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Evaluating the Adaptability of Different Released Onion (*Allium cepa* L.) Varieties in West Shewa, Ambo

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Abstract: Onion (*Allium cepa*) belongs to the family Liliaceae, an important group of crops worldwide. The production and productivity of onion in West Showa are constrained by different factors such as lack of adopted improved varieties, pest and disease attack and poor cultural practice. Thus, this study was initiated to test the best adaptable onion varieties and to increase production and productivity of onion. The objective of this study was therefore, to evaluate different onion varieties to give high yield and disease resistance in Ambo area. Five recently released onion varieties were used in the field experiment obtained from Melkasa Agricultural Research Center. The experiment was conducted at Ambo Agricultural Research Center on station in order to evaluate different released tomato varieties. It was laid out on randomized complete block design with three replications. The results of analysis of variance (ANOVA) showed that the varieties had significant ($P < 0.05$) differences for some traits such as: leaf length, number of leaves and total yield weight at Ambo in first year 2017. Although in the second year all traits except number of leaves were showed a significant ($P < 0.05$) difference among the treatment. This was an indication that the responses of the varieties were different in each year in some traits. On the other hand, leaf length and total bulb weight were had similar response in both years. From the two years experiment the variety Nafis was the best adaptable and high yielding variety compared to the other varieties in yield parameter it gives around 32.5- and 40.7-ton h^{-1} in both year 2017 and 2018 G. C respectively at Ambo. The variety Bombay red also best performed next to Nafis in second year 2018 it gives 36.5-ton h^{-1} .

Keywords: Adaptation, Onion, Nafis and Variety

1. Introduction

Onion (*Allium cepa*) belongs to the family Liliaceae, an important group of crops worldwide [1]. Onion exhibits particular diversity in the eastern Mediterranean countries, through Turkmenistan, Tajikistan to Pakistan and India, which are the most important sources of genetic diversity and believed to be center of origin [2]. Onion is widely grown in the world from a bulbous vegetable crop and it used for a flavor and seasoning of a variety of dishes, and is commonly known as “Queen of the kitchen” [3]. In terms of global weight of vegetables produced, at nearly 28 million tons per annum, only tomatoes and cabbages exceed bulb onions. Onion is one of the oldest bulb vegetables in continuous cultivation dating back to at least 4000 BC [4]. Globally it is one of the most important vegetable crops and its demand increasing worldwide [5]. Onion has been grown mainly as

food sources and used as H cousins and value addition for different dishes. In Ethiopia, the consumption of the crop is very important in the food seasoning and in daily stews as well as in different vegetable food preparation uses [6]. Onions are mainly grown as food materials though; it has medicinal properties and used for the treatment of several ailments such as skin diseases, ear pain, heart attack and strokes. The bulbs also, boiled and used in soups and stews, fried or eaten raw in salads. While the main role of onion is to provide flavor in cooking, and it is a source of vitamin C and potassium, contains about 60 calories in a medium-sized bulb, and has very low sodium content. The crop nutritional composition includes 2.0 g protein, 70 mg calcium and 53 mg phosphorus [7]. In Ethiopia, the consumption of the crop is very important in the food seasoning and in daily stews as

well as in different vegetable food preparation uses [8]. Onion is valued for its distinct pungency or mild-flavored form of essential ingredients of many dishes. Fresh onion has about 86.6% moisture, 11.6% carbohydrate including soluble sugars, 1.2% protein, 0.1% fat, 0.2-0.5% Ca, 0.05% P, traces of Al, Cu, Fe, Mn, Zn and vitamin A, B and C. It is a source of the vitamin's thiamine, riboflavin and niacin and is used for its medicinal value especially in the case of heart problems [9]. It also contains a phytochemical called quercetin, which is effective in reducing the risk of cardiovascular disease, an anticancer, and has promise to be an antioxidant [10].

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 [11, 12]. Ethiopia has an enormous potential for production of vegetable crops in general and onion particular and it is also among the most important export crops. In many parts of Ethiopia production of onion widely practiced by using irrigation in the dry season. Onion is one of the most important vegetable crops grown in the study area, Ambo. It contributes to the major share of daily cash source.

The Successful onion production depends on the selection of varieties that are adapted to different climatic conditions imposed by specific environment [13]. The production and productivity of onion in West Showa are constrained by different factors such as lack of adopted improved varieties, pest and disease attack and poor cultural practice. Lack of adopted improved variety is one of the most problems in Ambo. Farmers also requesting improved onion varieties which have high yielder and resistance to pest and disease in the study area. Therefore, this study was initiated to test the best adaptable onion varieties and to increase production and productivity of onion crops through introducing nationally released cultivars, thereby contribute to food security, poverty alleviation and sustainable environment.

2. Materials and Methods

2.1. Description of the Study Area

The experiment was conducted at Ambo Agricultural research center (AmARC) on station. This center is situated 126 km west of Addis Ababa and is located at 8°57'N latitude, 38°7'E longitude with an altitude of 2200 meters above sea level. The center receives an average annual rainfall of 1050 mm with average minimum and maximum temperatures of 10.4°C and 26.3°C, respectively, and relative humidity of 64.4%.

2.2. Experimental Materials

Five recently released onion varieties were used in the field experiment obtained from Melkasa Agricultural Research Center (MARC) which are listed table 1.

Table 1. Recently released onion varieties.

No	Variety	Year of release
1	Bombay Red	2004
2	Adama Red	-
3	Nafis	2010
4	Melkam	1997/98
5	Nasic red	2004

Sources: All improved varieties were released by MARC/EIAR

The experiment was conducted at Ambo Agricultural Research Center (AmARC) on station in order to evaluate different released tomato varieties. It was laid out on randomized complete block design (RCBD) with three replications. All agronomic practice was applied based on the recommended rate. The plant was transplanted from the nursery to the field and the spacing is 10cm×20cm×40cm between plant, row and ridge respectively. The plot size of each treatment will be 2m×3m or 6m².

2.3. Data Collection

All vegetative and yield data was recorded at field and ten plants were randomly selected and tagged used for data collection. The outer single rows at both sides of the plot and one plant at both ends of the rows were considered border plants [14].

Leaf length (cm) and number of leaves per plant: were collected from ten randomly selected plants and the mean value was computed for further analysis.

Date of maturity: The number of days was counted starting from seedling transplanting to 80% leave falls.

Bulb weight (gm): the mean bulb weight of ten randomly selected bulbs at harvest was computed and used for further analysis.

Bulb diameter (mm): ten sample plants were measured from the center of bulb using caliper and the mean values were computed for further analysis.

Total bulb weight (qt/ha): Total bulb weight per hectare was recorded from the total weight of bulb from 6m² plot area and converted to 10000 m².

2.4. Treatments and Experimental Design

The experiment was conducted at Ambo Agricultural Research Center (AmARC) on station in order to evaluate different released onion varieties. It was laid out on randomized complete block design (RCBD) with three replications. All agronomic practice was applied based on the recommended rate. The plant was transplanted from the nursery to the field after one month with in the spacing is 10cm×20cm×40cm between plant, row and ridge respectively. The plot size of each treatment was 2m×3m or 6m². All management practice was done as planed starting from site selection to harvesting.

2.5. Data Analysis

The data was subjected analysis of variance (ANOVA) performed using statistical software (SAS 9.3). The treatment

shows significant difference was subjected least significant difference (LSD) test at 5% level.

3. Result and Discussion

3.1. Analysis of Variance

The results of analysis of variance (ANOVA) showed that the varieties had significant ($P < 0.05$) differences for some traits such as: leaf length, number of leaves and total yield weight at Ambo in first year 2017. Although in the second year all traits except number of leaves were showed a significant ($P < 0.05$) difference among the treatment. This was an indication that the responses of the varieties were different in each year in some traits. On the other hand, leaf length and total bulb weight were had similar response in both years.

3.2. Leaf Length

The ANOVA was showed there is a significant difference among the treatment on the leaf length in both year 2017 and 2018 at Ambo (tables 2 and 3). The leaf length was ranged from 31.25 cm to 40.5cm and the longest and shortest leaf length was recorded from the variety Nafis (40.5cm) and Melkam (31.25 cm) respectively in the first season 2017. On the other hand, the leaf length in cm was ranged from 46.17cm to 54.17cm in the second year 2018, and the longest leaf length was recorded from the variety Nafis (54.17cm).

Table 2. Mean value of different parameters on onion varieties in 2017 G.C at Ambo.

Variety	Leaf length (cm)	Leaf number	Maturity date	Bulb diameter (mm)	Single bulb weight (g)	Total bulb weight ha ⁻¹ (qt)
Adama red	39 ^{ab}	11.133 ^{ab}	125.3	62.33	73.25	243.75 ^b
Bombey red	34 ^{ab}	12.267 ^{ab}	122.7	55.3	82.5	308.13 ^{ab}
Melkam	31.25 ^b	10.333 ^b	122.3	59.1	78	316.88 ^{ab}
Nafis	40.5 ^a	13.067 ^a	124.7	59.9	83	325.63 ^a
Nasik red	35.5 ^{ab}	12.2 ^{ab}	123.3	60.47	78.25	283.75 ^{ab}
CV%	6.72	10.45	1.922	6.927	16.63615	16.90081
LSD (5%)	6.166	2.322	ns	ns	ns	76.976

Means with the same letter(s) are not significantly different t ($P = 0.05$).

3.4. Bulb Diameter

The ANOVA indicated that there was no significant influence ($p > 0.05$) by varietal effect on bulb diameter in the first year (table 2). While in the second season there was a significant variation among the treatments and bulb diameter was ranged from 59.18mm to 64.45mm. The wider and narrow bulb diameter was observed in the variety Nafis (64.45mm) and Adama red (59.18mm) respectively (table 3).

3.5. Bulb Weight

Single onion bulb weight was not significantly ($p < 0.05$) affected by varietal effect in year one like bulb diameter. But, in the second season there was a significant difference ($p < 0.05$) among the variety and the highest single bulb weight was recorded from the variety Nafis 78g at Ambo in

While the shortest leaf length was recorded from the variety Adama red (46.17 cm) in second year at Ambo. Zeleke *et al.*, 2021 was reported the longest plant height was observed from the variety Nafis and the shortest plant height was recorded from the variety Melkam in Arsi zone [14]. On the other study Fikre and Mensa, also reported similar the above result and the variety Nafis was the longest variety at Gamo Zone Arbaminch zuriya [15].

3.3. Days to Maturity

The ANOVA indicated that days to maturity was showed a non-significance (at $P < 0.005$) difference among the treatments in first year at Ambo. While in the second season the ANOVA was showed significantly at ($P < 0.05$) different from the treatment. The shortest day was recorded from the variety Bombay red (129) and Melkam (129) days to maturity compared to the others in the second year at Ambo (table 3). The variety Nafis was requiring around 138 days and it is the longest days to matured compared to the variety Bombay red and Melkam in 2018 at Ambo. Zeleke *et al.*, 2021 were reported there is a significant difference in maturity date [14]. Early maturity indicates the cause of the plant might be enhanced transfer of photosynthetic materials from the leaves to bulbs that enhancing the growth rate of onion in this reason happen to early initiation of bulbs, early maturity and finally early harvesting [16].

second year (table 3). The variety Nafis significantly differs from the rest four varieties and it's strengthened Fikre and Mensa, studies they reported the variety Nafis and Bombay red were had high bulb weight at Gamo Zone Arbaminch zuriya [15]. In addition, Zeleke *et al.*, 2021, also reported the variety Nafis weighted maximum bulb weight (89.68 g) followed by Bombay Red (84.72 g), while variety Adama Red weighted minimum bulb weight (69.258) in Arsi zone [14].

3.6. Total Bulb Weight

The ANOVA indicates total yield was significantly influenced by varieties in both year at Ambo (tables 2 and 3). In first year, the highest total yield (325.63 qt ha⁻¹) was obtained from variety Nafis; which statistically different from Adama red (243.75 qt ha⁻¹), while the rest varieties were not statically different on each other's (table 2). On the other

hand, in second season the highest total yield was recorded from the variety Nafis and Bombay red 407.33 qt ha⁻¹ and 365.5 qt ha⁻¹ respectively (table 3). It is partially similar with Dessie *et al.*, 2020, studies at Fogera, the highest cured bulb

yield was obtained from variety Bombay red both in 2017 (34.815 t/ha) and 2018 (31.875 t/ha) [17]. The second highest yielder was variety Nasik red (29.858 t/ha) in 2017 and variety Nafis (27.292 t/ha) in 2018.

Table 3. Mean value of different parameters on onion varieties in 2018 G.C at Ambo.

Variety	Leaf length (cm)	Leaf no.	Maturity date	Bulb diameter (mm)	Single bulb weight (g)	Total bulb weight ha ⁻¹ (qt)
Adama red	46.17 ^b	13.2	135.333 ^{ab}	59.18 ^b	63.67 ^b	289 ^d
Bombey red	47.47 ^b	14.27	129 ^b	64.45 ^a	62.67 ^b	365.5 ^a
Melkam	46.27 ^b	12.53	129 ^b	60.9 ^{ab}	56.67 ^b	322.33 ^{cd}
Nafis	54.17 ^a	13.13	137.667 ^a	63.825 ^{ab}	78 ^a	407.33 ^a
Nasik red	49.6a ^b	12.87	133.333 ^{ab}	61.325 ^{ab}	62 ^b	354 ^{bc}
CV%	14.37	8.199	1.924	5.495	9.466802	6.104273
LSD (5%)	7.983	ns	4.813	5.244	11.515	39.943

Means with the same letter(s) are not significantly different t (P = 0.05).

4. Conclusion

Onion has many importance in West Shewa zone for the consumption and commercial purposes. Therefore, evaluating the adaptability of different onion varieties for yield and yield components is very important at Ambo. The area has high potential for production of onion in the offseason by using furrow irrigation. From 2017, in the two years experiment the variety Nafis was the best adaptable, resistance to pest and disease and high yielding variety compared to the other varieties in yield parameter it gives around 32.5- and 40.7-ton h⁻¹ in both year 2017 and 2018 G.C respectively at Ambo. The variety Bombay red also best performed next to Nafis in second year 2018 it gives 36.5-ton h⁻¹. Depending on this result concludes those varieties were popularized and demonstrated to farmers for onion production in Ambo, it's around and other similar agro-ecological areas. In west Shewa, there have high demand of onion seed from farmers. Therefore, I advise for seed multiplication private companies to multiply nafis variety and all farmers and investors can use this variety for consumption and markets in the study area.

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