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Growth and Yield Performance Evaluation of Hot Pepper Varieties for Green Pod Purpose under Wondo Genet Agro-ecology

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Abstract
The experiment was conducted during the 2020 and 2021 cropping seasons at Wondo Genet agricultural research center to identify better hot pepper varieties for green pod production. Four varieties that were released nationally were evaluated together with one farmers` local check using a randomized complete block design in three replications. Hot pepper varieties growth, yield components, and yield data were collected and subjected to analysis of variance using SAS software version 9.4. The results of the experiment showed that the hot pepper variety Melka Awaze was better in plant height, branch number, pod number, and marketable yield as compared to the rest varieties. The marketable yield from Melka Awaze was 17.12% more advantageous than the local check and 51.78% more valuable compared to the lower yield from Melka Zala. Therefore, Melka Awaze is the better variety for green pod production for the present study area.
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Introduction

Pepper (*Capsicum*) is a crop having longer time history in world agricultural practices and human diet which accounts for 7500 BC (Mac Neish, 1964). It has approximately 22 wild species and five domesticated species (Bosland and Votava, 2000). The cultivated pepper has different types, among which hot pepper (*Capsicum annuum* L.) is dominantly produced both at smallholder and commercial farms (Bosland, 1992). Hot pepper (*Capsicum annuum* L.) is one of the wide-growth warm-season vegetable crops from the Solanaceae family (Caporaso *et al*. 2013). Hot pepper is a versatile crop as it contributes a lot to national and international communities. It is a crop that can be used as fresh, dried, or processed.

Hot pepper has great attention from plant breeders, pharmaceutical companies, food industries, and biochemists. This is because hot pepper has nutritional, medicinal, and social values which have been increased globally (Bosland and Votava, 2000). Besides, the higher production of hot pepper has positive contributions to that of other agricultural crop productions for a better livelihood, particularly for income generation and improving food security of the growers and foreign exchange earnings (Beyene and David, 2007; Aliyi *et al*., 2019). However, because of various detrimental factors, such as biotic and abiotic, world hot pepper production is greatly influenced. Plant breeders were looking for a better variety of hot pepper for higher yield, disease resistance, market advantages, and specific product for an industry like vitamin and oleoresins contents.

In Ethiopia, hot pepper has been cultivated for a long period, and it is the main part of the daily diet of the people of different cultures and religions prospects. It is a horticultural crop having high domestic demand. It is cultivated for both green pod and dry pod yields. The disease is the major problem for most hot pepper producers in Ethiopia. However, improving hot pepper production and productivity is one of the national research considerations and certain varieties, such as Melka Awaze, Melka Shote, Mareko Fana, Bako Local, Melka Zala, Melka Dima, and Melka Eshete were released and agronomic management practices were evaluated recommended. However, adaptation and suitability for different agro-ecologies of the different hot pepper producing areas have not been determined fully concerning the nationally released hot pepper varieties. In addition, the national hot pepper yield is low as compared to world hot pepper productivity, which needs further improvement works. One of the efforts in reducing the yield and quality gap for hot pepper is the evaluation of the existing varieties, which enables the growers to select better adaptive varieties. Therefore, the current study was initiated to identify better hot pepper variety for better green pod yield and yield components at Wondo Genet, Southern Ethiopia.

Material and Methods

Description of the study area

The experiment was conducted in 2020 and 2021 for two consecutive years on the experimental field of Wondo Genet agricultural research center, which is located in Sidama regional state, Southern Ethiopia, at 7º 192 N latitude and 38º 382 E longitudes with an altitude of 1780 m.a.s.l. The site receives a mean annual rainfall of

1000 mm with minimum and maximum temperatures of 10^{oc} to 30^{oc}, respectively. The soil is a sandy clay loam with an average pH of 7.2 (Dessie and Kleman, 2007). The agro-climatic condition of the area is warm sub-humid in which both food and cash crops are grown. Some of the common crops in the area include enset, maize, coffee, khat, banana, sugarcane and common bean. Maize and enset production for food as well as enset-coffee agroforestry farming system are largely practiced in the area.

Experimental Material, Treatments and Design

The experiment consists of four hot pepper varieties namely Melka Awaze, Melka Zala, Melka Shote and Mareko Fana obtained from Melkasa Agricultural research center and farmers' variety (local) obtained from farmers for comparison. The treatments of the experiment include the experimental materials listed above. The design of the experiment was Randomized Complete Block Design (RCBD) in three replications.

Seedling Preparation and Field Management

Seeds of all experimental varieties were sown on a raised bed of 1 m*5 m size at Wondo Genet agricultural research center under greenhouse conditions. The beds were covered with dry grass mulch until seeds germination, recognized, and removed carefully after germination. Seedling management practices, such as watering and weeding, were conducted until transplanting at the nursery. The seedlings were transplanted on the main field using a spacing of 30 cm between plants and 70cm between rows on an experimental plot of the size of 3 m*2.8 m. Furrow irrigation was applied twice per week and all other agronomic practices were done accordingly during the field experimental period.

Data Collection

For the experimental data collection, ten central plants from the central rows were selected randomly for growth and yield parameters.

- Plant height (cm): The length of the plant was measured from the soil surface to the tip of the plant in each plot at plant maturity from ten plants selected at random.
- Branch number: The primary branch number was counted for each selected central plant at plant maturity.
- Pod length (cm): Ten pods were selected randomly, and the average pod length was measured from the tip of the pod to the basal end using a Venice caliper.
- Pod diameter (cm): Average pod diameter of the ten selected pods was measured at the widest point of the pods using a venire caliper.
- Number of pods per plant: The number of pods per plant was obtained by counting all fruits produced on ten randomly selected plants and divided by the number of sample plants.
- Marketable yield per plant (g): Pods from randomly selected ten plants were collected, sorted according to color, shape, size, and free of any mechanical or disease injuries and acceptable by the market and weighed using digital balance model number 14191-423F and divided by the number of sample plants
- Marketable yield per hectare (t ha^{-1}): it was obtained by converting pod yield per plant to pod yield per hectare.

Data Analysis

All collected data were subjected to analysis of variance using SAS software version 9.3. The least significant difference (LSD at p=0.05) was employed to identify significantly different treatments from each other.

Results and Discussion

Plant Height (cm)

Analysis of the combination of the two years' mean values showed a significant difference among varieties in terms of their plant height (Table 1). Farmers' hot pepper variety (local –check) was taller (66.53 cm) compared to the released varieties (Melka Shote (51.63 cm), Melka Zala (55.63 cm), and Mareko Fana (58.7 cm)) while statistically similar results were obtained as compared to the variety Melka Awaze (59.63 cm). The variation in plant height of hot pepper varieties of the present finding is in line with reports (MARC, 2005) as cited by (Teferi *et al*., 2015). Daniel and Abrham (2020) also reported similar findings with respect to the evaluation of the plant height of hot pepper varieties. Variation in plant height among the varieties might be due to the variations in genetic character and their responses to soil fertility, temperature, and water.

Branch Number

Significant primary branch number results were obtained among the hot pepper varieties evaluated. The higher branch number was recorded at Melka Awaze (8.77) and Melka Shote (8.20) hot pepper varieties while Mareko Fana and local-check showed significantly lower branch numbers (5.40 and 5.67 respectively) (Table 1). Similar

significant variations in the primary branch number of hot pepper varieties were also reported at Debremarkos University at the Zalima site (Tesheshigo *et al*., 2019). However, the current result is in contrast to the nonsignificant results of a study conducted at Dilla University (Teferi *et al.,* 2015).

Pod Length (cm)

Significant variations were observed among hot pepper varieties for pod length (Table 1.) Melka Zala (8.85) and local-check (8.86) varieties were superior in pod length to Melaka Awaze (7.22) but similar to Mareko Fana (7.71) and Melka Shote (7.94) (Table 1). A study report also showed a higher pod length from Melka Zala variety than the others (Jemberu, 2016).

Pod Diameter (cm)

Mean values analysis showed significant variations among the hot pepper varieties. Following the local check, Mareko Fana showed the higher significant pod diameter and Melka Awaze variety the lower significant pod diameter (1.81 and 1.36 respectively) (Table 1). This is similar to the findings of (Tesheshigo *et al*., 2019). The shorter pod diameter (0.96) was recorded in the Melka Shote variety which is similar to the findings of (Kassa and Atsbha, 2015).

Table1: Combined mean values for growth parameters of hot pepper varieties for green pod purpose at Wondo Genet in 2020 and 2021

Varieties	Plant height (cm)	Branch number	Pod length (cm)	Pod diameter (cm)
Melka Awaze	59.63^{ab}	8.77^{a}	7.22^{c}	1.36^{c}
Melka Zala	55.63^{bc}	6.63^{b}	8.85^{a}	1.08^{d}
Melka Shote	51.63^{c}	8.20^{a}	7.94^{abc}	0.96^{e}
Local-check	66.53^{a}	5.67^{c}	8.65^{a}	2.00^{a}
Mareko Fana	58.70^{bc}	5.40^{c}	7.71^{abc}	1.81^{b}
$LSD_{0.05}$	7.30	0.82	1.32	0.12
CV (%)	10.30	9.74	13.43	6.64

Means in a column followed by the same letters are not significantly different at P≤5%.

Pod Number per Plant

Mean values analysis revealed significant results and significant variation in pod number per plant among hot pepper varieties (Table 2). The higher significant result was from the Melka Awaze variety (55.47) and followed by the Melka Shote variety (43.23). The higher pod number per plant might be due to the higher primary branch number per plant as indicated in table 1 above. The growing environmental and varietal factors that favor the hot pepper primary branch number may possibly also be the major reason for the variation in pod number per plant. Jember (2016) also reported a higher significant pod number per plant from Melka Awaze than the other varieties under consideration in the present study.

Marketable Yield per Plant

Result analysis showed the existence of significant variation in marketable yield per plant among hot pepper varieties (Table 2). Melka Awaze variety resulted in the higher marketable yield per plant (300.48g) followed by the local-check variety (249.12g).

Marketable Yield per Hectare

The combined analysis of mean values showed significant variations in marketable yields among hot pepper varieties (Table 2). There was a 51.78% yield difference recorded between the higher (Melka Awaze, 14.31t/ha) and the lower (Melka Zala, 6.89t/ha) marketable yields per hectare. The three hot pepper varieties (Melka shote, Melka Zala, and Mareko Fana) resulted in lower marketable yield per hectare as compared to the local check.

Table 2: Combined mean values for yield parameters of hot pepper varieties for green pod purpose at Wondo Genet in 2020 and 2021

Varieties	Pod number per plant	Marketable yield per plant (g)	Marketable yield per hectare (t ha^{-1})
Melka Awaze	55.47^{a}	300.48^{a}	14.31^{a}
Melka Zala	19.50^{d}	144.65^{d}	6.89^{d}
Melka Shote	43.23^{b}	187.98^{c}	8.95^{c}
Local-check	25.80^{c}	249.12^{b}	11.86^{b}
Mareko Fana	23.53^{cd}	209.38^{c}	9.99^{c}
$LSD_{0.05}$	5.39	30.07	1.50
CV (%)	13.26	11.35	11.89

Means in a column followed by the same letters are not significantly different at P≤5%.

Conclusion

Agriculture is a very important tool for economic development, food security, and nutrition. Crop production and productivity play a key role in this sector. However, due to the effects of climate change and modern breeding, attention to crop landrace is being lost. Hence, consideration of the alternative crop variety is critical in agricultural studies. The present study focused on the evaluation of four hot pepper varieties together with the local variety at Wondo Genet agricultural research center for two years (2022 and 2021). The hot pepper variety, Melka Awaze, was superior in terms of primary branch number per plant, pod number per plant, and marketable yield per hectare which was 17.12% advantageous compared to the local check. Hence, we recommend Melka Awaze hot pepper variety for Wondo Genet and similar areas based on the present finding for green pod production.

Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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