties	5	42.375*	22.96 ^{ns}	4.904 ^{ns}	46.727^{ns}
Error	17	9.908	52.925	8.914	25.150
CV(%)		20.96	15.55	27.40	10.50

Ns= non-significant, *=significant, **= highly significant, ***= very highly significant at P<0.05,
CV=Coefficient of variance

Table 2: Mean square values for bulb diameter and bulb weight of onion varieties at Weyito (Enchete kebele) and Omorate (lobet kebele) location

		Weyito (Enchete kebele)(2019)		Omorate (lobet kebele)(2018)	
Source	**Degree of freedom**	**Average Bulb Diameter**	**Average Bulb Yield**	**verage Bulb Diameter**	**Average Bulb Yield**
Replication	2	0.175*	14.311*	0.150*	11.760*
Varieties	5	0.992**	60.906**	0.932**	62.486**
Error	17	0.338	11.420	0.359	11.136
CV (%)		10.46	10.53	11.86	19.65

Ns= non-significant, *=significant, **= highly significant, ***= very highly significant at P<0.05,CV=Coefficient of variance

Table 3: Mean value for growth, yield and yield components of onion varieties at Weyito (Enchete kebele) and Omorate (lobet kebele) location

	Locations							
	Weyito (Enchete kebele) (2019)				Omorate (lobet kebele) (2018)			
Varieties	**NLPP**	**PH(cm)**	**BD(cm)**	**ABY(t/ha)**	**NLPP**	**PH(cm)**	**BD(cm)**	**ABY(t/ha)**
DZSHT- 91-2B	21.7^{a}	45.3	6.3^{a}	27.2^{az}	13.1	43.5	5.7^{a}	23.7 a
Nafis	17.3^{ab}	50.3	5.9^{a}	22.8^{ab}	10.9	44.8	5.4^{a}	19.4ab
Nasik Red	15.0^{ab}	47.2	5.7^{a}	22.3^{abc}	10.2	54.1	5.2^{ab}	19.0ab
Adama Red	13.0^{ab}	42.2	5.5^{ab}	16.3^{cd}	9.6	49.5	5.0^{ab}	15.5bc
DZSHT-157-1B	11.6^{b}	48.5	4.6^{b}	18.7^{bcd}	11.6	45.1	4.9^{ab}	12.5c
Local	12.7^{b}	47.1	5.4^{ab}	15.2^{d}	10.0	49.1	4.1^{b}	12.1c
LSD (5%)	5.73	NS	1.06	6.15	NS	NS	1.09	6.07

LSD (5%) = Least significant difference at P=0.05, NS= non-significant, NLPP =Number of leaves per plant, PH=Plant height, BD=Bulb diameter and ABW=Average bulb yield.

Conclusions

From the results of the study, the highest average bulb yield was produced from DZSHT- 91-2B and Naifs varieties, respectively. It can be concluded that variety DZSHT- 91-2B is the superior onion variety followed by Nafis which can improve onion production in low land area of South Omo Zone and its vicinity. Therefore, it can be promoted to PED at around tested areas.

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