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Performance evaluation of hot pepper (Capsicum annum L.) varieties for productivity under irrigation at Raya Valley, Northern, Ethiopia

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ABSTRACT

In order to identify the performance of Hot pepper (Capsicum annum L.) varieties, the field experiment was carried out at the research field of Meoni Agricultural Research Center, Ethiopia in 2013 and 2014 cropping season under irrigation condition. The experiment was consisted of three hot pepper varieties arranged in completely randomized block design with four replications. In 2013 cropping season, establishment percentage, days to 50% maturity, plant height, fruit length, marketable yield, unmarketable yield and total yield were significantly influenced by varietal effect. Similarly, variety was exerted significance influence on plant height, fruit length and fruit diameter in 2014. The highest marketable yield (352.68 q ha⁻¹) was obtained at Melka awaze variety while the lower marketable yield was (292.26 q ha⁻¹) was obtained at Melka shote, which, however did not statistically different with that of Mareko fana variety in 2013. Therefore, it can be recommended to use Melka awaze variety for production by growers in the study area.

Keywords: Hot pepper, marketable yield, unmarketable yield, total yield

INTRODUCTION

Hot pepper (Capsicum annum L.) belongs to the genus Capsicum and family Solanaceae (Rodriguez et al., 2008). The genus consists of approximately 22 wild species and five domesticated species of C. annum L., C. frutescens L., C. Chinenses L., C. baccatum L. and C. pubescens (Bosland and Votava, 2000; Patricia et al., 2003). The capsicum species can be divided in to several groups based on fruit or pod characteristics ranging in pungency, colour, shape, intended use, flavor and size. Despite their vast trait differences most cultivars of peppers commercially cultivated in the world belongs to the species C. annum (Bosland, 1992).

Hot pepper fruits are considered to be vegetables, botanically they are berries. The fruits are the most widely consumed as a spice; though there are about 25-30 species of Capsicum, Capsicum annum is the most widely cultivated species (Csillery, 2006; Ravishankar et al., 2003). It is the world’s most important vegetable after tomato and used as fresh, dried or processed products, as vegetables and spices or condiments (Acquaah, 2004).

The total area devoted to hot pepper worldwide is estimated at four million hectare with an average annual increase of 5% (Weiss, 2002). Hot pepper is the leading vegetable crop produced in the Ethiopia. The national production of green and dry hot pepper was 2,541,883.97
and 412,503.57 tones with average productivity of 66.88 and 23.31 tones ha\(^{-1}\), respectively (CSA, 2013). Thus, Capsicum productivity in Ethiopia is far below the world average that strongly demands immediate productivity improvement. People consume pepper for intake and improvement. People consume pepper for intake and food security in Ethiopia (Roukens, 2005).

Hot pepper is the main parts of the daily diet of most Ethiopian societies. The fine powdered pungent product is an indispensable flavoring and coloring ingredient in the common traditional sauce “Wot”, whereas the green pod is consumed as a vegetable with other food items. The average daily consumption of hot pepper by Ethiopian adult is estimated 15g, which is higher than tomatoes and most other vegetables (MARC, 2004).

In spite of its importance, hot pepper production system for green and dry pod has stayed as low input and low output with a national average yield of 7.6 tons ha\(^{-1}\) for green pod whereas it was 1.6 tones ha\(^{-1}\) for the dry pod, respectively (CSA, 2006). The decline of hot pepper production in the country is also attributed to lack of improved, good quality and well adapted varieties, nutrient depletion (poor soil fertility), inappropriate fertilizer utilization (due to an increase in the price of fertilizers), poor agronomic practices, poor disease and pest management and poor harvesting and post-harvest practices (Fekadu and Dandena, 2006; Alemu and Ermiyas, 2000).

In Raya valley, hot pepper is a major spice and vegetable crop produced by the majority of farmers. Therefore, strong help for producers to achieve sustainable production in order to increase their income and secure their livelihood by providing best adaptable and high yielding varieties. The present situation indicates that in Raya area there is limitation of well adapting hot pepper varieties including both improved and the local ones. As a result, varietal information for the improvement of the crop for high fruit yield in the existing agro-ecology is insufficient. In addition to this, there is no research work on evaluation of hot pepper which enables the growers to select best performing varieties in the study area.

Therefore, evaluation of selected varieties for their agronomic performance is one of the considerations to ease the existing problems of obtaining best adaptable varieties for which the output of this study was likely to assist and sensitize hot pepper growers and processors. Therefore, the objective of this study was to ascertain best performing hot pepper variety with improved cultural practices under irrigation condition.

**MATERIALS AND METHODS**

The field experiment was carried out at Mehoni Agricultural Research Center (MARC), Ethiopia in 2013 and 2014 cropping season under irrigation conditions. The center is situated at about 678 km north of the capital, Addis Ababa. Geographically it is located at 12° 41'50" North latitude and 39° 42'08" East longitude with an altitude of 1578 m.a.s.l. The site receives mean annual rainfall of 750 mm with an average minimum and maximum temperature of 18 and 25°C, respectively. The soil textural class of the experimental area is clay loam with pH of 7.9.

Treatments were arranged in randomized complete block design (RCBD) with four replicates. Seeds of three varieties of hot pepper namely; Mareko fana, Melka shote and Melka awaze were sown in seed beds having 15 cm rows apart and grown for 55 days. Uniformly grown seedlings were selected, hardened and transplanted to the experimental field after attaining 20-25 cm height or 55 days of sowing in the nursery. Seedlings of hot pepper taken from the nursery were transplanted to experimental field having a plot size of 3 m width and 3.5 m length.

During planting a 70 cm and 30 cm spacing was maintained between rows and plants. To control the interference a spacing of 2 m between replications and 1.5 m between rows was maintained. Plants in the 3 middle rows out of the 5 rows per plot constituted the net plot used as the sampling unit. Ten plants from the middle rows were taken for sampling and data analysis. All appropriate agronomic practices such as weeding, watering and hoeing were conducted uniformly both at the nursery and experimental field.

Data on establishment percentage, plant height (cm), days to 50% maturity, fruit length (cm), fruit diameter (cm), marketable yield (q ha\(^{-1}\)), unmarketable yield (q ha\(^{-1}\)) and total yield (q ha\(^{-1}\)) was collected and analyzed. All the collected agronomic and growth components data were subjected to analysis of variance (ANOVA) using SAS PROC GLM (2002) at \(P<0.05\). The Least Significant Difference (LSD) Test was used to compare the mean separations at \(P<0.05\).

**RESULTS**

**Agronomic characters**

**Establishment Percentage (%)**

The analysis of variance table revealed that establishment percentage was significantly \(P<0.01\) affected by variety in 2013 (Table 1); however, it did not exert any significant influenced \(P>0.05\) in 2014. The
highest establishment percentage (87.50%) was recorded at Mareko fana variety whereas the lowest value (81.00%) was recorded at Melka shote in 2013. On the other hand, even though there was no statistical difference among the varieties in the 2014 cropping season slightly higher establishment percentage (87.75%) was recorded at Melka awaze variety (Table 3).

Days to 50% maturity

According to data shown in table 1, variety exerted significant (P<0.01) effect on days to 50% maturity in 2013 cropping season; which however, did not significantly influence (P>0.05) in 2014. In 2013, significantly higher day to 50% maturity (83.00) was obtained at Melka awaze while significantly lower days to 50% maturity (74.25) was obtained at Mareko fana variety. Although variety did not exert significantly effect on days to 50% maturity in 2014, slightly higher day to 50% maturity (110.50) and lower (104.75) value was obtained at Melka awaze and Mareko fana varieties, respectively (Table 3).

Plant height

The findings regarding plant height was significant influence (P<0.01) due the varietal effect in both cropping seasons (Table 1). Melka awaze was recorded the highest plant height (82.04 cm) in 2013. While the lowest plant height (54.50 cm) was recorded at Melka shote in the same year. Similarly, in 2014 significantly higher plant height (81.64 cm) was recorded at Melka awaze; whereas, significantly lower value (64.85 cm) was recorded at Mareko fana (Table 3).

Fruit length

Variety was exerted significant (P<0.05) influence on fruit length of hot pepper plant in 2013 and highly significant (P<0.01) influenced in 2014 cropping season (Table 1). In 2013, the maximum fruit length (10.12 cm) was recorded at Melka shote while the minimum fruit length (8.70 cm) was recorded at Mareko fana variety. In the second cropping season, significantly higher fruit length (10.62 cm) was obtained at Melka awaze; which however, did not significantly different with Melka shote variety. On the other hand, significantly lower fruit length (9.18 cm) was obtained at Mareko fana variety (Table 3).

Fruit diameter

Table 2 also evidenced the availability of data regarding fruit diameter was significantly (P<0.001) affected by varietal difference in 2014; conversely, it did not influence (P>0.05) in 2013cropping season. Even though there is no significant difference among the varieties slightly higher fruit diameter (1.59 cm) was recorded at Melka awaze while slightly lower fruit diameter (1.15 cm) was recorded at Melka shote variety (Table 3).

### Table 1. Mean square from the first year (2013) and second year (2014) analysis of variance for the performance of Hot pepper varieties

<table>
<thead>
<tr>
<th>SOV</th>
<th>DF</th>
<th>Establishment percentage</th>
<th>Days to 50% maturity</th>
<th>Plant height (cm)</th>
<th>Fruit length (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replication</td>
<td>3</td>
<td>3.67</td>
<td>2.75</td>
<td>4.30</td>
<td>49.86</td>
</tr>
<tr>
<td>Variety</td>
<td>2</td>
<td>46.33**</td>
<td>4.08ns</td>
<td>82.58**</td>
<td>34.75ns</td>
</tr>
<tr>
<td>Error</td>
<td>6</td>
<td>4.00</td>
<td>2.75</td>
<td>4.81</td>
<td>144.19</td>
</tr>
<tr>
<td>CV (%)</td>
<td></td>
<td>2.38</td>
<td>4.41</td>
<td>2.81</td>
<td>11.20</td>
</tr>
</tbody>
</table>

ns= non significant, *=significant, **= highly significant at P<0.05
SOV= Source of variance, DF=Degree of freedom, CV=Coefficient of variance

### Table 2. Mean square from the first year (2013) and second year (2014) analysis of variance for the performance of Hot pepper varieties (Continued)

<table>
<thead>
<tr>
<th>SOV</th>
<th>DF</th>
<th>Fruit diameter (cm)</th>
<th>Marketable yield (q ha^-1)</th>
<th>Unmarketable yield (q ha^-1)</th>
<th>Total yield (q ha^-1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replication</td>
<td>3</td>
<td>0.34</td>
<td>0.002</td>
<td>270.38</td>
<td>1039.78</td>
</tr>
<tr>
<td>Variety</td>
<td>2</td>
<td>0.48ns</td>
<td>0.605***</td>
<td>3682.33*</td>
<td>933.01ns</td>
</tr>
<tr>
<td>Error</td>
<td>6</td>
<td>0.24</td>
<td>0.010</td>
<td>353.40</td>
<td>1261.81</td>
</tr>
<tr>
<td>CV (%)</td>
<td></td>
<td>4.86</td>
<td>7.22</td>
<td>5.86</td>
<td>10.14</td>
</tr>
</tbody>
</table>

ns= non significant, *=significant, **= highly significant, ***= very highly significant at P<0.05
SOV= Source of variance, DF=Degree of freedom, CV=Coefficient of variance
Table 3. Description of mean performance of Hot pepper varieties in 2013 and 2014 cropping season

<table>
<thead>
<tr>
<th>Variety</th>
<th>Establishment age (%)</th>
<th>Days to 50% maturity</th>
<th>Plant height (cm)</th>
<th>Fruit length (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2013</td>
<td>2014</td>
<td>Mean</td>
<td>2013</td>
</tr>
<tr>
<td>Mareko fana</td>
<td>87.50a</td>
<td>85.50</td>
<td>61.50</td>
<td>74.25b</td>
</tr>
<tr>
<td>Melka shote</td>
<td>81.00b</td>
<td>86.50</td>
<td>58.75</td>
<td>76.50b</td>
</tr>
<tr>
<td>Melka awaze</td>
<td>86.00a</td>
<td>87.75</td>
<td>61.88</td>
<td>83.00a</td>
</tr>
<tr>
<td>LSD</td>
<td>3.46</td>
<td>ns</td>
<td>3.79</td>
<td>ns</td>
</tr>
</tbody>
</table>

Means followed by the same letter in the same column are not significant difference at P<0.05

Table 4. Description of mean performance of hot pepper varieties in 2013 and 2014 cropping season (Continued)

<table>
<thead>
<tr>
<th>Variety</th>
<th>Fruit diameter (cm)</th>
<th>Marketable yield (q ha⁻¹)</th>
<th>Unmarketable yield (q ha⁻¹)</th>
<th>Total yield (q ha⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2013</td>
<td>2014</td>
<td>Mean</td>
<td>2013</td>
</tr>
<tr>
<td>Mareko fana</td>
<td>1.55</td>
<td>1.78a</td>
<td>1.67</td>
<td>317.56b</td>
</tr>
<tr>
<td>Melka shote</td>
<td>1.15</td>
<td>1.01c</td>
<td>1.08</td>
<td>292.26b</td>
</tr>
<tr>
<td>Melka awaze</td>
<td>1.59</td>
<td>1.26b</td>
<td>1.43</td>
<td>352.68a</td>
</tr>
<tr>
<td>LSD</td>
<td>ns</td>
<td>0.17</td>
<td>32.53</td>
<td>ns</td>
</tr>
</tbody>
</table>

Means followed by the same letter in the same column are not significant difference at P<0.05

recorded at Melka shote variety in 2013. Likewise, in the second cropping year the highest fruit diameter (1.78 cm) was produced at Mareko fana while the lowest fruit diameter (1.01 cm) was produced at Melka shote (Table 4).

Yield components

 Marketable yield

Variety was exerted significant (P<0.05) influence on marketable yield of hot pepper plant in 2013; but it was not significantly influenced (P>0.05, Table 2) in 2014. In 2013, the maximum marketable yield (352.68 q ha⁻¹) was obtained at Melka awaze whereas the minimum marketable yield (292.26 q ha⁻¹) was obtained at Melka shote, which however, did not statically different with Mareko fana variety. In 2014, even if variety had no any influenced on marketable yield slightly higher (353.43 q ha⁻¹) and lower (325.45 q ha⁻¹) value was obtained at Melka awaze and Mareko fana varieties, respectively (Table 4).

Unmarketable yield

Unmarketable yield had significantly affected (P<0.01) by variety in 2013, nevertheless, did not significantly influenced (P>0.05, Table 2) in 2014. The highest unmarketable yield (9.94 q ha⁻¹) was recorded at Melka shote variety whilst the lowest unmarketable yield (6.91 q ha⁻¹) was recorded at Mareko fana (Table 4).

Total yield

Total yield data in the Table 2 indicated significantly influenced (P<0.05) by variety in 2013; other than, it was not influenced (P>0.05) in 2014 cropping season. In 2013, significantly higher total yield (361.25 q ha⁻¹) was produced at Melka awaze whereas significantly lower total yield (302.20 q ha⁻¹) was obtained at Melka shote variety. Even though total yield did not influence by variety slightly higher (367.74 q ha⁻¹) and lower (338.57 q ha⁻¹) value was obtained at Melka shote and Mareko fana varieties, respectively (Table 4).

DISCUSSION

Hot peppers are important crops in many
developing countries. However, lack of research on adaptability and improper or inadequate crop management practices can result in poor crop yields and high production costs. In Ethiopia particularly to the Raya Valley, where hot pepper is among the highest acreage and values of low elevation vegetables lack of best performing variety is the major hindrance for farmers and growers due inefficient research work in the area. Therefore, the main target of this research was to come up with best adapting variety and disseminating this technology to local producers.

Currently, although the crop is cultivated for its fruits which are used locally, its yield is on the decline as a result of lack of adaptable variety, incidence of pest and disease conditions, inadequate use of fertilizers, inadequate irrigation facilities, lack of an organized system for vegetable processing and marketing and the low income derived by farmers during the regular growing seasons (Emmanuel et al., 2014).

Among the three varieties studied in both seasons, Melka awaze recorded the highest plant height (82.0 cm) while Melka shote recorded the least (54.50 cm). These results are in harmony with the reports by other workers (Bozokalfa et al., 2009; Lahbib et al., 2013; Iqbal et al., 2009). On the other hand, other reports indicated that average plant height ranges from 16.6 to 57.6 cm (Nsabiyera et al., 2012), 23.8 to 25.02 cm (Mochialh et al., 2012), 32.1 to 68.3 cm (Nkansah et al., 2011), 60 to 90 cm (Dewitt and Rosaland, 2009) and 72 to 117 cm (Valadez-Bustos et al., 2009). Rudall (1994) stated that increase in plant height is accompanied by a corresponding increase in stem girth/thickness, boosting the plant’s resistance against lodging. Varietal differences may account for variation in plant height in this study as explained by Decoteau and Graham (1994).

Variation in total yield per hectare among varieties, extrapolated from yield per plot, is presented in Table 4. This is further partitioned into marketable and unmarketable yield per hectare. Moreover, Melka awaze recorded the highest mean total yield of 360.09 q ha\(^{-1}\) whereas Mareko fana recorded the least value with 331.52 q ha\(^{-1}\). On the other hand, mean marketable yield ranged from 353.43 q ha\(^{-1}\) in Melka awaze to 325.45 q ha\(^{-1}\) in Mareko fana. Mean unmarketable yield per hectare also ranged from 7.29 q ha\(^{-1}\) in Melka shote to 6.08 q ha\(^{-1}\) in Mareko fana. Working with 35 genotypes of hot pepper, Nsabiyera et al. (2012) reported that total yield range 1.0 to 17.9 t ha\(^{-1}\), Nkansah et al. (2011) recorded values between 10.4 to 39.3 t ha\(^{-1}\) and Sezen et al. (2011) also reported fruit yield of 21.39 to 35.92 t ha\(^{-1}\) in cayenne pepper. In Taiwan, Jordan and Tanzania, total yield of pepper has been reported to vary from 5.64 to 35.25 t ha\(^{-1}\), 8.5 to 27.2 t ha\(^{-1}\) and 10.06 to 38.46 t ha\(^{-1}\), respectively (AVRDC, 2004). According to this report Anloga, a farmers’ variety (landrace), recorded the highest undamaged fruit yield per hectare, reflecting its superior adaptation to local conditions compared to the other genotypes. In total, from this study Melka awaze was best adapted and yields the highest marketable and total yield which can be profitable for growers in Raya valley provided.

**CONCLUSION**

This study which is aimed to ascertaining best performing hot pepper varieties at Raya valley was carried out under irrigation condition for two consecutive cropping seasons. Variety exerted significant difference on marketable, unmarketable and total yield in 2013 cropping season; however, it did not show any significant influence in the second season (2014). The result revealed that the highest marketable, unmarketable and total yield was produced at Melka awaze, Melka shote and Melka awaze varieties, respectively in 2013 whereas lowest values were obtained at Melka shote variety. Therefore, Melka awaze was well performed agronomically and was recommended for production by growers in the study area.

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**REFERENCES**


