GENETIC AND BREEDING VALUE OF TOMATO VARIETIES WITHOUT GENICULATE JOINT OF FLORAL PEDUNCLE

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Abstract. One of the main problems of modern vegetable farming is the creation of new economically efficient varieties with complex valuable characters adapted to different growing conditions. In tomato breeding, the genotypes that possess the j-2 and j-2^{in} (jointless-2) genes are particularly important, because the fruits of such plants are easier detached from the peduncle and are less deformed during harvesting and transportation. The presence of peduncles causes the decrease of fruit quota and reduction of product quality, conferring them a bitter taste. In order to reveal the variability of agronomical traits and specify the value of tomato genotypes without geniculate joint of floral peduncle, a comparative assessment was carried out based on a range of useful characters. The varieties were evaluated in terms of the most valuable biological parameters (yield, fruit weight, fruit quota, vegetation period, pericarp thickness, cold and draught resistance). Genotypes characterized by both precocity and high productivity were identified in the collection of cultivated tomatoes. The analysis of tomato varieties based on resistance to cold permitted highlighting of highly resistant genotypes, which may be used as initial material for breeding purposes.

Keywords: tomato, breeding, resistance, cold, draught.

Rezumat. Valoarea genetico-ameliorativă a formelor de tomate fără articulaţie geniculată a pedunculului floral. Una din problemele principale ale legumiculturii contemporane este crearea soiurilor cu caractere valoroase complexe, adaptate condiţiilor de creştere şi eficacitate economică. O importanţă deosebită în ameliorarea tomatelor le prezintă formele posesoare ale genelor j-2 şi j-2^{in} (jointless-2), deoarece la aceste genotipuri fructul mai uşor se desprinde de pedicel, nu se deformează la recoltare şi transport. Prezenţa pedicelului duce la diminuarea cotei fructelor marfă şi calităţii produselor de tomate, conferindu-le, totodată, gust amărui. Pentru a demonstra variabilitatea caracterelor agronomice şi a preciza valoarea genotipurilor de tomate fără articulaţie geniculată a penduncului floral, s-a efectuat evaluarea comparativă a genotipurilor de tomate, după un complex de caractere utile. Evaluarea genotipurilor s-a efectuat în baza utilizării celor mai valoroşi parametri biologici (recolta generală şi recolta marfă, masa medie a fructului, cota fructelor marfă, perioada de vegetaţie, masa fructului, grosimea pericarpului, rezistenţa la arşiţă şi frig). În colecţia tomatelor de cultură au fost identificate genotipuri care îmbină însuşirea de precocitate cu productivitatea înaltă. Analiza genotipurilor de tomate în baza rezistenţei la arşiţă şi frig a permis evidenţierea genotipurilor înalt rezistente care prezintă interes ca material iniţial în ameliorare.

Cuvinte cheie: tomate, ameliorare, rezistenţă, frig, arşiţă.

INTRODUCTION

One of the main problems of contemporary vegetable cultivation is the creation of new economically efficient varieties with complex valuable characters adapted to growing conditions. Mechanized technologies, applied for a range of crops: pea, tomato, onion, bean, etc. have led to an increase of labour productivity up to 10 – 20 times, a significant decrease of the products' price, an amplification of the yield, creation of better working conditions for the employees. The use of mechanized technologies within the breeding programs of vegetables (including tomato) requires certain conditions that must be considered by breeders. The newly developed varieties should satisfy the specific constraints of mechanized harvesting, should be productive, with simultaneous fruit ripening to assure a single-time collection, and the fruits should be able to maintain their physical and chemical qualities for a long period of time.

In tomato breeding, the genotypes that possess the J gene are particularly important. The fruits of such plants are easier detached from the peduncle and are less deformed during harvesting and transportation.

The aim of the given research was the study of the productivity, as well as cold and draught resistance of tomato varieties without geniculate joint of floral peduncle.

MATERIAL AND METHODS

28 tomato samples of different geographical origin that are carriers of **j** and **j-2** genes were selected from the collection of the Center for Vegetal Genetic Resources, Institute of Genetics and Plant Physiology, Academy of Sciences of Moldova (Table 1). Culture by seedling and tomato growing technology approved for the Republic of Moldova were used.

The selected varieties were subjected to thermal stress under laboratory conditions with the purpose of distinguishing genetic sources of cold and draught resistance.

Sample resistance to high temperatures was assessed according to methodical recommendations IVAKIN, 1979, based on the growing abilities of embryonic roots after the maintenance at 43^{o}C for 6 hours. The evaluation of tomato varieties in terms of cold (+10^{o}C) resistance was made in accordance with the protocol of Russian Phytotechnical Institute SMIRNOVA & GARANIKO, 1990.

Table 1. Biological material origin.
Tabel 1. Originea materialului biologic.

No.	Genotype name	Origin
1	Breeding Line 325	Canada
2	Ermak	Exp. st. Birucesc (Russia)
3	Kolokolicik	Moldova
4	69 B-243	-
5	H-102	USA
6	Antei	Ukraine (Crimea)
7	Victorina	Moldova
8	Step 1008 (442)- BK-BK	USA
9	L-3000	USA
10	Lebyajenskiy	Exp. st. Volgograd (Russia)
11	Mashinyi adygeisciy	-
12	Campbell 24	Canada
13	Atlacnyi	Kharkov (Ukraine)
14	Myti	Kharkov (Ukraine)
15	Karasi	Kharkov (Ukraine)
16	Maestro	Kharkov (Ukraine)
17	Funtik	Kharkov (Ukraine)
18	Peto 76	USA
19	Planeta	Moldova
20	Evrica	Moldova
21	Izabeli	Moldova
22	Nezabutca	Moldova
23	Amulet (Тм)	Russia
24	Sharm (Тм)	Russia
25	F 249 (Тм)	Armenia
26	Lucezarnyi (Тм)	Kazakhstan
27	Meruert (Тм)	Kazakhstan
28	Samaladai (Тм)	Kazakhstan
st	Youliana	Moldova

RESULTS AND DISCUSSIONS

The main objective of the undertaken research consisted in the elucidation of breeding value of tomato genotypes of different origin. Comparative assessment of specimens selected from a specialized collection allowed to distinguish genetic sources useful for the creation of new lines with complex profitable traits.

Precocity is one of the most valuable traits for tomato varieties, because it permits a longer harvesting period. It was observed that the precocity may be enhanced by crossing the varieties with short interphase periods. For one parent this period is referred to the time between the mass seedling appearance to flowering, while for the second one – from flowering till ripening (MAMEDOV et al., 2002). The cultivated tomato collection is characterized by a significant variability of this trait. Phenological observations made throughout the vegetation period have shown big differences among the developmental phases, depending on the variety and climatic conditions. Based on the vegetation period, tomatoes are classified in: ultra-early (<105 days), early (106-110 days), medium (111-115 days), late (116-120 days) and very late (> 120 days). The studies depicted a large diversity of the varieties in terms of interphase period "mass seedling appearance to flowering" (Table 2). Late flowering was observed at: Myti (86 days), Funtik (83 days), Breeding Line 325 (81 days), Ermak (80 days), Lebyajenskiy (77 days), Atlasnyi, Maestro (76 days), Karasi, Amulet (Тм), F 249 (Тм), Sharm (Тм), Lucezarnyi (Тм), Meruert (Тм) (74 days) Victorina and L-3000 (73 days). In 2008 the mentioned character varied from 58 to 86 days. The analysis of phenotypic variability of interphase period "flowering - ripening" resulted in significant differences among the studied genotypes. A shorter period was observed for Lebyajenskiy (34 days), Mîti (35 days), Step 1008(442)-BK-BK (37 days), Funtik (41 days), Kolokolicik, Antei, Campbell 24, Youliana (43 days). According to existing standards, the analysed varieties can be divided into: ultra-early (69 B-243, H-102, Step 1008(442)-BK-BK, Lebeajenschii, Peto 76, Youliana), early (Campbell 24, Evrica, F 249 (Тм), Nezabutca, Lebyajenskiy*),* medium (Antei, Planeta)*,* late (Myti, Izabeli, Meruret (Тм)) and very late (Breeding Line 325, Ermak, Victorina, L-3000, Mashinyi adygeisciy, Atlasnyi, Karasi, Maestro, Funtik, Amulet (Тм), Sharm (Тм), Lucezarnyi (Тм), Samaladai (Тм)). Hence, the analysed genotypes may be used as initial breeding material for the creation of new varieties with different vegetation period.

Pericarp thickness is an important parameter that determines the quota of the fruits. Pericarp size and variability should be taking into consideration while creating tomato genotypes intended for mechanical cultivation. GUSEVA, 1989 states that intensive varieties require a pericarp of 0.2 cm and thicker. Data from the specialized literature (BACULINA, 1970; BLAŞCIUC, 1983; MAMEDOV et al., 2002; MIHNEA et al., 2008; MIHNEA, 2008; SMIRNOVA & GARANIKO, 1990) provide evidence for a considerable genotypic variability of the mentioned trait. The studied varieties were assessed in terms of pericarp size and significant differences were ascertained (Fig. 1). According to the existing standards of tomato morphological traits, pericarp can be: thin (< 3 mm), average (3-6 mm), and thick (>6 mm). Based on the comparative analysis of the results, tomato varieties were divided in 3 groups: those with a thick

pericarp (Atlasnîi, Evrica, Amulet (Тм), with a thin one (Myti), and 25 genotypes with middle-sized pericarp. Therefore, along with other valuable characters, the majority of selected varieties are suitable for transportation.

Table 2. Phenotypic variability of interphasic periods in tomato.
Tabel 2. Variabilitatea fenotipică a perioadelor interfazice la tomate.

No.	Genotype name	Appearance of plantlets/flowering, days	Flowering/ripenin, days	Vegetation period, days
1	Breeding Line 325	81	45	125
2	Ermak	80	47	126
3	Kolokolicik	58	43	100
4	69 B-243	62	44	105
5	H-102	62	44	105
6	Antei	69	43	111
7	Victorina	73	54	126
8	Step 1008 (442) - BK-BK	69	37	105
9	L-3000	73	52	124
10	Lebyajenskiy	77	34	110
11	Mashinyi adygeisciy	86	45	125
12	Campbell 24	65	43	107
13	Atlacnyi	76	47	122
14	Myti	86	35	120
15	Karasi	74	50	123
16	Maestro	76	47	122
17	Funtik	83	41	123
18	Peto 76	58	48	105
19	Planeta	58	58	115
20	Evrica	65	43	107
21	Izabeli	63	55	117
22	Nezabutca	63	46	108
23	Amulet (Тм)	74	48	121
24	Sharm(Тм)	74	50	123
25	F 249 (Тм)	63	46	108
26	Lucezarnyi (Тм)	74	49	122
27	Meruert(Тм)	74	47	120
28	Samaladai (Тм)	70	53	122
st	Youliana	63	43	105

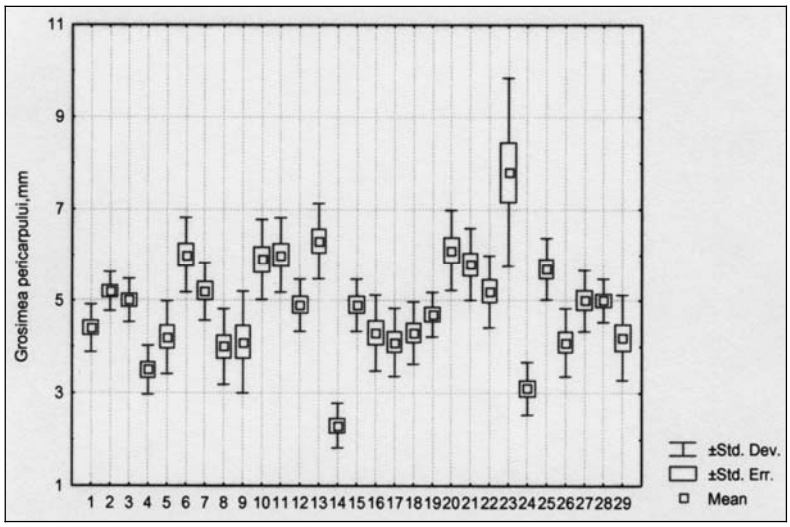

Figure 1. Comparative analysis of tomato varieties based on pericarp thickness.
Figura 1. Caracteristica comparativă a soiurilor de tomate în baza grosimii pericarpului.

Legend: 1. Breeding Line 325; 2. Ermak; 3. Kolokolicik; 4. 69 B-243; 5. H-102; 6. Antei; 7. Victorina; 8. Step 1008 (442) - BK-BK; 9. L-3000; 10. Lebyajenskiy; 11. Mashinyi adygeisciy; 12. Campbell 24; 13. Atlacnyi; 14. Myti; 15. Karasi; 16. Maestro; 17. Funtik; 18. Peto 76; 19. Planeta; 20. Evrica; 21. Izabeli; 22. Nezabutca; 23. Amulet (Тм); 24. Sharm (Тм); 25. F 249 (Тм); 26. Lucezarnyi (Тм); 27. Meruert (Тм); 28. Samaladai (Тм); 29. Youliana.

Fruit weight is one of the main traits that determine the direction of tomato breeding programs. Based on this parameter, the examined varieties were grouped as follows: with big fruits (>100 g) – Breeding Line 325, Ermak, Atlasnyi; average fruits (51-100 g) – Antei, Victorina. Step 1008 (442)- BK-BK, L-3000, Lebyajenskiy, Mashinyi adygeisciy, Campbell 24, Karasi, Peto 76, Evrica, Izabeli, Amulet (Тм), F 249 (Тм), Meruret (Тм), Samaladai (Тм), Youliana and with small fruits (<50g) – Kolokolcik, 69 B-243, H-102, Myti, Maestro, Funtik, Planeta, Sharm (Тм).

Although the absolute weight of the fruits varies within each population, according to the assessment results, the biggest mass was noticed at fruits of Atlasnyi, while the smallest – at H-102 variety (Fig. 2).

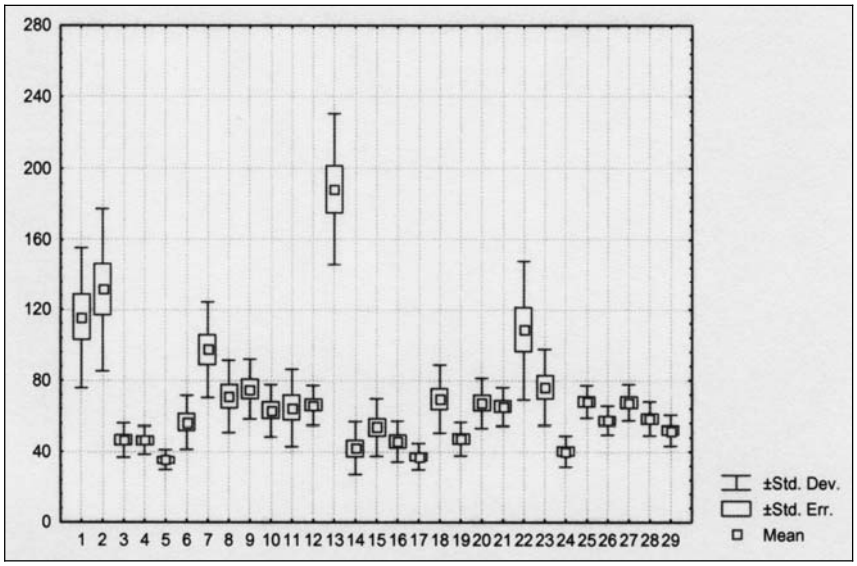

Figure 2. Distribution of tomato varieties based on fruit weight.
Figura 2. Distribuirea soiurilor de tomate în baza mesei fructului.

Legend: 1. Breeding Line 325; 2. Ermak; 3. Kolokolicik; 4. 69 B-243; 5. H-102; 6. Antei; 7. Victorina; 8. Step 1008 (442)- BK-BK; 9. L-3000; 10. Lebyajenskiy; 11. Mashinyi adygeisciy; 12. Campbell 24; 13. Atlacnyi; 14. Myti; 15. Karasi; 16. Maestro; 17. Funtik; 18. Peto 76; 19. Planeta; 20. Evrica, 21. Izabeli; 22. Nezabutca; 23. Amulet (Тм); 24. Sharm (Тм); 25. F 249 (Тм); 26. Lucezarnyi (Тм); 27. Meruert (Тм); 28. Samaladai (Тм); 29. Youliana.

The results of the analysis of genotype productivity, assessed in comparison with the control variety (Iuliana), are presented in figure 3. A large variability, depending on both the genotype and climatic conditions, was established. In 2008, the productivity of the varieties under investigation fluctuated between 11.8 t/ha (Lucezarnyi) and 44.8 t/ha (Maestro). In comparison with the control (the yield of which constituted 31.6 t/ha), an increased productivity was registered for Kolokolicik (35.5 t/ha), H-102 (36.0 t/ha), Myti (37.4 t/ha), Maestro (44.8 t/ha). The yield of the varieties: Breeding Line 325, Ermak, 69 B-243, Victorina, Step 1008 (442)-BK-BK, L-3000, Lebyjenskhiy, Mashinyi adygeisciy, Karasi, Funtik, Peto 76, Izabeli, Nezabudca, Amulet (Тм), Sharm (Тм), F 249 (Тм), Lucezarnyi (Тм), Meruert, Samaladai, was lower than that of the control.

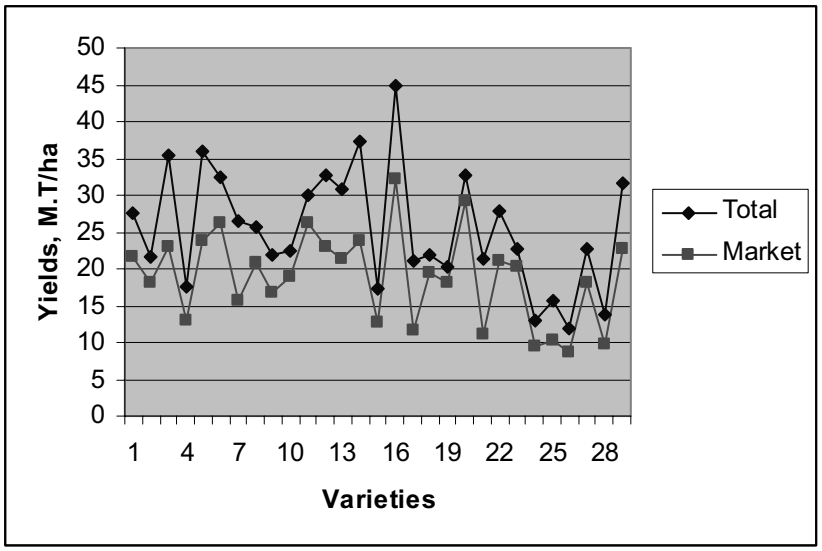

Figure 3. Assessment of the genotypes in terms of productivity.
Figura 3. Evaluarea genotipurilor de tomate în baza productivității.

Legend: 1. Breeding Line 325; 2. Ermak; 3. Kolokolicik; 4. 69 B-243; 5. H-102; 6. Antei; 7. Victorina; 8. Step 1008 (442)-BK-BK; 9. L-3000; 10. Lebyajenskiy; 11. Mashinyi adygeisciy; 12. Campbell 24; 13. Atlacnyi; 14. Myti; 15. Karasi; 16. Maestro; 17. Funtik; 18. Peto 76; 19. Planeta; 20. Evrica; 21. Izabeli; 22. Nezabutca; 23. Amulet (Тм); 24. Sharm (Тм); 25. F 249 (Тм); 26. Lucezarnyi (Тм); 27. Meruert (Тм); 28. Samaladai (Тм); 29. Youliana.

As a result, the analysis of valuable traits have emphasized a large variability in terms of vegetation period, fruit size and other parameters, allowing thus the recommendation of the studied varieties as initial material for hybridization with the aim of developing new valuable genotypes.

The selected varieties were subjected to thermal stress under laboratory conditions with the purpose of distinguishing genetic sources of cold and draught resistance. The assessment data (Fig. 4) highlighted a presence of significant resistance variability from 26.7% to 100.0% for cold and from 24.4% to 88.4% for draught. An increased level of cold resistance was attested at Breeding Line 325, Kolokolcik, Victorina, Step 1008 (442)-BK-BK, L-3000, Lebyajenskiy, Karasi, Evrica, F 249 (Тм), Nezabudca, Samaladai, while Victorina, Campbell 24, Izabeli, Funtik, Mashinyi adygeisciy , F 249 (Тм) have proved to be draught resistant. The varieties that combine both cold and draught resistance are of a special value for breeding. Such varieties are: Victorina, Mashinyi adygeisciy, F 249 (Тм). They might be used for breeding purposes as sources of stress resistance genes.

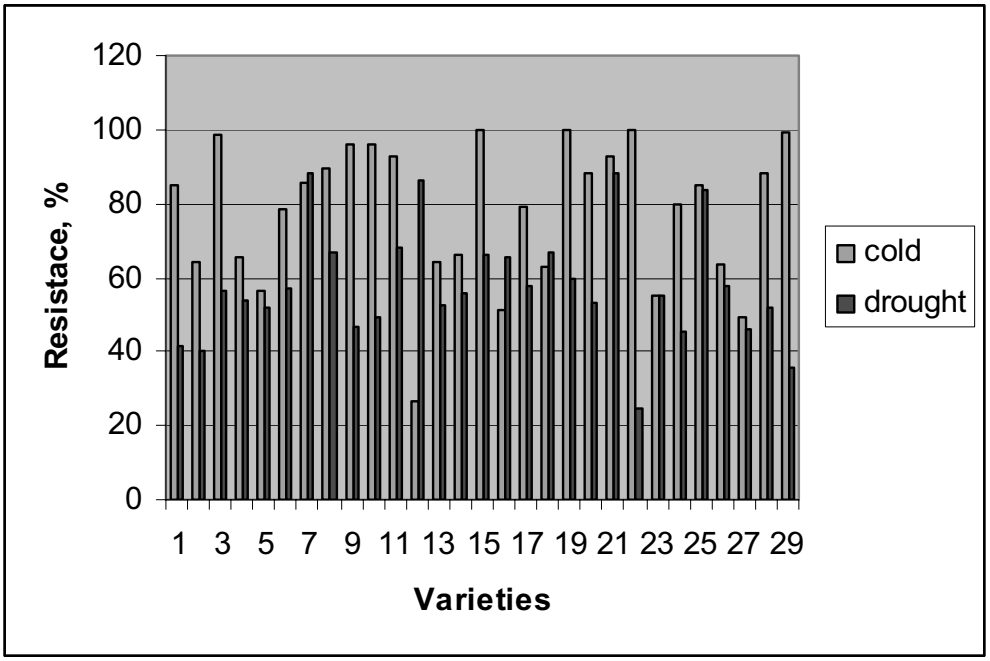

Figure 4. Evaluation of tomato genotypes based on cold and drought resistance.
Figura 4. Evaluarea genotipurilor de tomate după rezistența la frig şi arşiță.

Legend: 1. Breeding Line 325; 2. Ermak; 3. Kolokolicik; 4. 69 B-243; 5. H-102; 6. Antei; 7. Victorina; 8. Step 1008 (442)- BK-BK; 9. L-3000; 10. Lebyajenskiy; 11. Mashinyi adygeisciy; 12. Campbell 24; 13. Atlacnyi; 14. Myti; 15. Karasi; 16. Maestro; 17. Funtik; 18. Peto 76; 19. Planeta; 20. Evrica; 21. Izabeli; 22. Nezabutca; 23. Amulet (Тм); 24. Sharm (Тм); 25. F 249 (Тм); 26. Lucezarnyi (Тм); 27. Meruert (Тм); 28. Samaladai (Тм); 29. Youliana.

CONCLUSIONS

At the Centre for Vegetal Genetic Resources, Institute of Genetics and Plant Physiology, a collection of tomato varieties without geniculate joint of floral peduncle was established. This collection is characterized by a wide variability in terms of vegetation period, fruit weight and other traits, which allows recommending its varieties as initial material for the development of new valuable genotypes.

The varieties: 69 B-243, H-102, Step 1008 (442)-BK-BK, Lebeajenschii, Peto 76, Campbell 24, Evrica, F 249 (Тм), Nezabudca, Lebeajenschii may be used in breeding programs as genetic sources of precocity.

The analysis of tomato varieties without geniculate joint of floral peduncle based on resistance to cold permitted highlighting of highly resistant genotypes: Breeding Line 325, Kolokolcik, Victorina, Step 1008 (442) - BK-BK, L-3000; Lebyajenskiy, Mashinyi adygeisciy, Karasi, Evrica, F 249 (Тм), Nezabudca, Samaladai, which are recommended for the development of new highly productive varieties resistant to low temperatures.

Based on the study of the influence of high temperatures over embryonic roots growth, it was ascertained that the varieties: Victorina, Campbell 24, Izabeli, Funtik, Mashinyi adygeisciy, F 249 (Тм) manifest an increased level of drought resistance.

As a result of the research, Victorina, Mashinyi adygeisciy, F 249 (Тм) were emphasized as being both cold and draught resistant.

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