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RESEARCH ON CONSERVATION, EVALUATION AND GENETIC HERITAGE EXPLOITATION OF TOMATO

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Abstract *Concerns on tomato breeding at V.R.D.S. Buzău existed since the institution settlement, in 1957. Over time, Breeding Laboratory created valuable tomato varieties with a well-defined genetic constitution, appreciated by growers and consumers. Many old varieties, created between 1970-1980 (ex. 'Buzău 1600', 'Buzău 22', 'Buzău 47') were kept genetically pure being on high demand nowadays. After 1996, the Breeding Laboratory restarted intensive research on tomato breeding. Particular attention was paid to purchase genotypes, accessions, varieties, local populations and foreign genotypes with the aim of forming a solid germplasm collection. Secondly, the germplasm collection that is steadily growing, currently reaching over 1500 genotypes, was evaluated, distributed on two fields, collection field and work field. Particular attention regarding the assessment was given to the genetic stability and type of plant growth. In terms of genetic stability, cultivars evaluated were grouped as: stable, advanced and segregating. Concerning the type of growth SP gene expressivity was followed and genotypes were grouped as follows: genotypes with indeterminate growth (SP +) semi determinate genotypes (Sp) and determinate genotypes (sp). Up to now, breeding works were completed with the approval of new genotypes and their widespread as cultivated crop. Among the recently approved cultivars are: 'Siriana' F1, 'Kristinica', 'Darsirius', 'Chihlimbar', 'Florina', 'Ema de Buzău', and for pending approval 'Măriuca', A 80 ('Estera'), A 2000 ('Bizon'), A 28 ('Hera'). Genetically stable accessions were tested through general and specific combining ability in order to develop new hybrids.*

Key words*: breeding, biodiversity, hybridization.*

INTRODUCTION

Among the vegetables grown in Romania, tomato is the most cultivated species both as crop and for fresh market.

Due to its Latin American origin and related domestication history, cultivated tomato has faced several bottlenecks over ages. This led to a drastic reduction of its genetic diversity. Explorations of tomato center of origin permitted major advances in the character-rization of its diversity (Bauchet, 2012).

Concerns on tomato breeding at V.R.D.S. Buzău existed since the institution settlement, in 1957.

At the beginning were cultivated local populations and foreign cultivars, especially Bulgarian.

As a result, its genetic basis has been seriously narrowed, known as the 'domestication syndrome' (Aflitos, 2014)

For the first time in Romania, at Vegetable Research Development Station Buzău hybrid seed was obtained by known commercial tomato Bulgarian hybrid 10X Bizon.

Later, here were obtained the first Romanian tomato varieties as follows: 'Buzău 1600', 'Buzău 22', 'Buzău 47', 'Diana'.

Traditionally, tomato improvement has been carried out by classical breeding approaches by introgression genes from the wild relatives (Mohan, 2016).

V.R.D.S. varieties have well-defined genetic constitution and showed durability unaltered for over 40 years. The varieties are required and appreciated by growers and consumers even today.

MATERIALS AND METHODS

After 1996, research on tomato breeding at V.R.D.S. Buzău resumed intensively after a well-organized schedule:

Phase I objective was a continuous enrichment and improvement of germplasm collection in this species.

Phase II aimed to evaluate the germplasm collection and its distribution on fields and breeding phases.
Phase III aimed the introduction of valuable genotypes in intensive breeding works.
Phase IV aimed to develop germplasm collection by acquiring new genotypes, varieties and hybrids.
Germplasm collection has been divided into distinct groups according to the type of plant growth and genetic stability (Figure 1).

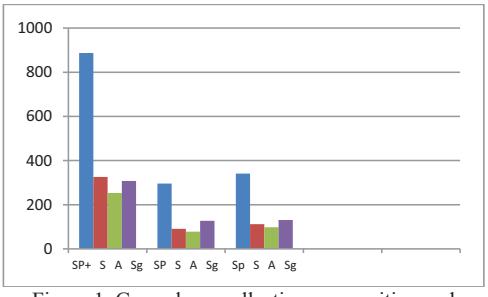


Figure 1. Germplasm collection composition and breeding phases:

SP+ (indeterminate accessions) - 887 accessions from which S (Stable) 326, A (advanced)- 253 and Sg (segregating)-308;
SP (semi determinate accessions) - 296 accessions from which S (Stable) 91, A (advanced) – 78 and Sg (segregating)-127;
Sp -(determinate accessions)- 341 accessions from which S (Stable) 112; A (advanced)- 98 and S (segregating)-131

Collected germplasm resources were evaluated in terms of stability and their use in breeding process according to the following plan (Figure 2):

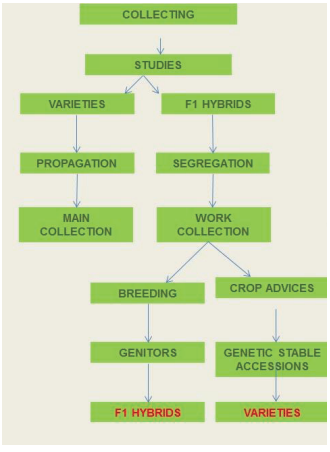


Figure 2. The use of germplasm resources of tomato

The breeding process emphasised the use of genotypes with distinct phenotypic expression. Among them stood out particular accessions as: A 524, A 203, A 532, A 208, A 609 (Figure 3).

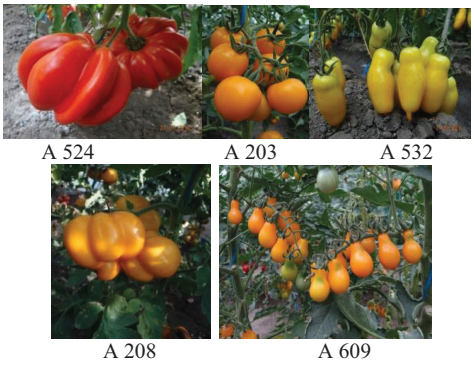


Figure 3. Genotypes with distinct phenotypic expression

Besides the main goals of breeding: productivity, earliness, crop quality, was followed the obtaining of cultivars with genetic resistance to species pathogens (Figure 4).

Figure 4. Wild tomato containing valuable gene for breeding process

In breeding process were used genitors with the nematode resistance *mi* gene and genitors with vigourous and healthy root system selected and recommended as valuable parent stocks (Figure 5).

Figure 5. Wild tomato, recommended as parent stocks

RESULTS AND DISCUSSIONS

The genetic stable genotypes were tested in the process of general and specific combining ability.

For general and specific combining ability test were used as tester genitors the following accessions: SP+, A 19, A 24 x13, A 165, A 23 and self-pruning accessions A 10, A 22, A 46, A 50, A 66 and A 67.

Results obtained from general combining ability test of the 326 genetic stable genotypes with indeterminate growth (+ SP), a total of 182 have passed the general combining ability.

Of the 91 genetic stable genotypes with semi-determinate growth (SP), a total of 38 have passed the general combining ability.

Of the 112 genetic stable genotypes determinate (sp), a total of 57 have passed the general combining ability.

Results obtained from specific combining ability test of the 66,248 possible hybrid combinations for SP+ genotypes, for testing specific combining ability, there were made a total of 642 hybrid combinations.

Of the 2,888 possible hybrid combinations for SP genotypes, in order to achieve specific combining ability, it has been made a number of 86 hybrid combinations.

Of the 6,498 possible combinations hybrid for sp genotypes to achieve specific combination, it was performed a total of 184 hybrid combinations.

Valuable hybrid combinations obtained by testing specific and general combining ability (Figure 6).

30 hybrid combinations showed visible reproductive, somatic, metabolic, adaptive heterosis phenomenon.

To prove the stability and uniformity of the parents and the compatibility between them and the uniformity of the hybridization results, hybridization process was repeated for six years so far.

As hybrid control variant in the experiments was used 'Siriana' F1 hybrid (Figure 7).

Valuable lines that demonstrated lineage genetic stability and correspond to breeding objectives were approved and patented and registered in the Official Catalogue of Crop Plants of Romania under the following names: 'Ema de Buzău', 'Chihlimbar', 'Kristinica', 'Darsirius', 'Florina', 'Măriuca'.

H. F1	Yield/PL. (KG)	H. F1	Yield/PL. (KG)	H. F1	Yield/PL. (KG)
H1BZ	4,200	H9S	4,200	H20	6,750
H1SA	3,000	H10S	3,795	H21	4,100
H1SB	3,300	H11S	5,270	H22	4,350
H2S	4,500	H12S	5,340	H23	6,700
H3S	4,560	H13SA	6,150	H24	4,150
H4S	4,396	H13SB	6,100	H25	4,350
H5S	5,800	H14SA	6,100	H26	6,850
H6S	3,000	H14SB	6,200	H27	3,850
H7S	4,752	H15SA	6,600	H28	4,600
H8S	3,654	H15SB	6,500	H29	3,950
				H30	4,194

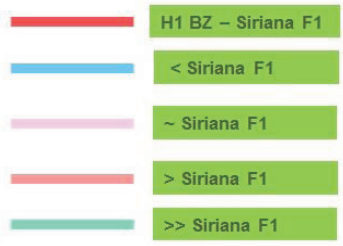


Figure 6. Hybrid combinations that expressed heterosis phenomenon

Figure 7. Hybrids (H15, H14, H11 and H12)

In addition, there were a total of three lines pending approval with the following proposed names: L 2000 ('Bizon'), L 80 ('Estera') and L 28 ('Hera').

Varieties suitable for industrialization were biochemically analyzed, placing particular emphasis on the dry matter content, acidity, sugar content of the fruits etc.

Tomato varieties suitable for fresh market

'EMA DE BUZĂU', indeterminate variety, suitable for both greenhouse and field. The plant can reach a height of 2.5-3 m in greenhouse and 1.8-2.2 m in field.
It has an high yield/ plant, 3 kg in greenhouse and 2-2.5 kg as field crop.
It presents a high number of fruits per plant of over 280 red colored and tiny, 6-10 g/fruit with medium consistency.
Strong character of this variety is given by the unique taste and flavor.

'CHIHLIMBAR', determinate variety, suitable as crop field. The cultivar presents a vigorous plant, with an average height of 85 cm, big fruits, orange colored. The fruit weights 225 g, yield/plant-2.5 kg and the fruits can be harvested without peduncle.

Tomato varieties suitable for industrialization

'KRISTINICA', determinate variety, with an average height of 60 cm, small vigour and reduced foliage. The variety presents an average number of 6 fruits/ truss. Before reaching maturity the fruit has green shoulders (*U* gene).
The fruit is round shaped and weights 120 g. the fruits are consistent and red colored.
Yield/plant-2.5 kg and 50 – 60 t/ha.

'DARSIRIUS', determinate variety, semiearly, suitable for field and industrialization, the plants height is between 50-60 cm with 4-6 vigorous shoots. The fruits are ovoid shaped with an average weight above 80 g. Can be easily harvested without peduncle.

'FLORINA', determinate variety, suitable as field crop. The fruits has an average weight of 160 g, round shaped, slightly ribbed, suitable both for fresh market and processing. Yield/plant- over 2.5 kg.
'MĂRIUCA', determinate variety, suitable as field crop and processing with big ovoidal fruits.

The industry varieties were biochemical analysed and it was found that in the case of dry matter content, due to the pericarp density, 'Darsirius' variety ranked the first place with 5.8%; dry soluble matter remains at the rate of 5% as in the case of the variety 'Kristinica' In the case of varieties of 'Florina' T, R and r. Daria ('Măriuca') an equal value of 4.5% was recorded. Also, 'Kristinica' has registered a value of 0.43% acidity, at the opposite side being 'Darsirius' with 0.35%. The highest content in sugar was recorded by 'Darsirius' while Daria ('Măriuca') has registered a rate of 2.44 percent (Figure 8).
Regarding the sugar: acidity ratio, 'Darsirius' was first valued with 8.97%, followed by 'Florina' R with 16%. The highest content in ascorbic acid was measured at 'Florina' T followed by 11.97% at 'Darsirius' with 9.58%. The highest content of lycopene 9.08% was recorded by 'Florina' R (Table 1).

Tomato varieties pending approval

Accession 80 ('**Estera'**), indeterminate variety, suitable for both fresh market and industrialization, ovoid fruits which weight 16-20 g with a reduced number of seeds, less than 20 seeds/fruit.

Accession 2000 ('**Bizon'**), indeterminate variety, suitable as crop field trained to a trellis. The genitors originate from a heirloom tomato called "Ox heart". It presents very large fruits ranging from 300-950 g, heart-shaped, with green cap which disappears when reaching physiological maturity.

Accession 28 ('**Hera'**), indeterminate variety with red fruits long pepper shaped. The water excess causes fruit cracks on the shoulders.
The variety has a high yield/ plant, suitable for fresh market (Figure 9)

Table 1. The biochemical analysis of tomato fruits for industrialization

Parameter	Variety					
	'Măriuca'	'Kristinica'	'Florina' T	'Florina' R	'Darsirius'	Average values*
d.m. %	5.18	5.26	5.35	5.30	5.8	5.98±0.83 (cv=14%)
s.s. %	4.5	5.00	4.5	4.50	5.00	4.75±0.35 (cv=7%)
Acidity (as Citric acid),%	0.41	0.43	0.39	0.37	0.35	0.38±0.03 (cv=8%)
Sugar,%	2.44	2.97	2.88	3.02	3.14	3.37±0.77 (cv=21%)
Sugar acidity level	5.95	6.91	7.38	8.16	8.97	10.76±0.09 (cv=1%)
Ascorbic acid, mg/100 g^{-1}	8	7.02	11.97	8.30	9.58	9.67±0.65 (cv=7%)
Lycopene, mg/100 g^{-1}	6.5	5.00	8.18	9.08	6.00	8.00±1.5 (cv=19%)
Average weight, g± a.s.	93.5±22.1 (cv=24%)	108.9±13.5 (cv=12%)	139.9±29.1 (cv=21%)	167.9±26.0 (cv=15%)	86.9±13.3 (cv=15%)	92±10 (cv=11%)

** Viorica and Vipon varieties (ICDLF Vidra); d.m.-dry matter content; s.s.-soluble solids; Gr.-weight*

Figure 8. The biochemical analysis of tomato fruits for industrialization

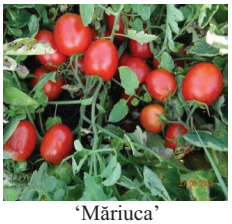

'Ema de Buzău'


'Estera'


'Kristinica'


'Darsirius'


'Florina'


'Măriuca'


'Chihlimbar'


'Bizon'

Figure 9. Tomato varieties

CONCLUSIONS

The researches have been completed so far with making a valuable germplasm collection consisting of 1524 genotypes;
Evaluation and division of germplasm collection on collection fields and work fields;
Genetic stable genotypes were evaluated in terms of general and specific combining ability;
It was obtained a total of 30 valuable hybrid combinations which expressed visible heterosis phenomenon;
It was patented a hybrid and six varieties and three varieties are undergoing approval.

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