Original Research Article

Evaluation of Hybrid Onion Adaptability for Yield and Yield Parameters under North Western Zone of Tigray

Abstract

Field experiment was conducted to study the adaptability of seven registered hybrid onion varieties and one standard check for yield and yield attributing parameters of onion (Allium cepa L.) in Tselemti District, North Western Zone of Tigray during October/2019. Seven hybrid onion varieties namely: MALBEC F1, NEPTUNE, RUSSET, JAMBAR, RED KING F1, RED COACH F1, ANKIN F1 and NASIK RED (Standard Check) were tested in Randomized Complete Block Design (RCBD) with three replications. Accordingly, treatments were assigned randomly to the experimental plot within a block. The results showed that the difference in variety had significant effect on all characters except the non-significant effect of shown on neck thickness and bulb length. The highest marketable bulb yield was obtained from MALBEC F1 followed by NEPTUNE, RUSSET, JAMBAR and RED KING F1 (49.81, 49.04, 48.02, 46.49 &45.65 t ha-1) respectively and the lowest bulb yield were obtained from NASIK RED (34.90) and ANKIN F1 (34.04 t ha-1). Therefore, it is recommended that (MALBEC F1, NEPTUNE, RUSSET, JAMBAR and RED KING F1) hybrid onion varieties are the best adaptable and high yielder in the study area.

1. Introduction

Onion (Allium cepa L.) a member of Amaryllidaceous family is one of the most important condiment crop. This most widely used condiment, believed to be originated in Central Asia, possesses tremendous popularity as well as economic importance all over the world. About 170 countries of the world cultivate onions for domestic use while some also grow onions for trade. About 9.2 million acres of onions are harvested each year on a global scale and 8% of this harvest is internationally traded. China, India, and the US are the world's leading onion producing countries (FAO, 2014).

Onion is a recently introduced bulb crop in the agriculture commodity of Ethiopia and it is rapidly becoming a popular vegetable among producers and consumers (Dawit et al., 2004). It is more widely grown in Ethiopia for local consumption and for flower export (Lemma and Shimeles, 2003). It is valued for its distinct pungency/mild flavour and also consumed universally in small quantities and used in many homes almost daily, primarily as a seasoning for flavoring of dishes, sauces, soup, and sandwiches in many countries of the world (Geremew et al., 2010).

Ethiopia has enormous potentials to cultivate the vegetable crops at small as well as large commercial scale. The country has high potential to benefit from onion production, and the demand for onion is increasing from time to time for its high bulb yields, seed and flower production potential (Lemma and Shimelis, 2003). In Ethiopia, onion planted to 36.4 million hectares with a total production of 273,859 tons. The total production and the total cultivated area for onion grew by 18.7%

and 59.7% respectively between 2015 and 2020. The productivity of onion, however, declined by 25.7 percent over the same production period (CSA, 2020).

There are a number of constraints that cause low productivity of onion in Ethiopia. The low yield of onion in the country is reported to be due to lack of improved varieties, low fertility of soil, inappropriate fertilizer rate and poor management practices (Lemma and Shimelis, 2003). Among those constraints lack of improved and adaptable hybrid onion varieties are the most limiting factors in the study areas. However, successful production depends on the selection of varieties that are adapted to different conditions imposed by specific environment (Brewester 1994).Therefore the present study was conducted with the objectives of identifying the best adapted and high yielder hybrid Onion variety in the study area.

Objective

- To identify the best adapted and high yielder hybrid onion variety in north western zone of Tigray

2. Methodology

The experiment was conducted at Tselemti Wereda Shire-Maitsebri (SMARC) experimental Station during 2019 irrigation season. Seven hybrid onion varieties namely: MALBEC F1, NEPTUNE, RUSSET, JAMBAR, RED KING F1, RED COACH F1, ANKIN F1 and NASIK RED (Standard Check) were evaluated for their adaptability and yield performance. The field experiment was laid out in Randomized Complete Block Design (RCBD) with four replications. Accordingly, treatments were assigned randomly to the experimental plot within a block. A plot size of 2 x 2 m (4 m^2) was used. The blocks were separated by 1.5m, whereas plots within a block were 1m apart from each other. Each plot consists of 5 rows of 2m length, with a spacing of (40 cm, 20cm, and 5cm) between furrows, double rows and plants respectively. Recommended amount of fertilizer (200kg/ha DAP & 100kg/ha Urea) were used. All agronomic management practices (ploughing, cultivation, watering, nursery and transplanting method, weeding and others) were applied uniformly to all plots as per standard recommendations for the crop

Description of the study Area

The experiment was conducted at Tselemti & Medebayzana woreda specific location at Maitsebri and at Selekeleka Shire-Maitsebri Agricultural Research Center (SMARC) research stations respectively during 2017 & 2018 under off season condition. Tselemti woreda specific location Maitsebri research station is located 400 km west of Mekelle and 85 km from Shire along the way Shire to Gondar (Figure-1). The research station lies at latitude $13^0$05' North and longitude $38^0$08' East and has an altitude of 1304 m.a.s.l. The Agro-ecological zone of the woreda is hot to warm-moist lowlands and Tepid to cool-moist mid highlands with 2.65% 'Dega' (cool highland), 19% 'Weinadega' (mid highland) and 78.35% 'Kola' (hot lowland). The mean annual temperature ranges from a minimum of 18.4ºC (November-January) to an average annual maximum of 32.7ºC (February-May). It is a low altitude area with average (6 years) annual rainfall of 1176.7 mm. Generally, rainfall starts in June and ends in September (Metrological data, 2019)

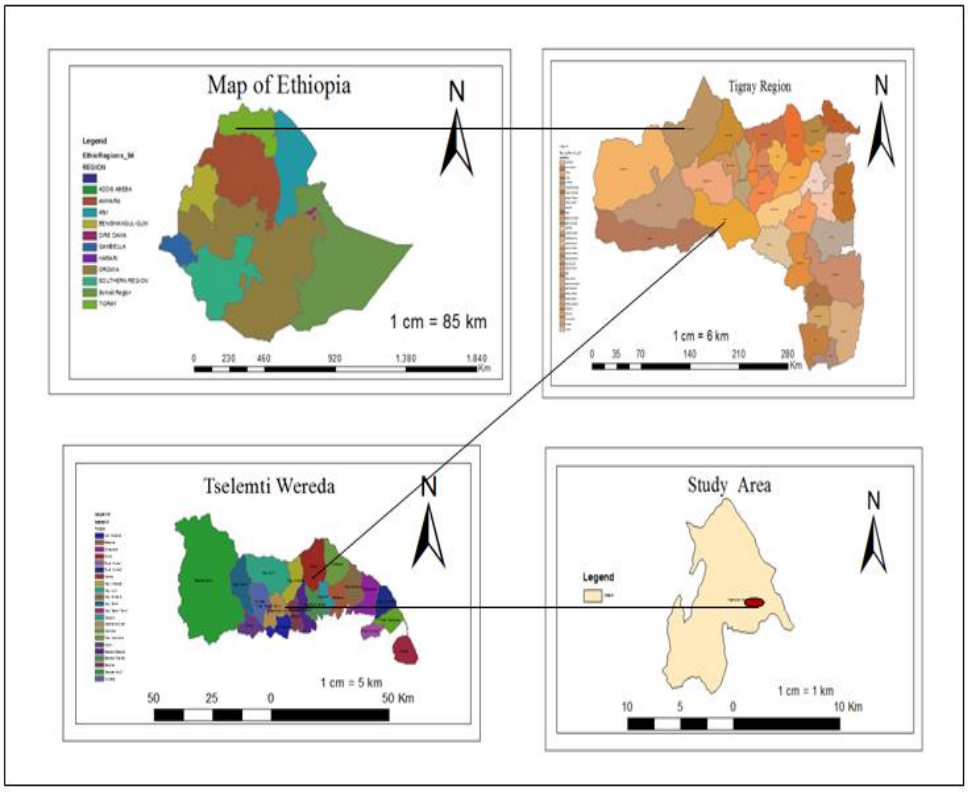

Figure 1. Maps of the country, Tigray Region, Tselemti woreda and Maitsebri Research Station

2.1. Method of Agronomic Data Collection

All data relating to yield and yield components were collected from the central three rows by excluding plants from either end of the rows. Six (6) plants/plot were selected randomly from each plot and observations on growth, yield and yield components of the crop such as: plant height, average leaf length, average leaf number, average neck thickness, average bulb length, diameter &yield were recorded.

Plant height (cm): Plant height was measured from the ground level up to the tip of the Longest leaf using ruler. Plant height of sex randomly selected plants were measured in the central rows of each plot at physiological maturity stage of the crop and the average was Computed.

Days to physiological maturity: It was registered on plot basis as the actual number of days from date of transplanting to when about 75% of the leaves fell down and 2/3 leaves had turned yellow

Number of leaves per plant: The number of fully developed leaves of six randomly selected plants was counted at the active green leaf stages and the average was computed to obtain number of leaves per plant.

Leaf length (cm): Leaf length was recorded as the average length of the longest leaves in six randomly selected plants at maturity.

Bulb diameter (cm): Bulb diameter was measured at right angles to the longitudinal axis at the widest circumference of the bulb of six randomly selected plants in each plot using veneer calliper (Saud et al., 2013) at harvest.

Bulb length (cm): Bulb length was the vertical average length of the matured bulb of six randomly selected plants in each plot which was measured by veneer calliper.

Bulb neck thickness (cm): The average neck thicknesses of six randomly selected plants in each plot were obtained by measuring the neck of bulbs at the narrowest point at the junction of bulb and leaf sheath using a veneer calliper.

Marketable bulb yield (t ha^{-1}): Marketable bulb yield was determined after discarding the unmarketable bulb, weight healthy bulbs and having nationally accepted marketable bulb weight of 60 g (Tegbew, 2011) at harvest in each plot and converted to t /ha.

2.2. Method of Data Analysis

All crop data collected in this study were subjected to two way statistical analysis of variance (ANOVA) following a procedure appropriate to a randomized complete block design as suggested by (Gomez and Gomez, 1984).When the treatment were significant, least significance differences (LSD) by Dunken's multiple range comparison were used for mean separation at p=0.05.

3. Results & Discussion

3.1. Days to Bulb Maturity

The analysis of variance showed that days to maturity was significantly ($P < 0.05$) influenced by onion cultivars. Malbec F1 was matured significantly earlier than the other varieties at about 126 days, whereas Ankin, Red Coach F1, Red King F1, Russet, Neptune and Jambar had not shown significance different among each other but Nasik red variety was matured late in 142.1days (Table 1). The variation in maturity among hybrid onion varieties might be due to their genetic differences and diverse environmental conditions. Similarly Azoom et al., (2014) also reported that significant differences among onion varieties for days to bulb maturity.

3.2. Plant Height

The analysis of variance showed that plant height was significantly ($P < 0.05$) affected by onion cultivars. The plant heights of Nasik red, Nafis and Adama red varieties attained maximum plant was obtained from Red Coach F1 height of (41.22 cm) whereas minimum plant height was recorded from Neptune (28.17 cm) and Ankin F1(29.11cm) (Table-1). The observable differences among onion varieties regarding plant height results were might be because of genotypic variability among them Zeleke et al. (2021).

Despite the fact that they had grown in the same environment the difference in plant height among the onion varieties could be due to the difference in their genetic make-up of the varieties that was differently influenced by the environment. The result was similar to the finding of Ghafoor et al. (2003) and Yemane et al. (2014) who reported that plant height was shown significant differences among onion cultivars.

3.3. Neck Thickness

The neck thickness is one of the important growth parameters which indicates the vigor and extended growth of the plant and was observed a significant ($p<0.05$) difference among the onion cultivars. The highest neck thickness was observed from cultivar Ankin F1 (14.55 mm) and Red king F1 (14.28 mm) but they did not show significance difference among the two cultivars whereas the smaller neck thickness was recorded from the cultivar Russet (12.06 mm) (Table- 1). Neck thickness of bulb depends on genotype and sometimes it is influenced by temperature and rainfall received during

cropping period. Patil (1984) reported that thin bulb neck is responsible for natural top fall and good storage quality and thick bulb neck correlates with poor keeping quality.

Table-1: Effect of onion varieties on days to maturity, plant height, neck thickness, bulb length, bulb diameter, mean bulb weight and marketable bulb yield.

S/N	Variety	DM (days)	PH (cm)	NT(mm)	BL(mm)	BD(mm)	MBW(gram)	MBY(tha^{-1})
1	Malbec	126 a	31.00 b	13.17 ab	52.28 a	40.83 a	93.11 a	49.81 a
2	Ankin F1	132 b	29.11 b	14.28 a	52.11 a	28.10 c	69.33 e	34.04 c
3	Red Coach F1	131.2 b	41.22 a	13.17 ab	51.17 a	34.61 b	83.28 bc	44.61 b
4	Red King F1	130 b	33.44 ab	14.55 a	50.61 a	38.28 ab	83.22 bc	45.65 ab
5	Russet	130.4 b	33.44 ab	12.06 b	49.61 a	38.17 ab	86.22 b	48.02 ab
6	Neptune	131.3 b	28.17 b	13.17 ab	53.22 a	39.56 a	90.84 a	49.04 ab
7	Jambar	132.1 b	34.33 ab	12.61 b	53.78 a	34.33 b	81.67 c	46.49 ab
8	Nasik Red	142.5 c	33.41 ab	12.50 b	49.90 a	28.72 c	75.09 d	34.90 c
Mean		131.94	33.01	13.19	51.58	35.32	82.84	44.07
CV (%)		3.31	13.9	6.1	6.7	6.3	2.12	5.7
LSD		6.501	8.068	1.408	6.029	3.892	2.889	44.035

ns= non-significant at 0.05 probability level; Means with in the same column followed by the same letter do not differ significantly at the 5 % level of significance: DM= Days to bulb maturity; PH= Plant height; NT=Neck thickness; BL=Bulb length; BD=Bulb diameter; MBW= Mean bulb weight; MY=Marketable bulb yield

3.4.Bulb Length

There were no statistically significance difference ($P < 0.05$) shown on bulb length between onion cultivars (Table 1). Even though there were no significance differences in bulb length among the onion cultivars but there is little bit difference between the onion cultivars. The highest bulb length (53.78 mm) was recorded from Jambar cultivar and the cultivar Russet recorded lowest bulb length (49.61mm). Variation of bulb size depends on the physiological processes regulating the development of bulbs. Moreover, onion cultivars reveal wide variation in their yielding ability and potential when grown under varied agroclimatic zones of the country (Suhas et al., 2018)

3.5.Bulb Diameter

The results from the ANOVA table indicated that the onion cultivars had significant ($p < 0.05$) impact on the onion bulb diameter (Table 1). The maximum bulb diameter was recorded from Malbec (40.83 mm) and Neptune (39.56 mm) cultivars whereas the minimum bulb diameter had observed from the cultivars Ankin F1 (28.10 mm) and Nasik Red (28.72 mm). Similarly, variations in onion bulb of different varieties due to genetic constitution have been reported by (Aghora and Pathak, 1991).

3.6. Mean Bulb Weight

There was significant ($P \leq 0.05$) difference among the onion cultivars on mean bulb weight (Table 1). The highest mean bulb weight (93.11 g) was obtained from Malbec followed by Neptune (90.84 g) and the lowest mean bulb weight was recorded from Ankin F1 (69.33 g). In agreement with the finding of Tadese et al. (2022) who reported that there was significance difference among varieties for average bulb weight. It is also in line with the finding of Zeleke et al. (2021) who mentioned that analysis of variance showed that significant difference between improved onion varieties in relation to average bulb weight in gm.

3.7. Marketable Bulb Yield

The onion cultivar had a significant effect ($P < 0.05$) on marketable bulb yield (Table 1). Malbec had significantly higher marketable bulb yield (49.81 t ha^{-1}) followed by Neptune (49.04 t ha^{-1}) and Russet (48.02 t ha^{-1}) but they had not shown significantly differences between Neptune and Russet cultivars whereas the lowest marketable bulb yield were recorded from the cultivar Ankin F1 (34.04 t ha^{-1}) and Nasik Red (34.90 t ha^{-1}) . A cultivar may performs differently under diverse agro-climatic conditions and various cultivars of the same species grown even at the same environment this is due to the genetic makeup of the cultivars and the interaction effects of genotype x environment (Yemane et al., 2013). This is in line with the finding of Tadese et al. (2022) who reported that there was significance difference ($p \leq 0.05$) among varieties for marketable bulb yield. According to Aklilu (1994) finding using the improved cultivars increases the productivity of onion bulbs. Gautam et al. (2006) indicated that yield of fresh onion bulb was significantly affected by varieties.

4. Summary and Conclusion

Onion ((Allium cepa) is a recently introduced crop to Ethiopia. Onion is widely recognized as an important vegetable condiment as a form of dry bulb and cash crop in Ethiopia. It is successfully produced under rained as well as irrigated conditions in different agro ecologies of the country by small holder farmers and commercial growers. However, the productivity of onion is below standard due to many production constraints. Lack of improved onion cultivars is among the major limiting factor for onion production and productivity. Therefore the present study was conducted with the objectives of identifying the best adapted and high yielder hybrid Onion cultivars in the study area.

The experiment was conducted at Tselemti Wereda Shire-Maitsebri (SMARC) experimental Station during 2019 irrigation season. Seven hybrid onion varieties namely: MALBEC F1, NEPTUNE, RUSSET, JAMBAR, RED KING F1, RED COACH F1, ANKIN F1 and NASIK RED (Standard Check) were evaluated for their adaptability and yield performance. The field experiment was laid out in Randomized Complete Block Design (RCBD) with four replications.

The analysis of variance revealed that the highest bulb diameter, mean bulb weight and marketable bulb yield were obtained from MALBEC F1 followed by NEPTUNE, RUSSET, JAMBAR and RED KING F1 (49.81, 49.04, 48.02, 46.49 &45.65 t ha^{-1}) respectively and the lowest bulb yield were obtained from NASIK RED (34.90 t ha^{-1}) and ANKIN F1 (34.04 t ha^{-1}). Therefore, it is recommended that (MALBEC F1, NEPTUNE, RUSSET, JAMBAR and RED KING F1) hybrid onion varieties are the best adaptable and high yielder in the study area.

COMPETING INTERESTS DISCLAIMER:

Authors have declared that they have no known competing financial interests OR non-financial interests OR personal relationships that could have appeared to influence the work reported in this paper.

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