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Genotype expression of traditional pear variety 'Tiranka' depending on ecological factors

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Abstract

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The tests were conducted in the region of Gostivar, Resen, Kratovo and Veles. 'Tiranka' is a winter traditional pear variety (*Pyrus communis* L.). It starts to blossom in the first to the second decade of April and it flourishes earliest in Veles, and at the latest in Resen. It forms solid, medium-sized fruit with an average weight of 175.8 g, with a long handle and with an average 2.8 seeds in the fruit. The largest fruit is given in the region of Gostivar (214 g). The strongest and firmer are the fruits of the Veles region. The fruits contain an average of 15.3% soluble dry matter, 14.2% total sugars and 0.27% total acids. The best appearance and taste are the fruits of the Resen region. Regarding the investigated properties, statistically significant differences were found between the samples depending on the genotype, the climate and the orographic conditions.

Keywords: pear; variety Tiranka; fruit morphological characteristics; fruit physiological characteristics

Intoduction

The aspiration for maximum benefits, the application of new industrial varieties, and the replacement of local varieties with foreign, significantly reduce genetic diversity. With the intensification of agricultural production and the introduction of foreign varieties, diseases that destroyed the entire variety, foreign and domestic, were introduced (Milutinovic et al., 2005). The presence of *Erwinia amylowora* Burr. and *Psylla pyri* pests in the 90s of the 20th century caused enormous damage to fruits in the Republic of Macedonia.

In the past, traditional pear varieties have been grown: 'Karamanka', 'Summer kajkushka', 'Zimska kajskushka', 'Tiranka', 'Zimorka', 'Tatliya', 'Vodenka', 'Chalganka' and others (Avramovski et al., 2005). Their general characteristic is vitality and longevity with the possibility of reaching the age of 100-150 years, whose age is spoken by the locals. They are very well adapted to local conditions and have natural resistance to some diseases and therefore the use of chemicals for protection is insignificant and unnecessary.

Today, traditional varieties are rare (Mratinic, 2000). They are represented sporadically in yards. Individual trees can be found in the displaced areas and mountainous areas, where still practiced extensive agriculture (Selamovska and Nikolich, 2012; Selamovska et al., 2012; Selamovska, 2013).

Unenviable situation imposed the need to preserve the traditional domestic sorting pears (Selamovska et al., 2013a). Through the studies, we are making efforts to revitalize the pear in Macedonia.

Materials and Methods

Plant material

The subject of the study is traditional pear (*Pyrus communis* L.) variety 'Tiranka', which was one of the most common traditional pear varieties in Macedonia. When choosing

varieties for certain soil and climatic conditions it is necessary to know their certain biological, morphological and productive properties, their behaviour towards various abiotic and biotic factors. The following properties have been investigated: blooming and ripening time, fruit mass (g), fruit densities (mm), firmness (g/cm^2), fruit length (cm), number of seeds in the fruit. The chemical-physiological properties of the fruits have been investigated: content of total sugars (%), total acids (%) and soluble dry matter (%). The firmness of the fruits is measured using a penetrometer. The classification of fruits was done according to Rubcov (Mratinic, 2000). The description of the variety is performed according to the IPGRI descriptor (Thibault et al., 1983). The obtained data were statistically processed using analysis of variance and LSD test (*P < 0.05, **P < 0.01).

All specimens were found as solitary trees, with age over 100 years, in hilly and mountainous regions. The origin of 'Tiranka' is unknown. In the past it was one of the most common varieties in Macedonia. It is encountered under the synonyms of elbasanka, tiranka (Selamovska, 2013). The variety is resistant to wind and diseases, it is sensitive to stronger frost and drought (Niketic, 1951). It grows well at most favourable fertile and moderately wet soils (Dimitrovski, 1974).

The surveys are carried out in the region of Veles, Kratovo, Gostivar and Resen, which are part of three orchard regions: central (Veles), eastern (Kratovo) and western orchard region (Gostivar and Resen).

Local climate conditions

Veles region belongs to the continental-sub-Mediterranean climate and vegetation-soil area (Filipovski et al., 1996), up to 600 meters above sea level, which combines the influence of the sub-Mediterranean and eastern continental climate. The average annual temperatures in this climate range from 11.8°C to 13.6°C (mean 12.7°C). The sum of active temperatures above 10°C is 3662-4293°C (mean 3942°C). This area is characterized by the smallest amount of precipitation compared to other areas. The annual rainfall

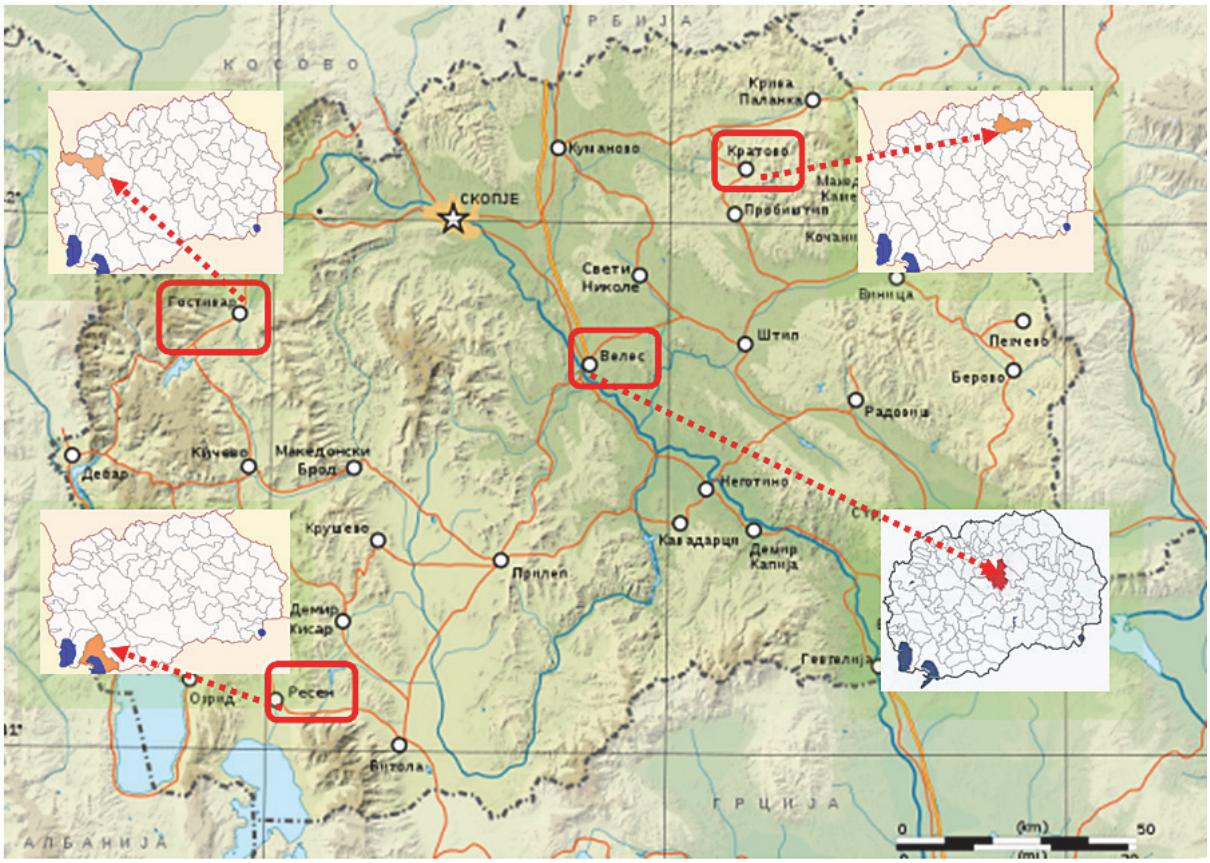

Fig. 1. Map of Macedonia with marked regions of the collected fruit of researched traditional pear variety

is 460-583 mm (mean 507 mm). The drought index average is 22.6. The altitude ranges from 170 to 300 m.a.s.l. (Fig. 1).

Kratovo and Gostivar regions fall into a warm continental climatic-vegetation-soil area, located at an altitude of 600-900 m. It features an average annual temperature of 9.6-11.8°C (mean 10.9°C) and a the mean annual amount of active temperatures above 10°C is 3975°C. In this area there is about 40% more precipitation than in the previous, continental-sub-Mediterranean. It has a lower degree of aridity, with an average drought index of 33.5. The average annual amount of precipitation is 700 mm. According to the values of the Lang landing factor, the Kratovo region has a semidry climate. The altitude in Gostivar ranges from 510 to 580 m.a.s.l., while Kratovo is placed at a higher level ranges from 570-700 m.a.s.l. (Fig. 1).

Resen region belongs to the cold continental climatic-vegetation-soil area (Filipovski et al., 1996), located at an altitude of 900-1100 m.a.s.l.. As a result of the higher altitude, cold continental climate with a certain influence of the mountain climate dominates in this area. The Resen region has an average annual temperature 9.6°C. The average annual amount at active temperatures above 10°C is 2563°C. The annual amount of precipitation is 800-900 mm. The drought index is 25-40.8 (mean 33.5). The humid climate prevails (Fig. 1).

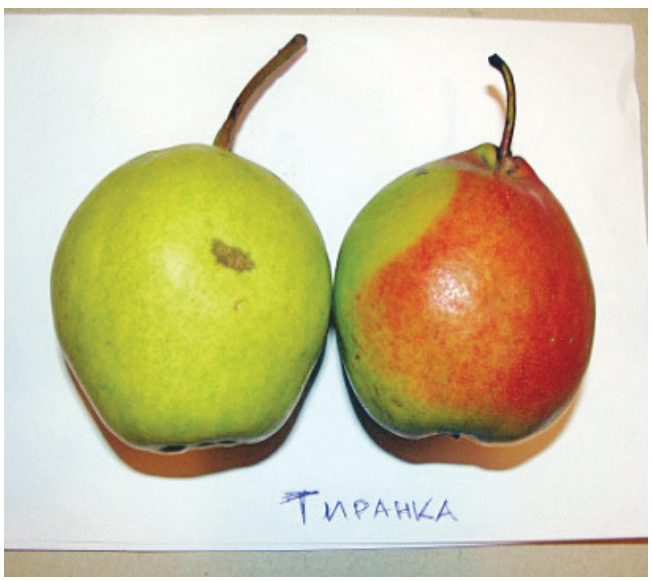

Fig. 2. Traditional pear variety 'Tiranka'

Results and Discussion

According to morphological characteristics, the tree is long-lasting, very lush, branched, with a half-edged to horizontal branches. The crown is high, pyramidal. Very native variety, fruiting over 30 000 kg/ha (Stančevic, 1983). In Gostivar region, in the village of Galate, an old Tiranka tree, for over 100 years, produces about one tonne of fruit (Selamovska et al., 2014).

It starts to blossom in the first to the second decade of April, depending on the climate conditions. It flourishes earliest in the region of Veles, and at the latest in the region of Resen. In comparison, although the Veles and Kratovo regions have almost equal amount of active temperatures above 10°C, the variety in Veles is blooming earlier. The reason for this is the lower altitude on which the Veles region is located and the warmer climate. With an increase in altitude for every one meter, the air temperature decreases by 1°C (Ristevski and Simovski, 1986). According to the time of ripening, Tiranka is a winter variety. It's been picked at the end of October. The fruits mature and are consumed in the winter months. They are kept until April, May. It belongs to the most beautiful domestic varieties of pears (Selamovska et al., 2013a). In the early spring, market prices are high (Selamovska et al., 2013b).

The fruit is round (form 1.3), towards the stalk and the calyx slightly narrows, which makes it with the only recognizable form, which is not found in other varieties of pears.

Table 1
Morphological fruit traits of traditional variety 'Tiranka'

Region	Fruit morphological characteristics					
	Fruit mass ± SD (g)	Fruit length ± SD (cm)	Fruit width ± SD (cm)	Stalk length ± SD (cm)	Healthy seeds in fruit	Fruit firmness ± SD (g/cm^2)
Gostivar	214.1±9.02	7.9±0.60	7.7±0.37	4.2±0.46	2.1±0.16	1187.5±69.62
Resen	189.8±4.49	7.4±0.30	7.5±0.24	4.2±0.34	4.5±0.18	1325.0±45.55
Kratovo	193.2±4.37	7.4±0.23	7.2±0.31	4.1±0.33	3.5±0.26	1305.0±6.62
Veles	106.2±3.75	5.7±0.31	5.7±0.37	5.1±0.22	1.3±0.15	1350.0±41.99
Average	175.8	7.1	7.5	4.4	2.8	1291.9
$LSD_{0.05}$	8.72**	46.21**	0.45	0.53	0.29	60.76**
$LSD_{0.01}$	11.78**	62.40**	0.61	0.72	0.39	82.05**

Table 2
Physiological fruit traits of traditional variety 'Tiranka'

Region	Fruit physiological characteristics		
	Soluble dry matters ± SD (%)	Total acids ± SD (%)	Total sugar ± SD (%)
Gostivar	15.4±0.32	0.268±0.01	15.2±0.23
Resen	14.2±4.26	0.228±0.06	13.5±0.36
Kratovo	14.2±0.16	0.402±0.01	13.60±0.18
Veles	17.6±0.54	0.201±0.08	14.5±0.36
Average	15.3	0.27	14.2
$LSD_{0.05}$	0.51	0.41	0.22
$LSD_{0.01}$	0.74	0.55	0.39

The fruit exoderm is thick, firm, fine-coloured, with a basic green colour, which later yellowing becomes a lemon yellow with further diffuse redness. Fruits grown in the Resen region are more intensely reddish, compared to fruits from other regions (Fig. 2).

According to the average weight of the fruit (175.8 g) and the classification of Rubcov, the variety Tiranka forms medium-sized fruits (length 7.1 cm and width 7.5 cm) (Table 1). The largest fruits are given in the region of Gostivar (214.0 g) and Kratovo (193.2 g), and the smallest in the region of Veles (106.2 g), for which statistically significant differences have been determined. Areas that are at higher altitude, have higher relative humidity, which positively affects the development of the pear, resulting in larger fruits.

The stalk of the fruit is solid, bent and long (4.4 cm). The calyx is wide and open. In the fruit average 2.8 healthy seeds are found. The mesocarp is whitish, very juicy, crunchy, hard, with a good, sweet-sour taste, has a medium texture and medium to many stony cells. The influence of climatic conditions is felt on the taste, the firmness and the presence of rocky cells in the fetus. In dry years and in drylands such as the Veles region, Tiranka gives smaller and firmer fruits with a bitter taste of mesocarp (edible part) and a higher amount of rocky cells compared to other, humid regions. The best appearance and taste are the fruits of the Resen region. The fruits have an average firmness of 1291.9 g/cm^2 for which trait the differences are statistically significant. When the fruits ripen, the edible part rots. Until it starts softening, the mesocarp is hard and is not used in fresh condition.

The fruits contain an average 15.3% soluble dry matter, 14.2% total sugars, 0.27% total acids. The highest percentage of soluble dry matter is in the region of Veles (17.6%). In the region of Kratovo and Resen, fruits with the lowest content of soluble dry matter (14.2%) and total sugars (13.5%) are obtained. The fruits are used for cooking, baking and for pickling. In the region of Kriva Palanka they are used for making brandy. In the investigated properties of the fruit, the differences are not statistically significant (Table 2).

Table 3
Correlation between the researched peer fruit parameters grown on different localities

Locality	FWg:FL	FWg:FWd	FF:FWg	SDM:TSC
Gostivar	0.107	0.516	0.487	0.098
Resen	0.293	0.146	-0.336	-0.596
Kratovo	0.467	0.636	0.526	-0.364
Veles	0.460	0.069	-0.095	0.318

Legend: FWg – Fruit weight, FL – Fruit length, FWd – Fruit width, FF – Fruit Firmness, SDM – Soluble Dry Matters, TSC – Total Sugar Content

Table 3a
Correlation between the researched peer fruit parameters grown on different localities

Locality	SDM:TAC	TSC:TAC	FF:TSC	FF:TAC
Gostivar	-0.435	0.380	-0.100	-0.060
Resen	-0.190	0.331	-0.257	0.262
Kratovo	0.322	-0.401	-0.525	-0.137
Veles	0.540	0.617	0.196	0.721

Legend: SDM – Soluble Dry Matters, TAC – Total Acid Content, TSC – Total Sugar Content, FF – Fruit Firmness

In relation to the tested correlation between the properties of the fruit (Table 3, 3a) on the locality Veles, a strong correlation was found between the content of soluble dry matter versus the total acidity content (0.540), further between the content of total sugars versus the total acid content (0.617) as well as between the strength of the fruit and the content of the combined acids (0.721). There is strong correlation between the firmness and the weight of the fruit (0.526) and between the firmness of the fruit and the content of total sugars (0.525) at the locality Kratovo. In the vicinity of Gostivar, dependence was found only between the weight and the width of the fruit (0.516) and in the Resen vicinity it was between the content of soluble dry matter and total sugars (0.596) and it was strongly dependent. For other examined properties of the fruit, the interdependence ranges from very low to medium.

Conclusions

The traditional variety 'Tiranka' according to ripening time is winter variety. The fruits are harvested towards the end of October. Blooming is in the first decade of April (Veles) until the second decade of April (Resen), depending on the genotype, climatic conditions and orographic conditions. It forms medium-sized fruits, with a firm, bent and long stalk. The largest fruit is given in the region of Gostivar (214.0 g) and Kratovo (193.2 g), and the smallest is in the region of Veles (106.2 g). The fruits are solid (with average firmness 1291.9 g/cm2). They have a long stalk. Average 2.8 healthy seeds are found in the fruit. They contain 15.3% soluble dry matter, 14.2% total sugars, 0.27% total acids. The content of the chemical composition varies depending on the climate and orographic conditions.

Aknowledgement

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