New Hybrid Creations Of Aubergines Achieved At PGRB Buzau, Romania

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Abstract

The Plant Genetic Resource Bank has a valuable collection of over 240 genotypes for this species. The current market requirements found that Romania is deficient in terms of hybrid breeding of this species. As growers increasingly prefer F1 hybrids, they are forced to purchase unknown hybrid creations, many of which are not adapted to Romanian soil and climatic conditions. The research started with the evaluation of the germplasm database, with particular emphasis on old varieties and landraces. The evaluation identified 62 genotypes with distinct phenotypic expressiveness and genetically stable.

These gene lines were subjected to intensive breeding work, testing the general combining capacity, using the landraces Danubiana and Bucurestene as test genitors. Of these, 28 genotypes passed the general combining capacity test and were subjected to specific combining tests. Three of these combinations showed superiority in terms of heterosis, with valuable results in relation to uniformity in F1, production capacity, and resistance to the attack of the main pathogens: H2F1BRGV21 (Danubiana x L50), H13F1BRGV21 (Bucurestene x L28), H20F1BRGV21 (Pana corbului x L54). The Rebeca hybrid was used as a control variant.

In terms of fruit weight, H13F1BRGV21 with a fruit weight of 590 gr. was in the first place, H20F1BRGV21 with a fruit weight of 572 gr. was in second place and H2F1BRGV21 showed a fruit of 380 gr., lower than the control variant Rebeca F1 which showed a fruit of 550 gr. was in third place. In regard to total production, H13F1BRGV21 and H20F1BRGV21 outperformed the control and H2F1BRGV21 recorded a smaller but earlier production.

The evaluation of the germplasm collection was carried out in the greenhouse on an area of 600 m2. The cultivation technology used was the specific one, in strips, i.e. 70 cm between rows and 140 cm between strips, with a distance of 40 cm between plants per row.

During the research carried out in PGRB Buzau, seeds were offered to interested growers and the received feedback was favorable.

From 2022, these creations will be proposed to ISTIS Romania for certification and registration and will be expanded on a large scale in production.

Keywords: breeding, genotypes, hybridization, Solanum melongena

INTRODUCTION

The role of agriculture is an extremely important one for today's society, providing the necessary food production for the population, and representing in a source of raw materials for different industries (Radu L., 2018). From the point of view of the total surface cultivated with vegetables and fruit trees, Romania is situated on the sixth place in E.U. after France, Spain, Poland, Italy, and Germany. The surface occupied by vegetables represents 3,4 % of the total cultivated Surface (Apostu I., 2012). Vegetables are vital to the general good health of human beings, providing essential vitamins and minerals, dietary fiber, and phytochemicals, and reducing the risk from dangerous diseases and other medical conditions. Vegetables are grown worldwide in almost 200 countries (Silva Dias J., 2011). The eggplant is one of the most important solanaceous crops and is widely cultivated across the world for its fruits, mainly used as a vegetable (Rotino et all., 2014). Aubergine cultivation is widespread all over the world, especially in tropical and temperate climate regions, as well as tomatoes, potatoes, and peppers being one of the crops with significant economic importance. Therefore, the species has a considerable genetic diversity, including cultivated and wild varieties. In Europe, the eggplant is cultivated mainly in Turkey (827,000 t), Italy (220,000 t), Spain (206,000 t), and Romania (123,000 t/year) (Caruso et. all., 2017). Eggplant (Solanum melongena L.) is not only a kind of tasty food but also with underlying medicinal use (Konczak et al., 2004). Eggplant fruits (*Solanum melongena* L.) are widely consumed around the world due to their generous composition of nutraceuticals (Gürbüz, N et. all., 2018). Regarding nutritional value, eggplant has a very low caloric value and is considered among the healthiest vegetables for its high content of vitamins, minerals, and bioactive compounds for human health (Raigón, M. D. et. all., 2008). The main component of aubergines that recommends it and differentiates it from other vegetables, is the high content of phenolic compounds, especially chlorogenic acid (CGA) which has special properties for the human diet, being an excellent anti-oxidant, anti-inflammatory, cardioprotective, anti-carcinogenic, anti-obesity and anti-diabetic. CGA is, by far, the major phenolic compound of the eggplant fruit, and typically makes between 80% and 95% of the total hydroxycinnamic acids present in the fruit flesh (Prohens et al., 2013; Stommel and Whitaker, 2003; Whitaker and Stommel, 2003).
Annually, the demand for vegetable consumption is increasing. In contradiction to this, the production of vegetables is facing more and more challenges, mainly caused by climate change which is affecting the consecrated parameters of vegetable production through the alarming alternation of seasons, the increasing occurrence of drought, flooding, the intensification of solar radiation which has caused a lot of damage due to sunburn. At the same time, the attack of various pathogens has intensified, which has been tried to be controlled by the excessive use of phytosanitary substances, thus depreciating the soil, resulting in increasingly poor quality production, and even in some cases representing a potential danger for human consumption.

Aubergine is a crop that develops over a long period, therefore it can be susceptible to attack by various pathogens and can be depreciated if during its development the water supply is deficient,

being one of the species with high requirements for this parameter. To overcome these factors that can compromise the crop, growers have opted to use hybrids instead of eggplant varieties. These are more resistant to disease and pest invasion as well as have a higher production capacity.

In general, eggplant breeding programs aim to develop high-yielding varieties, mostly F1 hybrids, with high fruit quality, shelf-life, and resistance to major disease and insect pests, and with broad adaptation to environmental stress (Daunay and Hazra, 2012).

The Plant Genetic Resource Bank has a valuable collection of over 240 genotypes for this species. The current market requirements found that Romania is deficient in terms of hybrid breedings of this species. As growers increasingly prefer F1 hybrids, they are forced to purchase unknown hybrid creations, many of which are not adapted to Romanian soil and climatic conditions.

MATERIALS AND METHODS

The research started with the evaluation of the germplasm database, with particular emphasis on old varieties and landraces. The evaluation identified 62 genotypes with distinct phenotypic expressiveness and genetically stable (Figure 1).

Figure 1. PGRB aubergine collection database

The evaluation of the germplasm collection was carried out in the greenhouse on an area of 600 m^2. The cultivation technology used was the specific one, i.e. 70 cm between rows and 140 cm between strips, with a distance of 40 cm between plants per row (Figure 2).

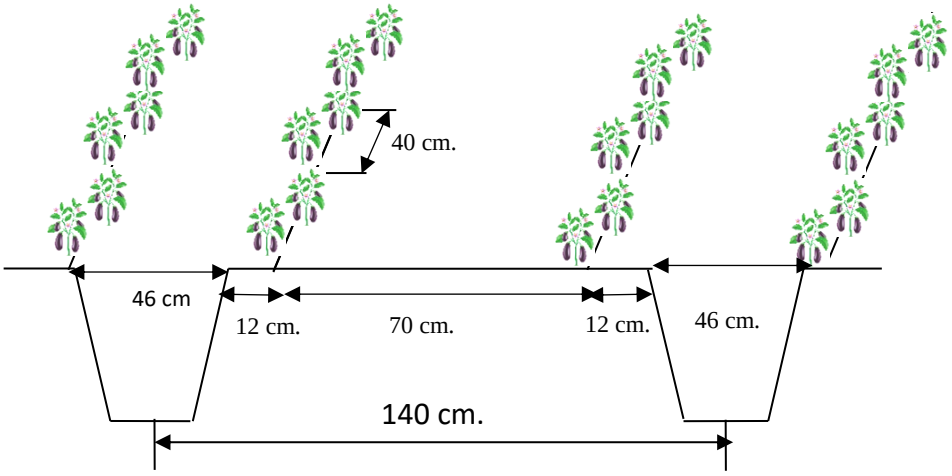

Figure 2. Planting design for aubergine cultivation

These gene lines were subjected to intensive breeding work, testing the general combining capacity, using the landraces Danubiana and Bucurestene as test genitors.
During the growing season, phenological observations and biometric determinations were carried out for each hybrid under study using observation sheets conforming to the descriptors recommended by UPOV and IGPRI. Depending on the variety, fruit measurements were taken at approximately 60-80 days from planting, meaning July-August.
Statistical calculations were performed using SPSS software.

RESULTS AND DISCUSSIONS

These genetic accessions were subjected to intensive breeding work, testing the general combining ability, using the traditional Romanian landraces Danubiana and Bucurestene as test parents, resulting in 124 hybrid combinations.
From the chosen genotypes, 28 of these passed the general combining capacity test and were subjected to specific combining tests, obtaining many hybrid combinations, of which 3 were particularly valuable.
During the growing season, phenological observations and biometric determinations were carried out for each hybrid studied, using observational worksheets by the descriptors recommended by UPOV and IGPRI.
Statistical calculations were carried out using SPSS software.
Characterization of the genotypes in the germplasm collection was performed using the UPOV and IGPRI descriptors (Table 1).

Table 1. Genitors plant and fruit characterization

Genotype	Fruit length(cm)	Fruit weight (g)	Median diameter (cm)	Plant height (cm)	Plant breadth (cm)
1BG2021	21± 2 ghij	359 ±15,39 ab	5,68 ± 0,05 tuvwxy	52 ± 2,61 lmno	37 ± 3,41 stuvwx
2BG2021	17,5± 1,61 klm	844± 4,00 d	11,02 ± 0,57 cd	58 ± 3,85 hijk	45 ± 3,29 klmnopwr
3BG2021	10,08± 1,16 wxy	350± 3,29 ac	8,89 ± 0,64 fg	49 ± 3,63 nopqr	41 ± 3,40 pqrstuv
4BG2021	19± 1,41 jkl	548 ± 3,22 p	8,66 ± 0,46 fgh	45 ± 2,61qrstu	43 ± 2,83 nopqrst
5BG2021	21± 1,41 ghij	506 ± 4,26 s	7,03 ± 0,22 lmnop	43 ± 1,63 stuvw	33 ± 4,24wx
6BG2021	2,41± 0,89 aa	36 ± 4,43 an	4,6 ± 0,50 zaaabac	51 ± 3,41mnop	45 ± 4,29 lmnopqr
7BG2021	20,5± 1,61 ghij	507±5,29 s	7,46 ± 0,40 jklmn	42 ± 4,43 tuvw	36 ± 4,00 tuvwx
8BG2021	14,8± 1,75 pqr	213 ± 2,83 ak	5,11 ± 0,25 wxyzaa	46 ± 4,60pqrstu	42 ± 3,03 pqrstuv
9BG2021	19,2± 1,65 jk	362 ± 3,63 ab	5,91 ± 0,60 rstuvwx	39 ± 5,31vw	36 ± 2,87 x
10BG2021	12,7± 1,18 rstu	654 ± 4,24 k	11,33 ± 0,51 cd	67 ± 4,24def	41 ± 4,20 wx
11BG2021	6,88± 1,89 z	144 ± 3,41am	6,03 ± 0,28 qrstuv	41 ± 2,83uvw	31 ± 3,45 mnopqr
12BG2021	3,99± 1,43 aa	28 ± 2,00 ao	3,24 ± 0,24 ad	46 ± 3,03pqrstu	33 ± 4,43 rstuvw
13BG2021	15,11± 1,58 opq	233 ± 2,45 aj	4,64 ± 0,51zaaabac	69 ± 2,45de	45 ± 4,82 stuvwx
14BG2021	13,88± 1,96 qrst	698 ± 4,43 h	11,29 ± 0,60cd	50 ± 3,49mnopq	39 ± 2,86 pqrstuv
15BG2021	19,5± 1,48 ijk	411 ±4,00 y	6,49 ± 0,34opqrst	38 ± 3,41w	37 ± 3,69 fghij
16BG2021	20,3± 1,38 ghij	331 ±3,03 ad	5,26 ± 0,26 vwxyz	44 ± 3,03rstuv	41 ± 3,44 rstuvwx
17BG2021	20,8± 0,99 ghij	398 ± 3,95 z	5,25 ± 0,26 vwxyz	75 ± 3,13bc	53 ± 4,84 wx

18BG2021	19,4± ,142 jk	422 ± 6,36 x	6,57 ± 0,36 opqrs	43 ± 3,24stuvw	39 ± 5,40 wx
19BG2021	24,5± 1,49 de	687 ±3,03 i	7 ± 1,41lmnop	47 ± 3,09opqrst	33 ± 3,48 vwx
20BG2021	19,6± 1,64 ijk	399 ± 5,02 z	6,21 ± 0,76 pqrst	49 ± 3,41nopqr	33 ± 2,86 bc
21BG2021	17,1± 1,20 lmno	494 ± 5,02 t	5,06 ± 0,73 xyzaa	46 ± 2,61pqrstu	34 ± 4,49 b
22BG2021	9,48± 1,46 xy	301 ± 3,03 aeaf	7,67 ± 0,58 ijkl	53 ± 3,41klmn	64 ± 4,24 stuvwx
23BG2021	12,76± 0,94 rstu	725 ± 3,35 f	9,7 ± 0,67 e	55 ± 3,63jklm	67 ± 3,85 ghijk
24BG2021	19,4± 1,19 jk	243 ±3,85 ai	4,2 ± 0,69 abac	62 ± 3,03fghi	37 ± 4,34 pqrstuv
25BG2021	8,21± 1,40 yz	163 ± 3,63 al	5,29 ± 0,39 abac	50 ± 4,00mnopq	52 ± 3,69 rstuvw
26BG2021	27,2± 1,08 bc	305 ± 4,10 ae	4,1 ± 0,58 ac	55 ± 3,63jklm	41 ± 4,53 ijklmno
27BG2021	15,6± 1,59 mnopq	292 ± 3,63 ag	5,35 ± 0,23 uvwxyz	51 ± 3,51mnop	39 ± 4,63 ijklmno
28BG2021	19,7± 1,62 hij	558 ± 6,96 o	8,18 ± 0,64 ghij	57 ± 3,03ijkl	49 ± 3,09ghijkl
29BG2021	14,66± 1,22 pqrs	328 ± 4,43 ad	6,36 ± 0,18 pqrst	55 ± 2,63jklm	49 ± 3,51 nopqrst
30BG2021	12,84± 0,75rstu	621 ± 3,85 l	11,64 ± 0,55 c	60 ± 4,00 ghij	52 ± 3,46 bcde
31BG2021	19,9± 2,05 hij	614 ± 7,46 l	7,87 ± 0,78 hijk	61 ± 2,04 ghij	43 ± 4,24 defgh
32BG2021	16,3± 1,01mnop	481 ± 5,66 u	6,86 ± 0,61 lmnopq	65 ± 3,22 efg	61 ± 4,45 opqrstu
33BG2021	12,1± 1,24 tuv	564 ± 3,41 o	9,74 ± 0,57 e	69 ± 3,41 de	56 ± 4,69 opqrstu
34BG2021	15,4± 1,17 mnopq	473 ± 3,03 v	8,47 ± 0,15 fghi	71 ± 2,61cd	42 ± 5,40 opqrstu
35BG2021	20,4± 1,68 ghij	962 ± 5,40 c	10,56 ± 0,26 d	48 ± 3,42 nopqrs	36 ± 5,02 opqrstu
36BG2021	32,3± 1,14 a	349 ± 6,81 ac	4,16 ± 0,26 ac	52 ± 3,43lmnopq	45 ± 5,40 opqrstu
37BG2021	21,9± 1,37 fgh	211 ± 5,22 ak	4,41 ± 0,21aaabac	50 ± 2,83ghij	44 ± 4,47opqrstu
38BG2021	17,5± 1,47 klmn	422 ± 5,25 x	6,79 ± 0,33 mnopq	60 ± 3,47 ghij	39 ± 5,02 opqrstu
39BG2021	26,6± 0,77 c	272 ± 5,62 ah	4,22 ± 0,19 abac	75 ± 4,00 bc	55 ± 5,25 opqrstu
40BG2021	27,6± 1,27 bc	410 ± 6,00 y	5 ± 1,25 yzaaab	62 ± 2,61fghi	58 ± 4,43 opqrstu
41BG2021	20,4± 0,60 ghij	458 ± 6,00 w	6,37 ± 0,41 pqrst	72 ± 2,51cd	66 ± 4,82 opqrstu
42BG2021	11,66± 1,27 uvw	678 ± 5,62 j	15,4 ± 1,00 a	69 ± 2,67de	62 ± 4,44 opqrstu
43BG2021	10,33± 0,75 vwx	296 ± 4,24 afag	8,14 ± 0,54 ghij	67 ± 3,03def	58 ± 4,00 opqrstu
44BG2021	13,01± 1,19 rstu	674 ± 4,34 j	11,19 ± 0,57 cd	49 ± 4,82 nopqr	37 ± 3,53 opqrstu
45BG2021	20,4± 1 ghij	615 ± 4,43 l	6,03 ± 0,32 qrstuv	55 ± 3,63 jklm	51 ± 3,61 opqrstu
46BG2021	15,31± 1,53 nopq	308 ± 4,82 ae	5,81 ± 0,30 stuvwxy	59 ± 3,45hij	50 ± 3,85 opqrstu
47BG2021	21,7± 0,65 fghi	373 ± 5,10 aa	5,94 ± 0,34 rstuvw	65 ±2,00 efg	58 ± 4,30 opqrstu
48BG2021	23,3± 0,94 ef	424 ± 5,40 x	5,28 ± 0,22 vwxyz	71 ± 2,66 cd	59 ± 4,46 opqrstu
49BG2021	15,6± 1,17 mnopq	532 ± 3,85q	7,57 ± 0,31 jklm	52 ± 3,22 lmno	48 ± 2,93 opqrstu
50BG2021	16,7± 1,25 mnop	605 ± 4,86 m	9,19 ± 0,53 ef	47 ± 3,85 opqrst	43 ± 3,85 opqrstu
51BG2021	12,56± 1,39 stu	810 ± 6,26 e	15,34 ± 0,37 a	46 ± 3,03 pqrstu	39 ± 4,05 opqrstu
52BG2021	20,5± 1,47 ghij	651 ± 4,47 k	4,3 ± 0,34aaabac	41 ±2,83 uvw	35 ± 4,63 opqrstu
53BG2021	19,3± 0,65jk	379 ± 4,90 aa	5,71 ± 0,21 tuvwxy	55 ± 2,61 jklm	49 ± 4,51 opqrstu
54BG2021	27,4± 0,58 bc	521 ± 3,85 r	5,3 ± 0,26 uvwxyz	63 ± 3,27 fgh	47 ± 5,22 opqrstu
55BG2021	23,6± 1,35 ef	418 ± 4,90 x	5,24 ± 0,28 vwxyz	59 ±4,24hij	50 ± 3,41 opqrstu
56BG2021	15,36± 1,02 mnopq	494 ± 5,02 t	7,25 ± 0,40 klmno	48 ±2,81 nopqrs	41 ± 4,35 opqrstu
57BG2021	21,2± 0,88 ghij	467 ± 5,83 v	6,69 ± 0,31 nopqr	45 ± 2,02qrstu	37 ± 4,82 opqrstu
58BG2021	25,8± 1,07 cd	502 ± 5,02 s	6,13 ± 0,14 qrstu	46 ± 3,41pqrstu	39 ± 4,82 opqrstu
59BG2021	24,6± 1, 09 de	593 ± 3,63 n	6,39 ±0,29 pqrst	47± 3,03 opqrst	40 ± 5,02 opqrstu
60BG2021	15,5± 1,47 mnopq	1053 ± 4,34b	13,13 ± 0,23 b	55 ± 4,00 jklm	44 ± 4,90 opqrstu

61BG2021	29,1± 1,43[b]	1308 ± 4,10[a]	10,6 ± 0,62[d]	82 ±3,02[a]	74 ± 5,62 [opqrstu]
62BG2021	22,4± 1fg	712 ± 3,63[g]	8,1 ± 0,34[ghij]	79 ±4,90 [ab]	67 ± 5,02 [opqrstu]

As there is great morphological diversity, the application of specific hybridization methods has been successful.

These genetic lines were subjected to intensive breeding activity, testing the overall combining ability, using Danubiana and Bucurestene varieties as test parents. Of these genotypes, 28 genotypes passed the general combining ability test and were subjected to specific combining tests resulting in 1568 hybrid combinations using simple hybridization.

Three of these combinations showed superiority in heterosis, with significant results in terms of uniformity in F1, yield capacity, and resistance to attack by the main pathogens: H2F1BRGV21 (Danubiana x L50), H13F1BRGV21 (Bucurestene x L28), H20F1BRGV21 (Pana corbului x L54). The hybrid Rebeca F1 was used as a control variant (Table 2).

Table 2. Production in 2021- mean values in eggplant hybrids and their parents (ton/hectar)

Control variant (Rebeca F1)	**P1♀ Danubiana**	**P2 ♂ G 50**	**P.A.**	**H2F1BRGV21**
92.4	53.76	58.8	56.28	63.84
Control variant (Rebeca F1)	**P1♀ Bucureştene**	**P2 ♂ G 28**	**P.A.**	**H13F1BRGV21**
92.4	93.24	95.76	94.36	99.12
Control variant (Rebeca F1)	**P1♀ Pana corbului**	**P2 ♂ G 54**	**P.A.**	**H20F1BRGV21**
92.4	89.04	94.08	91.56	96.04

* P.A.- Parents average

In regard to total production, H13F1BRGV21 and H20F1BRGV21 outperformed the control variant and H2F1BRGV21 recorded a smaller but earlier production. Thus, H2F1BRGV21 recorded a 30.91% lower production than the control variant, H13F1BRGV21 reported a 7.27% higher increase compared to the control variant, and H20F1BRGV21 reported a 3.94% increase compared to the control variant. All hybrids recorded significantly higher yields than their parents.

CONCLUSIONS

The research was completed with the establishment and enrichment of a valuable germplasm collection of this species. The evaluation of the germplasm collection in terms of genetic stability was carried out, and the general and specific combinability of accessions showing genetic stability was achieved.

A number of 3 new hybrids were developed which visibly show heterosis and have distinct phenotypic expressivity. A valuable electronic and literal database was created, which contributes to the development of subsequent creations.
The specific documentation for the registration and patenting of the 3 newly obtained creations has been prepared, which will be evaluated by ISTIS Romania starting with 2023.
Seeds and seedlings of the achieved creations were also offered to the interested farmers and growers, receiving positive feedback from them regarding the quality of the production.

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