

## **INFLUENȚA DEFICITULUI HIDRIC ASUPRA UNOR INDICATORI BIOLOGICI AI POMILOR ȘI DE CALITATE AI FRUCTELOR LA UNELE SPECII POMICOLE CULTIVATE IN SISTEM SUPERINTENSIV**

### **INFLUENCE OF THE WATER DEFICIT ON SOME BIOLOGIC INDICATORS OF THE TREES AND ON FRUITS QUALITY OF SEVERAL FRUIT SPECIES CULTIVATED UNDER SUPERINTENSIVE SYSTEM**

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#### **Abstract**

**Due to the soil and climate diversity of our country, fruit species meet favorable conditions for successful cultivation. In the context of actual climate changes, there is a need for integrated interdisciplinary research on the influence of microclimate changes, rapid diagnosis and real-time warning of changes caused by water insufficiency is strongly felt. The physiological responses of the trees to the water stress are dynamic, as the level of the water stress increases and the intensity of the response increases. The main factors on which depend the adaptation of the plants to the water stress are: the species, age, group of varieties, phenology, transpiration, photosynthetic and assimilation potential etc. The paper presents results obtained at the RIFG Pitesti-Maracineni during 2017-2019 period, regarding the influence of the water deficit registered in the last years, on some biological indicators of the trees (pollen viability, buds viability, cross trunk section surface) and quality of the fruits (fruit mass, firmness, soluble dry matter and total sugars content, acidity (pH), total sugars/pH ratio, vitamin C, in the fruits of some varieties, belonging to cherry, plum, peach and apple species, cultivated under superintensive system and with prospects for national extension into commercial farms.**

**Cuvinte cheie:** pomi, stress hidric, indicatori fiziologici, indicatori calitate.

**Key words:** trees, water stress, biologic indicators, quality indicators.

#### **1. Introduction**

Due to the pedo-climatic diversity of our country, fruit species meet favorable conditions for successful cultivation. However, analyzing the distribution of precipitations on the territory of our country, it is found that, on more than 20% of the territory (Dobrogea, south and east of the Moldavian Plateau), the average value of annual precipitations is below 500 mm, which requires the mandatory application of irrigation in the orchards (Grumeza, et al., 1989, 2005; Iancu, 1980; Ionescu, 1976; Păltineanu, et al., 2000-2015). The inadequate distribution of rainfall, especially the drought periods that occur during the vegetation period, obliges us to the irrigation of the orchards, with daily amounts, applied in rounds, depending on soil texture, to ensure the optimum level of moisture in the soil during the entire growing period. In general, it was appreciated that, in fruit species, daily water consumption ranges from 4 to 7 mm/day, depending on the species, rootstocks and vegetation phenophase, the highest consumption being recorded from flowering to harvest (Popescu, 1992). The main factors on which the adaptation of the plants to the hydric stress are: the species, age, group of varieties, phenology, transpiration, photosynthetic, assimilation potential, etc. (Burzo et al., 1996; Chaves, et al., 2003). In the context of actual climate changes (Chiemlewski, Metz, Mülle, Bruns, 2004, 2005; Petcu, 2008), there is a need for integrated interdisciplinary research on the influence of microclimate changes on plants; rapid diagnosis and real-time warning of changes caused by water insufficiency is strongly felt. Beside the monitoring of water deficit into the soil and atmosphere, using modern tools which includes automatic or semi-weather stations equipped with a wide ranges of sensors and dedicated software, it is also vital to know the physiological response of the tree fruits varieties, grown under superintensive systems, in terms of assimilation, production and quality indicators, prior their extension into mass fruit production, or to use these indicators and the correlation found among them, to conduct the irrigation and use of water supplies in order to mitigate the water deficit.

#### **2. Material and methods**

The researches were conducted between 2017 and 2019 at RIFG Pitesti-Mărăcineni. Experimental module organized is complex and consists of: a) 1 plot of cherry, established in 2017, the trees were

planted at a distance of 4.0 m between rows and 1.0 m between trees along the row (density  $D = 2500$  trees / ha) and driven as a spindle, with individual support system and fertirrigation installation, b) 1 plot of peach established in spring 2010, planted at a distance of 4.0 m between rows and 3.0 m between trees along the row (density  $D = 833$  trees/ha), c) 1 plot of plum grafted on the Saint Julien low vigor rootstock, set up in the spring of 2009, at the planting distance  $4.0 \times 2.25$  m (density  $D = 1111$  trees/ha), and d) 1 plot of apple, which was established in spring 2016, at the planting distance of  $3.0 \times 1.0$  m; density  $D = 3.333$  trees / ha on the M9 rootstock, with trees driven in the form of a thin axis. The experimental device was located on a plain terrain placed on the second terrace of the Arges River, on a low to medium fertile alluvial clay unit (more than 30% of clay; humus less than 1.7%; nitrogen index 0.33-1.43; PAL 1.3-2.5 mg/100g, but well supplied with potassium, up to 40 mg/100 g). Soil reaction is slightly acid ( $pH=5.8-6.8$ ). The orchard floor was covered with grass between the tree rows, cleared with total herbicides on stripes of 1.0-1.2 m wide, along the tree rows. Each experimental plot received the right amount of nutrients by fertirrigation, according to each species needs and adequate phytoprotection programs, to keep specific pest and diseases under economic damage threshold.

The set of sensors and recorders was mounted on WatchDog platforms provided by Spectrum, USA and iMetos from Pessl Austria, equipped with expert software. Dynamics of soil water potential at four depths of soil profile, were measured on a WD 1400 recorder with Watermark Soil Moisture Sensors 6450WD, to shows how water was distributed according to ETo-PM and the tree consumption after planting.

The pollen viability on cherry varieties was assessed using the microscope Optika 383 PL with 5MP Optikam HDMI Easy - 4083.13E CS mount camera, under direct light, while the flower buds viability was examined under an Optika Bell Photonics stereomicroscope.

The fruits main quality parameters were assessed using many equipment types such as: precision balance 1EK200G (fruit mass, g), hardness tester HPE II (fruit firmness [N], ATAGO 100 refractometer (dry soluble mater content, °Brix), ISFET 100 pH meter (fruit flesh juice pH), while total sugars content were determined using conversion tables and the total sugars content / acidity (pH) was obtained by calculation. All the experimental data were stored, processed and analyzed using the facilities of and Specware Pro 9.0 iMetos and MS Office Excel 2010 software. Pictures were taken on fresh material with Optikam HDMI Easy - 4083.13E CS mount camera digital camera and processed with the free software Irfan View 4.25 and Photofiltre 7.0.2.

### 3. Results and discussions

#### Results on water deficit and soil water potential

Assessment of the Table 1 including the monthly rainfall registered during 2015-2019 at RIFG Pitesti-Maracineni and surrounding area reveals an average precipitation sum of only  $623.23 \text{ l / m}^2$ . According the collected data, in 2017, total precipitation was  $632.30 \text{ l / m}^2$  and the strongest deficit in March ( $66.65 \text{ l/m}^2$ ), June ( $-46.65 \text{ l/m}^2$ ) and September ( $-117.10 \text{ l/m}^2$ ). In the year 2018 total precipitation was  $733.60 \text{ l/m}^2$ , with the strongest deficit in April ( $-52.37 \text{ l/m}^2$ ), May ( $-46.40 \text{ l/m}^2$ ) September ( $-97.89$ ) and October ( $-60.53 \text{ l/m}^2$ ). In 2019 the driest year of the study period was the sum of only  $519.9 \text{ l/m}^2$ , with the strongest deficit in March ( $-36.62 \text{ l/m}^2$ ), May ( $-34.37 \text{ l/m}^2$ ) and September ( $-60.64 \text{ l/m}^2$ ). These values were strongly correlated with the soil water potential dynamics shown in figures 1-3 and with necessity to trigger the drip irrigation system in order to mitigate the water deficit and provide a good physiological and production status of the trees.

Examination of the Fig. 1, achieved from our Specware Pro 9.0 database, reveals that in 2017 the critical periods with the highest water suction value were 5-8 August and 16 August - 7 October, with a potential higher than 110 kPa. A closer look in the Fig. 2 highlights that in 2018, the critical periods with the highest water potential were 1-8 May, with a water suction ranging between 110-119 kPa and 1 September-17 December, with a potential ranging between 110-200 kPa. Assessment of the Fig. 3 suggests that in 2019, the critical periods with the highest water suction were in 1-3 June ranging around 110 kPa and 14 August-20 October ranging between 110-200 kPa.

Soil water matric potential (suction) is a reliable indicator, used to trigger the irrigation system and improvement of trees supply with water using drip irrigation. Moreover, these results suggest that in the latest years the rain water deficit and soil water potential, interfered with some fruit trees physiological and production status indicators of fruit trees.

#### Results on some biological indicators of fruit set and yielding

Under such circumstances, in 2019, an intense study was carried out in the lab, on the pollen of some promising cherry, plum and apple varieties, grafted on low vigor rootstocks, to find out if the drought registered during the study period, affected some of the key biological indicators for fruit set and yielding.

On cherry trees, the study was carried out in April, on 19 promising varieties. The pollen collected during the flowering period was examined at the end of each day of flowering period on the microscope, regarding the dehydration frequency (DF%) and overall viability (PV%) (Fig. 4 and Fig. 5).

Examination of the Fig. 4 reveals morphological variations of pollen grains ranging from severe dehydration ('Sweet Heart/Gisela-6' variety) to partial dehydration ('Tamara / Weiroot 2') variety.

A closer assessment of the Fig. 5 indicates that, the most dehydrated pollen was the one belonging to 'Sweet Heart/Gisela-6' (DF%=98.03, PV%=1.27) 'Regina / Gisela-6' (DF%=53.05; PV%=46.95) and 'Lapins / Gisela-6' (DF%=51.68; PV%=48.32) varieties. Opposite, the less dehydrated pollen was the one belonging to the varieties 'Tamara/Weiroot-2' (DF%=0.45; PV%=99.55), 'Penny/ Gisela-5' (DF%=17.78; PV%=82.22), 'Regina / Weiroot-2' (DF%=18.18; PV%=81.82). In this stage of the study, we conclude that for the studied cherry varieties a minimum pollen viability (PV%) required for a good cherry yield is around 70%.

On plum trees, the study regarding flower buds viability (BV%) was conducted early in March, on 7 promising varieties, 5 from Romania, 1 from Serbia and 1 from USA, wide spread into the culture and used as reference standard. Assessment of Fig. 6 reveals that plum flower buds viability was very good (BV%=100) on 'Centenar' variety - regardless the rootstocks, 'Andreea / Adaptabil' and on 'Stanley' variety, grafted on Saint Julien, followed by 'Stanley/Myrobolan' (BV%=97.98) and 'Agent Adaptabil' (BV%=97.89). For the Serbian variety 'Cacanska Rodna', flower buds viability (BV%) ranged between 94.69 and 96.55. In this stage of the study, we conclude that the most sensitive plum variety was 'Carpantin / Saint Julien' on which buds viability BV% was 92.77.

On apple trees, the study regarding flower buds viability (BV%) was conducted early in March, on 5 promising varieties, grafted on two rootstocks, 4 on low vigor M9 and 1 on medium vigor M106. Examination of Fig. 7 suggests that flower buds viability (BV%) was very good, ranging from 89.29 at 'Jonagold de Costa / M 9' to 96.88 at 'Red Braeburn / M 9'. On the other varieties, 'Jonagold Novajo', 'Red Jonaprince', 'Golden Reinders' and 'Jonagold Boerencamp' flower buds viability (BV%) was ranging between 90.48 and 96.00. The lowest bud viability (BV%) was registered for 'Idared' variety grafted on M 106.

### **Results on some biological indicators of fruits quality**

In modern fruit bearing orchards the most drastic effects of water stress are reflected on plants physiology, assimilation capacity, the production level and fruits quality as well.

In this sense, assessment of the Fig. 8 reveals that in 2019 on young superintensive cherry orchard subject to the water deficit, many variations of main fruits quality parameters occurred, according the varieties and the rootstock used.

On cherry trees, first of all, the water deficit leads to decrease of the fruits mass (FM) from the average value of 11.5 g to 9.0 g at 'Lapins / Gisela-12', 8.5 g at 'Regina / Gisela-5', and 8.0 g at 'Kordia / Gisela-5' until 7.10 g at 'Ferovia / Gisela-5'.

A consistent drop of the soluble dry matter content (°Brix) of the fruit juice was noticed from an average value of 17.74 °Brix to 17.70 °Brix at 'Regina / Gisela-5', 14.50 °Brix at 'Ferovia /Gisela-5', 14.20 °Brix at 'Lapins / Gisela-12', 13.15 °Brix at 'Kordia / Gisela-5'. The most severe drop of the dry matter content to 11.40 ° Brix was found for 'Sweetheart / Gisela-12'.

Regarding the fruit juice total sugar content (TS %), the highest value was reached at 'Sweetheart / Gisela-12' 14.50%, while on the other varieties this parameter value dropped lower than the average value of 14.12% until 9.52% at 'Ferovia / Gisela-5'.

Other fruit quality parameter that changed was the fruit juice total acidity (TA%), from an average value of 25.50% to a higher value of 27.35% at 'Sweetheart/Gisela 12'. The lowest value of the total acidity TA=16.70% was found for 'Ferovia / Gisela-5'.

On peach trees, assessment of the Fig. 9 shows that, the water deficit lead first to an increase in the fruits firmness on both varieties studied. At 'Filip / Adaptabil', the average fruits firmness (N) was 76.66, while on 'Redhaven / Adaptabil' fruits firmness (N) was even higher, at a value of 80.07 (N). A difference regarding the fruits soluble dry matter content (° Brix) was found from 13.5 for 'Filip / Adaptabil' to 9.62 at 'Redhaven / Adaptabil'. The trend was the same also for fruits juice total sugar content (TS%), which reached 11.36 in 'Filip / Adaptabil' and 7.72 in 'Redhaven / Adaptabil' and for total sugar content / pH ratio, 2.57 versus 2.06.

On plum trees, the influence of the water deficit was assessed on 'Stanley' plum variety which is well known and a comparison standard for other European plum cultivars (Fig. 10).

First of all, the water deficit leads to a decrease in the fruits mass (FM) up to 49.6 g, an increase in the fruit firmness (N) up to 85.2, in the soluble dry matter content (°Brix) up to 15.0 and in the fruits juice total sugar content (TS%) at 13.4%.

On apple trees, the water deficit, leads to a decrease in fruits mass (FM) from 196.85 g to 186.30 g on 'Golden Reiders / M9' and from 220.77 g to 210.93 g on 'Jonagold de Costa / M9'. The smallest fruit mass was recorded on 'Jonagold Novajo / M9', only 185.05 g.

A consistent drop of the soluble dry matter content ( $^{\circ}$ Brix) of the fruit juice was registered on 'Golden Reiders / M9' and from 15.19 to 13.78  $^{\circ}$ Brix and 'Jonagold de Costa / M9', from 15.65 to 13.43  $^{\circ}$ Brix. The lowest soluble dry matter content of was found for 'Jonagold Novajo / M9', only 11.07  $^{\circ}$ Brix.

The trend was the same also for fruits juice total sugar content (TS%), which decreased from 13.64 to 12.14 on 'Golden Reiders / M9' and from 14.13 to 12.51 on 'Jonagold de Costa / M9'. The lowest fruits juice total sugar content was found for 'Jonagold Novajo/M9', only 9.26% (Fig. 11).

### Results regarding correlations among some biological indicators of fruits quality

In the next step, the reach amount of data regarding some indicators of the fruits quality, allowed us to look for some correlations among the fruits quality indicators (fruit mass, firmness, soluble dry matter content, total sugars content, total sugars / acidity (pH) ratio), obtained under the conditions of water deficit, to keep the relevant ones and to highlight those which are statistically insured and useful in general attempt to mitigate the water deficit (Table 2).

In this sense, on cherry trees, a reverse correlation was found between the fruit mass (FM) and the fruits firmness N ( $R^2=-0.1885^{**}$ ;  $r=0.4342$ ), which suggest that water deficit affects mainly the cells multiplication and development and finally, the cherry yield.

Also, a direct correlation was found between fruits juice soluble dry mater content ( $^{\circ}$ Brix) and fruits juice total sugars content / acidity ratio ( $R^2=1.0000^{***}$ ;  $r=1.0000$ ) which indicate that water deficit affects the overall assimilation efficiency.

On peach trees, a reverse correlation was found between fruit mass (g) and fruits juice soluble dry mater content ( $^{\circ}$ Brix) and total sugars content TS% ( $R^2=-0.1208$ ;  $r=0.3476^{***}$ ) and a direct correlation between fruits juice soluble dry mater content ( $^{\circ}$ Brix) and fruits juice total sugars content / acidity ratio ( $R^2=0.9111^{***}$ ;  $r=0.9545$ ) which indicates that water deficit affects the overall assimilation efficiency.

On plum trees, a direct correlation between fruits juice soluble dry mater content ( $^{\circ}$ Brix) and fruits juice total sugars content / acidity ratio ( $R^2=0.5850$ ;  $r=0.7649$ ) indicates that water deficit affects mainly the overall assimilation efficiency.

On apples trees, a direct correlation was found between the fruit mass (FM) and the fruits firmness (N) ( $R^2=-0.0561$ ;  $r=0.7409$ ), which suggests that water deficit affects mainly the cells multiplication and development and finally the apples production amount, and one between fruit mass (FM) and fruits juice soluble dry mater content in  $^{\circ}$ Brix and fruits juice total sugars content ( $R^2=0.0976$ ;  $r=0.3124^{***}$ ).

Also, a direct correlation was found between fruits juice soluble dry mater content ( $^{\circ}$ Brix) and fruits juice total sugars content / acidity ratio ( $R^2=0.5850$   $r=0.7649^{***}$ ) which indicates that water deficit affects the overall assimilation efficiency.

These correlations demonstrate that water deficit affects both the cells multiplication and development and finally the apples production amount and quality.

## 4. Conclusions

In the latest years the rain water deficit and soil water potential influenced with some fruit trees physiological and production status indicators.

Soil water potential is a reliable indicator, used to trigger the irrigation system and improvement of trees supply with water using drip irrigation. In the case of albeluvisoil the recommended deficit threshold is around 100-110 kPa.

In this stage of the study we conclude that for studied cherry varieties minimum pollen viability (PV%) required for a good cherry yield is around 70%.

We concluded that for plum trees a flower buds viability higher than 92% provide a very good yield and a sensitive variety as 'Carpantin / Saint Julien' can be used as indicator.

We concluded that for apple trees, a flower buds viability higher than 89% provides a very good yield, and a sensitive variety 'Jonagold de Costa / M9' and can be used as indicator.

Among the cherry varieties, the most sensitive to water deficit was 'Ferovia /Gisela-5' and can be used as indicator.

On cherry and peach trees, the increase in fruit firmness over 80.0 N and the drop of fruits juice soluble dry mater content lower than 11.00  $^{\circ}$ Brix is damaging for the fruit yield and fruits quality.

On apple trees, a final fruit mass lower than 190 g indicates that water deficit negatively influenced the fruits yield and quality; the sensitive variety 'Jonagold Novajo / M9' can be used as indicator.

The sensitive cherry, plum, peach and apple varieties can be monitored and used as indicators for trigger the irrigation system and improvement of trees supply with water in plots and fruit growing areas.

The correlations found among some fruits quality indicators demonstrate that water deficit affects both the cells multiplication and development and, finally, the apples production amount and quality.

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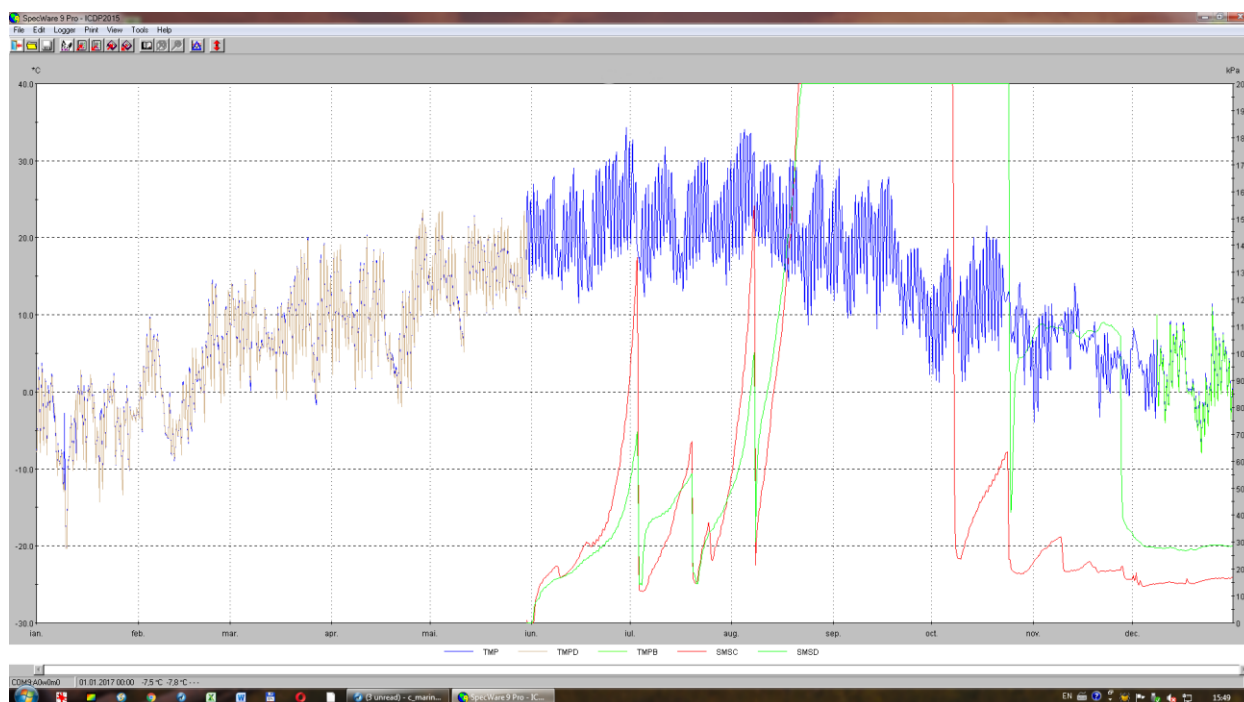
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### Tables and Figures

**Table. 1 Soil water deficit at RIFG Pitesti-Maracineni, 20 Octombrie 2019, Lat. N 44.513; Long. E 24.52; Alt 287m**

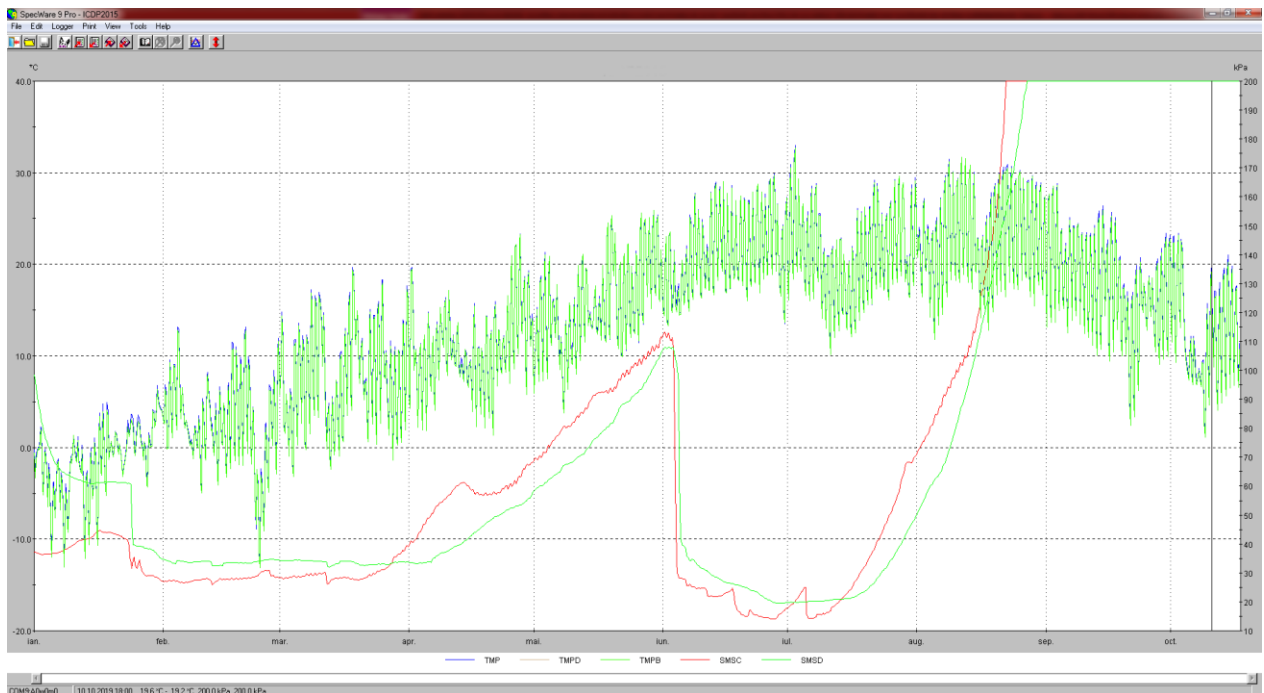
Month	2015	2016	Year 2017	2018	2019	Average 2015- 2019	Annual deficit 2017	Annual deficit 2018	Annual deficit 2019
January	60.20	30.60	15.10	36.00	63.70	41.12	-30.30	0.70	22.58
February	36.70	26.90	23.20	43.00	14.80	28.92	-8.60	14.07	-14.12
March	73.60	90.10	15.20	89.00	21.20	57.82	-66.65	29.37	-36.62
April	44.80	76.70	50.60	5.00	35.60	42.54	-10.15	-52.37	-6.94
May	42.60	134.10	127.50	55.00	46.30	81.10	39.15	-46.40	-34.80
June	81.50	119.60	53.90	198.00	197.10	90.42	-46.65	103.00	106.68
July	38.20	27.90	95.70	139.30	93.40	51.04	62.65	85.37	42.36
August	53.50	40.00	53.70	23.80	9.70	31.38	6.95	-25.27	-21.68
September	204.00	98.40	34.10	14.30	11.90	72.54	-117.10	-97.87	-60.64
October	59.50	72.90	60.60	3.80	26.20	43.84	-5.60	-60.53	-17.64
November	98.70	52.90	59.80	70.50	-	70.48	-16.00	0.03	-
December	1.50	3.70	42.90	16.00	-	12.03	40.30	-0.03	-
<b>Sum</b>	<b>794.8</b>	<b>773.8</b>	<b>632.3</b>	<b>733.6</b>	<b>519.9</b>	<b>623.23</b>	<b>-152.0</b>	<b>-49.93</b>	<b>-103.33</b>



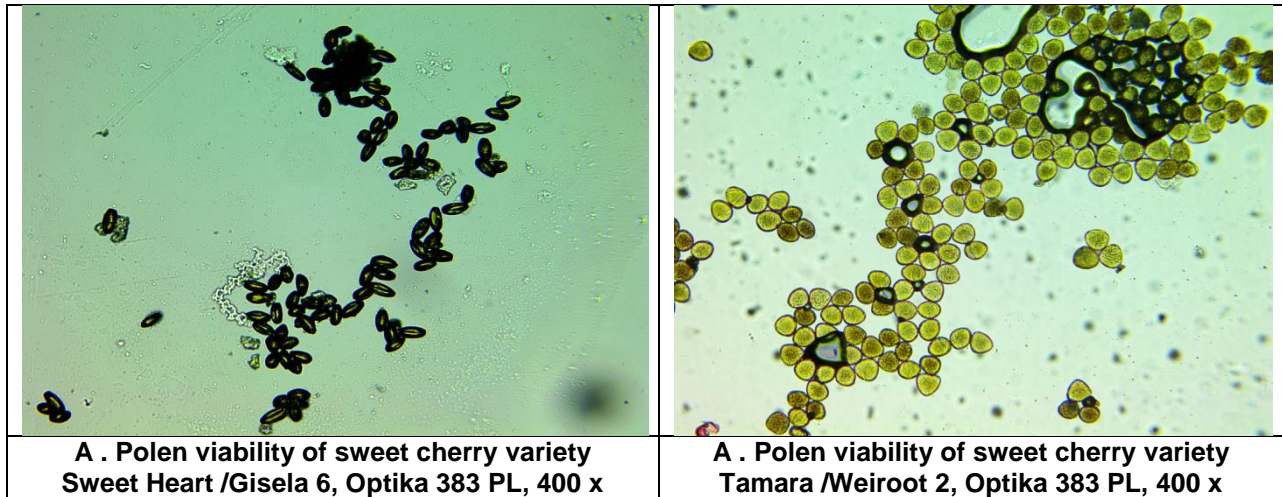
**Fig. 1. Soil water potential dynamic RIFG Pitesti-Maracineni, 1.01.-- 30.12.2017, Lat. N 44.513; Long. E 24.52; Alt 287m**



**Fig. 2. Soil water potential dynamic RIFG Pitesti-Maracineni, 1.01.-- 30.12.2018, Lat. N 44.513; Long. E 24.52; Alt 287m**



**Fig. 3. Soil water potential dynamic RIFG Pitesti-Maracineni, 1.01.-- 20.10.2019, Lat. N 44.513; Long. E 24.52; Alt 287m**



A . Polen viability of sweet cherry variety Sweet Heart /Gisela 6, Optika 383 PL, 400 x

A . Polen viability of sweet cherry variety Tamara /Weiroot 2, Optika 383 PL, 400 x

Fig. 4. Polen viability examples of some cherry varieties grown under superintensive system RIFG Pitesti-Maracineni, 15--24 April 2019 Lat. N 44.513; Long. E 24.52; Alt 287m

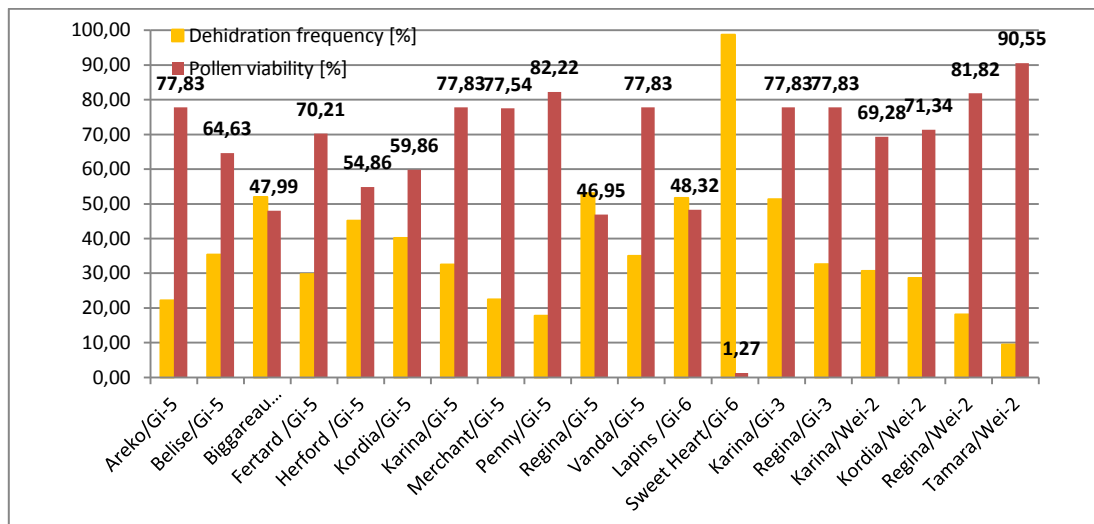


Fig. 5. Polen viability of some cherry varieties grown under superintensive system RIFG Pitesti-Maracineni, 15--24 April 2019 Lat. N 44.513; Long. E 24.52; Alt 287m

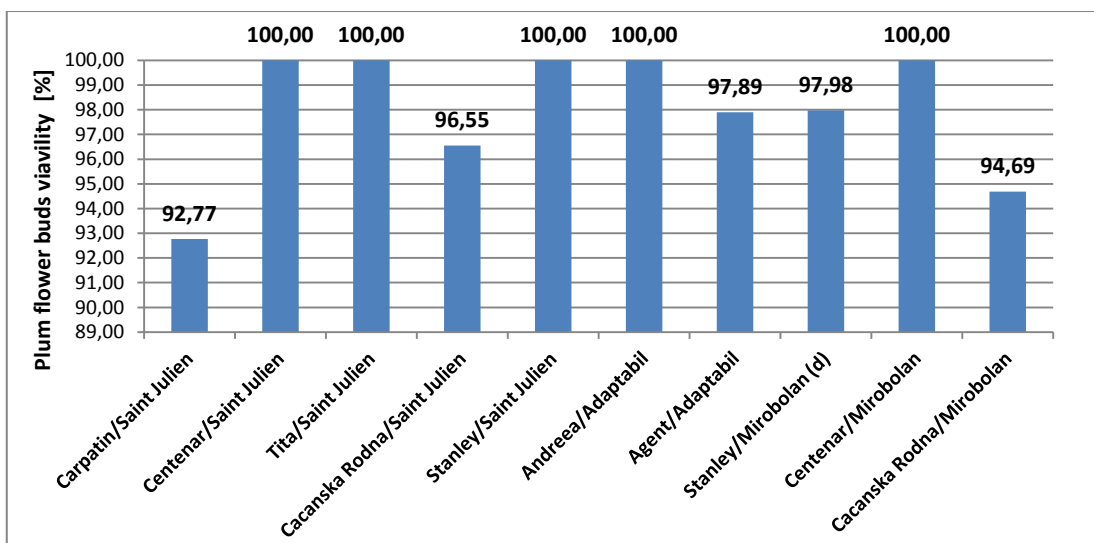


Fig. 6. Flower buds viability of some plum varieties grown under superintensive system RIFG Pitesti-Maracineni, 5 Mach 2019 Lat. N 44.513; Long. E 24.52; Alt 287m

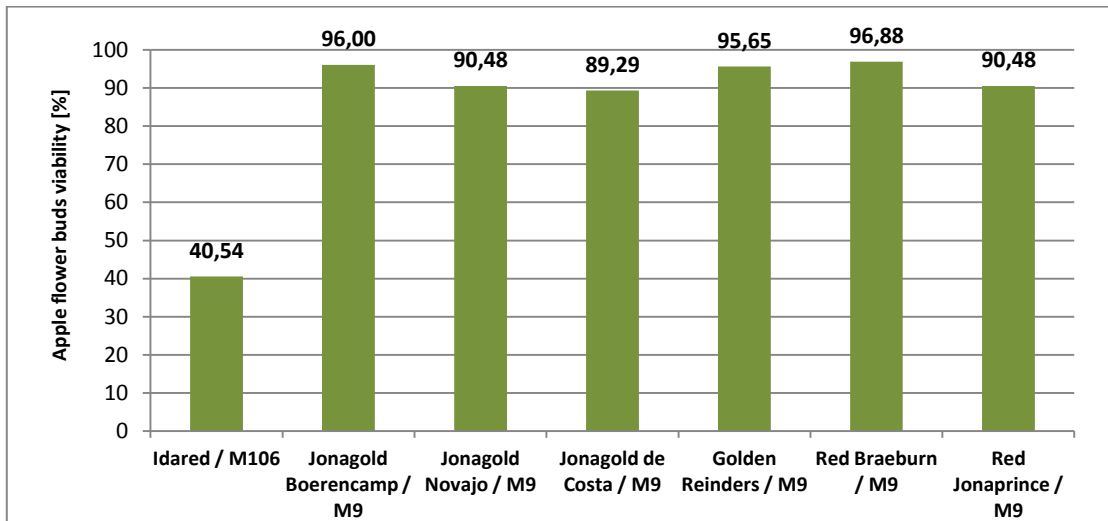


Fig. 7. Flower buds viability of some apple varieties grown under superintensive system RIFG Pitesti-Maracineni, 5 March 2019 Lat. N 44.513; Long. E 24.52; Alt 287m

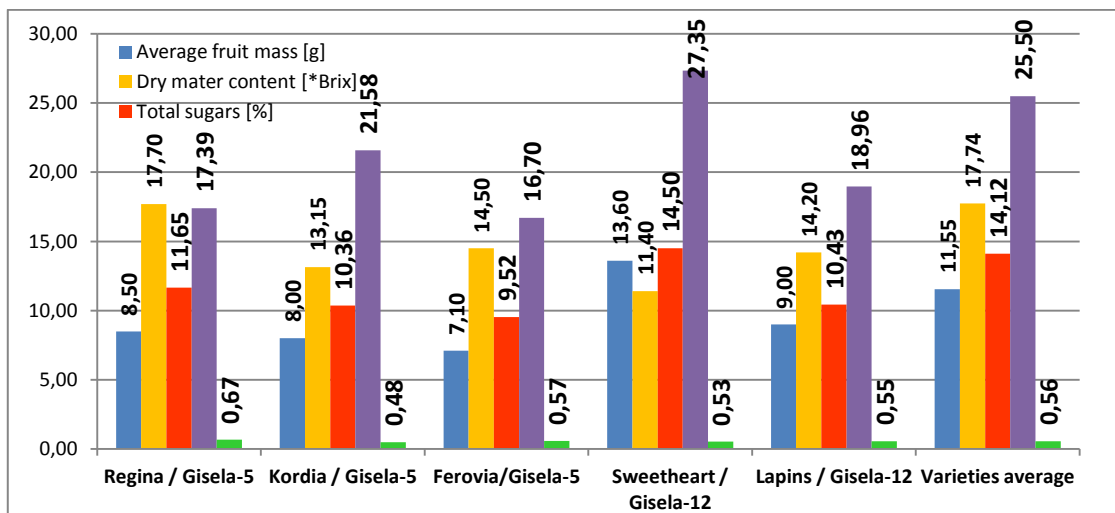


Fig. 8. Variation main fruits quality parameters of some sweet cherry varieties grown under superintensive system RIFG Pitesti-Maracineni, 20.06--22.07 2019 Lat. N 44.513; Long. E 24.52; Alt 287m

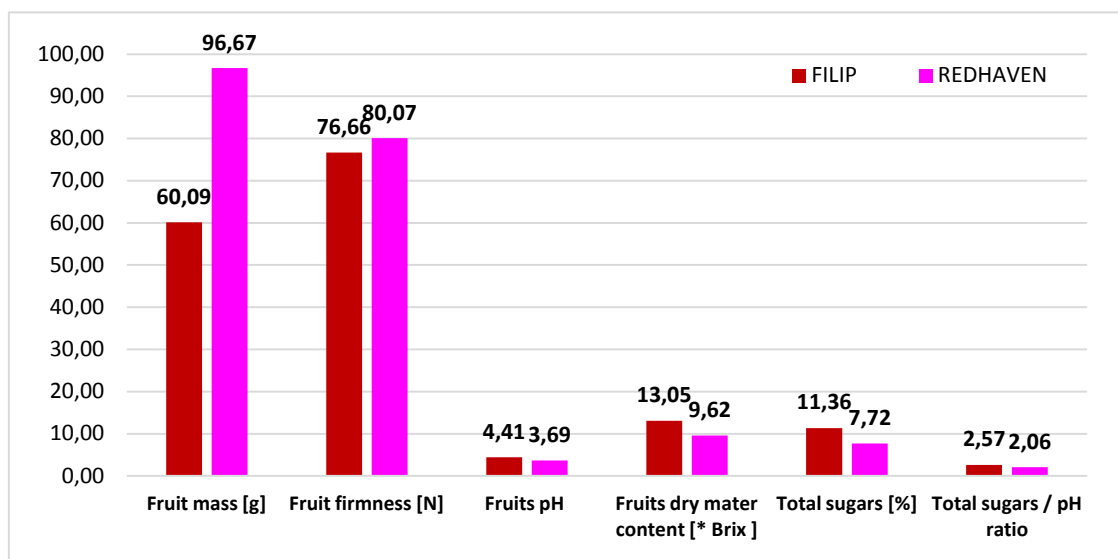


Fig. 9. Variation main fruits quality parameters of some peach varieties grown under superintensive system RIFG Pitesti-Maracineni, 20.06--22.07 2019 Lat. N 44,513; Long. E 24,52; Alt 287m

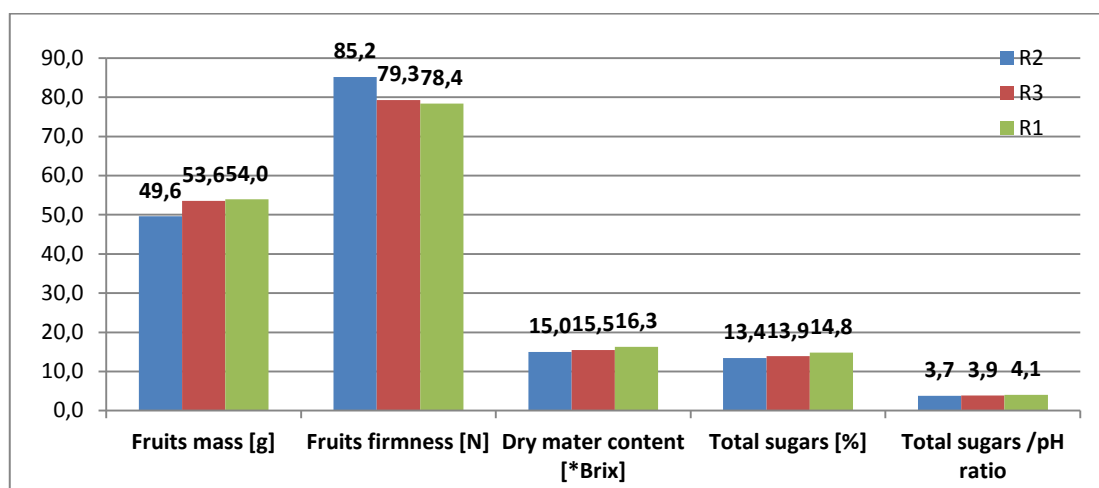


Fig. 10. Variation main fruits quality parameters of 'Stanley plum grown under superintensive system, RIFG Pitesti-Maracineni, 20.06--22.07 2019 Lat. N 44,513; Long. E 24.52; Alt 287m

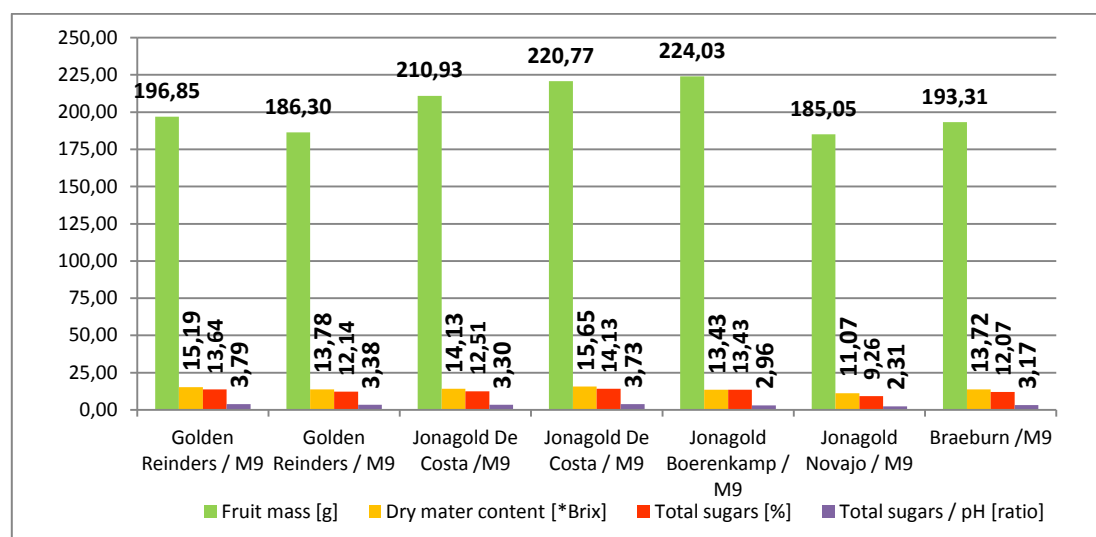


Fig. 11. Variation main fruits quality parameters of some apple varieties grown under superintensive system RIFG Pitești-Mărăcineni, 12.09.2019 Lat. N 44.513; Long. E 24.52; Alt 287m

Table. 2 Correlations between main fruits quality parameters on some fruit species grown under superintensive system RIFG Pitesti-Maracineni, 2019 Lat. N 44,513; Long. E 24,52; Alt 287m

Species	Parameters	Fruit firmness [N]	Dry mater content [*Brix]	Total sugars content [%]	Total sugars / acidity (pH) ratio
CHERRY	Fruit mass [g]	R <sup>2</sup> =-0.1885** r=-0.4342	R <sup>2</sup> =0.0467 r=0.2162	R <sup>2</sup> =0.0467 r=0.2162	-
	Dry mater content [*brix].	-	-	-	R <sup>2</sup> =1.0000*** r=1.0000
PEACH	Fruit mass [g]	R <sup>2</sup> =0.0007 r=0.0265	R <sup>2</sup> =-0.1208 r=-0.3476***	R <sup>2</sup> =-0.1208 r=-0.3476***	-
	Dry mater content [*brix].	-	-	-	R <sup>2</sup> =0.9111*** r=0.9545***
PLUM	Fruit mass [g]	R <sup>2</sup> =0.0008 r=0.2830	R <sup>2</sup> =0.0025 r=0.0500	R <sup>2</sup> =0.0025 r=0.0500	-
	Dry mater content [*brix].	-	-	-	R <sup>2</sup> =0.5850 r=0.7649***
APPLE	Fruit mass [g]	R <sup>2</sup> =0.0561 r=0.7409***	R <sup>2</sup> =0.0976 r=0.3124***	R <sup>2</sup> =0.0976 r=0.3124***	-
	Dry mater content [*brix].	-	-	-	R <sup>2</sup> =0.0905 r=0.3008***