Bulletin UASVM Horticulture, 70(1)/2013, 164-171
Print ISSN 1843-5254; Electronic ISSN 1843-5394

Suitability of Some Romanian Tomato Landraces to Organic Crop in Plastic Tunnel

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Abstract. The paper presents the results obtained within a trial set in 2012, in organic system, in a plastic tunnel provided by UASMV Cluj-Napoca using eight tomatoes landraces. The seeds were provided by Suceava Gene Bank. The trails main question was: Are the studied tomatoes landraces suitable to organic crop under plastic tunnel conditions? During the vegetation period the following fruits characteristics were assessed: taste, aroma, weight, degree of crimp, firmness. The tomatoes juice was analysed from a chemical point of view concerning: the content in total sugar, acidity (titration), dry matter (desiccation), nitrates (potentiometric); calcium, magnesium, copper, iron (spectrophotometric with atomic absorption); boron, phosphorus, manganese, potassium, zinc (ASU L 00.00-19/1). Related to the plants, the germination and binding percentage was calculated, also the yield; moreover, the following things were examined too: plant resistance to late blight (*Phytophtora infestans* Mont.) and green house white fly (*Trialeurodes vaporariorum* Westwood) attack and calcium deficiency. Based on the results, AB 343 had the highest production – of 3.38 kg/ plant; SJ 370 had the best aroma, obtaining 3 points (out of maximum 4 points) in case of the majority of tasted fruits; CJ 358 and BN 345 were highly sensitive to calcium deficiency while SJ 370 and SM 340 registered no symptoms of *Phytophtora infestans* attack. Taking into account all studied aspects it can be concluded that, out of the 8 landraces, the best results obtained in organic system under plastic tunnel conditions were recorded in case of the 3 following landraces: AB 343, SJ 370 and SJ 373.

Keywords: landrace, tomato, organic system, aroma, calcium deficiency, blight, greenhouse white fly.

INTRODUCTION

At European level there is an increasing concern for the development of organic agriculture. As far as it concerns this issue, treaties and conventions were signed, laws and directives were issued and research programs were developed.

As a consequence of the increased rate of vegetable species disappearance, within the ONU's conference that took place in Rio de Janeiro (1992) the Convention on Biodiversity was adopted. This Convention seconds the idea of conserving biodiversity. The need of agro-biodiversity conservation is the result of intensification of genetic erosion due to a intensive agriculture based on the cultivation of modern varieties to the prejudice of landraces (Maxim *et al.*, 2010). One of the irreversible and long time effect of industrialised agriculture is the loss of genetic diversity (Sanderson *et al.*, 2002).

The Directive 98/95 of the European Union and the Convention regarding Genetic Resources of Plants for Alimentation and Agriculture (2001) are two other regulations that protect vegetal genetic resources (Zaharia, 2003; Maxim, 2008; Maxim *et al.*, 2010). The above mentioned Directive foresees the possibility of entering the local varieties of crop plants in Common Catalogue (Chable, 2005).

European Union adopted in 2005 a new directive that endorses the severance of the list containing the modern varieties from the one containing the local varieties.

Out of the definition given by the Directive 2008/62/CE (*„a local variety in an ensemble of populations or clones of a plant species that have naturally adapted to the environmental conditions of their region*) arises an important characteristic – high geterogenity. (Maxim *et. al.*, 2010). This characteristic presumes a high adapting capacity to stress factors as: drought, frost, pests, diseases, etc..This is possible because of the continuous gene combinations that the local varieties develop (Moldovan, 2003).

Due to the high genetic diversity they possess, traditional varieties can be used for obtaining new varieties and on the other hand they may have on important role in long term food security (Străjeru *et al.*, 2009; Sancez *et al.*, 2008). Other advantages of local varieties are: the taste which generally is better than the taste of modern varieties and the suitability to organic crop (Guillet, 2006).

According to data from the Ministry of Agriculture and Rural Development (Romania), organic cultivated area was 143 194 ha in 2006 and grew up to 260,000 ha in 2010. This report presents initial results regarding Romanian landraces of tomatoes organically cultivated in plastic tunnel.

MATERIALS AND METHODS

The trial was organised as a collection of 8 tomatoes landraces belonging to *Lycopersicon esculentum* Mill. and originating from five Transylvanian counties (Tab. 1). Suceava Gene Bank provided the seeds. The eight local varieties have the following codes: SJ 370, SJ 371, SJ 373, CJ 356, CJ 358, AB 343, BN 345, SM 340 (Fig.1). The letter is the abbreviation of the county and the digit represents the order number given when the seeds were collected.

Tab. 1

Information regarding the tomatoes landraces used within the trial

Local variety	Origin	Type of growth	Latitude	Longitude	Altitude
SJ 370	Crasna commune, Sălaj county	indeterminate	47.17^0 N	22.9^0 E	320
SJ 371	Crasna commune, Sălaj county	indeterminate	47.17^0 N	22.9^0 E	320
SJ 373	Crasna commune, Sălaj county	indeterminate	47.17^0 N	22.9^0 E	320
CJ 356	Câţcău village, Cluj county	indeterminate	47.13^0 N	23.47^0 E	247
CJ 358	Iclod village, Cluj county	indeterminate	46.98^0 N	23.8^0 E	250
AB 343	Sebeş locality, Alba county	indeterminate	45.96^0 N	23.57^0 E	250
SM 340	Satu-Mare locality, Satu-Mare county	indeterminate	47.47^0 N	22.88^0 E	126
BN 345	Sângeorz-Băi locality, Bistriţa-Năsăud county	indeterminate	47.36^0 N	24.68^0 E	440

The sowing was realised on 27.02.2012 in a heated tunnel. For sowing were used pots of 7 cm containing peat. When sowing, the air temperature was 15^0 C.

A fertilization with cow urine in a concentration of 1:15 and a quantity of 30 ml/plant was applied to the seedlings. On 21.04.2012 the seedlings were planted in plastic bags with a capacity of 10 litres containing a mixture of earth and peat in a ratio of 1:2. The distance between the lines was 50 cm and between plants within a line was 70 cm being realised a density of 2.9 plants/m^2.

Fig. 1 Tomatoes landraces (UASVM Cluj-Napoca 2012)

During the vegetation period the following maintaining works were accomplished: manual weed control, late blight control, leaf stripping, twig removing, watering, fertilization and tip growth removing at the end of August. Fruit springing was stimulated by manually shaking the plants three times per week.

Depending on the air temperature the plans were watered with 2 to 4 l water/plant.

Fertilization was done four times in the entire period. As fertilizer cow urine was used in a ratio of 1:10 and applied in soil 1 l/plant. According to the Order No. 1270/2005 issued by Ministry of Agriculture and Rural Development, cow urine can contain 0.2 – 1% N and 0.2 – 1% K_2O.

For blight control two treatments with Bordeaux mixture (0.5 - 1%) were applied; the second was mixed with nettle soak. In order to obtain the soak fresh nettles (*Urtica dioica*) were picked up. A kilogram of plants was dipped in 10 l water and after that placed in sunlight until the next day when the mixture was filtrated. The maximum quantity of Copper allowed in organic agriculture is of 3 kg Cu/ha.

RESULTS AND DISCUSSIONS

Based on the number of germinated seeds, the germination percentage was calculated. Thus SJ 371 had the highest germination percentage (87.69%) followed by AB 343 and CJ 358 with 81.82%. The third place was occupied by BN 345 with 78.35% (Fig. 2).

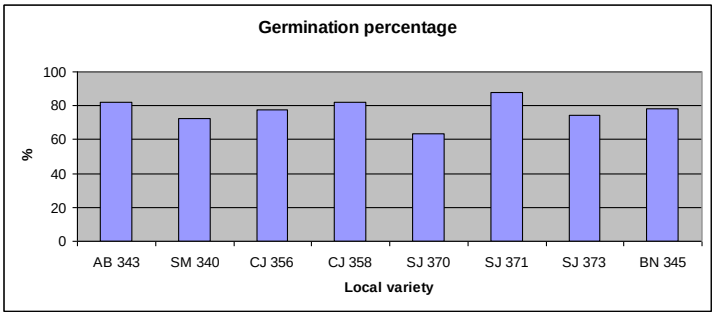

Fig. 2 Germination percentage of the studied landraces

The highest fructification percentage was registered at SJ 371 - 49%, followed by SM 340 – 44.5% and SJ 373 – 38.6% (Fig. 3).

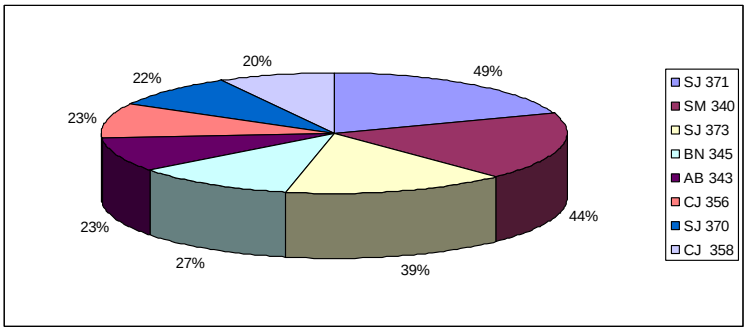

Fig. 3 Fructification percentage at the studied local varieties

According to the Romanian horticultural literature it can be obtained in plastic tunnel a yield of 5.5 – 7 kg/m^2 (Ciofu *et. al.*, 2004).

In this paper the most important landraces, speaking from the yield point of view, were the following ones: AB 343 and SJ 370 with 9.9 kg/m^2 and in case of CJ 358 - 8.7 kg/m^2 (Tab. 2) were obtained.

In order to characterize the fruits a series of determinations and biometrical measurements (Tab. 3) were realised.

For appreciating aroma points from 1 to 4 were given, for wrinkle degree – points from 1 to 5 and for taste – points from 1 to 6. Thus:

- aroma: 1 – insipid, 2 – slightly flavoured, 3 – flavoured, 4 – strongly flavoured;
- wrinkle degree: 1 – very wrinkled, 2 – wrinkled, 3 – slightly wrinkled, 4 – very slightly wrinkled, 5 – uniform;

- taste: 1 – sour, 2 – sourish, 3 – sweet slightly sourish, 4 – sweet sourish, 5 – sweet, 6 – very sweet;

In order to determine these characteristics, 20 fruits/variety were randomly picked.

Tab. 2

The yield registered in case of the studied landraces

Local variety	Yield/plant (kg)	Yield/m² (kg)
SJ 370	3.4	9.9
SJ 371	2.2	6.4
SJ 373	2.9	8.4
CJ 356	2.5	7.3
CJ 358	3.0	8.7
SM 340	2.0	5.8
AB 343	3.4	9.9
BN 345	2.5	7.3

To reckon the shape index (SI) the length and width of fruit were measured and used the next formula: SI=h/L, where h=fruit thickness (measured from stalk to bottom) and L= $(L_M+L_m)/2$ where L_M=big diameter, L_m=small diameter, L=fruit diameter.

When SI<1 – flattened fruit, SI=1 – round fruit, SI>1 – egg-shaped fruit.

To calculate density, the fruit was immersed in 1l water and the weight was measured according to the dislocated volume of water.

The firmness was determined by using a hand penetrometer which expresses the measured value in kg/cm^2.

According to Indrea *et. al.*, 2000 and Petro-Turza 1986/1987 fruit chemical composition varies depending on sort, fertilizer, ripening degree, external and depositing factors.

Out of fresh fruits the following items were determined: total sugar, acidity (titration) expressed in malic acid, nitrates (potentiometric). For determining iron, calcium, magnesium and copper spectrophotometric with atomic absorption method was used. The method used for determining boron, phosphorus, manganese, potassium and zinc content was ASU L 00.00-19/1 and desiccation for dry matter (Tab. 4, 5, 6).

Tab. 3

Fruit characteristics at studied landraces

Landrace	Taste (no. points)	Aroma (no. points)	Wrinkle degree (no. points)	Weight (gr.)	Shape index	Average density (gr/cm^3)	Average firmness (kg/cm^2)
SJ 370	99	40	64	50 - 495	0.5-0.9	1.1	2.6
SJ 371	64	25	90	62 - 213	0.6-0.8	1.0	2.1
SJ 373	54	29	82	69 - 375	0.6-0.9	0.9	2.6
CJ 356	60	14	63	52 - 573	0.5-0.9	1.0	2.4
CJ 358	53	19	70	91 - 718	0.6-1.3	1.0	2.1
SM 340	80	31	77	61 - 234	0.5-0.9	1.5	2.0
AB 343	64	44	70	60 - 432	0.5-1.0	1.0	2.8
BN 345	68	18	66	63 - 564	0.4-0.9	1.2	3.5

Tab. 4

Data concerning chemical fruit content at the studied landraces

Landrace	Total sugar (gr/l F.M.)	Acidity (%)	Dry matter (%)
SJ 370	27.8	0.3	5.0
SJ 371	35.7	0.2	5.7
SJ 373	29.1	0.3	5.1
CJ 356	27.8	0.2	5.0
CJ 358	26.5	0.4	4.9
SM 340	21.3	0.3	4.4
AB 343	31.4	0.2	5.3
BN 345	34.6	0.3	5.7

Some German tomatoes local varieties contain between 2.53 and 2.83 g sugar/100 g F.M. (fresh matter) (Klein, 2010). The pleasant taste is given by a balanced ratio between sugar content and acidity. Generally speaking, the most appreciated is the sweet sourish taste.

Tab. 5

Data concerning fruit content in various metals at the studied landraces (I)

Landrace	Nitrate (mg/l)	Calcium (mg/100g F.M.)	Magnesium (mg/100g F.M.)	Copper (mg/100g F.M.)	Iron (mg/100g F.M.)
SJ 370	55.2	11.7	5.8	0.08	8.6
SJ 371	43.2	11.5	5.0	0.08	10.5
SJ 373	42.1	10.1	6.5	0.07	6.7
CJ 356	38.3	11.2	6,1	0.05	10.7
CJ 358	44.2	12.3	10.3	0.08	8.5
SM 340	40.4	9.9	10.6	0.08	7.6
AB 343	41.9	7.3	6.0	0.08	8.1
BN 345	48.3	7.4	10.4	0.07	7.6

According to some authors, tomatoes may contain round 24 mg C vitamin/100g F.M. (fresh matter) (Ciofu *et. al,*. 2004) or 10.9 mg/100 g F.M. – average value obtained in case of some German local varieties (Rodriguez-Burruezo *et. al.,* 2005).

Tab. 6

Data concerning fruit content in various metals at the studied landraces (II)

Landrace	Boron (mg /100g D.M.)	Phosphorus (mg/100g D.M.)	Manganese (mg/100g D.M.)	Potassium (gr/100g D.M.)	Zinc (mg/100g D.M.)
SJ 370	0.8	379.2	1.1	4.4	2.7
SJ 371	1.1	429.9	0.9	5.6	2.4
SJ 373	0.8	326.4	0.9	4.2	2.5
CJ 356	0.8	352.8	1.1	4.5	2.9
CJ 358	0.8	356.2	1.1	4.5	2.4
SM 340	0.8	386.9	0.8	4.4	3.2
AB 343	0.9	403.7	1.0	6.0	2.5
BN 345	1.3	512.8	1.6	5.1	3.0

Fresh fruits usually contain 4.7% to 7.5% dry matter (D.M.) (Souci *et. al.*, 1994). The Order 293/640/2001-1/2002, emitted by the Ministry for Agriculture (Romania) makes the provision of maximum 300 ppm NO_3/kg fresh product. In case of some German tomatoes landraces the average value of calcium varies between 85 and 125 mg/100g D.M. and for magnesium are attained values between 140 and 240 mg/100 g D.M. (Klein, 2010).

During the vegetation period observations concerning the presence of calcium deficiency were obtained and the attack of *Phytophthora infestans* respectively *Trialeurodes vaporariorum* (Tab. 7).

The degree of attack was expressed by means of numbers from 0 to 3 where: 0 – resistant, 1 – slightly sensitive, 2 – sensitive, 3 – very sensitive.

Tab. 7

Behaviour of the studied landraces to the issues came during vegetation period

Landrace	Calcium-deficiency	*Phytophthora infestans* attack	*Trialeurodes vaporariorum* attack
SJ 370	1	0	2
SJ 371	1	1	2
SJ 373	1	1	1
CJ 356	1	1	2
CJ 358	3	1	1
SM 340	1	0	1
AB 343	1	1	1
BN 345	3	1	1

CONCLUSION

The above presented data represents the results of the first year research within the PhD studies. For this reason in the second year there are used just three of the eight landraces as follows: SJ 370, SJ 373 and AB 343. In a holistic view, these three local varieties had the best qualities.

The highest yield was achieved by: AB 343 and SJ 370 – 9.9 kg/m^2. The mentioned varieties obtained the highest score for aroma: AB 343 – 44 points and SJ 370 – 40 points. SJ 373 had the most uniform fruits and a slightly sensitivity to calcium deficiency. This variety proved also a slightly sensitivity to *Phytophthora infestans* and *Trialeurodes vaporariorum* attack.

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