Description of Valuable Genotypes from Germplasm Collection of Hot Peppers Set by Directions of Use

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Abstract

The Genetic, Breeding and Biodiversity Laboratory from Vegetable Research and Development Station Buzau (VRDS Buzău) has a valuable germplasm collection of hot pepper consisting of 200 genotypes structured by their genetic stability. In this study, seven genotypes were characterized from an agro-morphological point of view. The aim of this study was to choose the most valuable genotypes for directions of use as: fresh consumption, chili powder or for pharmaceutical use. The agro-morphological results will be used in the breeding program to obtain new genotypes adapted to the pedoclimatic conditions of Romania.

Keywords: breeding, *Capsicum* spp., chilli

Introduction

Hot pepper (*Capsicum* spp.) is thought to be the most popular spice in the World. Over 20% of the world's population are using hot pepper in different forms. It is used for culinary purposes but it can also be eaten fresh or used as spice or food colorant. *Capsicum* species are also used in medicine and cosmetics. Due to the high content of bioactive compounds (e.g. ascorbic acid, flavonoids, phenols and carotenoids) and essential nutrients, hot peppers have antioxidant, antiviral, antimicrobial, anti-inflammatory and anticancer properties (Quresh *et al.,* 2015, Ribes-Moya *et al*., 2018). In addition, chili peppers are an excellent source of vitamin A, B, C, E and P. Fresh red chili peppers contain more vitamin A than carrots and fresh green chili peppers contain more vitamin C than orange or kiwifruits (Quresh *et al.,* 2015). The aim of this study was to choose the most valuable genotypes for directions of use as: fresh consumption, chili powder or for pharmaceutical use.

Materials and methods

VRDS Buzau has a valuable germplasm collection of hot peppers consisting of 200 genotypes, structured in 3 groups according to their genetic stability: 57 stable genotypes, 93 advanced genotypes and 50 segregant genotypes. Out of this, 7 stable genotypes named A10A, A12B, A13B, A16E1, A37A, A100 and A135 were studied and characterized from an agro-morphological point of view in order to choose the most valuable genotypes for directions of use. The breeding

Table 1. Qualitative characters of chilli peppers targeted in this study

Descriptors	Polymorphism
Calyx margin (CM)	1.entire; 2. intermediate; 3. dentate; 4.other.
Calyx annular constriction (CC)	0. absent; 1. present.
Fruit: colour before maturity (FCBM)	1. white; 2. yellow; 3. green; 4. orange; 5. purple; 6. dark purple; 7. other.
Fruit: colour at maturity (FCAM)	1. white; 2. lemon yellow; 3. pale orange-yellow;4. yellow orange; 5. pale orange; 6. orange; 7.light red; 8.red; 9. dark red; 10. Purple; 11. Brown; 12. Black; 13. other.
Fruit shape (FS)	1 elongate; 2 almost round; 3 triangular; 4 campanulate; 5 blocky; 6 other.
Fruit: shape at pedicel attachment (FSP)	1. sharp; 2. obtuse; 3. truncated; 4. cordate; 5. lobed.
Fruit: neck at base (FNB)	0. absent; 1. present.
Fruit: shape of blossom end (FSB)	1. sharp; 2. bont; 3. deep; 4. deep and sharp; 5. other.
Fruit: blossom end appendage (FA)	0. absent; 1. present.
Fruit: shape in cross section (FSCS)	3. eliptic; 5. angular; 7. circular.
Fruit: number of locules (FNL)	
Fruit: texture of surface (FTS)	1.smooth or very slightly wrinkled; 2.slightly wrinkled; 3.strongly wrinkled.
Placenta: length (PL)	1. <1/4 fruit; 2. ¼-1/2 fruit; 3. >1/2 fruit.

method used was repeated individual selection. The crop technology applied was the one specific for chili peppers (Barcanu-Tudor *et al.,* 2019). During the vegetation period, quantitative and qualitative observations were made using IPGRI descriptors. The quantitative traits as plant height (PH), plant diameter (PDM), leaf length (LL), leaf width (LW), petiole length (PL), number of fruits per plants (NF), yield of fruits per plant (Y), fruit length (FL), fruit width (FW), fruit weight (W), weight of fruit pulp (WP), weight of fruit receptacle (WR), pedicel length (PDL), pedicel diameter (PD), pericarp thickness (PT)) were subjected to analysis of variance followed by Duncan's multiple range test. The qualitative traits targeted in this study are presented in Table 1. Similar studies were made by Ortiza *et al.* (2010), Rêgo *et al*. (2012) and Rahman *et al*. (2017). For the fully ripen fruits, the dry matter content was determined by drying the fresh material in the stove for 15 hours at 105°C until the samples reached a constant weight.

Results and discussions

To establish the variability among the studied germplasm, thirteen qualitative traits were recorded and evaluated. In Table 2 the qualitative traits and their descriptors values are presented.

During the agro-morphological assessment, six characters showed distinct variation among the investigated accessions (FCBM, FCAM. FS, FSP, FSCS, FNL) and a number of seven characters (CM, CC, FNB, FSB, FA, FTS, PL) showed slight variation among the accessions. Phenotypic plasticity were observed in fruit shape, fruit colour at harvest maturity and fruit colour at physiological maturity, so accessions A10A, A12B, A13B and A100 had green fruits at harvest maturity, A135 had yellow and A37A had black fruits. At physiological maturity 42% of the studied accessions presented dark red fruits, 28 % had red fruits, 15% had yellow orange fruits and 15% developed pale orange-yellow fruits. The number of locules of fruits varied from 2 (A16E1 and A135) to 5 (A10A). Fruit shape (Fig. 1) was campanulate for 57% of genotypes (A10A, A12A, A13B and A135) truncated for 15% of genotypes (A37A) and 28% of genotypes presented elongated fruit shape (A16E1 and A100).

Analysis of variance showed significant differences (p<0.01) between populations for all variables tested (Tab. 3). The highest yield per plant was recorded in A10A, followed by A135 and the lowest value was registered in A37. The fruits of A135 showed the thickest pericarp (5.34 mm),

Table 2. Quantitative traits of the studied genotypes

Accession	CM	CC	FCBM	FCAM	FS	FSP	FNB	FSB	FA	FSCS	FNL	FTS	PL
A10A	3	0	3	9	4	4	0	4	0	5	5	3	3
A012B	2	1	3	4	4	0	0	4	0	3	3	3	3
A13B	2	1	3	8	4	0	0	4	0	7	4	3	3
A16E1	2	1	3	8	1	3	0	1	1	3	2	1	3
A37A	2	1	6	9	3	3	0	4	0	7	3	1	2
A100	2	1	3	9	1	2	0	4	0	7	4	3	3
A135	2	0	2	3	4	2	0	4	0	7	2	3	2

Note: The abbreviations are explained in Table 1.

Figure 1. Fruit shape of the genotypes: campanulate (A10A, A135) and truncated (A37A)

Table 3. Quantitative traits of the studied genotypes

Accession	A10A	A12B	A13B	A16E1	A37A	A100	A135
PH (cm)	200.05±2.05^{e}	124.85±2.35^{d}	81.50±5.50^{a}	113.85±1.55^{c}	96.35±1.05^{b}	85.30±1.10^{a}	89.75±4.25^{ab}
PDM (cm)	116.75±1.75^{e}	127.55±1.75^{f}	90.50±4.50^{d}	74.40±1.02^{c}	64.50±1.10^{b}	54.90±0.80^{a}	84.95±0.75^{d}
LL (cm)	19.10±2.60^{d}	15.85±0.65^{cd}	18.05±0.45^{d}	12.35±0.15b^{c}	16.30±1.20^{d}	10.215±0.06^{b}	4.60±0.40^{a}
LW (cm)	6.00±0.90^{bcd}	5.50±0.20^{bc}	9.60±0.01^{e}	2.86±0.12^{a}	6.20±0.3^{cd}	4.77±0.21^{b}	7.15±0.15^{d}
PL (cm)	6.30±0.80^{cd}	2.65±0.25^{a}	4.75±0.55^{b}	7.35±0.09^{d}	3.60±0.4^{ab}	4.60±0.05^{b}	4.95±0.25^{bc}
NF	34.50±2.50^{d}	24.00±4.00^{c}	23.50±1.50^{c}	9.00±1.00^{a}	17.00±2.00b^{c}	13.00±1.00^{ab}	47.50±2.50^{e}
Y g/plant	735.26±65.05^{e}	259.92±36.48^{ab}	571.06±5.44^{d}	402.06±36.14^{c}	218.75±25.40^{a}	315.65±24.41^{b}	655.42±15.07^{e}
FL (cm)	3.25±0.09^{a}	5.27±0.35^{bc}	4.82±0.07^{b}	12.27±0.06^{f}	5.32±0.03^{c}	9.79±0.06^{e}	5.89±0.01^{d}
FW (cm)	5.99±0.39^{d}	2.99±0.34^{ab}	5.08±0.06^{c}	2.98±0.01^{ab}	2.68±0.01^{ab}	2.55±0.01^{a}	3.35±0.17^{b}
W(g)	20.10±0.95^{b}	11.40±3.42^{a}	24.38±1.32^{b}	44.78±0.96^{c}	12.87±0.02^{a}	24.28±0.01^{b}	13.82±0.41^{a}
WP (g)	17.92±1.12^{cd}	9.23±2.69^{a}	21.46±0.81^{d}	34.49±1.04^{e}	10.05±0.02^{a}	14.38±0.02^{bc}	12.04±0.54^{ab}
WR (g)	2.18±0.16^{ab}	2.16±0.72^{ab}	3.51±0.08^{c}	10.28±0.08^{d}	2.81±0.04^{bc}	9.90±0.01^{d}	1.78±0.13^{a}
PDL (cm)	5.71±0.36^{c}	3.68±0.56^{b}	4.13±0.12^{b}	3.67±0.02^{b}	3.89±0.02^{b}	2.64±0.01^{a}	4.37±0.07^{b}
PD (cm)	0.27±0.02^{ab}	0.31±0.07^{ab}	0.34±0.05^{ab}	0.23±0.01^{a}	0.37±0.05^{b}	0.73±0.01^{c}	0.32±0.02^{ab}
PT (mm)	4.47±0.03^{f}	1.94±0.02^{a}	2.23±0.04^{b}	3.71±0.01^{e}	2.72±0.01^{c}	3.06±0.01^{d}	5.34±0.01^{g}

Note: Values are mean ± SD. Means within the same row carrying different superscript letter were significantly different at $p < 0.01$ according to a Duncan`s multiple range test; PH-plant height, PDM-plant diameter, LL-leaf length, LW-leaf width, PL-petiole length NF-number of fruits per plants, Y- yield of fruits per plant, FL-fruit length, FW-fruit width, W-fruit weight, WP-weight of fruit pulp, WR-weight of fruit receptacle, PDL-pedicel length, PD-pedicel diameter, PT-pericarp thickness.

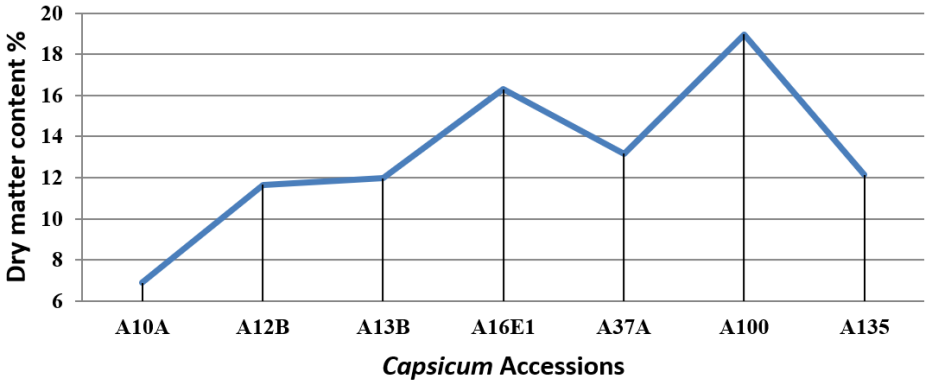

Figure 2. Dry matter content (%) of the investigated *Capsicum* accessions

followed by A10A (4.47 mm), and the thinnest pericarp recorded in A12 (1.94 mm). Fruit weight varied between 11.40 g to 44.78 g, the highest value was observed in A16E1 and lowest in A12B. Regarding plant height, accessions A10A exhibited the maximum value, 200.05 cm, this being one of the highest accessions from germplasm collection. Plant diameter ranged from 54.90 cm (A100) to 116.75 cm (A10A).

According to Ribes-Moya *et al*. (2018), dry matter content is an important trait for breeding hot pepper for the food industry because the fruits that have a high dry matter content can be used to obtain the chili powder. Lannes *et al.* (2007), in one of their reports claims that chili fruits with thin pericarp are suitable for powder making, while fruits with thick pericarp are more suitable for processing peppers into paste. In this study, accession A100 (Fig. 2) reached the maximum value for the dry matter content (18.97%), followed by A16E1 (16.30%). Due to the high dry matter content and large fruits with thicker pericarps, A100 and A16E1 can be recommended to be used for chili powder.

Accessions A37A, A135 and A10A had fruits with different phenotypic traits and special aroma, also they recorded a high productivity, so they can be recommended to be used for fresh consumption. Accessions A12B and A13B belong to the *Capsicum chinense*, with a high content of capsaicin (Lagunovschi-Luchian *et al*., 2016) and thus they could be used for both medical and cosmetic purposes.

Conclusions

The germplasm collection was evaluated by agro-morphological traits and the following accessions were chosen for fresh consumption: A37A, A135 and A10A; accessions A12B and A13B can be used for both medicinal and cosmetic purposes, while accessions A100 and A16E1 can be recommended for chili powder.

In conclusion, VRDS Buzau has a large variety of genotypes in chilli peppers and the research will continue by enriching the germplasm collection in order to add new genotypes for different directions of use. Accession A37A will be forwarded to ISTIS Bucharest for approval and patenting due to his phenotypic traits.

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