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Performance Evaluation of Hot Pepper (*Capsicum annum* L.) Varieties for Green Pod Yield and Yield Related Traits Under Irrigated Condition in Guder West Showa Zone, Ethiopia

Ousman Yimer

Holetta Agricultural Research Center, Ethiopian Institute of Agricultural Research, Holetta, Ethiopia

Email address:
Ousmna24@gmail.com

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Abstract: Capsicum (Capsicum spp.) also known as pepper, is a major vegetable and spice crop grown all over the world for fresh, dried, and processed goods. Pepper is the most important vegetable crop in Ethiopia. This study was conducted to evaluate the performance of released hot pepper varieties and recommend the best adaptable and high-yielding variety/ies for the Western Shoa zone. Four different hot pepper varieties (Mareko fana, Melka shote, Melka awaze, and Melka zala) were tested in a randomized complete block design with three replication at Guder 2015/16 under irrigated conditions. The results from the analysis of variance revealed the presence of significant differences among varieties for marketable yield and total yield. Variety Melka awaze had the highest marketable and total yield of 13.67 t/ha & 13.87 t/ha, respectively. The variety followed by Melka awaze is the variety Melka shote (13.53 t/ ha). In contrast, Mareko fana recorded the lowest marketable yield of (7.23 t/ ha), and the lowest total yield was recorded by Melka zala (7.5 t/ha). The research results suggested promoting both the Melka awaze and Melka shote varieties for widespread cultivation in Guder and under comparable agroecological conditions would help to increase the productivity of hot pepper. Farmers could also use Mareko fana for dry pod purposes which is an attractive color.

Keywords: Green Pod, Guder, Hot Pepper, Varieties

1. Introduction

Pepper is a major vegetable and spice crop that was first domesticated in the American tropics. Today, Pepper is grown all over the world for fresh, dried, and processed products [16]. The huge Solanaceae family, which has more than 90 genera and 2500 species of flowering plants, includes the genus Capsicum along with other significant vegetables such as tomato, potato, and eggplant. This genus is native to tropical and subtropical America [8]. The Capsicum genome has an estimated size of 3.5 Gb and includes mainly diploid species with 12 chromosomes (2n =2x = 24). Within the genus, there are documented species with 13 chromosomes (2n =2x = 26) and one tetraploid species (2n =4x = 48), which is C. annuum var. glabriusculum, the wild form of the cultivated pepper.

Recent research divided the Capsicum species into 11 clades based on key morphological feautures, provenance, and evolutionary relationships [2]. The typical pungency in pepper is the due to the presence of capsaicinoids [14]. Nearly 90% of all capsaicinoids are made up of the two most common chemicals, capsaicin and dihydrocapsaicin [9]. Peppers are a very good source of the chemicals that give fruits their color and act as antioxidants [6]. Additionally, peppers are recognized as active ingredients in cosmetics, medications, and pest control [1].

The majority of Ethiopian regions cultivate hot peppers, which is among the country's top vegetable crops. The potential regions for growing pepper are Eastern and Southern Shoa, Western, North Western Wellega, Gojja), and Northern parts of the country [5]. During the summer (Belg) season, national production of green and dry hot pepper was 5082.17 and 798.88 tones with average productivity of 4.88 and 10.12 tones ha^{-1}, respectively [3]. Due to its strong flavor and aroma, it is a high-value crop grown in Ethiopia which is used as a vegetable and spice. It is a crucial traditional crop

that is mostly used for its pungency and color in Ethiopian cuisine [10].

In Ethiopia a number of different pepper varietals are cultivated. It varies in the size of fruit, shape of fruit, color of fruit, pungency of the fruit, and the manner of growth. Despite its significance, Ethiopian pepper production, both for green and dry pod, is modest. Numerous factors, such as the use of subpar varieties, poor cultural practices, poor disease and pest management, the rising prevalence of fungal, bacterial, and viral diseases, poor harvesting and post-harvest practices, and lack of knowledge regarding the use of specific varieties for specific areas, have all have all contributed to the production being hindered [4]. In order to overcome the aforementioned limitations selection of varieties for specific area is one of the solutions to ease the current challenges. Therefore, the objective of this study is to assess the performance o released hot pepper varieties in the country and recommend the best adaptive and high-yielding variety/ies for Ethiopia's Western Shoa zone.

2. Materials and Methods

2.1. Description of Experimental Site

The experiment was carried out at Guder, Toke Kutaye district, in the West Showa Zone of Oromia National Regional State, Ethiopia. Guder is located 12 kilometers from the West Showa Zone's capital city, Ambo, and 128 kilometers west of Addis Ababa. The latitudinal range of the area is between 1,600 and 3,192 m.a.s.l [15]. The major soil types are vertisols and nitosols. The mean annual rainfall is 800 and 1000mm. The minimum and maximum temperature is 10 and 29°C, respectively and the experiment was conducted at farmers' field.

2.2. Experimental Materials

For this research trial, the Melkassa Agricultural Research Center provided the released pepper cultivars Mareko fana, Melka awaze, Melka shote, and Melka zala. Experimental materials and its unique characters are shown in Table 1.

Table 1. *Description of releasedhot pepper varieties with their agro-ecological adaptations.*

Name of Varieties	Year of release	Maturity (days)	Dry pod yield (t/ha)	Area of Adaptation (Altitude)	Unique features
Mareko fana	1984	110-130	1.5-2.0	1400-1900 m.a.s.l.	High acceptance for local use due to its brown pod color
Melka awaze	2007	100-110	2.5-2.8	1000-2200 m.a.s.l.	Early maturing, Tolerant to soil borne diseases,
Melka shote	2007	110-120	2.0-3.0	1000-2200 m.a.s.l.	Tolerant to soil borne diseases
Melka zala	2004	130-150	1.5-2.5	1400-1900 m.a.s.l.	Tolerant to soil borne diseases

2.3. Experimental Design and Management

The experiment was carried out in a farmer's field under irrigated conditions. The treatments were arranged in randomized complete block design (RCBD) with three replications. The seed of each variety was sown on the seed tray at the Holleta Agricultural Research Center. After eight weeks, the seedlings were moved to the farmer's field and transplanted to the main field. The seedlings were transplanted with a spacing of 70cm between plants and 30cm between rows. The plot size was 3 m x 1.5 m = 8.4 m^2 with a total of 20 plants per plot were used. The spacing of 0.5 m and 1 m was used between plots and between blocks, respectively.

DAP was applied at the rate of 200 kg/ha before transplanting and urea at the rate of 100 kg/ha was side dressed in a split application where 50% of urea was applied after 21 days of transplanting. Seedling management, weeding, and other cultural practices were applied as per the recommendation for the crop. Harvesting was done when the green pods got firm green mature pods from two middle rows. After harvest, the pods were weighed and the yields were recorded.

2.4. Data Analysis

All collected data (pod length, pod diameter, plant height, marketable green pod yield, and total green pod yield per plot were subjected to analysis of variance (ANOVA) using SAS statistical Software [11]. Means of parameters were separated using least significant difference test.

3. Results and Discussion

3.1. Plant Height

Varieties showed highly significant differences in plant height as indicated in Table 2. The variety Melka shote (67.76 cm) had the tallest plant height followed by Melka zala (62.61 cm) and Melka awaze (58.34 cm). The shortest plant height was recorded by Mareko fana (47.39 cm). Similar results were reported by Haileslassie, G. et al. the highest plant height was recorded by Melka awaze; whereas, significantly shortest plant height was recorded by Mareko fana [7].

3.2. Fruit Length and Diameter

The varieties showed highly significant ($P<0.01$) differences across the varieties for fruit length and fruit diameter (Table 2). As a result, Melka zala (10.73 cm) had the longest fruits, followed by Melka shote (9.38 cm) and Melka awaze (8.91 cm). However, the smallest length of fruits was recorded by Mareko fana (8.88 cm). In addition, the widest fruit diameter was recorded by Mareko fana (2.05 cm), followed by Melka awaze and Melka zala with 1.59 and 1.53 cm, respectively, whereas, the smallest fruit diameter was recorded by Melka shote (1.23 cm). Similar results were reported by Haileslassie,

G. et al. and Seleshi, D. et al. [7, 12].

Table 2. *Mean performance of hot pepper varieties evaluated at Guder during 2015/16 off season.*

Name of Varieties (cm)	Plant height (cm)	Fruit length (cm)	Fruit diameter (cm)	Markatable yield (ton/ha)	Total yield (ton/ha)
Mareko fana	47.39c	8.88b	2.05a	7.23b	7.6b
Melka awaze	58.34b	8.91b	1.59b	13.67a	13.87a
Melka shote	67.76a	9.38b	1.23c	13.28a	13.53a
Melka zala	62.61b	10.73	1.53b	7.44b	7.5b
CV	4.32	6.98	6.6	13.21	13.33
LSd	5.09	1.323	0.75	2.75	2.83

Means with the same letter (s) in the same column are not significantly different at P<0.05, CV =Coefficient of variation, least significance difference (LSD) test at 5% probability level

3.3. Marketable Fruit Yield and Total Fruit Yield

The results from ANOVA showed that significant difference was observed among the varieties for marketable yield and total yield (Table 2). The variety Melka awaze had the highest marketable and total yield of 13.67 t/ha & 13.87 t/ha, respectively. The variety followed by Melka awaze is the variety Melka shote (13.53 t/ ha) while Mareko fana recorded the lowest marketable yield of (7.23 t/ ha) and the variety Melka zala recorded the lowest total yield (7.5 t/ha). Similar results were by Haileslassie, G. et al. and Shamil & Merga in which Melka awaze recorded the highest marketable and total fruit yield [7, 13].

4. Conclusion

Pepper is one of the most important and profitable vegetable crops in Ethiopia, but due to its different constraints, production is still low in the country. The main objective of this study was to identify the best-performing pepper varieties in the farmer's field of Guder areas. The research results showed highly significant differences in all parameters of fruit length, fruit diameter, plant height marketable yield, and total yield. The result revealed that the highest marketable and total yield were recorded by Melka awaze and Melka shote and whereas the lowest marketable and total yield were recorded by the varieties Marko fana and Melka zala, respectively. Thus, the research results suggested that promoting both Melka awaze and Melka shote varieties for widespread production in Guder and with similar agroecological areas contributes to boosting the productivity of hot pepper. In addition, farmers could also use Mareko fana for dry pod purposes which is an attractive color. Further research should be carried out over repeated years in order to boost the production of hot peppers in the Guder regions of West Shoa zone.

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