Prospects for the use of the tomato genetic collection of the FSBSI ARRIBPP to develop varieties with group resistance to *Alternaria* sp. and *Phytophthora infestans* (Mont.) de Bary.

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Abstract. The resistance of mutant tomato lines to the main diseases upon the provocative infectious background was assessed. We used as experimental material 22 lines of the tomato genetic collection of the FSBSI ARRIBPP, Krasnodar. According to the results of assessing the damage by *Alternaria* sp. in the field it was found that line 41 exhibitted high resistance, there were no signs of disease damage. Mutant lines 80, 387, 434, 568, 620 showed resistance, the degree of the disease development varied within 1–8 %. Lines 172, 467, 509, 518 with a degree of development of 12–23 % were characterized by semi-resistance. Lines 41, 387 showed high resistance to *P. infestans*. No visible signs of damage by *P. infestans* were detected in these genotypes. Lines 341, 509, 518, 568 had semi-resistance to the pathogen, the degree of development varied from 10 to 18 %. The genotypes Mo 41 and 387 that showed high and relatively high resistance to *Alternaria* sp. and *P. infestans* are of the greatest interest for breeding and genetic work as sources of group resistance.

1 Introduction

Tomato is the most popular fruit crop in the world due to its wide range of use, nutritional value and unique taste [1-2]. However, biotic and abiotic factors hinder the commercial production of this culture when grown in open ground [3].

Among the biotic factors that can lead to significant yield losses of tomato crops, the most dangerous and harmful are fungi of the genus *Alternaria* sp. and oomycete *Phytophthora infestans* (Mont.) de Bary.

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Recently, *Alternaria* sp. has become a leader in harmfulness among fungal diseases [4-6]. Damages of tomato plants caused by *Alternaria* sp. lead to yield losses, mold of seeds and fruits, and the metabolites of the fungus cause allergic reactions [7].

For many years, *P. infestans* oomycete has been recognized as the most dangerous pathogen in Russia, which reduces tomato yield up to 50 %, and in epiphytotic years up to 80 % or more [8-13]. Under the pathogen effect, the assimilation surface of tomato plants leaves decreases, fruits rot. The greatest damage was noted with increased humidity in open ground and in plastic-covered unheated greenhouses [14].

Cultivated tomato has a narrow genetic diversity, which was the result of its intensive selection and inbreeding during evolution. As a result, cultivated tomato species are more susceptible to disease than wild species and mutant forms. Thus, yield losses caused by pathogenic infections can be eliminated by developing resistant varieties with the help of plant breeding methods using the resistance genes of wild species and mutant forms of tomato [15-18].

To develop resistant varieties, breeders need tomato genetic collections with identified genes. One of such collections is supported at the FSBSI ARRIBPP, Krasnodar, where we comprehensively study the collection and select parent material for practical use in realizing the tasks of private selection [19].

Marker selection of the initial forms of tomato is a relatively new approach in breeding, which is based on the direct selection of plants by genes that determine economically valuable characteristics. As a result, the analysis of breeding material is carried out in a short time and most of the studied mutant forms can serve as a source of important economically valuable properties [20-23].

The aim of the study is to assess the resistance of mutant samples of the tomato genetic collection of the FSBSI ARRIBPP to diseases upon a provocative infectious background.

2 Materials and methods

As an experimental material, we used 22 samples from the collection of tomato mutant forms of the laboratory of the tomato genetic collection of the FSBSI ARRIBPP, Krasnodar (Table 1).

Table 1. Tomato mutant forms from the collection of FSBSI ARRIBPP

Mo	Gene symbol	Gene name	Origin	Chromosome, locus
41	au^2	aurea	RAD	1 (32)
45, 60	Jau	Jaundiced	SPON	1
47	Cf-4	Cladosporium fulvum resistance-4	SPON	no data
56	au	aurea	RAD	1 (32)
80	$yv^{4(ver)}$	yellow virescent	RAD	no data
161	Ad	Alternaria resistance	SPON	no data
172	ps	positional sterille	SPON	2 (61)
341	Wo^m	Morgans Woolly	SPON	2 (46)
350	vit	deformis	RAD	3 (111)
387	yv	yellow virescent	SPON	6 (34)
395	rv; og	reticulate virescent; beta-carotene	CHEM; SPON	3 (6)
406	gq, dl, wd	grotesque; dialityc; wilty draft	SPON	no data
411	mta	mutata	RAD	(17)

434	inf	informa	RAD	5
445	suf	sufflava	RAD	2 (66)
452	s	compound inflorescence	SPON	2 (30)
467	j	jointless	SPON	11 (28)
509	d, wv, af, tf	dwarf, white virescent, anthocyanin free, trifoliate	SPON; SPON; RAD;	2, 2, 5, 5
518	wd	wilty dwarf	SPON	9 (20)
568	yg-4	yellow-green-4	RAD	no data
620	lyr	lyrate	SPON	5 (31)

Screening of 22 test mutant tomato lines for resistance to *Alternaria* sp. and *P. infestans* was carried out in the field of FSBSI ARRIBPP in 2019 upon the provocative infectious background created as a result of the repeated cultivation in one place for three years, without the use of plant protection products, with plant residues embedded in the soil. Plants were placed in randomized blocks with three replications. Each replication included 10 plants of each genotype. Sowing pattern: 1.5 m × 0.75 m. There were no chemical treatments. Recording of diseases was carried out with the appearance of the first signs of the disease. Resistance of mutant lines to *Alternaria* sp. and *P. infestans* was assessed by the degree of damage according to the modified method [24-25]. Meteorological conditions of 2019 vegetation period were favorable for the growth and development of tomato. In July, increased humidity and high air temperature contributed to the intensive development of *Alternaria* sp. on tomato crops. *P. infestans* oomycete actively developed since the second half of August. The mass spreading of the pathogen was recorded in the second decade of September with a combination of optimal weather conditions: air humidity above 80 % at night, air temperature from + 20 °C to + 24 °C in the daytime.

The infestation area under the disease progression curve (AUDPC) was calculated for each genotype in each replication using an expanded modified formula [25]. Pearson correlation coefficients for various variables were calculated using the StatSoft Statistica V. 10.0 software package for statistical analysis.

3 Results and discussion

The first symptoms of *Alternaria* sp. in the form of dark spots were noted in the second decade of June. During the growing season, the disease developed in all aerial parts of plants. The intensity of *Alternaria* sp. development averaged 27.2 % (Table 2).

The first signs of *P. infestans* infection appeared in the second decade of August. On average, the intensity of *P. infestans* development was 48.1 % during the growing season (Table 2).

According to the results of the assessment of the tomato mutant lines for damage by *Alternaria* sp. in the field it was found that line 41 showed high resistance (HR), there were no signs of disease damage. Mutant lines 80, 387, 434, 568, 620 showed resistance (R), the degree of disease development ranged from 1-8 %. Lines 172, 467, 509, 518 with the development degree of 12–23 % were characterized by semi-resistance (SR). Lines 47, 60, 161, 341, 406, 411, 452 showed semi-susceptibility (SS) to the disease, with the development degree in the range of 27–36 %. Lines 45, 56, 350, 395, 445 were susceptible (S), the disease development degree ranged from 51–56 %.

Lines 41, 387 were characterized by high resistance to *P. infestans*. No visible signs of *P. infestans* damage were detected in these genotypes. Lines 341, 509, 518, 568 showed semi-resistance to the pathogen, the development degree varied from 10 to 18 %. Semi-susceptibility was shown by lines 80, 172, 434, 620. The disease development degree

ranged from 27–42 %. The highest susceptibility was demonstrated by lines 45, 47, 56, 60, 161, 350, 395, 406, 411, 445, 452, 467 with the damage degree of 52-100 %.

Table 2. Assessment of tomato mutant lines for damage by *Alternaria* sp. and *P. infestans* in the field, Krasnodar, 2019

Mo	*Alternaria* sp.			*P. infestans*	
	Development degree (Defolia-tion), %	AUDPC	Damage score/resistance degree	Development degree (Defolia-tion), %	AUDPC
41	0	0	0/HR	0	0
45	67	2559	4/S	55	1910
47	36	1889	3/SS	98	3342
56	51	2445	4/S	52	1738
60	28	1498	3/SS	54	1873
80	3	72	1/R	27	920
161	31	1699	3/SS	95	2539
172	12	534	2/SR	32	1305
341	45	2076	3/SS	16	809
350	52	2438	4/S	52	2060
387	8	343	1/R	0	0
395	54	2644	4/S	57	1898
406	27	1569	3/SS	100	3528
411	32	1804	3/SS	84	2847
434	6	190	1/R	42	1684
445	56	2729	4/S	73	2624
452	29	1497	3/SS	81	3098
467	15	755	2/SR	67	2298
509	23	1020	2/SR	13	466
518	19	1176	2/SR	18	482
568	1	12	1/R	10	343
620	3	57	1/R	33	1243
Average	27,2	1318,4		48,1	1682,1

As a result, lines with the highest field resistance to *Alternaria* sp. (41, 80, 387, 434, 568, 620) and *P. Infestans* (41, 387, 341, 509, 518, 568) had low AUDPC values. Significant correlation was noted ($r = 0.98$ at $P < 0.01$). The relationship between the resistance of genotypes to diseases was average ($r = 0.47$-0.48 at $P < 0.05$; $r = 0.55$-0.56 at $P < 0.05$) (Table 3).

Table 3. Pearson correlation coefficients for the assessment parameters of the tomato field resistance to *Alternaria* sp. and *P. Infestans*

Experiment options	Def-Alt	AUDPC-Alt	Def-Phyt
AUDPC-Alt	0,98**		
Phyt	0,47*	0,55**	
Def-AUDPC- Phyt	0,48*	0,56**	0,98**
Def-Alt; Def-Phyt - percentage of plant damage by *Alternaria* sp. and *P. infestans*, respectively; AUDPC-Alt; AUDPC-Phyt - infestation area under the disease progression curve of *Alternaria* sp. and *P. infestans*, respectively; *, ** - significant correlation at $P < 0.05$ and $P < 0.01$, respectively			

4 Conclusions

According to the results of the conducted research, the damage assessment of 22 tomato mutant lines showed that lines 41 and 387 as sources of group resistance are of the greatest interest for further studies. These genotypes showed high resistance and relatively high resistance to the two diseases under study.

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