Evaluation of Hot Pepper Varieties (capsicum species) for Growth, Dry pod Yield and Quality at M/Lehke District, Tigray, Ethiopia

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Abstract - A field experiment was conducted at Axum Agricultural Research Center, Rama irrigation site, to investigate the performance of different varieties of hot pepper for growth, dry pod yield and quality. The experiment was conducted from December2013 to June2014 under irrigated condition using five hot pepper varieties (Marekofana, MelkaShote, Melkaawaze, Melkazala and Melkaeshet).The experiment was conducted on a randomized complete block design with three replication. The result of the study showed significant difference on days of 50%flowering,days to 50%maturity,fruit length, fruit diameter, fruit weight, number of fruit per plant, plant height, marketable yield, unmarketable yield and total yield(Qt/ha).As a result the earliest variety to attain days to 50%flowering was Marekofana; the variety to attain shortest days to maturity were asMelkaShote and Melkazala, while the highest fruit number per plant was recorded at MelkaShote. On the other hand the widest fruit diameter was recorded at Melkaeshet and Marekofanavarieties;where the thinnest fruit size of was attained at MelkaShote. The highest marketable yield(Qt/ha) of hot peppers was recorded MelkaShote, Melkaawaze ,Melkafana, Melkazala and Melkaeshet respectively, while the highest total yield and pest tolerance MelkaShote followed by Melkaawaze. The highest yielding capacities were attributed to their early flowering and maturity, high marketable yield and total yield,dry weight content of the varieties as well as their reaction to disease and pests. Since this study was done two seasons at one location; it would be advisable to use MelkaShote and Melkaawaze varieties to M/Lehke areas or on this given area to gain higher yield.

Keywords- Hot pepper, variety, fruit and yield

1. Introduction

Pepper is an annual herbaceous, frost sensitive plants that in temperate areas, but in tropical areas may behave as perennial. They are the source of capsaicin, the most commonly used spice in the world. The world production of pepper is nearly 10 million metric ton of fresh pepper on 1.1 million hectares and ranks in the middle range of vegetable in terms of popularity (FAO, 1992).

It grows well under warm and high humid conditions, but requires dry weather at maturity. It gives best green fruit yield and better seed set at 21^{o}c to 27^{o}c during the day and 15 to 20^{o}c at night. High temperature in combination with low humidity (40 to 50%) causes abscission of buds and flowers of poor fruit and subsequent low seed set. Pepper adapts well in sandy loam soil and well drained good clay loam (Lemma, 1998).

Pepper is one of the leading vegetables produced in the country that occupy about 44% of the total vegetable production area in the country with a total volume of production 770 thousand quintals (CSA,2004 as cited in EHSS.2006). It is important in the local dishes (as *karia*, *berbere*) and processing industrials (coloring agent) and export in the form of Oleoresin (red pigment) and ground powder.

Different types of pepper varieties are produced in Ethiopia. It varies in mode of growth in fruit characteristics such as fruit size, shape, color, and pungency. The degree of pungency varies considerably from mild to hot. The fruits are erect or hanging depending on the variety.

The present situation indicates that in Central zone of TigrayMerebLehkeworeda there are limited *Capsicum* species and varieties including both improved and the local ones. 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 was 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.

2.1 Origin and Distribution

The origin of *Capsicum* species is extended from Mexico in the North to Bolivia in the South of Latin America, where it has been part of human diet since about 7500BC (Purseglove*etal*., 1981). Spanish and Portuguese explorers spread pepper around the world. Pepper was introduced to Spain in 1493, England in 1548 and Central Europe in 1585. From Europe it went to Asia. Currently the crop is produced in various countries around the world including India, China, Pakistan, Indonesia, Sri Lanka, Thailand and Japan in Asia, and Nigeria, Uganda and Ethiopia in Africa. India and Indonesia were the largest producers. Currently China is the main producer and exporter in the world.

2.2 Taxonomy and Morphology

Hot pepper (*Capsicum* species) belongs to the Family Solanaceace, Genus *Capsicum*, and species *frutescence* L., group of vegetables. Cultivated peppers are all members of the world *capsicum* species. There are an estimated 1,600 different varieties of pepper throughout the world with five main domesticated species that includes *C. annum* L., *C. frutescens*L. C.*Chinenses*., C. *baccatum*L., *and C. pubescens*R. (Bosland*et al*., 2000). *Capsicum* peppers are commercially classified by the concentration of *capsaicin* (C18H27NO3) which determines a variety's "hotness", *Capsicum* species are diploid, most having 24 chromosome number (2n=24). But recent studies indicated the chromosome number for non-pungent species is n=13. They vary in size, shape, color, flavor and degree of hotness, from mild to very hot (Tong and Bosland, 2003).

According to Salter (1985), their production and consumption have steadily increased worldwide during the 20th century due to their roles as both vegetable and spices. Just like their Solanaceous cousins, tomato, and potatoes, peppers have rapidly become important components of diverse cuisine around the world. This is reflected in the large acreages devoted to their production in such countries as India, Mexico, China, Korea, USA and Africa. In addition, interest in both sweet and pungent types of peppers is growing in many countries not traditionally associated with spicy cuisine; protected culture has developed in northern latitude countries such as Holland and Canada and also in Mediterranean countries such as Spain, and Israel, to supply the increased demand (Wien, 1997).

Capsicum species have a solitary (single) flower that starts at the axils of the first branching node with subsequent flowers forming at each additional node. Flower differentiation is not affected by day length, but the most important factor determining differentiation is air temperature, especially at night. The *Capsicum* flower is complete, bisexual, hypogenous and usually pentamerous (Bosland and Votava, 2000). Depending on the environmental conditions and variety, the period of receptivity of the stigma is 5-8 days, from several days before anthesis to fewer days afterwards, with maximum fertility on the day of anthesis (Aleemullah*et al*., 2000).

The most actively growing organ of a pepper plant after flowering is the fruit. The fruit is ordinarily seeded, but parthenocarpic forms do exist. The seed set affects development and subsequent growth of the fruit. On average there is a direct linear relationship between the number of seeds per fruit and final fruit size, until saturation at perhaps over 200 seeds per fruit (Marcel *et al*., 1997). Typically cultivated fruit reaches the mature green stage in 35-50days after the flower is pollinated. The fruits are characterized as non-climacteric in ripening (Bosland and Votava, 2000).

2.3 Cultivation and Importance

Hot peppers like most other plants, prefer well drained, moisture holding loam soil (sandy loam) containing some organic matter (Lemma and Edward., 1994). A pH of 6.5-7.5 is suitable and the land should be level to 0.01- 0.03 % slope to allow adequate drainage and prevent root diseases. Adequate water supply is essential. Water stress can cause abscission of fruit and flowers, especially when it occurs during flowering (Matta and Cotter, 1994) and reduces yield through reduced pollination. The extreme case can result in increased risk of diseases. Poorer soil types and water stress are believed to produce lower yields (Haigh*et al.*, 1996).

It is said to be introduced in Ethiopia by the Portuguese in the 17^{th}century (Haile and Zewde, 1989). The potential areas in the country for capsicum production is estimated to be about 59,991 hectares of land with the total production of 72,466tone for dry pod and 4783 ha of land with production of 44,273 tones for fresh pod (CSA,2006).

The proliferation of ethnic restaurants and food products from such as Mexico, India and Thailand has positively influenced the demand for peppers throughout the world. Both sweet and hot peppers are processed into many types of sauces, pickles, relishes and canned products.

According to Bosland and Votava (2000), sweet pepper and hot pepper, like tomato and eggplant are rich in Vitamins A and C and a good source of B2, potassium, phosphorus and calcium (Anonymous, 1998). It has been found that as hot peppers mature, the Pro-vitamin A(β Carotene) and ascorbic acid increase. This has led to extensive production of hot peppers in some countries for export markets. A substantial percentage of pepper acreage in the largest producing countries is dedicated to produce chili powder. However, the higher prices received by farmers for fresh products have helped sustain the vegetative pepper industry, despite rising production costs competition and increased demand. It has also created a need for the expansion of pepper cultivation in to areas where it has not ever been extensively grown (Beyene and David, 2007).

Pungency in *Capsicum* is produced by the *capsaicinoids*, an alkaloid (C18H27NO3) that is produced in glands on the placenta of the fruit. While seeds are not the source of pungency, they occasionally absorb capsaicin because of their proximity to the placenta. No other plant part produces capsaicinoids (Hoffman *et al*., 1983).

Hot pepper pungency is expressed in Scoville Heat Units (Scoville, 1912). The Scoville Organoleptic Test was the first reliable measurement of the pungency of hot peppers. This test uses a panel of limited human representatives, who taste a *Capsicum* sample and then record the heat level. The sample is diluted until pungency could no longer be detected. The most common instrumental method to analyze pungency is high-performance liquid chromatography (HPLC). It provides accurate and efficient analysis of content and type of capsaicinoids present in a capsicum samples. High-performance liquid chromatography analysis has become the standard method for routine analysis by the processing industry. The method is rapid and can handle a large number of samples (Woodbury, 1980).

The *capsaicinoid*content is affected by the genetic make-up of the cultivar, weather conditions, growing conditions, and fruit age. Plant breeders can selectively develop cultivars with varying degrees of pungency. Also, growers can somewhat control pungency by the amount of stress to which they subject their plants. Pungency is increased with increased environmental stress. More specifically, any stress to the hot pepper plant will increase the amount of *capsaicinoid*level in the pods. A few hot days can increase the *capsaicinoid*content significantly. In New Mexico, it has been observed that even after furrow irrigation, the heat level will increase in the pods. The plant senses the flooding of its root zone as a stress, and increases the capsaicinoid level in its pods. If the same cultivar was grown in both a hot semi-arid region and a cool coastal region, the fruit harvested from the hot semi-arid region would be higher in capsaicinoids than that of the fruits harvested in the cool coastal climate (Lindsay and Bosland, 1995).

Capsicum fruits are consumed as fresh, dried or processed, as table vegetables and as spices or condiments (Geleta, 1998), as, it increases the acceptance of the insipid basic nutrient foods. The nutritional value of hot pepper merits special attention, because it is a rich source of vitamin A, C and E. Both hot and sweet peppers contain more vitamin C than any other vegetable crops (Poulos, 1993). Oleoresins of paprika and *Capsicum* are the two important extracts of pepper (Bosland and Votava, 2000).

Medicinal use of *Capsicum* has a long history, dating back to the Mayas who used them to treat asthma, coughs, and sore throats. A survey of the Mayan pharmacopoeia revealed that tissue of *Capsicum* species is included in a number of herbal remedies for a variety of ailments of probable microbial origin (I-San Lin, 1994). According to Bosland and Votava (2000), pepper is the most recommended tropical medication for arthritis. The pharmaceutical industry uses capsaicin as a counter-irritant balm (cream), for external application of sore muscles (Thakur, 1993). Creams containing capsaicin have reduced pain associated with postoperative pain for mastectomy patients and for amputees suffering from phantom limb pain. Prolonged use of the cream has also been found to help reduce the itching of dialysis patients, the pain from shingles and cluster headaches. It is not only their nutritional quality and medicinal value that makes peppers an important food crops, but peppers also stimulate the flow of saliva and gastric juices that serve indigestion (Alicon, 1984). It has been said that peppers raise body temperature, relieve cramp, stimulate digestion, improve the complexion, reverse inebriation, cure a hangover, soothe gout and increase passion. On the other hand among its many modern innovative uses it has been tried to use it as a barnacle repellent. For example, anti-mugger aerosols with chilies pungency as the active ingredient have replaced mace and tear gas in more than a thousand police departments in the United States. The spray will cause attackers to gasp and twitch helplessly for 20 minutes (Bosland and Votava, 2000).

2.4. Production Status of Pepper in Ethiopia

In Ethiopia, the total area under hot pepper production for green pod has enhanced from 54,376 hectares with the total production of about 770,349quintalsto 81,544 hectares through 2003/04-2005/06 years. In Ethiopia, the crop is cultivated at diverse ecological zones from sea level to 2000 m.a.s.l under rain fed and irrigated conditions. Whereas sweet pepper and chili are grown in lower altitudes relatively in warmer areas than for hot pepper and is mainly grown in state farms for export.Birds'eye chili, which is the most pungent of all the peppers, is not in great demand, though few plants are commonly found around the homesteads in high rain fall warmer areas of the country (MARC, 2003).

In Ethiopia hot pepper production for dry pod has been low with a national average yield of 0.4 tons dry fruit yield/ha (Fekadu and Dandena, 2006). This variation in yield is attributed to lack of adaptable varieties with the existing agro-ecology and irrigation during dry seasons which can lead to flower abortion and resulted in low productivity.

Much effort has been made and still continued to solve such production constraints nationally and internationally. As to the national efforts, there are a number of strong vegetable research programs across agricultural research centers throughout the country. In collaboration with regional research centers, and universities, the centers have generated a number of outputs including improved varieties, appropriate agronomic practices and crop protection measures for the vegetable production sector that could be grown in the country both under rain fed and irrigated conditions (Fekadu*et al.*, 2008).

2.5. Effect of Varieties on Hot Pepper Production

Diverse hot pepper (*Capsicum* species) genotypes have been widely grown in tropics and tropical climate within Ethiopia over centuries. More than 100,000 tones (annual average) of dry fruit of hot pepper are produced in the country and used for export for worldwide market but substantial amount are consumed locally as spice which exceeds the volume of all other spices put together in the country. Nowadays there is serious shortage of dry fruits both for export and local markets partly due to very low productivity (0.4 t dry fruit yield/ha) of the crop (Lemma *etal.*,2008).

Though hot pepper has been cultivated for centuries in typical tropical climate within Ethiopia, the yield has remained very low due to limited improvement work on the crop. However, in the past three decades, diverse genotypes (more than 300) of the crop have been introduced from different regions of the world and local collections have also been made in the country. The genetic improvement of hot pepper is also lacking in the country due to non-availability of requisite genetic information. It is well recognized that the knowledge and understanding of the genetic basis of economic traits is important to enhance the progress in developing new varieties of the crop through breeding (Usman*et al*., 1991).

The varietal analysis techniques have been found to be the useful tools to obtain precise information about the types of gene actions involved in the expression of various traits and to predict the performance of the progenies in the latter segregating generations. Each variety has its own significant effect on yield and yield components, and each variety has its own traits that are part and parcel as quality parameters of the crop (shape, size, color, taste and pungency). The most important traits among others include, number of branches per plant(count), plant height, number of fruits per plant, days to maturity (count from days of transplanting), dry fruit yield per plant, fruit length and single fruit weight (Lemma *et al.*,2008).

Even though about a dozen hot pepper cultivar was released, in Ethiopian pepper research history, two cultivars, namely Marekofana and Bako local, released in 1976, are being extensively produced in the commercial farms and by the peasant sector (Engels *et al.*, 1991; Alemuand Ermias, 2000).

2.6. Varietal Studies and Achievements on Hot pepper in Ethiopia

Globally due to its economic importance, especially in Asian countries such as Thailand, China, and the Philippines, the Asian Vegetable Research Development Center (AVRDC) had begun the varietal evaluations to develop more productive and adaptive cultivars for the region. Accordingly, the AVRDC has chosen hot pepper as one of its principal crops. Subsequently, with collaboration from the International Board for plant Genetic Resources (IBPGR), at the very beginning was able to have a collection comprising 5,177 accessions from 81countries/territories (Yamamoto and Nawata, 2005). The main emphasis of pepper work is centered on collection, multiplication, conservation, characterization, evaluation, documentation, and distribution in comparison with the local varieties which are specific to agro- ecological sites throughout Asia, with the help of evaluation trials, the activity which has not yet been widely and consistently strengthened in our case (AVRDC, 1993).

In Ethiopia Capsicums have been grown for a long time by local farmers and considered as an indigenous vegetable crop and due to a long period of cultivation in different part of the country a great deal of natural hybridization has occurred among different capsicum species. As a result many local genotypes have evolved with various plant and fruit characters as well as disease and pest reactions. Research on *capsicum* started with minor observation and mass selection from local materials in different experimental stations of Awasa and Bako (MARC, 20003).However, later strong research activities on varietal screening and cultural practices were started at Bako Agricultural Research Center. Major activities like varietal screening against diseases, adaptation studies and plant selections have been attempted at Nazret and Jimma Research Centers and at different trial cites in Bako area. In the last 30 years, extensive research has been conducted mainly on hot pepper in different research centers and in Ambo plant protection centers and Haramaya University. Some improved cultivars from each type have been developed and some management practices like spacing, sowing date, rate of fertilizer, planting method, seeding rate and disease and pest control measures were recommended (MARC, 2003). Currently different research activities are also in progress at different centers to alleviate some of the main production constraints and develop better productive varieties from local collections and imported materials.

In Tigray, the varieties Marakofana and Bako local were introduced in to the farmers as early released cultivars through different organizations. Thus, the less production potential for pepper cultivars is among the limiting factors for pepper production in the region. But, pepper has become one of the most important vegetable crops in the region for different purposes. At present, there is a shortage of different varieties which are adaptable and high yielder to different agro-ecological zone of Tigray (AxARC, 2014). Farmers in M/Lehke district of Myweni irrigation schemes produce pepper widely. However, the yield and quality of the variety which are currently under production is low due to lack of improved varieties, poor management practices and prevalence of disease and pest; and are not introduced as much as the interest of small scale producers. Hence, introduction and adaptation of improved varieties from different regional and national research centers is the main solution for producers who are produced varieties of low yield, susceptible to many diseases and pests and low acceptability in quality of the local market (AxARC, 2014).

3. MATERIALS AND METHODS

3.1 Description of the Study Area

The study was carried out at MerebLehkeWoreda (Rama Irrigation site) of Axum Agricultural Research Center (AxARC). Rama is located at about 1101 km from Addis Ababa and 77kms to the north of Aksum town, at14^{0}409'38"N" latitude, and 38^{0}735'45"E longitude (AxARC, 2014). Altitude of the location ranges 1300-1600 m.a.s.l. and has an annual minimum and maximum rainfall ranges from400 to 700 mm respectively, The mean maximum and minimum temperatures are34^{0}C 14^{0}C respectively and the soil type of the site is sandy loam typically (AxARC and BoARD, 2014,Annual Report Unpublished)

3.2 Experimental Materials

The varieties used were MarekoFana, MelkaZala, MelkaShote, Melkaeshet and Melkaawaze brought from Melkassa agricultural research center.

Table 1. Pepper varieties tested

Variety	Maintainer	Adaptation m.a.s.l	Temperature(0C)	Rain Fall	Seed Source
Marekofana	MARC	1400-2200	20/29	600-1337	MARC
Melkaeshet	MARC	1200-2200	20/29	900-1200	MARC
Melkazala	MARC	1200-2200	20/29	900-1200	MARC
Melkaawaze	MARC	1200-2200	18/29	900-1300	MARC
MelkaShote	MARC	1000-2200	15/27	900-1300	MARC

3.3 Experimental Design and Research Management

The trial was carried out in randomize block design (RCBD) having three replicates in a gross plot size of 4.2mx3m (12.6m^2) with a spacing of 1.5m between replicates and 1m between plots. The treatments included five improved varieties of hot pepper. The varieties were Marakofana, Melkaeshet, MelkaZala, Melkaawaze and MelkaShote variety.

Seeds were sown in October, 2013 on a seed bed size of 1x5m. The seed bed was covered with a dry grass for 20 days. Then, beds were covered by raised shade to protect the seedling from strong sun shine and heavy rainfall until the plants were ready for transplanting. Watering was done based on climatic conditions with a fine watering can, and was hand weeded. Transplanting to the actual field was done when the seedlings attained 20 to 25 cm height and or at 54 days after sown. The Seedlings were spaced30 cm between plants and70 cm between rows. 200 kg/ha DAP as a side dressing during the transplanting operation and 100 kg/ha for UREA, half of it during the transplanting and half of it 15 days after transplanting was applied (EARO, 2004). There were four rows per plot and 10 plants per row with a total of 40 plants per plot.

3.4 Data Collection and Analysis

Data were collected from a net plot area of 2.8 m x 2.8mcontaining five rows where the two most outer rows and0.3 m length in both ends were left as border effects. Dayto 50% flowering, days to 50% maturity, plant height(cm), fruit number plant-1, fruit length (cm), fruit diameter(cm), fruit weight (gm.), and marketable dried pod yield(qt ha-1)were collected and analyzed. Five plants from themiddle rows were taken to collect data of plant height (cm) and five fruits from each these plants were also taken to consider fruit length (cm), fruit diameter (cm) andfruit weight (g) of each variety.

All the collected data were subjected to the analysis of variance (ANOVA) using the SAS computer package version 9.1 (SAS Institute, 2004).

4. RESULTS AND DISCUSSION

Table2.The mean values of phonology and growth components of hot pepper varieties in 2014 cropping season at MerebLehke irrigation scheme

	Variety	Days to 50%flowering	Days to 50%Maturity	Fruit length (cm)	Fruit Diameter (cm)	Fruit weight (gm.)	Plant Height (cm)
1	Melkaawaze	64.33ab	111.67b	9.86bc	1.2cd	6.83d	72.4b
2	Melkaeshet	61.67b	105.67c	11.16ab	2.21a	23.69a	62.93c
3	Marekofana	60b	111b	9.0c	2.82b	12.67b	70.67bc
4	Melkashote	72.67a	121a	10.57bc	0.98d	6.54d	70.47bc
5	Melkazala	71.33a	122.67a	12.67a	1.38c	9.58c	83.4a
	LSD (5%)	8.42	4.53	1.58	0.34	2.57	7.87
	CV (%)	6.78	2.1	7.9	10.68	11.52	5.81

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, least significance difference (LSD) test at 5% probability level as described in Gomez and Gomez (1984).

Days to 50%flowering

Varieties showed significant difference on days to flowering. The highest (72.67) and lowest (60) days to flowering was shown in MelkaShote and Marekofana, respectively (Table2). This indicated that MelkaShote took longer days to flower while Marekofana flowered earlier. Earliness or lateness in the days to 50% flowering might have been due to the 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 (SamAggrey and Bereke-Tsehai, 2005).

Days to 50%Maturity

Significant (P≤0.05) variations were observed among the hot pepper varieties in the number of days plants attain 50% flowering and 70% physiological maturity. MelkaZala required the longest time (71.33days) until 50% of the plants to flower and 122.67 days until they mature. Melkaeshet required the shortest time (61.67days) to flower and 105.67 days to mature. But there is no significance difference between Melkazala and MelkaShote. This result was in agreement with the finding of Lemma *etal.*(1994),which indicated a range of 96 to 99 and 100 to 126 days to flowering and maturity respectively for different *Capsicum* genotypes including varieties in the present study.Geleta (1998) also reported 74 to 97 days and 114 to 158 days for flowering and maturity, respectively, of 18 *Capsicum* genotypes grown at Melkassa Research Center. The results indicate that, the traits are affected by both genotype and environment.

Plant height

Plant height significantly (P<0.05) influence due to Varieties. The mean plant height of the hot pepper varieties evaluated differed significantly with the tallest being the Melkazala variety (83.47) and the shortest being variety *Melkaeshet (60.93)* (Table 2). This result was in agreement with the finding of MARC (2005), which reported Melkazala variety showed the tallest plant height (62cm) among the evaluated varieties at three locations.

Fruit Length

As fruit length of the hot pepper varieties significantly influenced (P≤0.05) due the varietal effect (Table2), the highest and lowest fruit length of pepper variety was observed in Melkazala (12.67) and Marekofana (respectively). The significant difference in fruit length among the hot pepper varieties attributed to the 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). Tibebu and Bizuayehu (2014) also reported similar findings.

Fruit Diameter

Effect of variety showed highly significant difference on fruit Diameter (Table 2). The highest fruit Diameter was recorded from Marko fana (2.82) and lowest fruit diameter of pepper variety was observed in MelkaShote(0.9).This result was in agreement with the finding of 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 Marko fana produced the highest fruit diameter (1.98cm). 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 Weight

Table 2 revealed that dry pod weight was significantly (P<0.05) influence due to the impact of varietal effect. Accordingly, the highest Fruit Weight was obtained from Melkaeshet (23.69) pepper variety. However the lowest was from MelkaShote (6.54). The results indicate that, the traits are affected by both genotype and environment.

Table 3: The mean values of Marketable yield and yield components of hot pepper varieties in 2014 cropping season at MerebLehke irrigation scheme

	Variety b	Fruit no. per plant	Marketable Yield(Qt/ha)	Un Marketable Yield(Qt/ha)	Total yield (Qt/ha)
1	Melkaawaze	46.67ab	26.57ab	3.5b	27.19
2	Melkaeshet	25.07b	25b	7.5a	26.94
3	Marekofana	32.87b	25b	3.4b	26.52
4	MelkaShote	60.2a	30.95a	1.86b	27.21
5	Melkazala	41.8ab	24.6b	2.6b	26.78
LSD	LSD (5%)	23.72	5.54	3.3	ns
	CV (%)	30.48	10.97	48.91	11.24

Fruit Number per Plant

According toTable2, there was a significant difference in fruit number per plant of the varieties Varietal difference causes significant difference in fruit number per plant. The Melkashote variety produced more number of fruits and was statistically superior to the others. Nevertheless, Marakofana and Melkaeshet produced less number of fruits and statistically inferior than the others. The highest fruit number in MelkaShote 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 per plant. In line with this result, Amare*et al.* (2013) found different fruit number per plant due to variety differences. Furthermore, Seleshi*etal* (2014) reported that number of fruits per plant 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 with stand the stress especially on the reproductive development, which is more sensitive to high temperature stress (day and night temperature) than vegetative development

Marketable Yield (Qt/ha)

Varietiesshowed significant ($P<0.05$) influence on marketable yield of hot pepper.The highest and lowest dry marketable yield was observed in Melkashote and Melkazala which is 30.95qt/ha and 24.60 qt/ha respectively. The variation of marketable yield of these varieties could be due to difference in genetic characteristics and agro ecological adaptability nature (Fekadu*et al*., 2008).

Unmarketable yield (Qt/ ha)

Varieties showed significant difference ($p<0.05$) on unmarketable yield. The highest unmarketable yield was obtained from Melkaeshet (7.4 Qt/ha), while the lowest was from MelkaShote (1.86Qt/ha).This result is similar with the work of MARC (2005) in which the marketable yield of Marko fana ranged between 1.5 tons and 2 tons. The result of marketable yield also shows that the variety MelkaShote had the highest unmarketable yield (0.1053) while the least unmarketable yield was recorded from variety of Melkaawaze (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 (Qt/ha)

As indicated in Table 3, non-significant difference was observed on total dry fruit yield of different pepper varieties. The highest and the lowest total yield were observed in MelkaShote and Marekofana which is 27.21qt/ha and 26.52qt/ha respectively.

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 poor crop yields and high production costs in Ethiopia particularly to the MerebLehke districts where hot pepper is among the highest acreage and values of low elevation vegetables lack of best performing variety is the major bootlicks for farmers and growers due inefficient research work in the area.

5. Conclusions and Recommendations

An adaptation trial is one of the most important mechanisms to select best varieties and demonstrate and disseminate the technology to the farmers easily. Based on this result, it can be concluded that Melkazala variety was late maturing and gave lower yield. However, Melkashote, Melkaawaze, Marakofana and Melkaeshet varieties gave the highest yield and Marekofana andMelkaawaze were early maturing varieties. However, MelkaShote and Melkazala were late in maturity relatively as compared to Marekofana and Melkaawaze. In general among these varieties the Melkashote and Melkaawaze variety are the most outstanding variety because of its highest biomass, disease tolerant, fruit number, yield and repeatable harvesting which leads to high yield per hectare, but with small fruit size. Therefore, MelkaShote was well performed agronomical and was recommended for production by growers in the study area.

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