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EFFECT OF PROMALIN IN REDUCTION OF SEEDS NUMBER ON APPLE, CV. RED DELICIOUS AND GOLDEN DELICIOUS

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Abstract

Apple cultivation in Albania is manly destined for fresh consumption. Increased productivity of apple is associated with quality parameters, and one of these quality parameters probably is the parthenocarpy that increases hypanthium mass by reducing endocarp mass. Parthenocarpy may be inducted by applying the plant growth regulators, one of them, a combination of GA_{4+7} with 6-benzyladenine, is used to stimulate the parthenocarpy in two main cultivars in Korça region, Golden Delicious and Red Delicious. The use of this preparation has strongly effect on inducting parthenocarpy in both cultivars regardless of the dosage or the method of treatment.

Keywords: apple, parthenocarpy, gibberellins, hypanthium.

1. INTRODUCTION

Apple is one of the most important fruit and one of the most consumed fresh fruit in Albania with 19 kg/year/capita (USAID, 2008). Korça region produces almost 70% of the apples grown in Albania, with approximately 40,000 tons fruits per year and with a tendency to increase the apple productivity as results of new planted orchards and new technology applied. Productivity potential of the apple is a complex quality (Teodorescu et. al., 2012 b) and the scientists are working to increase the apple productivity by increasing in the same time the quality of fruits. At the market the fruits are judged by the commercial value: appearance, shape, size, colour and after taste quality as texture flesh, juicy, flavour components that form the sensory ensemble (Teodorescu et.al., 2012 a) and new consumers are interested also in the residues product of fruits and thus parthenocarpy probably should be added as quality parameter of apples.

Parthenocarpy is one of the indicators related to the consumable quality of the fruit. The reduction of the seeds number to the fruit is related with increasing the hyparthium and reduction of endocarp mass (Figure 1), although that is a desirable quality from the consumer, affects positively even to more economic utilization of the hypanthium, as there are created less residues. The customers purchase the product to a higher utilized mass.

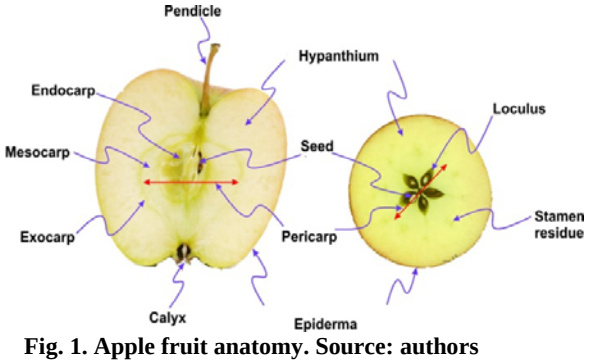

Fig. 1. Apple fruit anatomy. Source: authors

Parthenocarpy occasionally occurs as a mutation in nature, but it is usually considered a defect, as the plant can no longer sexually reproduce. The tendency of the parthenocarpy differs considerably in the function of species and varieties. Some apple cultivars perform parthenocarpy. For instance, Golden Delicious with its own parthenocarpy characteristics, tent strongly to create fruits in the absence of the pollen and optimal fecundation, in the presence of the high temperatures at the blooming stage (Wiedmer, 2009).

The growth regulators control the fruit`s growth and also the parthenocarpy. The relation between the endogenous growth regulators and the growth of the fruits without seeds is still unclear. Gibberellins-like activity has been demonstrated in endosperm and GA_4 and GA_7 are identified in immature apple seeds (Hayashi, 1968). The applications with the gibberellins and the combination of the gibberellins with the cytokines can induce the parthenocarpy to the treated fruits (Watanabe et. al., 2008).

A mixture of gibberellins and cytokinin, without auxin, was successful in increasing parthnocarpy in cultivar Red Delicious and Sturner (Jonkers, 1978). The effect of the GA_{4+7} to the number of seeds is different, it depends on the treatment period and the dosage. By leaving the full blooming period there is an increase of the seeds number at the fruit. The number of the seeds is reduced by the increase of the combined dosage of GA_{4+7} (Green, 1989). The effects of GA_4 and GA_7 on induced parthenocarpy were stronger than that of GA_3 (Watanabe et. al., 2008). According to Green (1989), the treatments with GA_{4+7} can reduce considerably the number of the seeds to the fruit, creating so far parthenocarpy fruits. To the apples, where the auxins are relatively inactive, the gibberellins induce the parthenocarpy and support the fruit growth toward the maturation (Hayashi et. al., 1968).

One of the most used plant growth regulator in apple cultivation is a combination of gibberellins GA_{4+7} and cytokine 6-benzyladenine, mostly known with

commercial name Promalin. Effect of the Promalin to the apple cultivation is to increase the mass and improve the shape of fruits (Icka and Damo, 2006; 2008; 2009) also to stimulate the parthenocarpy and the constant production (McArtney et. al., 2009; *PTFP Guide,* 2012 – 2013).
The aim of this paper is to determinate the parthenocarpy effect of Promalin used on apple cultivars Golden Delicious and Red Delicious to provide the quality and shape of apple.

2. MATERIALS AND METHODS

Korça Field is located in South East of Albania with an altitude 820 – 950 m above sea level. It has a Mediterranean continental climate, with dry and hot summer and cold and wet winter. It is the driest (760 mm rainfall per year) and coldest (up to – 27°C) region of Albania.
The orchard in the study is located 3 km on south-west of Korça city (40°35'35'' N and 20°45'52'' E) with an altitude 885 m above sea level. The soil texture of orchard is clay and soil quality index according Visual Soil Assessment is 18, classified as moderate (Damo and Icka, 2011). According the Standardized Precipitation Index evaluation the hydrological situation during the study period (2007 - 2009) is mainly a normal situation, except the year 2009 that is characterized by rainfall events (Icka et al., 2011).
The major apple cultivars growing in the Korça region are Red Delicious 52% and Golden Delicious 42% of apple orchards (USAID, 2008), for this reason it is very important to determine parthnocarpy effect of Promalin to these two cultivars of apples in this region. Apples are planted in distance 3.75 x 1.4 m with around 2200 apples/ha, and the rootstock for both cultivars is MM 106. The evaluation was made during three years period study 2007 – 2009. At least 50 fruits for each cultivar are analysed at harvest time.
The effect of the Promalin to the apple cultivars of Golden Delicious and Red Delicious was done by using three different dosage of Promaline V_2= 125 ml/hl applied two times, one at 80% bloom and next 14 days later; V_3= 30 ml/hl applied three times, firs at 80% bloom and the other two in a period of 7 days; and V_4= 30 ml/hl applied four times, first at 80% of bloom and the other three in a period of 7 days, compared with control V_1= 0 ml/hl. The collected data are statistically worked out with analyse of variance (ANOVA).

3. RESULTS AND DISCUSSION

In the table 1 are given the data of the average number of seeds present in the fruit at the harvest for the cultivar Golden Delicious and Red Delicious, and to the figures 3 and 4 is given the dependence of the average number of seeds per fruit from the dosage factor of Promalin.
The statistical elaboration related to the parthenocarpy caused by Promalin shows that the use of preparation is the source of the variability related to the number of the seeds to the fruit.
In case of Golden Delicious the comparison of the $LSD_{(001)}$ = 1.13 with the average results comes out that the variable of the seeds number between the V_1 and other variants (V_2, V_3 and V_4) are statistically verified. The differences between the V_2, V_3 and V_4 cannot be confirmed. The reduction of the average number of the seeds per fruit is considerable, from about 7.5 at the control to the 1.8 – 2.2 to other variants. Therefore the usage of the preparation regardless of the dosage and the number of treatment, strongly effect to the reduction of the seeds number to the fruit, giving this way an important parthenocarpic effect.
The correlation between the quantity of the preparation utilized and the average number of the seeds per fruit is strongly negative (r = - 0,793), which means that the increase of the dosage is accompanied by the reduction of the number of the seeds to the fruit.
The determination coefficient is R^2 = 0,949, and the regression equation of the average number of the seeds to the fruit (y), according the Promalin dosage (x) is $y = 1.4165x^2 – 8.7610x + 14.69$.

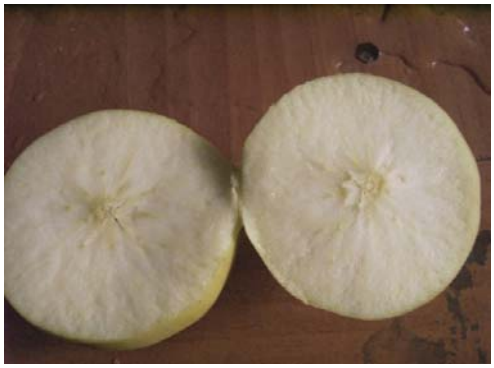

Fig. 2. Parthenocarpic fruit of Golden Delicious. Source: authors

Table 1. Parthenocarpy effect of Promalin in Golden Delicious and Red Delicious

Apple cultivar	Variants				$LSD_{(005)}$	$LSD_{(001)}$	r
	V_1	V_2	V_3	V_4			
Golden Delicious	7.6±0.23	2.1±0.40	1.9±0.68	2.1±0.39	0.84	1.13	- 0.723
Red Delicious	7.81±0.67	2.59±0.23	2.30±0.78	2.07±0.34	0.82	1.10	- 0.697

The comparison of $LSD_{(001)}$ = 1.10, in Red Delicious case, with the data of the average number of the seeds per fruit for each of the variants shows that V_1 has statistically confirmed differences with V_2, V_3 and V_4; whereas V_2, V_3 and V_4 have no statistical differences between each other. The treatments with Promalin have shown parthenocarpc effects to all the variations,

reducing the average number of seeds from 7.8 at the control variant to 2.0 – 2.5 at other variants.
For the cultivar Red Delicious the correlation between the dosage used and the number of seeds is negatively good (to the border with the values of the strong correlation), as it is shown by the correlation coefficient r = - 0,697.

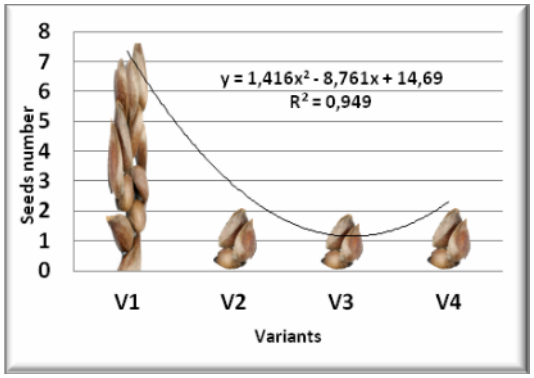

Fig. 3. Parthenocarpy effect in Golden Delicious cultivar

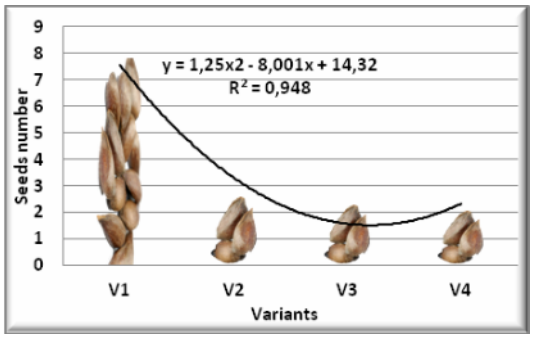

Fig. 4. Parthenocarpy effect in Red Delicious cultivar

The study shows that to the apple the Promalin stimulates the parthenocarpy, by confirming the results of other authors (Green, 1989; McArtney etc., 2009; *PTFP Guide,* 2012 –2013; Hayashi et. al., 1968). The tendency of parthenocarpy varies in the function of the apple cultivar. Golden Delicious cultivar performs great capabilities to generate parthenocarpic fruits, compared to the Red Delicious cultivar. This fact is shown not only by the smallest average number of the seeds to the treated variants with the preparation for the Golden Delicious cultivar, but also from the correlation scale between the average number of the seeds per fruit and the utilized dosage of Promalinës, which to the Golden Delicious cultivar is strongly negative (r = - 0.723, whereas to the Red Delicious cultivar good negative (r = -0.697). It is obvious that this is related to the own parthenocarpic characteristics of the Golden Delicious cultivar (Wiedmer, 2009).

4. CONCLUSIONS

The Promalin strongly stimulates the parthenocarpc effect to the Golden and Red Delicious cultivars, independently from the dosage and the used method of the preparation. The stimulating effects are impacted even by the cultivar characteristics. Golden Delicious cultivar is distinguished for a stronger stimulation of the parthenocarpy from the preparation.
The data of the study show that the studied dosages (125 ml/hl x 2; 30 ml/hl x 3 and 30 ml/hl x 4) generate almost the same parthenocarpy effect to both cultivars. The increase of the total dosage over 90 ml/hl has no marginal effect to the parthenocarpy stimulation. Therefore if the Promalin will be used to stimulate the parthenocarpy to the apple fruits, the recommended dosage and method should be the one used to the variant V_3 (30 ml/hl x 3 treatments).

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