

PRELIMINARY RESULTS REGARDING THE POSTHARVEST PATHOLOGY OF PAWPAW (*ASIMINA TRILOBA* DUNAL) FRUITS

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Abstract

Asimina triloba, the pawpaw, is one of the few fruit tree species native to the United States. The plant is native to eastern North America, growing spontaneously from the Gulf of Mexico till the Great Lakes. The tree produces large fruits, yellow-green colour, sweet and flavored. In Romania, the first plants were introduced in Transylvania in 1926 and have been grown locally, remaining unknown to the rest of the country. Starting with the year 2000, within the Faculty of Horticulture from Bucharest, there were cultivated several varieties and hybrids of pawpaw, in order to determine the suitability of this species for the establishment of new plantations in Romania. The fruits were harvested manually and stored in controlled atmosphere rooms with 1.5% CO₂, at 4°C temperature and 90% relative humidity. During the 2 months storage period were identified several pathogens affecting the pawpaw fruit. The micromycetes identification was carried out by isolation and successive subculture on PDA medium culture (Potato Dextrose Agar), followed by incubation at 22°C in the thermostated chamber.

Key words: *Asimina triloba*, storage pathogens, postharvest.

INTRODUCTION

The fruits are rich in active ingredients, vitamins and minerals. The fruits have an excellent exotic taste, that evolves during the storage from the taste of vanilla cream at crème brûlée, and finally, to chocolate cream taste.

Asimina triloba (pawpaw L. Dunal), is part of the family *Annonaceae* being known in North America - its area of origin, as Pawpaw (Stanica, F. et al., 2008). The genus includes the largest edible fruits originating in North America (Darrow, 1975). It is a large, thin, leathery fruit with two rows of almond-sized seeds. Its shape can vary from oval to elongated, peanut-shaped and can vary between 3 and 6 mm in length (McGrath M., 1994). Of the approximately 2300 species and 130 genera in the *Annonaceae* family, only the genus *Asimina* grows in temperate climates. All other genera of the family *Annonaceae* grow in the tropics. In south-eastern Florida and Georgia there are eight species of the genus *Asimina*: *Asimina angustifolia* Raf. - Pawpaw with narrow leaves, *Asimina incana* (W. Bartram) - Pawpaw with wool, *Asimina obovata* (Willd.)

Nash - Pawpaw with large flowers, *Asimina parviflora* (Michx.) Dunal - Pawpaw with small flowers, *Asimina pygmaea* (W. Bartram) Dunal - Pawpaw dwarf, *Asimina reticulata* Shuttlw. ex Chapman - Netted Pawpaw, *Asimina tetramera* Small - Pawpaw with four petals, *Asimina triloba* (L.) Dunal - Common Pawpaw (Callaway, 1993).

Pawpaw grows at the edge of forests and is noted for its high frost resistance, surviving winters at -25...-30°C, however, it is grown as an orchard crop in several states, including Alabama, California, Maryland, Michigan, Missouri., North Carolina, Kentucky, West Virginia, and Ohio. It has also been planted in Italy, China, Japan, Israel, Belgium, Portugal and Romania (Brannan, R. G et al., 2015). In Romania, it was introduced around 1900 in Pianu Nou, Alba County, by an emigrant returning from America. From there, some plants arrived in the locality of Geoagiu, where they are still found in the present of some locals (Stănică, F. et al., 2004).

In 2000, at the Faculty of Horticulture in Bucharest, 7 varieties and 3 hybrids of *Asimina triloba* (L.) Dunal imported from Italy were

introduced, with which three collections were established. One collection exists within the Bucharest Faculty of Horticulture, and the other two collections are in private gardens in Argeş and Ilfov counties (Stănică F., 2002; Stănică F. et al., 2004; Stănică F., 2012). Today, the northern banana is one of the most exotic plants that have been acclimatized in Romania with a huge potential on the domestic market, especially due to the special taste of vanilla and chocolate. *Pawpaw* fruits have a special taste, are rich in nutrients, dietary fiber, protein, minerals and vitamin C, they can be used as ornamental and medicinal species (Layne, D.R., 1996; Picchioni, G. A et al., 2004; Pomper, K.W., et al., 2002; Pomper and Layne, 2005).

The harvest season for pawpaw fruit is from mid-August to the end of September. A color change often occurs later in the ripening period. On the other hand, a decrease in fruit firmness is relatively obvious and a detectable indicator of maturity (Pomper et al., 2008). It is also recommended to harvest the fruits during the early ripening period, in order to increase the storage time (Archbold et al., 2003; Pomper & Layne, 2005; Szilagy B. A., 2015).

In Bucharest, the fruits of *Asimina triloba* (L.) Dunal ripen only at the beginning of October (Cepoiu, N. et al., 2003).

During ripening, the loss of firmness is extremely fast, the fruits soften quickly, at ambient temperature and this can be an obstacle in the development of a wider development market (Galii et al., 2008).

Monilinia spp is the plant pathogen responsible for the occurrence of grey mold and fruit rot in stone fruits species, and it is present in all cultivated areas (Cristea S. et al., 2017)

Agricultural production is vulnerable to contamination and infection with various microorganisms during storage and the safety of agri-food products can be achieved by maintaining climatic factors in the stored areas, thus limiting the population level of contaminating microorganisms. The most common genera of fungi identified in storage room are *Aspergillus*, *Penicillium* and *Fusarium* (Dudoiu, R. et al, 2016)

Micromycetes' development on storage room is conditioned by temperature and atmospheric

humidity present in stored areas and by its fluctuations in time (Cristea S., 2004)

The results showed that Romanian natural conditions are suitable for growing this species as one of the most exotic plants that were ever acclimated in Romania. The pawpaw has an huge potential on the domestic market.

MATERIALS AND METHODS

The present paper presents the results of research conducted between 2016-2017, a period in which no phytosanitary treatments have been applied, the plants proving their suitability to the organic production systems

Research has sought to identify the presence of mycoflora on the fruits of *Asimina triloba* (L.). The biological material consisted of samples of pawpaw fruit, stored in the room with a controlled atmosphere, from which samples were taken for analysis. The fruits were harvested by hand and stored in rooms with a controlled atmosphere with 1.5% CO₂ at 4°C and a relative humidity of 90%.

The samples were taken immediately after collection and stored for 60 days. The batch sampling was performed on three levels, respectively the base, the middle and the upper surface, then a sample of 100 fruits was constituted (Chira L., 2008).

PDA culture medium was used to isolate and identify microorganisms associated with the disintegration of pawpaw fruits.

The fruits were washed from the ground with tap water and finally rinsed with sterile water. No pesticides have been used as they can also affect pathogenic fungi. Since the aim was to isolate the fungi that spore on the surface, the introduction of the samples in the humid chamber was preceded by a day or two (Severin, V. et al., 2009).

Segments of 1-2 mm of tissue from the edge of the affected area are passed, with the help of a sterile scalpel and a repeating needle, in Petri dishes with a diameter of 70 mm, on the PDA culture medium. The vessels were incubated at 22°C for 9 days. Observations were made at 3, 6 and 9 days. The Euromex stereo microscope and the Euromex Ox Range microscope were used to identify fungi, based on the scientific literature (Raicu C., 1978; Hulea A., et al., 1986; Hulea A., 1969).

RESULTS AND DISCUSSIONS

Studying the spectrum of pathogens on the fruits of the "northern banana" it was found that the mycoflora present in the analyzed samples was composed of fungal species belonging to the genera *Alternaria* spp., *Verticillium* spp., *Penicillium* spp., *Fusarium* spp. and *Monilinia* spp.

The analysis of the 2016 samples shows that the fruits from the studied genotypes showed fructifications of the micromycetes *Alternaria* spp., *Verticillium* spp., *Penicillium* spp., *Fusarium* spp. and *Monilinia* spp.

Table 1. Mycoflora detected on pawpaw fruits

Genotypes	The pathogen agent				
	<i>Alternaria</i> spp.	<i>Verticillium</i> spp.	<i>Monilinia</i> spp.	<i>Penicillium</i> spp.	<i>Fusarium</i> spp.
R1P2	+	+	+	-	-
R1P8	-	-	-	+	-
R2P1	-	-	+	+	+
R2P3	+	+	+	+	+
10344	-	-	+	+	-
10836	-	-	+	+	+

In the samples of pawpaw fruits, from the 2016 harvest, micromycetes belonging to the genera *Alternaria* spp., *Verticillium* spp., *Penicillium* spp., *Fusarium* spp. and *Monilinia* spp. When analyzed genotype R2P3i was identified and detected the fungus *Alternaria* spp., who was present also on the skin of genotype R1P2, R2P3.

The pathogen *Penicillium* spp. was identified on the genotypes R1P8, R2P1, R2P3, 10344, 10836. The fungus *Fusarium* spp. was present on the genotypes R2P1, R2P3, 10836.

Micromycetes of the genus *Monilinia* spp. Were identified on genotypes R1P2, R2P1, R2P3, 10344 and 10836.

Observations made on the incidence of mycoflora detected on "northern banana" fruits in 2016 (Table 2) show that the micromycete *Alternaria* spp., present on genotypes R1P2, R2P3, had the highest frequency value, in the variety R1P2 with F = 70%.

Pathogens of the genus *Monilinia* spp, showed the highest incidence values in the variety R2P3 with 66%, 10344 (56%) and R2P1 with 45%. The lowest incidence value was noted in the R1P2 genotype (20%).

In the analyzed samples, the micromycete *Penicillium* spp. Was identified on the genotypes R1P8, R2P1, 10836, 10344, R2P3,

with frequency values of 100%, 48%, 44% and F = 17%, respectively.

Table 2. Incidence of mycoflora detected on pawpaw fruits expressed as a percentage (2016)

Genotypes	The pathogen agent (after 9 days)				
	<i>Alternaria</i> spp.	<i>Verticillium</i> spp.	<i>Monilinia</i> spp.	<i>Penicillium</i> spp.	<i>Fusarium</i> spp.
R1P2	70	10	20	-	-
R1P8	-	-	-	100	-
R2P1	-	-	45	20	35
R2P3	10	4	66	17	3
10344	-	-	56	44	-
10836	-	-	35	48	7

The results showed that *Alternaria* spp., *Verticillium* spp., *Penicillium* spp., *Fusarium* spp. and *Monilinia* spp. were found with pawpaw fruits studied. All five isolated organisms were confirmed to be pathogenic on pawpaw fruits, but in different percentages. Gupta and Pathak (1986) previously reported that pathogens were responsible for post-harvest pawpaw losses in southwestern Nigeria.

CONCLUSIONS

Research has shown that fruit rot and the development of pathogens depend on various factors. The optimum temperature range for the development of pathogenic fungi was 22°C.

Isolation of these pathogens confirmed the studies of Baiyewu and Amusa (1999), Baiyewu et al. (2007), Gupta and Pathak (1986) which showed pathogenic fungi cause significant losses in pawpaw fruits at post-harvest.

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