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Full Length Research Paper

Adaptation Trail of Different Improved Hot Pepper (*Capsicum species*) Varieties under Gedeo Zone, Dilla, Ethiopia

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Abstract
A field experiment was conducted to study the performance of different varieties of hot pepper for growth, dry pod yield for the study area. The study was conducted from March, 2014, to January, 2015. The field experiment was carried out in Dilla, Southern Ethiopia during the rainy season 0f 2014-1015. The experiment was laid out in a randomized complete block design with three replications. Treatments included five hot pepper varieties (Mareko Fana, Melka Zala, Melka Shote, Melka awaze and one local as a control). The result of the experiment showed that, the earliest variety to attain days to 50% flowering was recorded on Melka zala varietie. The highest fruit length, total dry weight content per plant, Fruit dry weight content , marketable and total yield (t/ha) was recorded from Variety Melka zala while the highest fruit number and weight of seed per plant was from local varieties and Mareko fana, respectively. In conclusion, results of the experiment revealed that Melka zala resulted in highest total (t/ha,) and marketable yields in Dilla, Gedo zone, Ethiopia during the rainy season.

Key words: *Hot pepper varieties, Total dry fruit yield.*

Introduction

Capsicum has been known since the beginning of civilization in the Western Hemisphere. It has been a part of the human diet since about 7500 BC Mac Neish, (1964). The genus Capsicum is a member of the Solanaceae family 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). Despite their vast trait differences most cultivars of peppers commercially cultivated in the world belongs to the species C. annum L. Bosland, (1992).

Even though the exact time of introduction of pepper not certainly known, it has been cultivated in Ethiopia for long period of time. Currently, it is produced in many parts of the country because, for most Ethiopians food is tasteless without hot pepper. That is, 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 "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 Ethiopia, pepper grows under warm and humid weather conditions and the best fruit is obtained in a temperature 21-27^{0}C during the daytime and 15-20^{0}C at night IAR, (1996). It 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 one of the major vegetable crops produced in Ethiopia and the country is one of a few developing countries that have been producing paprika and *capsicum* oleoresins for export market. 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. According to the EEPA, (2003), in the major pepper producing regions in the country, that is, Amhara, Southern Nations and Nationality People's Regional State (SNNPR) and Oromia pepper generated an income of 122.80 million Birr for farmers in 2000/01. This value jumped to 509.44 million Birr for smallholder farmers in 2004/05. This indicates that hot pepper serves as one of the important sources of income to smallholder farmers and as exchange earning commodity in the country Beyene and David, (2007).

In spite of its importance, the 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 t/ha for green pod whereas it was 1.6 t/ha for the dry pod respectively CSA, (2006). The decline of hot pepper production is also attributed to poor varieties, poor cultural practices, the prevalence of fungal (blights) and bacterial as well as viral diseases Fekadu and Dandena, (2006).

The present situation indicates that in study area there is no improved hot pepper varieties but there is one local variety named "Mita Mito" by local growers, the green pod yield (3 ton per hectare) of this local variety is very low compared to national average yield. As a result, varietal information for the improvement of the crop for high fruit yield and quality in the existing agro-ecology is insufficient.

There has also been no research on evaluation of hot pepper which enables the growers to select the best performing varieties in the study area. Evaluation of selected varieties are therefore one of the considerations to ease the existing problems of obtaining the desired varieties for which the output of this study was likely to assist and sensitize hot pepper growers and processors, further more the increasing demand for hot pepper to feed the growing human population and supply the ever-expanding pepper industries at national and international level has created a need for the expansion of pepper cultivation in to areas where it has not ever been extensively grown Beyene and David, (2007). Better adaptable and well performing variety (varieties) with improved cultural practices could be a possibility to boost quality and marketable production of the crop, so that the farmers benefited by cultivating those adaptable improved verities in the study area. Therefore, present studies was initiated with the objectives of investigating the performance of different varieties of hot pepper for growth, dry pod yield and identifying Hot pepper varieties for the study area.

Materials and Methods

Experimental Site

The field experiment was conducted at Dilla University farm experimental site of Gedeo zone, which is found in Southern Nations, Nationalities and Peoples Region (SNNPR). Dilla is located 357 km south of Addis Ababa this site is located at 5.84 - 6.43 latitudes and 38.08 - 38.44 longitudes. The site receives an annual average rainfall of 978 mm and the maximum and minimum temperature is 27^{o}c and 18.3^{o}c respectively.

Experimental Procedure

The five hot pepper varieties including the local check, which were collected from Melkassa Agricultural Research Center and local Farmers of Gedeo zone (Local check), were evaluated under Dilla location. The varieties use in the experiment were MarekoFana, Melka Awaze, MelkaZala, MelkaShote including the local check Seeds were sown on a seed bed size of 1x5m. The seed bed was covered with a dry grass for 20 days. Then, beds covered by raised shade to protect the seedling from strong sun shine and heavy rainfall until the plants are ready for transplanting. Agronomic practices were done as crop requirement in the nursery. The seedlings were transplanted and planted at spacing of 30 cm x 70 cm between plant and row respectively to the main field after attaining stage for transplanting on (20 to 25 cm height and or at 54 days after sowing). Other pertinent agronomic and horticultural practices applicable to hot pepper were also followed in the field based on the recommendation.

Treatments and Experimental Design

The experiment was conducted during rainy period on 2013/14 production period. Treatments consisted of five hot pepper varieties (MarekoFana, Melka Awaze, MelkaZala, MelkaShote and one local variety) and were arranged in a Randomized Complete Block Design (RCBD) with three replications. The plot size was 1.5 m x 3.5 m. Spacing between plots and replications were separated by 0.7m and 1 m respectively.

Data Collection

To measure dry weight Mean the samples were dried in an oven at 105^{o}C until constant weight reached, the same principles follow to measure fruit dry weight. The number of days where 50% of the selected plants started blooming beginning from the days of transplanting was used to measure days to 50% flowering. The marketable yield of plants was determined at each harvesting by sorting dried fruits according to color, shape, shininess, firmness and size of the fruits. After drying, the dried marketable fruits were separated; the weight of the respective categories were recorded and converted to t/ha , on the other hand unmarketable yield (t/ha) which was obtained by sorting the diseased ,discolored, shrunken shape and small sized, totally unwanted pods by consumers from marketable dried were recorded at each harvest and converted to t/ha .Total dry fruit yield (t/ha) was taken as weight of total (marketable and unmarketable) fruits harvested at each successive harvesting from the sample plants were recorded and summed up to estimate yield ,and other yield related parameters also taken.

Statistical Analysis

All the collected data were analyzed using SPSS16. The means were separated by least significant difference at 5%.

Result and Discussion

Fruit Length

A highly significant ($p<0.01$) difference was observed among varieties in terms of their fruit length (Table 1). Consequently, the longest fruits were recorded from variety Melka zala (10.45), followed by Melka shote (9.78), and Mareko Fana (8.61). The shortest length was recorded from local variety (4.39). The result also shows no significant difference between marko fana and melka awaze. The result in contrast with that of MARC (2005) which reported that the long fruit length of (15cm) observed for marko fana in variety trial of course in different site. The variations were most probably being attributed to their inherited traits or the growing environment.

Number of Fruits

Results of analysis of variance indicated a highly significant ($p<0.001$) among the varieties in terms of number of fruits per plant (Table 1). Local variety had the highest number of fruits (88 .3) even if the size is smaller compared with the other varieties, while the least number of fruits per plant was recorded from variety Melka Awze (28.00). The variations in fruit yield might be due to the influence of the growing environment's temperature, associated traits like canopy diameter that could limit the number of branches. Because, as a number of primary, secondary and tertiary branches increased, there could be a possibility of increasing the number of fruit producing buds for fruit production. Moreover, the variations in fruit development among varieties, could also be due to the temperature stress of the growing environment and the capability of each varieties to with stand the stress specially on the reproductive development, which is more sensitive to high temperature stress (day and night temperature) than vegetative development. This result is in line with the work of Sato (2005), who reported that, the reduction of fruit set under moderately elevated temperature stress was mostly due to a reduction in pollen release and viability in tomato plant (*Lycopersicum esculentum* Mill.).

On the other hand, number of fruit can be affected by fruit abortion and predation have all been proposed as factors explaining low fruit set in plants. This also is in agreement with Schemske (1980) who reported that, Pollination can be the first factor limiting fruit production.

Plant Height and Branch Number

As indicated in Table 1, no significant difference was observed on both plant height and branch number of different pepper varieties carried out in Dilla university demonstration site. Even if, statically non significant numerically the highest plant height observed in Melka Awwze and the lowest in treatment Mareko Fana variety (47.48) . The above result contradicts with the findings of MARC (2005), which reported that varieties Weldele and Melka Zala showed the tallest plant height of 61 and 62 respectively among the evaluated varieties at three locations. As indicated in (Ttable 1), statically no significant difference were observed on primary branch number of different hot pepper varieties but numerically the highest primary branch number observed Melka shote and local varieties (8.00) ,on the other hand the lowest observed on Melka awaze (5.00).

Number of Seed

Effect of variety showed highly significant difference on number of seeds per pod (Table 1). The highest number of seeds was recorded from Melka zala (138.0) but was not statistically different from Melka awaze (136.33); whereas the least number of seeds were recorded from Local variety (57.67). This result is in line with Lemma (1998), who pointed that seed number per pod is one factor that determine pod size. They observed a linear increase in individual fruit size and weight with seed number. Furthermore, this report is consistent with that of Russo (2003), who observed positive relationship between seed number and pod size, where fruit weight increased linearly with seed number in sweet pepper. Pepper plants that exhibited high vegetative growth due to effects of treatments have gained high leaf area, increased photosynthetic capacity and assimilate partitioning that resulted large pod size and hence in greater seed number per pod and large pod size.

Table 1. Mean number of Fruit length, Fruit number, Branch number**,** Plant height, Number of seed and Weight of seed per plant as affected by different varieties.

Treatment	Fruit length (cm)	Fruit number per plant	Branch number per plant	Plant height (cm)	Number of seed per pod	Weight of seed per pod (gm)
1	4.3933^{d}	88.3333^{a}	8.00	50.92	57.67^{d}	5.15^{b}
2	8.6100^{c}	53.3333^{c}	5.67	47.48	128.33^{b}	11.67^{a}
3	10.4567^{a}	58.3333^{bc}	5.67	51.33	138.00^{a}	7.08^{b}
4	9.7800^{b}	67.6667^{b}	8.00	58.41	73.33^{c}	5.60^{b}
5	8.0000^{c}	28.0000^{d}	5.00	68.99	136.33^{a}	7.82^{ab}
Sig	***	**	ns	ns	**	*
SE+	0.278	4.838	1.095	7.67	2.53	1.87

*NS, Non-significant at $p < 0.05$; *, significant at $p > 0.05$; SEM, standard error of the mean.*
Where Treatments indicate: 1, local variety; 2, Marko Fana; 3.Melka Zala; 4, Melka Shote; 5, Melka Awaze.

Weight of seed per plant

Results of analysis of variance indicated there is a significant difference among the varieties in terms of weight of seed per plant (Table 1). the variety Marko fana had the highest weight of seed (11.67) at Dilla university demonstration site followed by variety Melka Awaze (7.82), while the least number of fruits per plant was recorded from variety of local one (5.15), the result also shows that there is no statistical difference treatment 3, 4 and 1. This might be attributed to the genetic makeup of varieties and/or the agro ecological factors including, soil type and its nutrient contents, temperature, availability of irrigation or rain water in the growing area based on the study period.

Fruit dry Weight

The analysis of variance among varieties showed a highly significant difference ($p<0.001$) on fruit dry weight per plant (Table 2). The highest fruit dry weight per plant was obtained from Melka Zala (132.15) and the lowest fruit dry weight observed on local variety (52.37). The variations in fruit dry weight among varieties may be due to the genetic makeup of the varieties, and or due to the agro-ecological variations in which the varieties were evaluated.

Table 2. Mean number of dry weight content per plant, Fruit dry weight content, Marketable yield per plant, unmarketable yield, Total dry fruit yield and Day of fifty percent flowering as affected by different varieties.

Treatment	Dry weight content (gm)	Fruit dry weight (gm)	Marketable yield (t/ha)	Unmarketable yield (t/ha)	Total dry fruit yield (t/ha)	Day of fifty percent flowering
1	113.04^{d}	52.37^{e}	1.073^{e}	0.0923^{c}	1.165^{d}	70.00^{c}
2	209.82^{b}	103.06^{b}	2.066^{b}	0.101^{b}	2.168^{b}	72.67^{b}
3	236.17^{a}	132.15^{a}	2.410^{a}	0.0867^{d}	2.495^{a}	82.00^{a}
4	143.18^{c}	78.78^{c}	1.760^{c}	0.1053^{a}	2.062^{b}	74.00^{b}
5	135.70^{c}	70.19^{d}	1.526^{d}	0.088^{d}	1.613^{c}	67.67^{c}
Sig	**	***	***	***	***	**
SE±	3.83	2.12	0.044	0.0011	0.14	1.064

*NS, Non-significant at $p < 0.05$; *, significant at $p > 0.05$; SEM, standard error of the mean.*
Where Treatments indicate: 1, local variety; 2, Marko Fana; 3.Melka Zala; 4, Melka Shote; 5, Melka Awaze.

Dry Weight

As indicated in Table 2, very high significant difference were observed on dry weight content per plant of different pepper varieties carried out in Dilla university demonstration site. Accordingly the highest dry weight was scored from variety Malka Zala (236.17) followed by the Marko fana (209.82), while the least was from Local one (113.04). The recorded highest dry weight of pepper shoots and roots in this study might be attributed to vigorous and better plant architecture the varieties recorded, that could increase photosynthetic reactions of the crop, thereby increase assimilate partitions towards pods.

Marketable and Unmarketable Yield

Results of analysis of variance indicated there is a very high significant difference among the varieties in terms of marketable and unmarketable yield (Table 2). the variety Melka zala had the highest marketable yield (2.41) at Dilla university demonstration site followed by variety Marko fana (2.06), while the least marketable yield was recorded from variety of local one (1.07). This result is in conformity with the work of MARC (2005) in which the marketable yield of Marko fana ranged between 1.5 and 2. The result of unmarketable yield also shows that the variety Melka shote had the highest unmarketable yield (0.1053) while the least unmarketable yield was recorded from variety of Melka awaze (0.088). This unmarketable yield was recorded through subjective judgment based on shrunken shaped fruits, small sized, and discolored fruits that were estimated to be due to the differences in the inherent characters of the varieties, those lacked uniformity when drying, and or due to physiological disorders (bleaching) during the fruit set or due to the climatic conditions of the growing environment during harvesting additionally due to disease and vertebrate pests like birds.

Total Dry Fruit Yield and Day of Fifty Percent Flowering

As indicated in Table 2, very high significant difference was observed on total dry fruit yield of different pepper varieties. Accordingly the highest total dry fruit yield was scored from variety Malka Zala (2.495) while the least was from Local one (1.165). The number of days to fifty percent flowering showed highly significant ($p<0.001$) difference among varieties (Table 2). Earliest numbers of days to reach 50% flowering was observed from variety Melka awaze (67.6 days) even though it is statistically similar with local one. While the longest days to attain 50% flowering was recorded from Melka Zala (82.0 days), where Melka Shote and Marko fana were intermediate and statistically no difference between them. 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 and/ or 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. This result, therefore confirmed the findings of Sam-Aggrey and Bereke-Tsehai (1985) that reported earliness or lateness in flowering of pepper plants could be affected by the growing environment as well as the planting methods.

Conclusion

The outcome the study indicated that almost all of the parameters considered were significantly affected by the treatments except branch number and plant height. Yield related traits were also affected significantly by varieties with the growing environment. Higher records of marketable yield were obtained from variety Melka zala (2.41 t/ha), followed by Mareko Fana (2.06 t/ha) , the selection criteria of their marketable yield includes, long fruit size, thick fruit wall and dark-red pod color as a components of good quality.

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References

Beyene T. and David Phillips (2007). Ensuring Small Scale Producers in Ethiopia to Achieve Sustainable and Fair Access to Pepper Market. *Uganda Journal of Agriculture*, 3(2): 113-119.

Bosland, P.W. (1992). Chiles: a diverse crop. *Hort. Technology* 2: 6-10.

CSA (2006). Agricultural sample survey. 2005/2006 Report on area and production of crops. *Statistical bulletin,* vol 1:361. Addis Ababa, Ethiopia.

EARO (2004). Released crop varieties and their recommended cultural practices. Progress report. Addis Ababa, Ethiopia.

EEPA (2003). Spice Potential and Market Study. Product Development and Market Research Directorate, Addis Ababa.

Fekadu, M. and Dandena, G. (2006). .Status of Vegetable Crops in Ethiopia. *Ugandan Journal of Agriculture*, 2006, 12(2): 26-30.

Hoffman, P.G., M.C. Lego, and W.G. Galetto. (1983). Separation and quantitation of red pepper major heat principles by reverse-phase high pressure liquid chromatography. *J. Food Chem*. 31:1326-1330.

IAR (Inistitute of Agricultural Research), (1996). Progress report Addis Ababa. I-San Lin. R. 1994. Pharmacological properties and medical use of pepper (P.nigrum. L.). In: Caralambous G. 1994. (Ed), Spices, herbs and edible fungi. Elsevier Science B.V. pp. 469-479.

Lemma, D. (1998). Seed production Guideline for tomatoes, onion, and hot pepper. Institute of Agricultural Research. Addis Ababa, Ethiopia.pp.11-27.

Mac Neish, R.S. (1964). Ancient Mesoamerican civilization.*Science*.143: 531-537.

Melkasa Agricultural Research Center (2004). Progress Report Addis Ababa.

Melkasa Agricultural Research Center (2005): Progress Report on Completed Activities. pp: 1-7.

MoARD (2009). Variety Register. Issue No. 9. June 2006. Addis Ababa, Ethiopia.

Russo, V.M. (2003). Planting date and plant density affect fruit seed of Jalapeno peppers. *J. Hortsci.,* 38: 520-523.

Sam Aggrey, W.G. and Bereket and Tsehai Tuku, (1985). Proceedings of the first Ethiopian Horticultural workshop. 20-22 February.IAR. Addis Ababa. 212p.

Sato S. and Peel M.M (2005). The effect of moderately elevated temperature stress on the timing of pollen release and germination on tomato (*Lycopersicum esculentum* Mill). *Journal of Horticultural Science and Biotechnology,* 80: 23-28.

Schemske D. W. (1980). Evolution of floral display in the orchid *Brassavola nodosa*. *Evolution* 34: 489-493.