

THE STUDY OF TOLERANCE OF SOME SPECIES AND VARIETIES OF *CUCURBITACEAE* TO THE ATTACK OF PATHOGENS

Alexandru Bute, Silvica Ambăruș, Creola Brezeanu, Maria Călin, Petre Marian Brezeanu

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INTRODUCTION

Cucurbits are herbaceous vegetable plants with creeping stems. They are unisexual monoecious plants with entomophilous pollination. They are grown for the fruits and have a great importance in the human nutrition, being used as fresh preserved or semi-preserved vegetables. They are very demanding in terms of temperature and light. The Cucurbits are cultivated by sowing directly in the field and less often by seedling. The crops in protected areas are established only by seedling. Cucurbits require fertile soils and fertilizers with organic fertilizer in the year of cultivation. All species are sensitive to the attack of diseases and pests, requiring removing them with approved products (Călin, 2010). Important diseases that have occurred during the vegetation period are: downy mildew (*Pseudoperonospora cubensis*), powdery mildew (*Erysiphe cichoracearum* and *Sphaerotheca fuliginea*) and the anthracnose (*Colletotrichum lagenarium*).

Anthrachnose symptoms occur on all aboveground parts of cucumber plants. Lesions that appear on the cotyledons begin small and water-soaked. They are pale in color, chlorotic (yellow) or necrotic (brown), and are restricted. As the disease progresses the lesions become larger, coalesce, and eventually the cotyledons dry up and die. Similar symptoms appear on the leaves; initial symptoms can have water-soaked appearance and be vein delimited and angular similar to angular leaf spot or downy mildew (Palenchar et al. 2016). The fungus evolves especially in conditions of high atmospheric humidity and at an optimum temperature of 25°C. The mycelium of the fungus actively penetrates through the peel and after 3-7 days it bears fruit. The spread of spores during the growing season is ensured by drafts, raindrops or irrigation and insects. The resistance of the fungus over the winter is made in the vegetal remains from the field as well as in the infected seed. It is recommended to gather and burn plant debris, 3-4 years rotations of cucurbits, as well as their location in lands that do not retain water, in soils that will be irrigated by furrows. The establishment of crops will be done with healthy seed, thermally or chemically disinfected. During the vegetation treatments will be made with: Dithane M

75 WG-0.2%, Dithane M 45-0.2%, Nemispor 80 WP-0.2%, Vondozeb-0.2%, Kasumin 2 WP-0.15%.

Downy mildew is a potentially devastating disease of cucurbit crops that can cause significant yield losses. This disease, sometimes referred to as cucurbit downy mildew, is known to infect more than 40 cucurbit species, including cantaloupe, cucumber, pump-kin, squash, and watermelon. In Mississippi, this disease has been more of a problem in the fall than in the spring (Melanson, 2019). The disease was discovered in the middle of the last century in Cuba. In Europe it spread at the beginning of this century, and in Romania it was reported in 1928 in the south of the country. It appeared in Moldova only after 1970. Downy mildew attacks only the leaves, in the form of light green spots on the upper part, angular spots, well delimited by the veins of the leaves. The color of the spot's changes to yellow, then to brown, and on the underside, a gray-purple or beige lint appears. Under favorable conditions, the spots can join and a large part of the leaf is destroyed, and the plants will quickly run out of foliage.

The fungus is spread by rainwater or by irrigation water. Sprinkler irrigation applied in the morning until 10 o'clock, when the spread of sporangia is maximum, gives a strong downy mildew attack. The transmission of the fungus, from one year to another, is ensured by resistance spores present in plant debris, but infections in the following years can also come from spores brought by winds in areas with mild winters, where they remain viable on dry twigs.

As a first preventive measure, it is necessary to burn the remains of attacked plants or bury them in depth. In the vegetable crop rotation, the Cucurbits will return to the same parcel after at least 4 years. The range of approved products is very wide and must be used carefully, respecting the break time and taking care not to perform two successive treatments with the same type of product (Ciofu R. et al, 2004).

Numerous vegetable crops are susceptible to powdery mildew, but cucurbits are arguably the group most severely affected. *Erysiphe cichoracearum* and *Sphaerotheca fuliginea* are the main causal agents of cucurbit powdery mildew and one of the most important limiting factors for cucurbit production worldwide (Perez-Garcia et al.

2009). The disease is widespread in all cultivating countries and causes great damage due to the rapid drying of the leaves. Although it has been known for a long time, it was studied in detail by C. Sandu Ville only in 1967. The aerial organs stem, leaves and even fruits are attacked at all stages of development (Stan N., Munteanu N., 2001).

A white, floury mycelium appears on the surface of these organs in the form of felt. On the limb of the leaves, the spots may join and cover large areas of leaf limb that will soon dry out. Under this mycelium the tissues turn yellow and brown. In conditions of atmospheric drought, the attack extends to the tails of leaves, stems and even fruits. The optimal conditions for the installation and evolution of mushrooms differ. For *Erysiphe* the optimum temperature is 15-26°C and does not require high humidity, while for *Sphaerotheca*, the optimum temperature is 15-21°C but requires high humidity. Mushrooms spread during vegetation through spores carried by wind, water or insects. The most commonly infected are the mature leaves, while the newly formed ones are more resistant. It is recommended to cultivate resistant varieties, compliance to the crop rotation and destroy the host plants from the spontaneous flora to reduce the infection.

MATERIAL AND METHODS

The experiments were performed during 2019 - 2020 at Vegetable Research and Development Station Bacău – Romania in order to evaluate the behavior of Cucurbits cultivars during the entire vegetation period to all pathogens attack.

The trial was performed on the following *Cucurbita pepo* cultivars: V1 – Aredendo T-1, V2 – Local population 2, V3 – Milet F-1, V4 – Alburu de Sarzana, V5 – L9 / 2018 Bacău, V6 – Gary Zucchini, V7 – Early Garden, V8 – Winter Squash, V9 – Born Free, V10 – Bush Pink Banana, V11 – Winter Squash Spaghetti, V12 – Local population 4 China, V13 – L 4 Bacău, and V14 - Local population 11.

Also, on the *Cucurbita moschata* V15 – L 5. *Luffa cylindrica* V16 – L 1.

From *Lagenaria siceraria* the following: V17 – Local population (orange pear), V18 – Local population (green pear), V19 – Local population (small pear) and V20 – Local population green with stripes. From *Cucurbita maxima* the V21 – Turban and from *Momordica charantia* V22 – Brâncuși.

The cultivars were sown in a greenhouse on the 4th of May directly on cell plastic trays. They were kept inside the greenhouse until the 25th of May when they were planted on the field under black protective polyethylene foil. Also in the field was fitted auxiliary net for the climbing varieties (figure 1).

The observations were accomplished during 4 months period each year, once at every 15 days, after the variants were planted into the field.

The attack of pathogens was determined using the following indicators:

- Frequency of attack (F%)
- Intensity of attack (I%)
- Degree of attack (DA%)



Figure 1. Climbing varieties

The results obtained from this experiment will be used in conventional and organic farming systems in order to decrease the number of diseases treatments and finding and using the most disease and pest resistant varieties of *Cucurbitaceae*.

RESULTS AND DISCUSSIONS

The major diseases of squash cultivars that were reported are presented in table 1.

It can be observed that the only tolerant variety is L9/2018. Very sensible to anthracnose attack are the following varieties: Early Garden, Born Free, Winter Squash Spaghetti, Local population 4 China and L 4 Bacău.

The behavior of *Cucurbita spp.* cultivars varied a lot, this can be observed in tabel 2.

The behavior of *Lagenaria siceraria* varied according with the cu ltivars from table 3.

Table 1. The behavior of the squash cultivars throughout the vegetation period

No.	Cultivars	Attack			Comments
		Frequency (F%)	Intensity (I%)	Degree of attack (DA%)	
Colletotrichum lagenarium					
1	Aredendo T-1	100	29	29	
2	Local population 2	100	18.5	18.5	
3	Milet F-1	90	43.3	39	
4	Alburiu de Sarzana	100	18.5	18.5	
5	L 9 / 2018	100	5.9	5.9	Tolerant to this disease
6	Gary Zucchini	100	29.9	29.9	
7	Early Garden	100	100	100	Very sensible cultivar
8	Born Free	100	71.2	71.2	Very sensible cultivar
9	Bush Pink Banana	100	41.5	41.5	
10	Winter Squash Spaghetti	100	100	100	Very sensible cultivar
11	Local population 4 China	100	82.5	82.5	Very sensible cultivar
12	L 4 Bacau	100	88	88	Very sensible cultivar
13	Winter Squash	100	15.4	15.4	
14	Local population 11	100	52.9	52.9	
Erysiphe cichoracearum					
15	Local population 2	20	5.2	1.1	
16	Alburiu de Sarzana	70	5.4	3.8	
17	L 9 / 2018	100	2.4	2.4	Tolerant to this disease
18	Born Free	10	6.3	6.3	
19	Local population 4 China	25	3	0.8	
20	Winter Squash	50	8	4	

Table 2. The behavior of the *Cucurbita spp.* cultivars throughout the vegetation period

No.	Cultivars	Attack			Comments
		Frequency (F%)	Intensity (I%)	Degree of attack (DA%)	
Colletotrichum lagenarium					
1	L 5	100	60	60	Cucurbita moschata
Pseudoperonospora cubensis					
2	Turban	42.9	100	42.9	Cucurbita maxima
Erysiphe cichoracearum					
3	Turban	100	5.7	5.7	Cucurbita maxima

Table 3. The behavior of the *Lagenaria siceraria* cultivars throughout the vegetation period

No.	Cultivars	Attack			Comments
		Frequency (F%)	Intensity (I%)	Degree of attack (DA%)	
Colletotrichum lagenarium					
2	Local population green with stripes	100	52.2	52.2	Very sensible cultivar
3	Local population (green pear)	100	19.6	19.6	
4	Local population (small pear)	100	5.3	5.3	Tolerant to this disease
Pseudoperonospora cubensis					
6	Local population (orange pear)	100	89.5	89.5	Very sensible cultivar
Erysiphe cichoracearum					
8	Local population green with stripes	100	30.4	30.4	Very sensible cultivar
9	Local population (green pear)	100	3.7	3.7	
10	Local population (small pear)	100	3.3	3.3	Tolerant to this disease

At *Cucurbita spp.*, *Cucurbita maxima* was attacked by downy mildew, having a degree of attack of 42.9% and also by powdery mildew, having a degree of attack of 5.7%. While the *Cucurbita moschata* was attacked only by anthracnose. It had 60% DA%. It can be seen that pumpkin cultivars were sensitive to downy mildew and anthracnose and tolerant to powdery mildew.

Momordica charantia (V22 – Brâncuși) was tolerant to the attack of pathogens specific to cucurbits. Only sporadic attacks of anthracnose were

observed, the frequency of the attack being 35.7%, the intensity of the attack 10% and the degree of attack 3.6%.

Luffa cylindrica was very tolerant to diseases, the degree of attack being 0%.

Among the *Lagenaria* cultivars they were tolerant to diseases only Local population (small pear), has been attacked by anthracnose by 5.3% and powdery mildew 3.3% degrees of attack. The other varieties were tolerant to powdery mildew (less than

5.2%) except for the Local population green with stripes variant which recorded 30.4% DA.

CONCLUSIONS

Following the observation made and the results which we obtained it can be concluded that only a few varieties of *Cucurbitaceae* that were taken into the study are tolerant to the most common diseases, downy mildew, powdery mildew and anthracnose.

The most disease tolerant squash cultivar from the study is the V5 – L9 / 2018 which got the lowest percent of degree of attack (5.9) at the disease caused by *Colletotrichum lagenarium* and also the lowest percent of degree of attack (2.4) at the disease caused by *Erysiphe cichoracearum*. Proving sustainability and easy maintenance in the crops, not needing applied chemical treatments.

Luffa cylindrica was very tolerant to diseases, the variety (V15 – L1) with the degree of attack being 0%, with no disease attack reported.

The most disease tolerant *Lagenaria siceraria* cultivar that was taken into study is the V19 – Local population (small pear) which got the lowest percent of degree of attack (5.3) at the disease caused by *Colletotrichum lagenarium* and also the lowest percent of degree of attack (3.3) at the disease caused by *Erysiphe cichoracearum*, and without attack of *Pseudoperonospora cubensis* proving excellent resistance to diseases and pests, being easy to maintain in large crops.

The most sensitive to diseases are the following variants: V7 – Early Garden, V9 – Born Free, V11 – Winter Squash Spagetti, V13 – L 4 Bacau, V17 – Local population (orange pear), V20 – Local population green with stripes and V12 – Local population 4 China.

ABSTRACT

This is a study of tolerance of some species and varieties of *Cucurbitaceae* to the attack of pathogens that are based on the scientific results obtained in the field. This paper aims to add studies on disease resistant species, in order to achieve these objective, other intermediate analyzes were necessary which were made using the following indicators: frequency of attack (F%), intensity of attack (I%) and the degree of attack (DA%).

The results obtained from this experiment will be used in conventional and organic farming systems in order to decrease the number of diseases treatments and finding and using the most disease and pest resistant varieties of *Cucurbitaceae*.

The trial was performed on the following cultivars: *Cucurbita pepo* cultivars: V1 – Aredendo T-1, V2 – Local population 2, V3 – Milet F-1, V4 – Alburiu de Sarzana, V5 – L9 / 2018 Bacau, V6 – Gary Zucchini, V7 – Early Garden, V8 – Winter

Squash, V9 – Born Free, V10 – Bush Pink Banana, V11 – Winter Squash Spaghetti, V12 – Local population 4 China, V13 – L 4 Bacau, and V14 – Local population 11. Also, on the *Cucurbita moschata* V15 – L 5. *Luffa cylindrical* V16 – L 1. From *Lagenaria siceraria* the following: V17 – Local population (orange pear), V18 – Local population (green pear), V19 – Local population (small pear) and V20 – Local population green with stripes. From *Cucurbita maxima* the V21 – Turban and from *Momordica charantia* V22 – Brâncuși

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AUTHORS' ADDRESS

BUTE ALEXANDRU, AMBĂRUȘ SILVICA, BREZEANU CREOLA, CĂLIN MARIA, BREZEANU PETRE MARIAN - Vegetable Research and Development Station, Calea Bârladului Street, No. 220, Bacău, Romania, e-mail: alexandru.bute@outlook.com.