Varietal Evaluation of Tomato Varieties under Protected Environment and Organic Conditions in Summer Season in Martfeld, Germany

WH Jayasinghe[1], IP Wickramasinghe[1] and W Evers[2]
[1]Department of Agricultural Biology, Faculty of Agriculture, University of Peradeniya [2]Kleiner Krauter GbR, Martfeld, Germany

Abstract
Tomato (*Solanum lycopersicon* L.) is one of the major commercial vegetable crops widely grown in Germany. To date, there are only few varieties that were specifically bred for low-input systems in developed countries. Therefore five popular and commonly grown tomato varieties namely Temptation, Devotion, Bocati, Sportivo and Picoino were evaluated under organic and protected agriculture conditions for the yield potential. The experiment was arranged in randomized complete block design with 20 replicates, individual plants as replications. Fruit set after flowering was highest in Devotion (98.8%) and the lowest in Sportivo (88.1%). Devotion produced the highest marketable fruit yield of 8.2 kg/plant while Sportivo produced the lowest of yield 3.5 kg/plant. Also the results of the experiment revealed that the hybrid varieties Devotion and Temptation showed high yield potential than Bocati, Sportivo and Picoino. Thus these two varieties can be recommended for commercial production under organic and protected environment conditions.

Key words: Organic agriculture, Protected agriculture, Tomato

Introduction

Tomato (*Solanum lycopersicon* L.) is one of the major commercial vegetable crops in Germany and it is grown in both open field and protected environment conditions (PEA). Growing tomatoes under PEA is especially beneficial in climates that have cool, wet summers like in Germany, since it extends the season over which they bear fruits and offers protection from diseases.

The organic agriculture is a well-established system in Germany, dating back to 1924 with a longest tradition in organic farming history. Until recently, the organic market was a niche market, but food safety crisis in recent years and rising health awareness among German consumers have had a positive impact on the organic market. In addition, German consumers, not only demand high quality products, but also concerned about the pesticide and fertilizer usage of this crop. Therefore, production of organic tomatoes has an added advantage in German market because of high demand to the product (Harvey et al. 2002).

Under the open field conditions tomatoes can be subjected to various stresses and consequently reduces the yield, hence many farmers have adopted protected environment agriculture in order to overcome this problem. In contrary growing tomatoes in polytunnels can also create stress conditions to the plant (Abdelmageed et al. 2003; Abdelmageed et al. 2009).

To date, there are only few varieties that were specifically bred for organic and low-input systems in Germany (Lammerts van Bueren et al. 2002). The present study was undertaken to evaluate the yield performance of five tomato varieties under organic and protected environment conditions in summer season in Martfeld, Germany. These five tomato varieties are recommended for high input agricultural systems in Germany.

Materials and Method

The experiment was conducted at Kleiner Krauter farm, Martfeld, Lower Saxony, Germany, during April to July 2011. The farm is situated about 35km away from the nearest city Bremen at +52 ° 52 '27.73 "N, +9 ° 1' 5.30"W, and approximately 12m above the mean sea level.

F1 seeds from five popular and commonly grown varieties in Lower Saxony namely Temptation, Devotion, Bocati, Sportivo and Picoino were sown in flat trays filled with a standard peat mixture. The mixture contained

bark humus, horn chippings and had an electrical conductivity (EC) of 0.25 dS m^{-1} and a pH value of 5.0-6.0. Thirty days after sowing (DAS), the seedlings were transplanted inside polytunnels under organic conditions. Four hundred and forty plants from each variety were planted in five curve sided polytunnels, (32 m long, 8 m wide and 5 m high). The plants were planted in four main rows, where each row contained two lines of plants at a spacing of 60 cm by 50 cm and a walking space of 130 cm between rows. Watering was done every other day by opening drippers for overnight.

The experiment was set up in a randomized complete block design with 20 replicates, individual plants as replications. Mean separation was done by least significant difference method for $P \leq 0.05$.

All the observations were made at 15 days intervals after transplanting, in addition some data were collected when 80% of the plants showed flowering or at the time of harvest.

Results and discussion

Plant height was significantly different among the varieties. Temptation showed a height of 179.3 cm while Sportive showed the lowest height (156.3 cm) 90 days after transplanting (DAT). Whereas variety Bocati showed the highest number of leaves at 90 DAT. Picoino, Devotion and Temptation were intermediate while Sportivo had the lowest number of leaves. However plant girth did not show a significant different among the varieties.

Among floral characters the length of the petals, sepals and the stamen was significantly different between varieties (Table 1).

Tomatoes are usually classified according to their shape and size. Therefore fruit characters of these five varieties were also considered. Bocati has medium sized, round shaped, bilocular fruits with a smooth red colour. Picoino bears round shaped, triloculer fruits with a bright red colour. Sportivo bears beef type fruits which are shiny red colour and triloculer. Devotions are cocktail tomatoes with smooth red colour and two loculs. Temptation has median sized, flat round shaped, triloculer fruits. Single fruit weight of each variety is shown in the table 1.

Table 1 : Weight of single fruit and length of the petals, sepals, stamens and the performance of tomato varieties on days to flowering under protected environment conditions

Variety	Weight of a single fruit (g)	Length of the petals (cm)	Length of the sepals (cm)	Length of the stamen (cm)	Days to flowering from planting	Days to first harvest from planting	Number of fruits per cluster	Number of clusters per plant
Bocati	100-120	1.4^{b}	9.2^{dc}	10.5^{a}	38^{a}	69^{b}	8.7^{c}	5.9
Picoino	65-70	1.6^{a}	9.6^{b}	8.4^{b}	36^{b}	67^{c}	13.1^{a}	5.1
Sportivo	180-200	1.6^{a}	10.2^{a}	9.9^{ab}	33^{c}	73^{a}	8.8^{c}	4.8
Devotion	50-60	1.5^{ab}	9.3^{c}	8.4^{b}	29^{d}	60^{e}	11.3^{ab}	6.6
Temptation	60-80	1.5^{ab}	9.1^{d}	10.7^{a}	30^{d}	62^{d}	10.2^{bc}	6.1

Means followed by the same letter(s) within each column are not significantly different at $P > 0.05$, according to least significant difference test.

With an objective to study the earliness character of the variety, days to flowering from planting was also recorded. Out of five varieties Devotion took the shortest period of 29 DAT whereas, Temptation took 30 DAT which did not showed a significant difference. Other three varieties namely Bocati, Picoina and Sportivo took 38, 36 and 33 DAT respectively (Table 1). Similar results were obtained by Pandey et al. (2006).

Early maturity plays an important role in getting higher market price and income. Devotion took the shortest period of 60 days from planting to first harvest whereas Sporivo took the longest period (73 DAT) (Table 1). All the varieties were significantly different by the days to

first harvest and there was 13 days of difference compared to shortest maturity variety, Devotion.

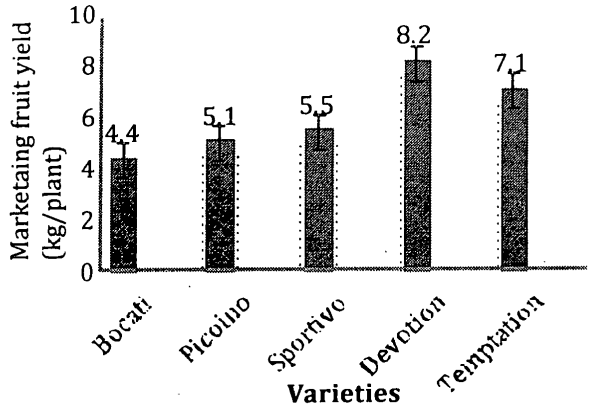

Figure 1: yield of different tomato varieties under organic and protected environment condition

Number of fruits per cluster is an important observation to evaluate the varieties for fruiting character and the relation of clusters to the yield. Five varieties tested here showed statistically significant difference on number of fruits per cluster. Picoino recorded the highest number (13.1 fruits per cluster) while Bocati and Sportivo recorded the lowest number (8.7 fruits per cluster). Devotion had a mean number of 11.3 fruits per cluster (Table 1). In general the number of fruits per clusters directly influenced to the fruit yield. However, fruit size and number of clusters per plant are also determinant factors.

However in this study the difference among the varieties on number of clusters per plant was not significant. The number of clusters per plant ranged from 4.8-6.6.

Marketable fruit yield is the most important character and the major determinant variable for selection. The marketable fruit yield of the five tested varieties can be categorized into two significantly different groups. Devotion and Temptation recorded the highest yields and rest of the varieties recorded the lower yields. Lowest yield was 3.5 kg/plant and was given by Sportivo, while Devotion gave the highest yield of 8.2kg/plant (Fig. 1).

Fruit set percentage of a tomato variety, which reflects the sensitiveness of a variety to perform under a particular temperature and environment has become one of the important parameters of summer and rainy season tomato production (Panddy et al. 2006). The fruit set percentage was significantly different and highly affected by the varieties. The highest fruit set (98.87%) was observed in Devotion whereas, the lowest fruit set (88.19%) was observed in Sportivo.

Conclusions

Out of five varieties tested in this experiment Devotion showed early flowering, fruiting and harvesting. In addition, it also produced the highest marketable fruit yield. Thus, Devotion variety can be recommend for organic and protected agriculture.

References

Abdelmageed AH, Gruda N and Geyer B 2003 Effect of High Temperature and Heat Shock on Tomato (*Lycopersicon esculentum* Mill.) Genotypes under Controlled Conditions [on line]. Accessed on 09.09.2011. Available at http://www.tropentag.de/2003/abstracts/full.

Abdelmageed AH, Gruda N and El-Balla MMA 2009 Performance of Different Tomato Genotypes in the Arid Tropics of Sudan during the Summer Season. I. Vegetative Growth. Journal of Agriculture and Rural Development in the Tropics and Subtropics. 110(2): 137–145.

Harvey M, Quilley S and Beynon H 2002 Exploring the Tomato. Transformations of Nature, Society and Economy. Edgar Publishing, Cheltenham, UK, pp. 304.

Lammerts van Bueren ET, Struik PC and Jacobsen E 2002 Ecological concepts in organic farming and their consequences for an organic crop ideotype. Netherlands Journal of Agricultural Science 50: 1–26.

Pandey YR, Pun AB and Upadhyay KP 2006 Participatory Varietal Evaluation of Rainy