BEHAVIOR OF SOME EGGPLANT CULTIVARS (*SOLANUM MELONGENA* L.) AT THE PATHOGENS ATTACK IN GREENHOUSE AND FIELD

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Abstract

The experiences organized at RDIVFG. Vidra in 2016 had as main purpose the assessment of different varieties and eggplants hybrids on the specific soil and climate conditions in the Vidra area. Six eggplant cultivars were studied, 3 romanians created at RDIVFG Vidra (Belona, Andra F1 and L (Luiza x Pop Unirea) and 3 foreign (Estelle F1, Sharapova F1 and Madrid F1) in greenhouse and field.

There were made assessments regarding the occurrence and evolution of the pathogen attack (*Botrytis cinerea, Alternaria solani* and *Verticillium dahliae*) in correlation with the environmental factors, the frequency and severity of the attack on the basis of which it was calculated the degree of attack. Also, observations have been made on the number of fruit per plant, the average fruit weight, yield and fruit quality. Among Romanian cultivars, the best yield was obtained at Andra F1 7.35 kg / sqm in greenhouse and 6.26 kg / sq m in the field. Among the foreign hybrids, have been highlighted Sharapova F1 with 9.04 respectively 7.8 kg / sq m yield and Estelle F1 with 8.44 respectively 6.63 kg / sq m in greenhouse respectively in the field.

In greenhouse the average yield was higher with 10.1 t / ha comparatively with the field, and the quality I of yield was higher with 10.4 t / ha. The most sensitive hybrid of *Verticillium dahliae* (verticillium wilt) is Sharapova F1 (FA = 36.4%; GA = 15.9%), followed by Madrid F1 (FA = 36.4%, GA = 13.6%) and Estelle F1 (FA = 27.3%, GA = 18.2%). Among the varieties / hybrids created at RDIFG Vidra, Belona was not attacked by *Verticillium dahliae* and Andra F1 showed a low sensitivity.

Key words: *Solanum melongena*, *Botrytis cinerea*, *Alternaria solani*, *Verticillium dahliae*

Eggplant (*Solanum melongena* L.) is herbaceous annual plant of the family Solanaceae. Eggplants cultivated *Solanum melongena* L., var, *esculentum* Dun. originating in India and Burma (S.D. Doijode, 2001; Tsao and Lo, 2006) where they grow in the wild. Their cultivation as vegetable plants began towards the end of the fifteenth century. In Romania, the eggplant culture became well known after the First World War, being appreciated as an important culture after 1950, when the surfaces and productions began to grow (Munteanu N.C., 2003). The eggplant is grown in many countries of the world due to its high content of bioactive components, including phenolic compounds, macro-and micronutrients (Luthria D.L., 2009). The yield and quality of eggplant fruit are determined, among others, by cultivation form, organic and mineral fertilization, soil moisture content and pathogen infection rates (Bletsos F.A. *et al*, 1999; Raigon M.D. *et al*, 2010). During the growing season, eggplant are attacked by viruses (Sadeghi M.S. *et al*, 2008), bacteria (Arsenijevic M. *et al*, 1997; Yerchyk V., 2008), fungus-like organisms such as *Phytophthora capsici* (Sholberg P.L. *et al*, 2007), and soil-borne fungal pathogens including *Verticillium* spp. and *Fusarium s*p. (Lewis J.A. *et al*, 1998; Janas R *et al*, 2002). Studies have been conducted on the correlation between virulence of pathogens and the hypersensitivity of some host (Ichim E. *et al*, 2016). Environmental, biotic and abiotic factors provide optimum conditions for many pathogen species that cause large production losses. Knowing the influence of abiotic factors on the growth and development of plant pathogens it is important study their biology (Cristea S. *et al*, 2000). *Verticillium dahliae, Alternaria alternata* and *Botrytis cinerea* have been identified as the main species affecting eggplants. *Verticillium dahliae* is a soil-borne phytopathogenic fungus that causes destructive disease in over 200 plant species, including a wide range of economically important crops (Pegg G.F., Brady B.L., 2002; Inderbitzin P., 2014). It could cause the serious *Verticillium* wilt on plants, and the symptom includes wilting, chlorosis, stunting, necrosis, vein clearing, and discoloration in stem tissue cross-

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sections (Fradin, E. F. and Thomma, 2006). Moreover, the dormant microsclerotia structures of *V. dahliae* remain viable in the soil for more than 20 years and cause serious *Verticillium* wilt symptoms after germination during plant infection (Agrios G., 2005). Verticillial wasting, slow-progressing vascular disease is common in protected areas and in the field. The first symptoms of wilting occur in the plant fructification phase. Plants attacked long before the end of the vegetation cycle (Docea E. *et al*, 2012). The pathogen *Alternaria* spp.produces blackish-brown spots on leaves, stems, petioles, and inflorescence which unite and form large necrotic areas (Oliveira M.F.D *et al*, 2004; Cristea S., 2005, Radu E. *et al* 2011). Also, the fungus *Alternaria* spp. is considered an important pathogen of the seed (Udayashankar A.C. *et al*., 2012; Cristea (Manole) M.S. *et al*, 2015; Cozea A., Cristea S, 2011; Mardare E.Ş. *et al*, 2014; Cristea S. *et al*, 2009) found on mustard and maize seeds (Gruia L. *et al*, 2016, Dudoiu R. Et al, 2016). The distribution of *Alternaria* species from cruciferous seeds under field conditions has been studied (Berca L.M., *et al*, 2015). Grey mold caused by the fungus *Botrytis cinerea* Pers.:Fr., has a wide host range, with over 200 hosts. Very good efficacy for controlling *Alternaria porri* f.sp. *solani* and *Botrytis cinerea* on *Solanaceus* family are metiram 80% 0.2% + thiophanate methyl 500g/l 0.14% and chlorothalonil 500g/l 0.2% + iprodione 500 g/l 0.1% (Sovarel G. *et al*, 2017). The pathogen can cause damping – off, as well as blight of the flowers, fruits, stems and foliage of many vegetables. It is a very common disease of Solanaceous crop that can be particularly damaging in greenhouse environaments because of the high RH. It is a major cause of post – harvest frot at harvest and in storage (Ferrer J.B., Owen J.H., 1959; Coley –Smith J.R. *et al*, 1980).

MATERIAL AND METHOD

The research realized at RDIVFG Vidra aimed to realize a comparative study of some eggplant cultivars in greenhouse and field conditions. The experiments were organized in greenhouse and open field conditions at RDIVFG Vidra, in2016. Six cultivars of eggplants were studied, 3 Romanians were created at RDIVFG Vidra (Belona, Andra F1 and L (Luiza x Pop Unirea) and 3 foreign (Estelle F1, Sharapova F1 and Madrid F1 in greenhouse and field. There have been made assessments on the occurrence and evolution of pathogen attack (*Botrytis cinerea, Alternaria solani* and *Verticillium dahliae*) in relation to the environmental factors, the frequency and severity of the attack on which the degree of attack was calculated. Observations have also been made on the number of fruit per plant, the average fruit weight, yield and its quality. The yield data obtained were processed by the variance analysis method.

RESULTS AND DISCUSSIONS

Three pathogens *Botrytis cinerea, Alternaria solani* and *Verticillium dahliae* were present in greenhouse and field eggplant crops. Their attack began in the following order: *Botrytis cinerea* (June I decade), *Alternaria solani* and *Verticillium dahliae* (June II decade). Their attack had a relatively slow evolution reaching at the end of the first decade of September to 5.0% in the field respectively 9.8% in greenhouse at *Botrytis cinerea*, 4.6% in the field and 10.1% in greenhouse at *Alternaria solani* and 6.9% in the field and 14.1% in greenhouse at *Verticillium dahliae (table 1).*

Table 1

The occurrence and evolution of pathogen attack on eggplants crops in greenhouses and fields

The pathogen	Type of culture	Date of the attack	The degree of attack / Frequency of attack (%)												
			May			June			July			August			September
			I	II	III	I	II	III	I	II	III	I	II	III	I
Botrytis cinerea	greenhouse	2.06	0	0	0	0.9	1.5	23	2,8	3.7	6.6	7.5	8.1	8.5	9.8
	field	10.06	0	0	0	0.4	0.8	1.3	1,8	2.3	3.1	3.8	4.2	4.6	5.0
Alternaria solani	greenhouse	12.06	0	0	0	0	1.2	1.8	2,7	3.9	6.8	7.3	7.8	8.5	10.1
	field	19.06	0	0	0	0	0.5	1.0	1,4	2.2	3.3	3.6	3.8	4.2	4.6
Verticillium dahliae	greenhouse	12.06	0	0	0	0	1.9	2.8	3,4	4.2	8.1	10.3	11.8	12.5	14.1
	field	20.06	0	0	0	0	1.0	2.1	2,8	3.2	3.5	3.9	4.4	6.5	6.9

The weather conditions between May and September 2016 (*Tables 2 and 3*) have created favorable premises for the apparition and evolution of pathogen attack. In a study by Mardare E.Ş.et al, (2015) shows that temperature plays a decisive role in the development of infections and pathogens. The abiotic factors (temperature, relative atmospheric humidity and light) are important factors in the *Alternaria* sp. fungus evolution.

Table 2

Climatic data in the field (Vidra 2016)

Month	Temperature (ºC)			Atmospheric humidity (%)			The precipitations amounth (mm)
	average	minimum	maximum	average	minimum	maximum	
June	21.9	16.1	28.4	71.3	56.8	89.5	33.5
July	23.7	17.0	31.0	59.7	48.1	78.3	2.0
August	23.4	17.5	30.6	60.6	49.5	77.2	110.0
September	18.9	13.1	26.3	62.8	51.9	80.2	43.5

Table 3

Climatic data in greenhouse (Vidra 2016)

Month	Temperature (ºC)			Atmospheric humidity (%)		
	average	minimum	maximum	average	minimum	maximum
May	23.5	11.3	39.5	62.5	31.4	89.3
June	27.7	16.7	40.4	65.4	34.8	94.2
July	28.9	17.1	41.6	61.3	30.1	97.7
August	26.4	17.1	38.2	69.1	38.8	97.3
September	20.8	16.2	31.1	76.7	50.1	97.8

Regarding the obtained yield, among the romanian cultivars, good results gave Andra F1 with 7.35 kg / mp in greenhouse and 6.26 kg / sq m in the field. At this hybrid, the fruit / plant number was 7.6/6.8 and the average fruit weight was 280.9 g/274.8g. Among the foreign hybrids good results gave Sharapova F1 with a yield of 9.04 / 7.80 kg / sq m and Estelle F1 with 8.44 / 6.63 kg / sq m. As regards the number of fruits / plants in the Sharapova F1 hybrid, it was 7.7 and 6.8 respectively and the average fruit weight of 350.7 g and 342.3 g respectively in the greenhouse / field (Tables 4 and 5). In greenhouse, the average yield was higher with 10.1 t / ha compared to the field and the quality I yield was higher with 10.4 t / ha (*table 6*).

Table 4

Yield of eggplant cultivars in greenhouse

No	Cultivar	Number of fruits / plant	Average fruit weight (g)	Yield /plant (Kg)	Yield/ sq m (kg)	Relative yield versus average (%)
1.	Belona	6.4	225.8	1.44	4.82°°°	67.33
2.	Andra F1	7.6	280.9	2.19	7.35	102.68
3.	Estelle F1	11.2	225.3	2.52	8.44***	117.90
4.	Sharapova F1	7.7	350.7	2.70	9.04***	126.29
5.	Madrid F1	6.5	325.9	2.12	7.10	99.19
6.	L (Luiza x Pop. Unirea)	5.7	325.2	1.85	6.20°°°	86.61
Average		**7.5**	**289.0**	**2.14**	**7.16**	**100.00**

DL 5%= 0.562; DL 1% = 0.772; DL 0.1% = 1.057

Analyzing the cultivar behavior of eggplants grown in greenhouse and field, compared to the average of experience, it was found that in 2016, Vidra, the highest yields were obtained at hybrids Sharapova F1 and Estelle F1, with a difference significant positive yield. Belona variety and the L hybrid (Luiza x Pop. Unirea) had lower yield, with differences very negative yield in comparison with the average of the experience (*Tables 4 and 5*).

Table 5

Yield of eggplants cultivated in field

No	Cultivar	Number of fruits / plant	Average fruit weight (g)	Yield / plant (Kg)	Yield / sq m (kg)	Relative yield versus average (%)
1.	Belona	5.8	213.3	1.27	4.25°°°	69.86
2.	Andra F1	6.8	274.8	1.87	6.26	102.90
3.	Estelle F1	9.0	220.2	1.98	6.63**	108.99
4.	Sharapova F1	6.8	342.3	2.33	7.80***	128.22
5.	Madrid F1	5.8	329.8	1.85	6.20	101.92
6.	L (Luiza x Pop. Unirea)	5.0	320.0	1.60	5.36°°°	88.11
Average		**6.5**	**283.4**	**1.82**	**6.08**	**100.00**

DL 5%= 0.263; DL 1% = 0.319; DL 0.1% = 0.596

Table 6

The quality of the eggplant yield in the two types of crops

No	Cultivar	Greenhouse yield quality (t / ha)			Field yield quality (t / ha)			Yield difference (t / ha)
		Total	I quality	II quality	Total	I quality	II quality	
1.	Belona	48.2	41.7	6.5	42.5	35.3	7.2	5.7
2.	Andra F1	73.5	67.1	6.4	62.6	49.1	6.5	10.9
3.	Estelle F1	84.4	74.9	9.5	70.1	63.0	7.1	14.3
4.	Sharapova F1	90.4	80.8	9.6	78.0	71.9	6.1	12.4
5.	Madrid F1	71.0	63.1	7.9	62.0	54.2	7.8	9.0
6.	L (Luiza x Pop. Unirea)	62.0	56.7	5.8	53.6	48.4	5.2	8.4
Average			**71.6**	**64.0**	**7.5**	**61.5**	**53.6**	**7.8**

Figure 1 **Belona** Figure 2 **Andra F1** Figure 3 **Estelle F1**

Figure4 **Sharapova** F1 Figure5 **Madrid F1** Figure 6 **L (Luiza x Pop. Unirea)**

Among cultivars studied none was attacked by *Phytophthora parasitica* (fruit rot, *table 7).* The most sensitive hybrid of *Verticillium dahliae* (verticillium wilt) is Sharapova F1 (FA = 36.4%, GA = 15.9%) followed by Madrid F1 (FA = 36.4%, GA = 13.6% F1 (FA = 27.3%, GA = 18.2%).

Among the varieties / hybrids created at Vidra's ICDLF, Belona was not attacked and Andra F1 showed a low sensitivity.

Table 7

Assessing the behavior of some cultivars of eggplants on attack soil pathogens

No	Cultivar	*Phytophthora parasitica* (F%)	*Verticillium dahliae* (FA/DA %)
1	Belona F1	0	0
2	Andra F1	0	9,1/ 6,8
3	Estelle F1	0	27,3/18,2
4	Sharapova F1	0	36,4/ 15,9
5	Madrid F1	0	36,4/ 13,6
6	Luiza x Pop. Unirea F1	0	17,3/6,8

CONCLUSIONS

The type of culture influences both the quantity and the quality of yield regardless the studied cultivar.

Among the Romanian hybrids the best results were obtained to Andra F1, with 7.35 kg / sq m yield in greenhouse and 6.26 kg / sq m in the field.

Belona is a Romanian variety of white eggplants with average 6.4 fruit / plant, respectively 5.3, but weighing less than 225.8g and 213.3g, respectively.

In greenhouse, the average yield was higher by 10.1t / ha compared to the field, and theyield of quality I was higher by 10.4t/ha.

The most sensitive hybrid of *Verticillium dahliae* (verticillium wilt) is Sharapova F1 (FA = 36.4%, GA = 15.9%) followed by Madrid F1 (FA = 36.4%, GA = 13.6% F1 (FA = 27.3%, GA = 18.2%) (*figure 1, 2, 3, 4, 5, 6*)

Among the varieties / hybrids created at RDIVFG Vidra, Belona was not attacked by *Verticillium dahliae* and Andra F1 showed a low sensitivity.

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