journal homepage: www.fia.usv.ro/fiajournal
Journal of Faculty of Food Engineering,
Ştefan cel Mare University of Suceava, Romania
Volume XII, Issue 1 – 2013, pag. 24 - 29

CHANGES OF TOTAL WATER AND DRY MATTER CONTENT IN HEALTHY LEAVES AND IN LEAVES INFECTED BY *TAPHRINA DEFORMANS* AT PEACH CULTIVARS *SPRINGCREST* AND *SPRINGOLD*

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Received 14 November 2012, accepted 5 February 2013

Abstract: *The objective of this study was to estabilish the changes produced in the total water and dry matter content in peach leaves from cultivars Springcrest and Springold infected under natural conditions by Taphrina deformans (Berk.) Tul. The infection with the pathogenic fungus produced an increasing in total water content in leaves of this two peach cultivars and a decreasing of dry matter content when compared with the values of this two physiological parameters recorded in healthy leaves. Both in healthy and in curled leaves, the dry matter content is increasing with the leaves aging. Total water content decreases in healthy and diseased leaves with the leaves age, but the values remained higher in attacked leaves. A linear negative correlation was found between the total water and dry matter content, in both healthy and infected leaves at this two peach cultivars.*

Keywords: *leaf curl, peach, fungi, phytopathogen agent*

1. Introduction

Taphrina deformans (Berk.) Tul. is an obligate parasite, the causal agent of peach leaf curl; this biotrophic fungus develops an intercellular, septate mycelium which induces an abnormal growth of the cells and produces the hypertrophy and hyperplasia of peach leaves tissues. Peach leaf curl is a disease devastating to both crop and tree longevity. A severe attack of *Taphrina deformans* generates early defoliation of peach trees followed by a massive fruit drop and if untreated, in a few years this disease can do to the drying of peaches. This study is important because in Romania peaches are appreciated in alimentation for their high nutritive value and flavour and also used in therapy and such disease like peach leaf curl influence the fruits growth and their quality.

Studies concerning the biology of fungus *Taphrina deformans* and peach leaf curl were made by many authors such as Mary Syrop [1], Roselli *et al.* [2], Melnicenco [3], Testone *et al.* [4], in Romania studies were carried out by Ene Ileana *et al.* [5], Stoian Elisabeta *et al.* [6], Georgescu Mihaela *et al.* [7, 8, 9] Ivascu Antonia *et al.* [10, 11], Teodorecu Georgeta [12] etc.

Cultivar (cv.) *Sprincrest* is very susceptible to *Taphrina deformans* [13] and it was obtained in California in 1969 [14]; cv. *Springold* in considered susceptible at the attack of fungus *Taphrina deformans*, it

was obtained at Fort Valley (SUA) and distributed in production in 1966 [15, 16].

2. Materials and methods

The material used in this study was represented by fresh peach leaves. Leaves showing curl simptoms were collected from cultivars *Sprincrest* and *Springold* cultivated in the Didactic orchard „Vasile Adamachi" Iaşi. For control, healthy leaves, were also collected.
The estimation of total water and dry matter content was made by using the gravimetric method described by Boldor *et al*. The fresh leaves were fixed for a few minutes at 105 ºC then dried out at 60ºC until the constant weight was achieve [17].
Data obtained in this experiment were statistically processed using the linear correlation model [18] of Microsoft Excel program.

3. Results and discussion

The values of total water content from healthy leaves and from leaves attacked by *Taphrina deformans* at cv. *Springcrest*, are presented in Fig. 1, from which it can be observed that the highest value of the total water content – 69.785 g% was registered at 4.05.2009, followed in decreasing order by the values recordered at 18.05.2009 (68.5551 g%), 25.05.2009 (66.0404 g%) at 1.06.2009 (65.3545 g%).
In the leaves infected by *Taphrina deformans*, the total water content had the smallest value at 1.06.2009 (76.8214 g%), followed in increasing order by the next values: 77.6348 g% (25.05.2009), 80.2711 g% (18.05.2009), 83.0569 g% (4.05.2009). Both, in healthy leaves and in diseased ones, the total water content is decreasing with the leaves ageing. In diseased leaves total water content is decreasing at one time with the disease evolution.
Dry matter content from healthy leaves recorded the smallest value – 30.2149 g% at 4.05.2009 and it was followed in increasing order by the values observed at 18.05.2009 (31.4448 g%), 25.05.2009 (33.9595 g%), 1.06.2009 (34.6454 g%); In the leaves infected with în *Taphrina deformans*, dry matter content is increasing at one time with the evolution of the fungus attack and it recorded the following values: 16.943 g% (4.05.2009), 19.7289 g% (18.05.2009), 22.3651 g% (25.05.2009) şi 23.1785 g% (1.06.2009).
The dry matter content at cv. *Springcrest* had smaller values in diseased leaves compared with the healthy ones, as evidence are the values of Diseased/Healthy ratio: D/H=0.5607 (4.05.2009), D/H=0.6274 (18.05.2009), D/H=0.6585 (25.05.2009), D/H=0.6690 (1.06.2009); total water content recorded higher values in diseased leaves when compared with the healty leaves and they registered specifically variation from one period to another, the D/H had the following values: D/H=1,1901 (4.05.2009), D/H=1.1708 (18.05.2009), D/H=1.1755 (25.05.2009), D/H=1.1754 (1.06.2009).

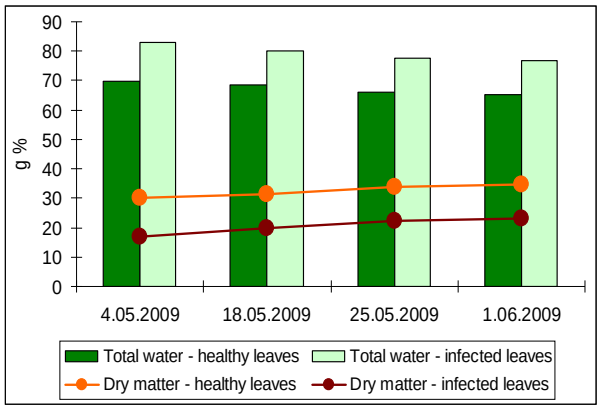

Figure 1. Total water and dry matter content in healthy leaves and in leaves infected by *Taphrina deformans* at cv. *Springcrest*

The percenage differences of dry matter content in attacked peach leaves over healthy leaves at cv. *Springcrest* were of: -43.9251% (4.05.2009), -37.2586% (18.05.2009), -34.1418% (25.04.2009) and

-33.0979% (1.06.2009); results revealed that the % differences in diseased leaves over healthy ones for total water content were: +15.9793% (4.05.2009), +14.5955% (18.05.2009), +14.9345 % (25.05.2009) and +14.9267% at 1.06.2009.

Analysing the regression equations (Fig. 2, 3) it was found that between total water content (the dependent variable) and the dry matter content (the independent variable) of the leaves at cv. *Springcres*t, a high negative linear correlation was observed both in healthy leaves (r=-0.9783*) and in leaves attacked by *Taphrina deformans* (r=-0.9764*); at one time with the increasing of dry matter content of the leaves it take place an decreasing of total water content.

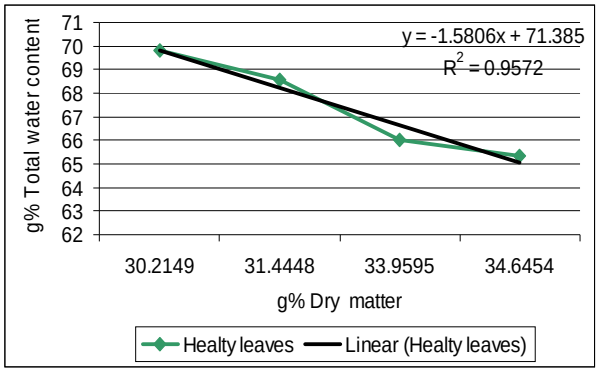

Figure 2. Correlation analysis between dry matter and total water content in healthy leaves at cv. *Springcrest* (* the correlation is significant at p < 0.05)

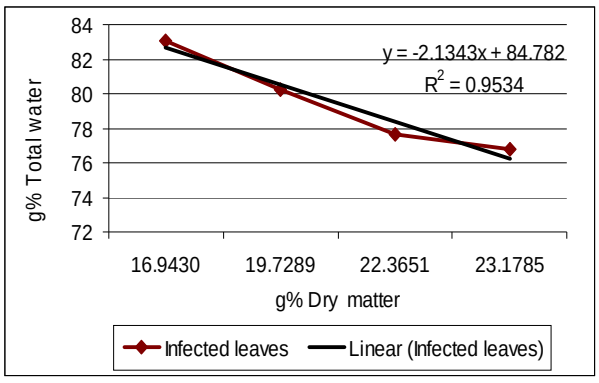

Figure 3. Correlation analysis between dry matter and total water content in leaves infected by *Taphrina deformans* at cv. *Springcrest* (* the correlation is significant at p < 0.05)

The total water content from diseased leaves is modifying at same time with the increasing of dry matter content, this modification is more intense in compare with changes which take place in healthy leaves, the regression coeficient had the following value b=-2.1343 in the case of diseased leaves and b=-1.5806 for the healthy leaves.

The results concerning the total water content and dry matter from healthy and diseased leaves at cv. *Springold* are presented in Fig. 4. The highest value of total water content in healthy leaves was recorded at 4.05.2009 (68.6174 g%), followed in decreasing order by the values recorded at: 18.05.2009 (67.7404 g%), 25.05.2009 (65.5511 g%) and at 1.06.2009 (65.1461 g%). Total water content from the leaves attacked by *Taphrina deformans* is decreasing at the same time with the disease evolution, so were recorded the next values: 81.8561 g% (4.05.2009), 80.8951 g% (18.05.2009), 77.432 g% (25.05.2009) and 77.1027 g% (1.06.2009).

Dry matter content, at the same peach cultivar, had the smallest value -31.3825 g% at 4.05.2009 and was followed in increasing order by the values recorded at: 18.05.2009 (32.2592 g%), 25.05.2009 (34.4488 g%), the highest value for this parameter -34.8538 g% was registered at 1.06.2009. In the leaves attacked by *Taphrina deformans* the dry matter content is increasing at one time with the development of the disease, this parameter recorded the smallest value -18.1438 g% at 4.05.2009, followed in increasing order by the values: 19.1048 g% (18.05.2009), 22.5679 g% (25.05.2009) şi 22.8972 g% (1.06.2009).

The D/H ratio for total water content at cv. *Springold* registered values higher then control at all dates when the determinations were made: D/H=1.1929 (4.05.2009), D/H=1.1941 (18.05.2009), D/H=1.1812 (25.05.2009), D/H=1.1835 (1.06.2009); dry matter content, registered

an decreasing in leaves attacked by *Taphrina deformans* when compared with the values from the healthy leaves, the ratio D/H had the following values: D/H=0.5781 (4.05.2009), D/H=0.5922 (18.05.2009), D/H=0,6551 (25.05.2009), D/H=0.6569 (1.06.2009).

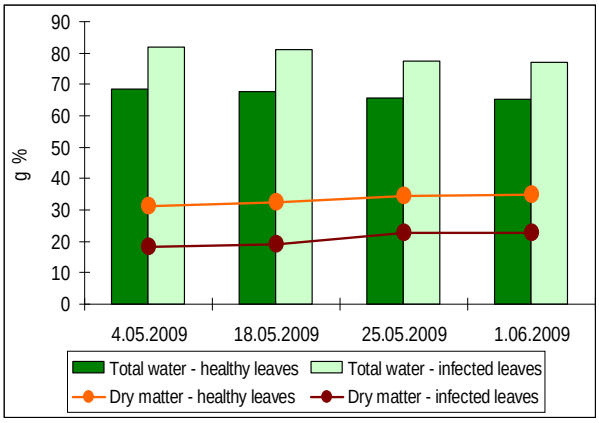

Figure 5. Total water and dry matter content in healthy leaves and in leaves infected by *Taphrina deformans* at cv. *Springold*

At cv. *Springold*, the percentage differences in attacked leaves over healthy leaves for dry matter content had the next values: -42.185% (4.05.2009), -40.7772% (18.05.2009), -34.4886% (25.05.2009), -34.305% (1.06.2009); total water content was higher in infected leaves than in healthy ones, the difference percent was of: +16.1731% (4.05.2009), +16.2614% (18.05.2009), +15.3436% (25.05.2009) and of +15.5073% at 1.06.2009.

From the regression equation (Fig. 6, 7) between dry matter and total water content it was observed that a negative linear correlation estabilished between this two variables, both in healthy leaves (r = -0,9679*) and in those infected by *Taphrina deformans* (r = -0.9502*). Thus, with the leaves maturation it take place an increasing of dry matter content which is accompanied by an decreasing of total water content. The modification of total water content is more intense in attacked leaves that in the healthy leaves, this is proved by the values or regression coefficients for diseased leaves b = -1.7724 and for the healthy ones b = -1.2603.

The results of this study, carried out at cvs. *Springcrest* and *Springold* revealed higher values in total water content in diseased leaves when compared with the values from healthy leaves at both cultivars.

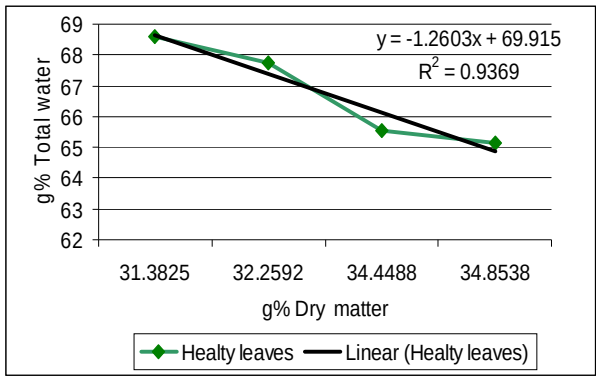

Figure 6. Correlation analysis between dry matter and total water content in healthy leaves at cv. *Springcrest* (* the correlation is significant at p < 0.05)

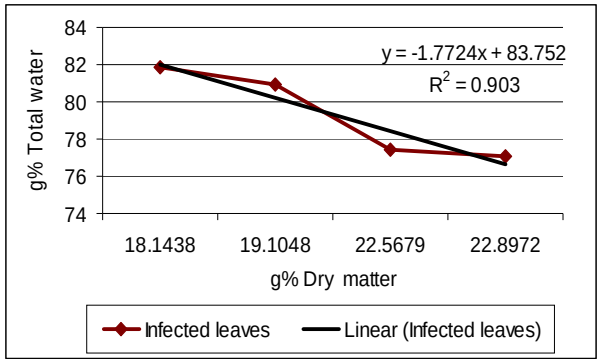

Figure 7. Correlation analysis between dry matter and total water content in leaves infected by *Taphrina deformans* at cv. *Springcrest* (* the correlation is significant at p < 0.05)

The higher content of total water in attacked leaves can be attributed to the degradation of cellulose, hemicellulose and pectic compounds of the cell wall by *Taphrina deformans*. It is well known from literature that *Taphrina deformans* hyphae which are growing in the intercellular spaces cause a partial dissolution of the leaves cell walls by secretion of

polysaccharide degrading enzymes, such as cellulase [19].

The increasing of dry matter content in diseased leaves at cvs. *Springcrest* and *Springold* is probably due to the presence and the development of mycelium of *Taphrina deformans* in intercellular spaces and due to ascus with ascospores formation. With the leaves aging, the total water content is decreasing at both cultivars studied; this could be due to the increased transpiration of affected leaves [20] which after this stage, gradually turn brown because of tissues necrosis which occures as the disease develops. In infected plants leaves lose their turgor and finally die and become dessicated. In both healthy and disease leaves, with aging of the tissues it take place an general increasing of dry matter content and a decreasing of total water content.

The results obtained in this study are simillar with those carried out at *Persica vulgaris* by Raggi and Booth, who observed that the leaves infected with *Taphrina deformans*, even dried leaves have a higher water content then the healthy ones [21, 22]; simillar results were mentionated and by Shehu and Aliero in the case of the attack of *Alternaria porri* on onion leaves [23]; the result are in contradiction with those mentionated by Nicolae Mariana and Mitrea Rodi at cv. *Superbă de toamnă* infected by *Taphrina deformans* [20] and with those observed by Tang *et al.* in the case of foliar attack of *Cercospora moricola* and *Phyllactinia corylea* at *Morus alba* [24, 25]; the reusults obtained are in discrepancy with those presented by Oerke *et al*. at *Cucumis sativus* infected with *Pseudoperonospora cubensis* [26] and with those observed by Aldesuquay and Baka in the case of *Senecio glaucus* infected by *Puccinia lagenophorae* and *Albugo candida* infecting *Cakile maritima* [27].

4. Conclusions

Total water content is higher in attacked leaves at both peach cultivars then the values of this physiological parameter recorded in the healthy leaves. Dry matter content had higher values, at both cultivars, in healthy leaves when compared with diseased ones.

Between this two variables (total water and dry matter content) it establishing a negative liniar correlation in both healthy and diseased leaves from cvs. *Springcrest* and *Springold.*

Total water content is decreasing with leaves age at both cultivars and in the same time dry matter content is increasing with leaves aging.

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