

## THE EVOLUTION OF THE FITOSANITARY STATUS OF THE STORED APPLES IN NATURAL CONDITIONS

## EVOLUȚIA STĂRII FITOSANITARE A MERELOR IN TIMPUL DEPOZITĂRII NATURALE

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### REZUMAT

Cercetările au avut loc la Bistrița, în condiții naturale de depozitare din octombrie până în martie și s-au urmărit două soiuri de mere Jonathan și Golden delicious.

S-a determinat microflora de câmp și de depozit care produce putrezirea fructelor. Soiul Golden delicious s-a comportat rezistent la păstrare, frecvența (F%), intensitatea (I%) și gradul de atac (Ga%) fiind scăzute, de exemplu, gradul de atac în martie a fost de 5,52%. Soiul Jonathan s-a prăbușit după trei luni de depozitare, frecvența atacului depășind 30%.

**CUVINTE CHEIE:** mere, depozitare naturală, stare fitosanitară, putregai

### ABSTRACT

The researches took place in natural conditions of storage from October to March, and were aimed at two apple cultivars: Jonathan and Golden delicious.

We had determinate the field and storage mycological flora which produces rotten stuff. The cultivar Golden delicious behaved as resistant in the storage period; the frequency (F%), the intensity (I%) and the degree of attack (D.A%) was low, for example the degree of attack in March touched 5,52%. The cultivar Jonathan broke down after three month of storage, the frequency of attack being above 30%.

**KEYWORDS:** apples, natural storage, phytosanitary state, rot

### DETAILED ABSTRACT

The researches took place in natural conditions of storage from October to March, and were aimed at two apple cultivars. Jonathan and Golden delicious. We've made monthly, in January, February and March, observations and analyses about the fitosanitary state of the stored apples, we've determined the frequency of attack (F%), the intensity of attack (I%) and the degree of attack (Da%). The apples brought in the storage were sane, without macroscopically symptoms.

As a result of the macroscopic and microscopic study, the incubation in „wet chambers” and on the agar mediums, on the stored apples Jonathan and Golden we've determined field and storage microorganisms that produce rots.

From the pathogens, which infects in field we identified on the surface and inside the fruits the following agents: *Fusicladium dendriticum* p.f. *Venturia inaequalis*, *Monilia fructigena* p.f. *Monilinia fructigena*, *Gloeosporium fructigenum* p.f. *Glomerella cingulata* and *Sphaeropsis malorum* p.f. *Physalospora cydoniae*.

In Jonathan cultivar we notice the marked increase of the frequency in the first storage months, the highest frequency of 32,44% being reached in March. The frequency of attack in Golden cultivar follow the same evolution, increasing constant until March, but with smaller values than in Jonathan's. It's obvious the premature break down of the apples Jonathan after two month of storage, comparative with the Golden cultivar that is more resistant to storage.

In Golden delicious cultivar the degree of attack is very low in the first months, under 2%, indicating a great storage resistance of this cultivar. In March the degree of attack reaches 5,52%, value which was exceeded by the Jonathan apples in the first storage weeks.

## INTRODUCTION

During the storage of the fruits occurs a depreciation of their quality due to the metabolic processes and to the activity of the microorganisms. The qualitative depreciation is a normal process during the fruit storage but its appearance amplitude is induced by the culture and storage technologies (Hulea Ana and all, 1982).

The microorganisms are one of the most important reasons which determine the qualitative depreciation of fruits, there alimentary and commercial value decrease owing to different pathogens, especially fungus, which manifest their destructive action during the storage (Crişan Aurelia, 1973).

Our researches took place at Bistrita, in the storehouse of the fruit growing farm of SC RAAL Bistrita SA. We studied two cultivars of apples, Jonathan and Golden delicious. The apples brought in the storage were sane, without macroscopically symptoms.

## MATERIAL AND METHOD

The apples from the two cultivars Jonathan and Golden delicious were pursued from bringing in storage in October – November 2003 until the exit from storage, in March 2003. We've made monthly, in January, February and March, observations and analyses about the fitosanitary status of the stored apples, we've determinate the frequency of attack (**F%**), the intensity of attack (**I%**) and the degree of attack (**Da%**). The drawing of the samples were according to the standards, the weight of the medium sample was three kilos.

At every variant, in three repetitions, we've pursued:

- Macroscopically identification of the pathogens according to the external symptoms;
- Microscopically identification of the spores from the fructifications off the fruits;
- Incubation in „wet chambers”, on blotting paper, at 25° degrees in thermostat, of different sections from epidermis, pulp and seminal loculus and studying at stereoscope of the developed mycelia and sporulation;
- Microscopically identification of the spores from the fructifications developed in „wet chambers”;

- Fungus studying on malt and Czapek agar-agar mediums (Hulea Ana, 1969).

The frequency of attack (**F%**) was determinate dividing the number of diseased apples (**n**) by the total number of apples (**N**) from every box; formula being:  $F\% = n / N \times 100$ .

The intensity of attack (**I%**) was percentage appreciated for every apple, and the formula for **I%** was:  $I\% = (i \times f) / n$ , where **i** is the percentage of covering with symptoms, **f** is the number of cases with symptoms and **n** is the number of diseased apples.

The degree of attack (**Da%**), express the extension of the attack's seriousness and was calculated by the formula:  $Da\% = (F\% \times I\%) / 100$ .

## RESULTS AND DISCUTIONS

As a result of the macroscopic and microscopic study, the incubation in „wet chambers” and on the agar mediums, on the stored apples Jonathan and Golden we've determinate field and storage microorganisms that produce rots (Table 1).

From the pathogens, which infects in field we identified on the surface an inside the fruits the following agents: *Fusicladium dendriticum* p.f. *Venturia inaequalis*, *Monilia fructigena* p.f. *Monilinia fructigena*, *Gloeosporium fructigenum* p.f. *Glomerella cingulata* and *Sphaeropsis malorum* p.f. *Physalospora cydoniae*. The most of this fungus were located on the surface and inside the fruits and *Monilinia* was found in the seminal loculus. The micro charge is bigger at the Jonathan apples than the Golden ones. On the Golden apples we've determinate only *Monilinia* and *Fusicladium*.

The pathogens, which infects in vegetation and manifest symptoms during the storage period were determinate in most cases on the Jonathan apples, on and inside the fruits, as we notice in tabel no. 1. We mention: *Phomopsis mali* p.f. *Diaporthe pernicioso* – on Jonathan, *Gloeosporium album* p.f. *Pezicula malicorticis* and *Cytospora pomicola* – on Jonathan and Golden, *Cylindrocarpon mali* p.f. *Nectria galligena* – sporadically on Jonathan and *Botrytis cinerea* – apical rotten stuff on the Golden apples.

Table 1: Micro fungus isolated from stored apples, Bistrița 2002/2003

Conidial stage (anamorph)	Perfect stage (teleomorph)	Localization			Mold symptom			Frequency	
		S	I	L	P	T	M	J	G
<i>Fusicladium dendriticum</i>	<i>Venturia inaequalis</i>	+						+	+
<i>Gloeosporium fructigenum</i>	<i>Glomerella cingulata</i>	+	+		+	+	+	++	
<i>Monilia fructigena</i>	<i>Monilinia fructigena</i>	+	+	+	+	+	+	++	+
<i>Sphaeropsis malorum</i>	<i>Physalospora cydoniae</i>	+	+		+			++	
<i>Cylindrocarpon mali</i>	<i>Nectria galigena</i>	+	+	+	+	+	+	+	
<i>Gloeosporium spp.</i>	<i>Pezicula spp.</i>	+	+		+			+	+
<i>Cytospora pomicola</i>		+	+		+			+	+
<i>Phomopsis mali</i>	<i>Diaporthe perniciososa</i>	+	+	+	+	+	+	+	
<i>Rhizopus stolonifer</i>		+	+		+	+		+	
<i>Fusarium spp.</i>		+		+	+	+		+	
<i>Botrytis cinerea</i>		+	+		+	+	+		+
<i>Penicillium spp.</i>		+	+		+	+		+++	++
<i>Trichotecium roseum</i>		+		+	+	+	+	+	+

**Legend:** S – surface of the fruit, I - , L – seminal loculus's, P – partial, T – total, M – mummy, J – Jonathan, G – Golden delicious, + - signaling (F%=1-5%), ++ + - invasion.

From the fungus that infect and produced rot during the storage period we notice a very high frequency of *Penicillium spp.* on the two cultivars, both on and inside the apples. Blue mold produced by *Penicillium spp.* Was the most important postharvest decay of stored apples in our storage as reported by others (Wojciech, 1999). Sporadically on the Jonathan apples developed species of *Fusarium*, *Rhizopus stolonifer* and *Trichotecium roseum*, which occurs on the Golden apples too.

In figure no. 1 we can watch the frequency of the fungal attack at the natural stored apples. In Jonathan cultivars we notice the marked increase of the frequency in the first storage months, the highest frequency of 32,44% being reached in March.

The frequency of attack in Golden cultivars follow the same evolution-increasing constant until March, but with smaller values than in Jonathan's. The maximum frequency of 7,48% was registered in March.

We also noticed the evolution of the frequency of the destroyed apples, which have the intensity of attack 100%, in figure no. 2. The frequency of the destroyed apples is very high (11,72%) in Jonathan cultivar starting January and increase evidently, doubling in March (21,49%). In Golden apples the frequency of the destroyed apples is sub unitary in January and February, recording an increase of

2,69% in the last month of storage. It's obvious the premature break down of the apples Jonathan after two month of storage, comparative with the Golden cultivar, which is more resistant to storage.

The intensity of attack, figure no. 3, records increasing values in the both cultivars during the storage, reaching close values in march: 76,17% in Jonathan cultivar and 73,76% in Golden delicious cultivar. We also notice the different evolution of the intensity of attack: in Jonathan cultivar take place an abruptly increasing till January, with a very high amplitude, 1% = 63,67%, followed by a slow increase next months; in the Golden cultivar the evolution is more uniformly, the increase installment being approximate the same. This aspect confirms that the Golden cultivar behaves more resistant at the fungal attacks during the storage.

The degree of attack of the stored apples is presented in figure no. 4. We notice a very high degree of attack in Jonathan apples, of 11,95% after two months of storage which doubles until March, reaching 24,7%.

In Golden delicious cultivar the degree of attack is very low in the first months, under 2%, indicating a great storage resistance of this cultivars. In March the degree of attack reaches 5,52%, value that was exceeded by the Jonathan apples in the first storage weeks.

Figure 1: The evolution of the frequency of attack of the apples in Nov.

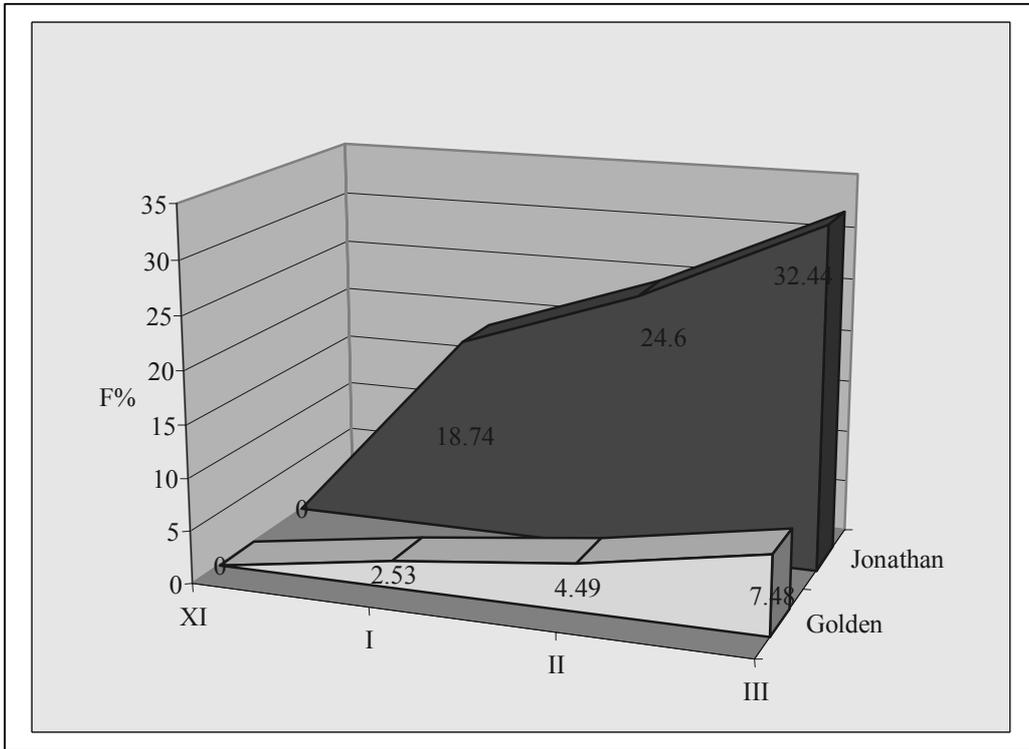


Figure 2: The evolution of the frequency of the destroyed apples in Nov. 2002

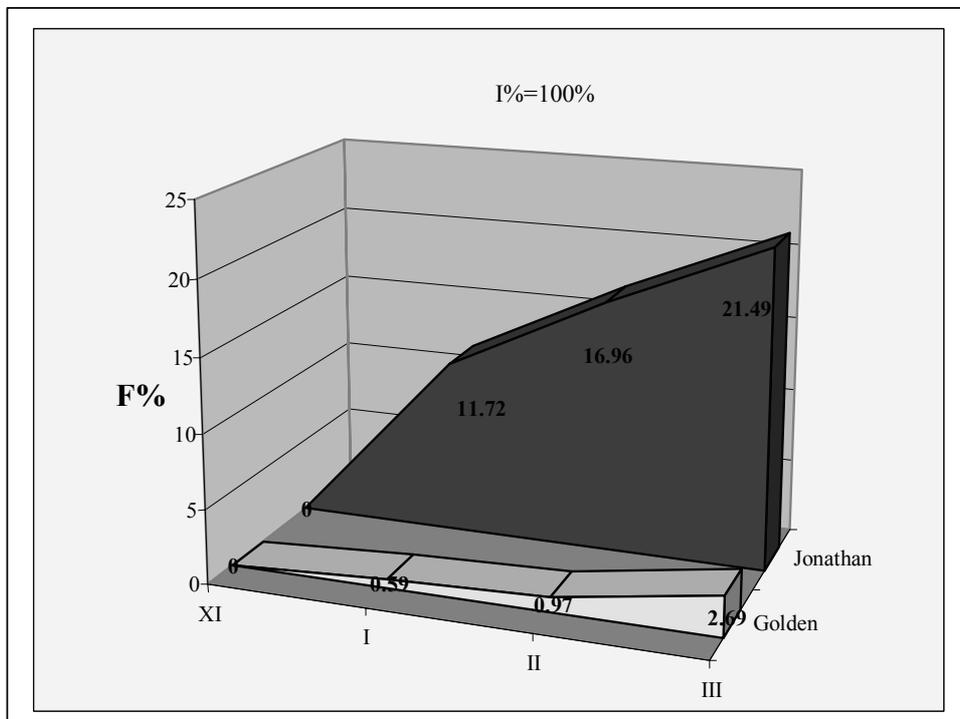


Figure 3: The intensity of attack (I%) on apples

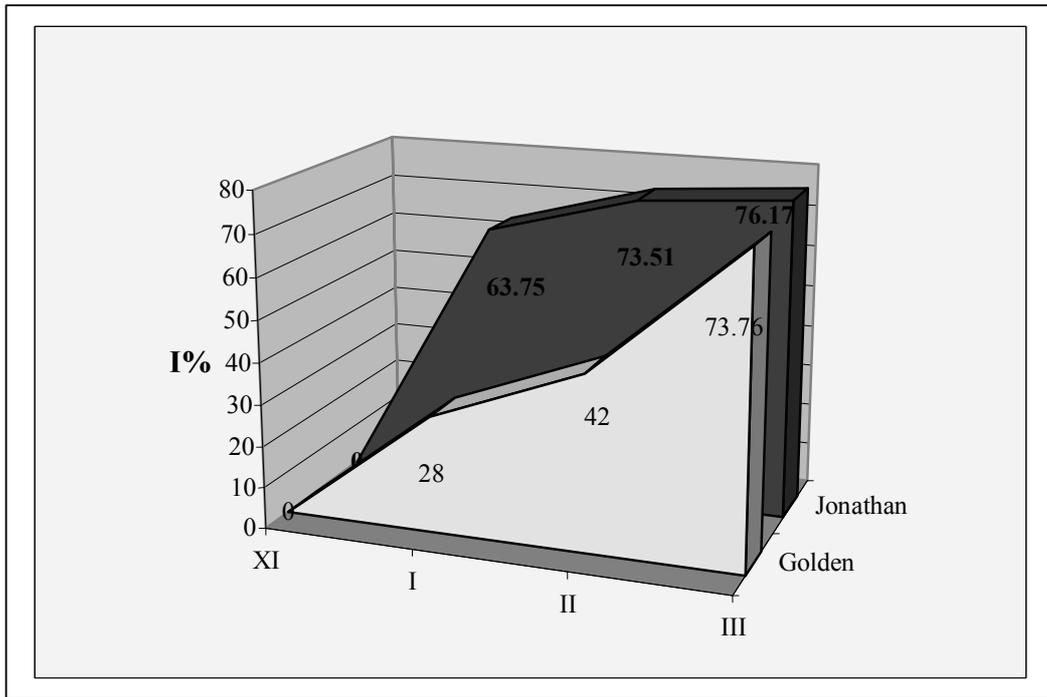
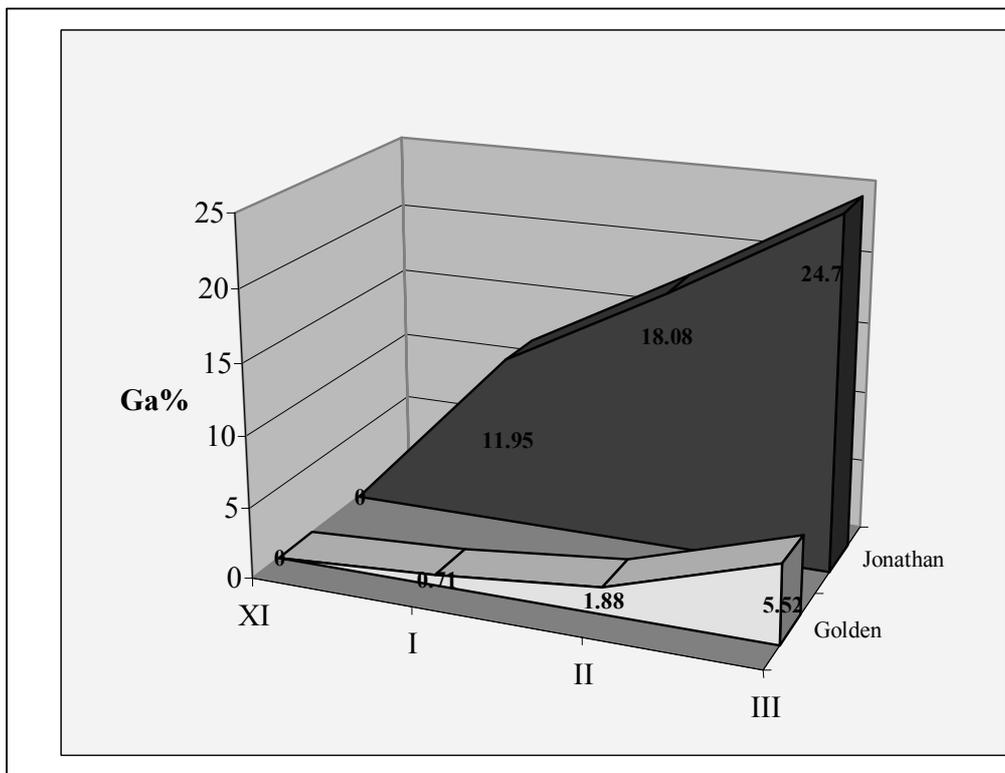


Figure 4: The degree of attack (Da%) on apples



## CONCLUSIONS

The most important post harvest decay of stored apples is blue mold produced by *Penicillium spp.*. The cultivar Golden delicious behaved as resistant in

the storage period; the frequency (F%), the intensity (I%) and the degree of attack (D.A%) were low. The cultivar Jonathan broke down after three month of storage, the frequency of attack being above 30%.

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