Hot pepper varietal evaluation for growth, dry pod yield and yield related parameters at Kolla-Tembien District, Northern Ethiopia

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Accepted 20 May, 2016; Published 30 May, 2016

Productivity of pepper is limited due to lack of improved varieties. Thus, an experiment was conducted to evaluate for best performing hot pepper variety in the study area. Treatments consisted of four hot pepper varieties accompanied with local variety, carried out in randomized complete block design (RCBD) with three replications. The analysed result showed that growth, dry pod yield and yield related parameters were significantly affected by varietal effect. According this finding, among the varieties, Melkashote was early matured and produced the highest dry fruit weight, fruit length, plant height and showed good performance in other parameters. Moreover, it gave the highest marketable dry pod yield as compared to the other varieties. It is, therefore, concluded that Melkashote variety well performed and can be recommended for the growers in the study area to improve pepper productivity.

Key words: Hot pepper, Variety, yield, Yield component.

INTRODUCTION

Pepper fruit (Capsicum species) is one of the most important vegetable crops. According to Bosland (1994) the genus Capsicum belongs to the family Solanaceae. The genus Capsicum consists of approximately 22 wild species and five domesticated species. The five domesticated species include, C. annum L., C. frutescens L., C. Chinenses., C. baccatum L., and C. pubescens R. (Bosland and Votava, 2000). Based on fruit/pod characteristics ranging in pungency, colour, shape, intended use, flavor and size, capsicum species can be also divided in to several groups. Despite their vast trait differences most cultivars of peppers commercially cultivated in the world belongs to the species C. annum L. (Smith et al., 1987; Bosland, 1992). Cobley and Steele (1976) reported that apparently between 5200 and 3400 BC, the native of Americans were growing Capsicum, which places it among the oldest cultivated crops.

Though the exact time of introduction of pepper to Africa in general and Ethiopia in particular is not certainly known, it is now distributed to pepper belt areas of the country, Ethiopia.

Hot pepper (Capsicum annuum L.) 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). According to the report of Weiss (2002), the total area devoted to hot pepper worldwide showed an average annual increase of 5%. Hot pepper has been cultivated in Ethiopia for long period of time. It is the leading vegetable crop produced in the country. Green and red hot pepper covered 3.82% and 67.53%, respectively, of the total estimated area under vegetables in the country. Similarly, the national production of green and red hot pepper was 412,503.57 and 2,541,883.97 quintals with average productivity of 66.88 and 23.31qt ha-1, respectively (CSA, 2014).

Currently, hot pepper is produced in many parts of the country. It 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 "Woñ", 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). Because of its wide use in Ethiopian diet, the hot pepper is an important traditional crop mainly valued for its pungency and color. The crop is also one of the important spices that serve as the source of income particularly for smallholder producers in many parts of rural Ethiopia (Beyene and David, 2007).

Pepper is a short-lived herb normally grown as annual under warm and humid weather conditions. Peppers are adapted to high temperatures, but excessively hot weather may produce infertile pollen and reduce fruit set. Temperatures above 32 °C may also cause excessive transpiration resulting in dropping of buds, flowers and fruits. Thus, the best fruit is obtained in a temperature 21-27 °C during the daytime and 15-20 °C at night (IAR, 1996). Plants are tolerant of slightly acid soils but a pH of 5.5 to 6.6 is preferable (Rice et al., 1987). Pepper is extensively grown in most parts of the country, with the major production areas concentrated at altitude of 1100 to 1800 m.a.s.l. (MoARD, 2009).

Hot pepper is popular in Kolla-tembien district particularly Adiha irrigation scheme as the agro-ecology of the area best fits for pepper production. It is a major spice and vegetable crop produced by the majority of farmers in the district. They produce pepper for consumption and to get income by selling it in nearby markets. Having a great role for improving the income and the livelihood of thousands of smallholder farmers, however, the crop is confronted with various production and marketing related problems. Hot pepper production is attributed to poor varieties, poor cultural practices, the prevalence of fungal (blights) and bacterial as well as viral diseases (Fekadu et al., 2008). Among the problems, lack of varieties is crucial. Farmers cultivate only local variety as they are far from varietal information. Further, no research has been conducted on evaluation of hot pepper which enables the growers to select the best performing varieties in the study area.

Evaluation of varieties, which are adaptable to the agro-ecology of the study area, highyielding and tolerant to pests moreover good quality for market is therefore very important for better production of the crop. Thus, the objective of this experiment was to select best performing hot pepper variety on dry pod yield and yield related traits under irrigation condition.

**MATERIALS AND METHODS**

**Description of experimental area**

The experiment was conducted in Adiha irrigation scheme of kola-tembien district during 2012 cropping season. It is located at 13° 41' 43" - 13° 48' 17" N Latitude and 39° 03' 30" - 39° 11' 41" E longitudes having mean annual rain fall and temperature of 607 mm and 22.8 °C, respectively. It is also situated at about 1573-2283 meter above sea level and dominantly comprised 62% sand soil, 12% clay and 26% silt loam soil particles. It is 103 km away to the North West direction from the capital city of Tigray, Mekelle, and 883 km north of Addis Ababa (capital city of Ethiopia) (Gebremedhin, 2010).

**Treatments and experimental procedures**

The trial was carried out in randomized block design (RCBD) having three replications in a gross plot size of 4.9 m x 3.6 m (17.64 m²) with a spacing of 1.5 m between replications and 1 m between plots. The treatments included four improved varieties of hot pepper and one local variety. The varieties were Melkazala, Melkashote, Weldele, Marakofana and local variety.

The seeds of the varieties were planted in well prepared seed bed at nursery site and the seed bed was covered or mulched with a dry grass for 21 days. Then, beds were covered by raised shade to protect the seedlings from sun and heavy rain fall damage until the seedlings were ready for transplanting. After 55 days of sowing or 3-4 true leaf stages uniform grown, healthy and vigorous seedlings were transplanted to the experimental field and planted at a spacing of 70 cm between rows and 30 cm between plants (EARO, 2004) in a plot size of 4.9 m length 3.6 m width. Urea at 100 kg ha⁻¹ and DAP at 200 kg ha⁻¹ were applied to each treatments where DAP was applied during planting while 50% of urea during planting and the remained 50% urea was applied after one and half month (EARO, 2004). All appropriate agronomic practices such as weeding, watering and hoeing were conducted uniformly both at the nursery and experimental field.

**Data collected and statistical analysis**

Data were collected from a net plot area of 4.2 m x 3.3 m containing five rows where the two most outer rows and 0.3 m length in both ends were left as border effects. Day to 50% flowering, days to 50% maturity, plant height (cm), fruit number plant⁻¹, fruit length (cm), fruit diameter (cm), dry pod weight (g) and marketable dried pod yield (qt ha⁻¹) were collected and analyzed. Five plants from the middle rows were taken to collect data of plant height (cm) and three fruits from each these plants were also taken to consider fruit length (cm), fruit diameter (cm) and fruit weight (g) of each variety. All the collected agronomic and growth components data were subjected to the analysis of variance (ANOVA) using the SAS computer package version 9.1 (SAS Institute, 2004). Mean separation was carried out using
Table 1. Mean values for phenology and growth components of hot pepper varieties in 2012 cropping season at Adiha irrigation scheme

<table>
<thead>
<tr>
<th>Varieties</th>
<th>Days to 50% flowering</th>
<th>Days to 90% maturity</th>
<th>Plant height (cm)</th>
<th>Fruit length (cm)</th>
<th>Fruit diameter (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Melkashote</td>
<td>49.01 d</td>
<td>118.00 c</td>
<td>48.33 a</td>
<td>11.00 a</td>
<td>1.07 b</td>
</tr>
<tr>
<td>Weldele</td>
<td>58.00 c</td>
<td>125.17 bc</td>
<td>50.33a</td>
<td>9.67 b</td>
<td>1.20 b</td>
</tr>
<tr>
<td>Markofana</td>
<td>64.30 b</td>
<td>130.32 ab</td>
<td>41.00 b</td>
<td>6.67 c</td>
<td>1.43 a</td>
</tr>
<tr>
<td>Melkazala</td>
<td>70.11 a</td>
<td>136.29 a</td>
<td>37.33 bc</td>
<td>7.50 c</td>
<td>0.83 c</td>
</tr>
<tr>
<td>Local</td>
<td>66.00 b</td>
<td>129.22 ab</td>
<td>41.00 b</td>
<td>4.67 d</td>
<td>1.17 b</td>
</tr>
<tr>
<td>CV (%)</td>
<td>2.42</td>
<td>4.18</td>
<td>7.57</td>
<td>8.84</td>
<td>9.94</td>
</tr>
<tr>
<td>LSD (5%)</td>
<td>2.80</td>
<td>10.63</td>
<td>6.22</td>
<td>1.31</td>
<td>0.21</td>
</tr>
</tbody>
</table>

Means with the same letter (s) in the same column are not significantly different at P<0.05; LSD = least significant difference; CV = Coefficient of variation

Table 2. Mean values for marketable yield and yield components of hot pepper varieties in 2012 cropping season at Adiha irrigation scheme.

<table>
<thead>
<tr>
<th>Varieties</th>
<th>Fruits plant⁻¹</th>
<th>Dry pod weight (g)</th>
<th>Marketable dried pod yield (qt ha⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Melkashote</td>
<td>42.00 b</td>
<td>12.00 a</td>
<td>12.96 a</td>
</tr>
<tr>
<td>Weldele</td>
<td>46.02 b</td>
<td>8.00 bc</td>
<td>11.13 abc</td>
</tr>
<tr>
<td>Markofana</td>
<td>29.17 c</td>
<td>8.33 b</td>
<td>8.94 bc</td>
</tr>
<tr>
<td>Melkazala</td>
<td>30.21 c</td>
<td>5.00 c</td>
<td>9.42 bc</td>
</tr>
<tr>
<td>Local</td>
<td>73.22 a</td>
<td>6.33 bc</td>
<td>11.58 ab</td>
</tr>
<tr>
<td>CV (%)</td>
<td>7.91</td>
<td>21.09</td>
<td>11.10</td>
</tr>
<tr>
<td>LSD (5%)</td>
<td>6.54</td>
<td>3.15</td>
<td>2.26</td>
</tr>
</tbody>
</table>

Means with the same letter (s) in the same column are not significantly different at P<0.05; LSD = least significant difference; CV = Coefficient of variation

Results and Discussion

Days to flowering

Varieties showed significant difference on days to flowering. The highest (70.11) and lowest (49.01) days to flowering was shown in Melkazala and Melkashote, respectively (Table 1). This indicated that Melkazala took longer days to flower while Melkashote flowered earlier. Earliness or lateness in the days to 50% flowering might have been due to their inherited characters, early acclimatization to the growing area to enhance their growth and developments. This result was in agreement with the finding of Seleshi et al. (2014) who reported that days to flowering of hot pepper varieties was significantly affected by the interaction effect of variety and location which could be due to the temperature of the growing area and due to the transplanting disturbance since it is subjected to loss of feeder roots during uplifting, and consumed their energy to repair damaged organs and thus the process demanded them more time to resume shoot growth.

Days to maturity

The values in Table 1 showed that there was statistically significant difference among pepper varieties at (P<0.05) in days to maturity. The highest and lowest days to maturity were recorded in Melkazala and Melkashote varieties, respectively (Table 2). Melkazala was late matured while Melkashote was early matured varieties. Melkashote matured 18 days earlier than Melkazala. This variation ascribed to the differences in the growing environment climatic conditions and genetic make-up of the varieties. This agrees with the report of Seleshi et al. (2014). Moreover, this finding was in agreement with Haileslassie et al. (2015) who reported that days to maturity were significantly affected by pepper varieties. However, this result was in contrary to the finding of Tibebu and Bizuayehu (2014) who reported those days to maturity was not significantly different due to varieties.
Plant height

Plant height significantly (P<0.05) influenced due to varieties. According to Table 1, Weldele had numerically the highest plant height though significantly at par with Melkashote. However, the smallest data was shown in Malkazalawhich however, did not significantly different from Markofana and local varieties. Weldele variety was 34.82% taller than Malkazala. This could be due to its efficient utilization of environmental growth resources so as to stimulate and enhance the photosynthetic and metabolic activities of the plant which reflected on the increase in the vegetative growth of Weldele. This result was in conformity with Seleshi et al. (2014) who reported that Weldele had the highest plant height among other nine hot pepper varieties. Similarly, El-Tohamy et al. (2006) noted that the increase in plant height could mainly be due to better availability of soil nutrients in the growing areas, especially Nitrogen and Phosphorus which have enhancing effect on the vegetative growth of plants by increasing cell division and elongation and the varietal variability to absorb the nutrients from the soil. Moreover, this result was consistent with the report of Lahbib et al. (2013).

Fruit length

The findings regarding fruit length were significantly influenced (P<0.05) due the varietal effect (Table1). Melkashote possessed the highest fruit length (11.00 cm) while the lowest was recorded on local (4.67). Markofana and Melkazala were similarly affecting fruit length.

The significant difference in fruit length among the hot pepper varieties attributed to their inherited traits and adaptability to the environmental condition of the study area. This current result was supported by the findings of Haileslassie et al. (2015) and Seleshi et al. (2014). Moreover, this finding was supported by the work of Tibebu and Bizuayehu (2014).

Fruit diameter

Concerned to this parameter, it was significantly (P<0.05) influenced due to varietal effect. The maximum value was registered on Markofana whereas the minimum was obtained from Melkazala. The fruit diameter of Melkazala was reduced by 41.96% of Markofana’s fruit diameter (Table 1). The other varieties were statistically similar in affecting fruit diameter. The difference in fruit diameter among the varieties could be most probably due to the ability of Markofana that absorbed ample solar radiation which resulted in more accumulation of photosynthetic assimilates. This in turn had an impact in partitioning of dry matter to wider fruit diameter formation. This finding is consistent with the report of Seleshi et al. (2014) who reported that the pod width difference among varieties could be due to different dry matter partitioning ability of plants and the soil fertility status of the growing locations. Likewise, Haileslassie et al. (2015) found that fruit diameter was significantly affected due to varietal effect. Similarly, this was conformed to the finding of Tibebu and Bizuayehu (2014) which showed Markofana produced the highest fruit diameter (1.98 cm). According to Beyene and David (2007), larger and wider hot pepper pods are considered to be the best in quality and have better demand for fresh as well as dry pod use in Ethiopian markets.

Fruit number plant\textsuperscript{-1}

According to Table 2, there was a significant difference in fruit number plant\textsuperscript{-1} of the varieties. Varietal difference causes significant difference in fruit number plant\textsuperscript{-1}. The local variety produced more number of fruits and was statistically superior to the others. Nevertheless, Markofana and Melkazala produced less number of fruits and statistically inferior than the others. The highest fruit number in local variety was most likely due to the fruit bearing capacity of the variety and more branch formation nature which leads to contain high number of fruits plant\textsuperscript{-1}. In line with this result, Amare et al. (2013) found different fruit number plant\textsuperscript{-1} due to variety differences. Furthermore, Seleshi et al. (2014) reported that number of fruits plant\textsuperscript{-1} was highly significantly affected by the interaction of variety by location. These authors also stated that fruit number difference might be due to the associated traits like canopy diameter that could limit the number of branches, the temperature stress of the growing environment and the capability of each varieties to withstand the stress specially on the reproductive development, which is more sensitive to high temperature stress (day and night temperature) than vegetative development.

Dry pod weight

Table 2 revealed that dry pod weight was significantly (P<0.05) influenced due to the impact of varietal effect. Accordingly, the highest dry pod weight was obtained from Melkashote pepper variety. However, the lowest was from Melkazala which was lowered by 58.33% of dry pod weight of Melkashote. This was attributed the ability of the variety to harvest ample solar radiation, which resulted in the corresponding increment of photosynthetic rate. This higher photosynthetic rate also results in seed holding capacity of the fruit as well as increasing the fruit length. These all accumulated to produce highest drypod weight of the variety. The work of Guerpinar and Mordogan (2002) also showed that pod dry matter
content of peppers was directly related to the amount of nutrient taken from the soil, which was proportional to the nutrients present in the soil or the amount of organic and inorganic fertilizers applied to the soil.

** Marketable dry pod yield**

Regarding with marketable yield of pepper, variety exerted significant (P<0.05) influence on marketable yield of hot pepper plant. Referring to Table 2, the highest marketable yield (12.96 qt ha⁻¹) was recorded from Melkashote which yielded 44.97% over Markofana where the lowest numerical yield was obtained though not statically different from the other varieties. The variation in marketable yield of these varieties could be due to their differences in genetic characteristics and agro ecological adaptability nature which is in line with the findings of Fekadu et al. (2008) who reported that the magnitude of genetic variability and heritability are necessary in systematic improvement of hot pepper for fruit yield and related traits. It was also in conformity with the report of Amare et al. (2013)

**Conclusions**

Availability of improved varieties is among the best technologies to improve pepper productivity. Results of this experiment showed that Melkashote variety was early matured and produced the highest dry fruit weight, fruit length, plant height and good performance in other parameters. Moreover, it gave the highest marketable dry pod yield as compared to the other varieties. However, the experiment should be repeated across locations for a wide range of recommendation.

**ACKNOWLEDGEMENTS**

The authors thank IFAD (International Fund for Agricultural Development) for funding this research project and also sincerely acknowledge the Abergelle Agricultural Research Center for providing all farm facilities.

**REFERENCES**


