

Modern trends in the assortment and growing technology of pome fruit species in the Republic of Serbia

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SUMMARY

Fruit plantations in the Republic of Serbia cover 170,426 ha, of which about 20% is occupied by pome fruit species. The share of pome fruits in the total fruit production in the Republic of Serbia is nowadays about 25% and further progress is expected due to larger demands for these fruits, especially apple. The pome group is dominated by apple, which is characterized by frequent changes in the assortment and growing technology. Current trends in apple production are related to establishing high-density plantings with modern cultivars according to market demands and consumer preferences, which also include anti-hail nets and irrigation systems. The following commercial cultivars are currently the most important: 'Golden Delicious Reinders®', 'Granny Smith Challenger®', 'Superchief Spur Red

'Superchief Spur Red Delicious®', 'Red Delicious Jeromine', 'Gala Buckeye', 'Gala Fendeca', 'Fudži Kiku 8', 'Braeburn Mariri Red®', 'Evelina®' 'Pink Lady®'.

[*Erwinia amylovora* (Burnill)].

(2017),

170,426 ha (

Delicious®, 'Red Delicious Jeromine', 'Gala Buckeye', 'Gala Fendeca', 'Fui Kiku 8®', 'Braeburn Mariri Red®', 'Evelina®', and 'Pink Lady®'. In addition, the improvements in storage technology were discussed.

In recent years, new pear and quince plantations have been established on larger areas, but in comparison to apple, they are not followed by a modern assortment and the application of intensive growing technology. The pear cultivar structure is dominated by summer ('William's Bon Chrétien', 'Santa Maria' and 'Carmen') and winter cultivars ('Abate Fetel' and 'Cure'), whereas 'Leskova ka', 'Vranjska' and 'Champion' are the most important cultivars within the quince assortment. The main problems in pear and quince production are the choice of the appropriate rootstocks and the cultivar sensitivity to the fireblight [*Erwinia amylovora* (Burnill)].

This paper was undertaken primarily to give an overview of the current assortment and growing technology in the apple, pear and quince production in the Republic of Serbia. Considering the situation in the world, the prospects for further improvement in the pome fruits production were presented.

Key words: apple, pear, quince, cultivar, orchard management

INTRODUCTION

Due to the favourable agro-ecological conditions for growing temperate zone fruit species, the Republic of Serbia has a long tradition of production and processing of these species. Our country is also the leading fruit producer in the region, and with regard to certain fruit species, the leading European and world producer. According to the data of the Republic Bureau of Statistics, Serbia (2017), the total area occupied by orchards amounts to 170,426 ha (average for the period 2013/2017),

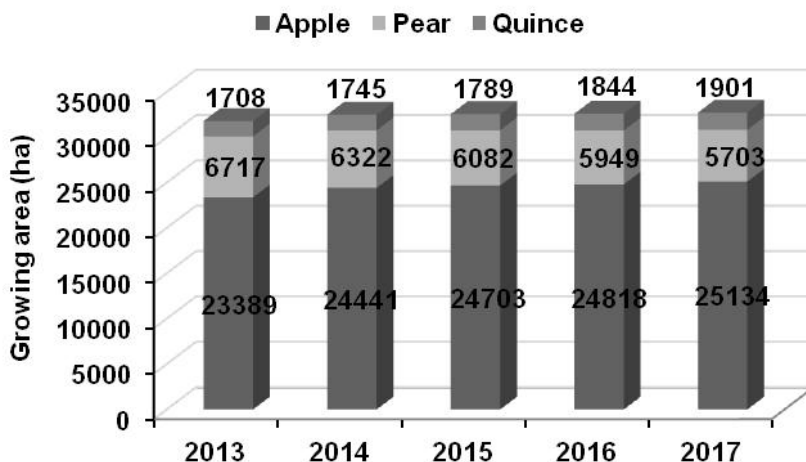
2013-2017),
 4.8
 %
 11
 %
 17 %
 19,25 %,
 25 % (2017).
 2017 ., 2013 .
 1745 ha 200 ha,
 1000 ha,
 [Erwinia amylovora (Burnill)]
 [Cacopsilla piry (L.)]
 (Keserovi et al., 2014).

which covers 4.8% of the total agricultural land area. Fruit production accounts for 11% of the total agricultural production value and, together with fruit products, have a 17% share of the agricultural product export structure.

In the structure of fruit growing area in the Republic of Serbia, pome fruit species account for 19.25%, while in the structure of total fruit production they represent 25% (Republic Bureau of Statistics, Serbia, 2017). Apple, pear and quince are known as very demanding fruit species in terms of growing technology, but highly profitable as well, therefore, the interest of growers is present. In our work, current assortment and growing technology of pome fruit species in the Republic of Serbia were analysed. With a review of world trends, suggestions of the necessary measures for further improvement of these fruit species production were given.

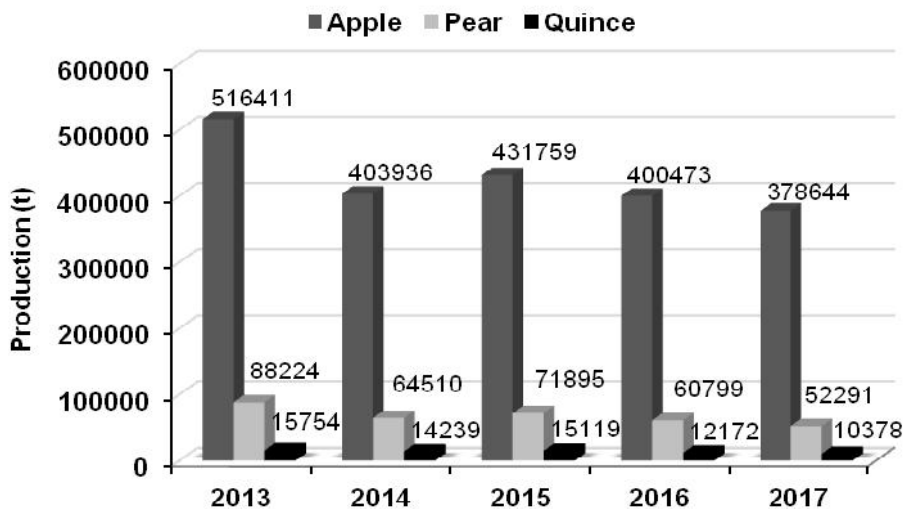
Production trends

The most important pome fruit in the Republic of Serbia is apple, followed by pear, whereas quince is the least prevalent. The areas of apple and quince orchards are being increased, while the pear growing areas are being reduced (Figure 1). In 2017, compared to 2013, the areas under apple and quince orchards were larger by 1,745 ha and 200 ha, respectively. In contrast, the areas under pear orchards decreased by almost 1,000 ha, caused by an inadequate choice of planting sites and rootstock, as well as the occurrence of bacterial fireblight [*Erwinia amylovora* (Burnill)] and pear psyllid [*Cacopsilla piry* (L.)] (Keserovi et al., 2014). The same authors stated that in the last years there has been a great interest in growing quince, so that the Republic of Serbia might become one of the world's leading producers of this fruit species.



1.
(2013/2017)
Fig. 1. Growing area of apple, pear and quince in the Republic of Serbia (2013/2017)

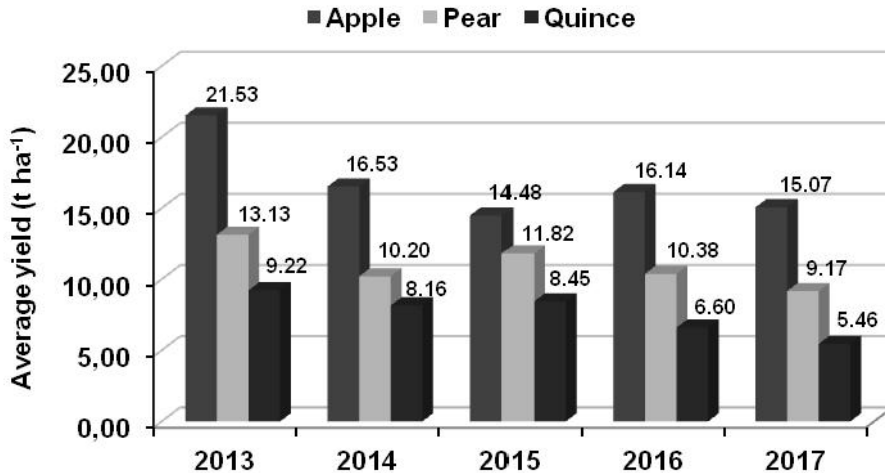
(FAO, 2018; Republic Bureau of Statistics, Serbia, 2017). In European scales, according to the apple-, pear- and quince-growing areas, our country is in the twelfth, tenth and first place, respectively (FAO, 2018; Republic Bureau of Statistics, Serbia, 2017).



2.
(2013/2017)
Fig. 2. Production of apple, pear and quince in the Republic of Serbia (2013/2017)

2013/2017 . 426 244,6 t
 (2),
 .
 543,8 t,
 (WAPA, 2016;
 , 2017).
 13532,4 t
 (FAO,
 2018,
 , 2017).
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 (2017),
 : 16,75 t ha⁻¹
 ; 10,94 t ha⁻¹ 7,58 t ha⁻¹
 (3).
 ,
 (FAO, 2018).

The average annual apple production in the Republic of Serbia in the period 2013/2017 was 426,244.6 tons (Figure 2), ranking our country as the seventh producer among European countries (WAPA, 2016; Republic Bureau of Statistics, Serbia, 2017). In the same period, the average annual pear production was 67,543.8 tons, which ranked our country on twelfth place in Europe (WAPA, 2016; Republic Bureau of Statistics, Serbia, 2017). Regarding the average annual production of 13,532.4 tons of quince, the Republic of Serbia represents a leading European producer (FAO, 2018, Republic Bureau of Statistics, Serbia, 2017). However, the real indicator of the situation in pome fruits production is yield. According to the data of the Republic Bureau of Statistics, Serbia (2017), average yields of certain pome fruit species in the assessed period are: apple – 16.75 t ha⁻¹; pear – 10.94 t ha⁻¹ and quince – 7.58 t ha⁻¹ (Figure 3). Compared to the yield of apple and pear of leading European countries, yields of these fruit species in the Republic of Serbia are several times lower (FAO, 2018).



3.
 (2013/2017)
 Fig. 3. Average yield of apple, pear and quince in the Republic of Serbia (2013/2017)

2013).
90 %

(Keserovi et al.,
80 100 t ha⁻¹,

26425,6 t ha⁻¹ (
, 2017).

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" "
" (Nikoli et al., 2012).

'Golden Delicious

- The yield and oscillations of the
- average annual production of pome fruit
- species have occurred as consequences
- of temperature changes during the period
- of dormancy, as well as the spring frost
- damage, drought, hail, surface water and
- alternate bearing. All of the above is an
- indicator that the largest number of
- orchards is extensive. In recent times,
- highly intensive apple plantations have
- been established, which will also affect
- the increase in total production and yield
- per unit area (Keserovi et al., 2013).
- Apple yields in these plantations range
- from 80 to 100 t ha⁻¹, with over 90% of
- extra and first-class fruits. Regarding this,
- average apple yields in some regions of
- the Republic of Serbia with a larger share
- of young and highly intensive plantations
- are 26,425.6 t ha⁻¹ (Republic Bureau of
- Statistics, Serbia, 2017). Furthermore,
- new plantations of pear and quince are
- being established, although they are not
- accompanied by intensive growing
- technology, as is the case of apple.

Choice of cultivars and rootstocks

- Choice of apple cultivars and
- rootstocks and their mutual combinations
- is the most important for establishing new
- commercial orchard. When choosing a
- cultivar, it is necessary to take into
- account high standards of fruit quality,
- specificity of the consumers' demands on
- target market and strong competition.
- Furthermore, the agro-ecological
- conditions of the sites in which the
- planting of new orchard is planned should
- be taken into account. In older apple
- orchards in the Republic of Serbia, the
- cultivar 'Idared' is most prevalent,
- followed by the cultivars from the group
- 'Golden Delicious', 'Granny Smith',
- 'Jonagold' and 'Red Delicious' (Nikoli et
- al., 2012). Among newly-introduced
- cultivars in modern plantations, a
- significant share belongs to the cultivars
- 'Golden Delicious Reinders', 'Granny
- Smith Challenger', 'Superchief Spur Red

Reinders', 'Granny Smith Challenger', 'Superchief Spur Red Delicious', 'Red Delicious Jeromine', 'Gala Buckeye', 'Gala Fendeca', 'Fuji Kiku 8[®]', 'Braeburn Mariri Red[®]', 'Evelina[®]' 'Pink Lady[®]' (Luki et al., 2016a).

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 ", 21 %, -
 2016 ., (WAPA, 2016). -
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 11 %, " " -
 , 9 %.
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 " " " " (Guerra, 2016.).

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 : 'Golden Delicious' – 'Reinders[®]'; 'Granny Smith' – 'Challenger[®]'; 'Red Delicious' – 'Superchief[®]Sandige', 'Redchief[®]Camspur', 'Scarlet Spur[®]Evasni' 'Red Cap Valdor[®]'; 'Red Delicious' – 'Red Delicious Redvelox[®]', 'Red Delicious Jeromine' 'King[®] Roat Red Delicious'; 'Fuji' – 'Fui Kiku 8[®]' 'Fubrax[®]'; 'Jonagold' – 'Red Jonaprince[®]'; 'Gala' – 'Gala Schnitzer Schinga[®]', 'Brookfield[®]Baigent Gala', 'Buckeye Gala[®]Simmons', 'Galaxy Selecta[®]' 'Devil Gala'; 'Braeburn' 'Hillwell[®] Hidala' 'Mariri Red[®]'.

9.

Delicious', 'Red Delicious Jeromine', 'Gala Buckeye', 'Gala Fendeca', 'Fuji Kiku 8[®]', 'Braeburn Mariri Red[®]', 'Evelina[®]' and 'Pink Lady[®]' (Luki et al., 2016a).

The leading apple cultivars in the European Union in 2016 (WAPA, 2016) were those from the 'Golden Delicious' group, with a production share of about 21%. Cultivars from the group 'Gala' follow with a share of about 11%, whereas the 'Idared' ranks third with a share of about 9%. According to the data from the same source, the share of the 'Idared' in the European Union's apple production has doubled in the last ten years, which can be associated with the demands of the Russian consumer market. Also, some analyses and estimations showed that, despite a large number of newly released apple cultivars, for ten years now the world's leading cultivars will still be 'Golden Delicious', 'Red Delicious', 'Gala', 'Fuji', 'Idared', 'Granny Smith' and 'Braeburn' (Guerra, 2016). Based on these analyses and considering the agro-ecological conditions of the Republic of Serbia for the establishment of intensive apple plantations, the following cultivars are recommended: 'Golden Delicious' – 'Reinders[®]'; 'Granny Smith' – 'Challenger[®]'; 'Red Delicious' spur type group – 'Superchief[®]Sandige', 'Redchief[®]Camspur', 'Scarlet Spur[®]Evasni' and 'Red Cap Valdor[®]'; 'Red Delicious' standard types group – 'Red Delicious Redvelox[®]', 'Red Delicious Jeromine' and 'King[®] Roat Red Delicious'; 'Fuji' group – 'Fui Kiku 8[®]' and 'Fubrax[®]'; 'Jonagold' group – 'Red Jonaprince[®]'; 'Gala' group – 'Gala Schnitzer Schinga[®]', 'Brookfield[®]Baigent Gala', 'Buckeye Gala[®]Simmons', 'Galaxy Selecta[®]' and 'Devil Gala'; 'Braeburn' group – 'Hillwell[®] Hidala' and 'Mariri Red[®]'.

The most prevalent apple rootstock in the world and in our country is M 9. Worldwide, different clones of the

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T337 NAKB.
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9
NAKB (T) 337.
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106 26
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18 19 (Milatovi , 2009).
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WAPA
(2016) -
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(42,3 %), " (13,4 %)
" (11.6 %).
, "
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mentioned rootstock, characterized by better rooting are used. The most important of them is T337 NAKB clone. Other rootstocks that are similar to M 9 are also used worldwide, although they show better results in terms of resistance to fireblight, wooly apple aphid and low temperatures, but none of them has been introduced in the Republic of Serbia.

- Leading rootstocks in modern high-density apple plantations, where intensive agro and pomo-technical measures are applied, should be M 9 and the clone NAKB (T) 337. They are recommended for moderately vigorous and vigorous cultivars. Rootstocks MM106 and M26 are recommended for grafting of spur types of ‘Red Delicious’ grown under non-irrigated conditions.

- The European pear has the most stable assortment of cultivars among fruit species. The production of pear both in the world and in our country is dominated by the cultivars released in 18th and 19th century (Milatovi , 2009). The pear assortment in the Republic of Serbia is dominated by summer cultivars of which most prevalent are ‘William’s Bon Chrétien’ and ‘Santa Maria’, while in recent years, the ‘Carmen’ has become more important cultivar. Among winter pear cultivars, the most commonly grown is ‘Abate Fetel’. In very old orchards, the cultivar ‘Cure’ is present, which is not recommended for the establishment of new plantations due to the poor fruit quality. According to the WAPA data (2016), the following pear cultivars are prevalent in the territories of the European Union: ‘Conference’ (42.3%), ‘Abate Fetel’ (13.4%) and ‘William’s Bon Chrétien’ (11.6%). Previous experience showed that the ‘Conference’ was not suitable for growing under Serbian ecological conditions, due to the occurrence of burns on leaves.

- When choosing a pear cultivar structure for commercial production, the lack of early and medium-early ripening cultivars on the market should be taken

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 SYDO. ú ,
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 (Nikoli , 2009),
 (Nikoli et al., 2012).
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plantations, the leading rootstock in the upcoming period should be: quince ADAMS, quince MA, quince Ba 29 and quince SYDO. Use of the quince MC is not recommended due to the susceptibility to severe winter frosts.

In the world's production of quince there are about 100 cultivars with no cultivar dominating the production (Nikoli , 2009), namely some cultivars are specific to certain region (Nikoli et al., 2012). In our country, the old indigenous cultivars 'Leskovacka' and 'Vranjska' are mainly grown, while the Bulgarian cultivar 'Champion' is present to a lesser degree. In order to intensify the quince production, apart from 'Leskovacka' and 'Champion', a domestic cultivar 'Morava', derived from planned hybridization at the Fruit Research Institute, a ak, as well as introduced cultivars 'Asenica', 'Triumph' and 'Hemus' are also recommended.

In the production of quince in the Republic of Serbia, vegetative rootstocks originating from quince have been used. In practice, the most commonly used rootstock is quince MA due to its good compatibility with all cultivars, but the priority should be given to the quince Ba 29 due to its stronger root and tolerance to higher lime content in the soil. The use of quince SYDO is recommended as well.

Growing technology

Planting material. Successful fruit production cannot be achieved without high quality nursery trees. Well-developed and healthy nursery trees allow early cropping and faster return of investments. For establishing highly intensive apple and pear orchards, nursery trees with adequate number of well-developed premature branches are deployed in the formation zone of the future crown. These are so-called knip nursery trees that provide early productivity (Hrotko et al., 2000; Wertheim et al., 2000), thereby

(Hrotko et al., 2000; Wertheim et al., 2000).

(Palmer and Warrington, 2000)

(Van der Berg, 2003).

[*Erwinia amylovora* (Burnill)].

(Nikoli , 2009).

20

controlling the vegetative growth of trees as well. Apart from that, in the first years after planting, manipulation with trees is easier (Palmer and Warrington, 2000), and during exploitation such trees are more productive and require less labor in the process of crown formation and care (Van der Berg, 2003). In the last few years, some nurseries in the Republic of Serbia started producing these trees, though such production does not meet the needs of growers in terms of cultivar assortment and quality of material and therefore the large quantities of apple and pear nursery trees are imported.

Similar situation is with nursery trees for the new quince orchards. The main problem in quince production is sensitivity to the fireblight [*Erwinia amylovora* (Burnill)], and one of the basic ways to overcome this problem is the use of one-year certified or standard nursery trees that come from selective and healthy mother trees (Nikoli , 2009). At this moment in our country, there are not enough mother trees for grafting, and some of the quality cultivars are not included in the official national list of cultivars. There is also a lack of quality mother planted rootstocks.

Plantation establishment.

Productivity of pome fruit species is known to be conditioned by an adequate selection and a combination of compatible cultivars, as well as their planting order. When establishing apple and pear plantations in the Republic of Serbia in the previous period, the most commonly used was the combination of cultivars in double rows. The main cultivar was represented with six or four rows and pollinizer cultivars with two or four rows. This concept has been retained in pear plantations to date, while in apple the concept of monocultivar orchards is used today, which means that a pollinizer cultivar is planted as every 20th tree in a row, thus achieving a share

3 %
 (crabapples)
 'Professor Springer', 'Golden Gem',
 'Crimson Gold', 'Everest', 'Red Santinel'
 'Hillary'
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 -
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 -
 (Keserovi et
 al., 2017).
 3.20 m 3.60 m
 0.60-0,65 m
 0,75-0,80 m
 3900 5200.
 4.5-5 m x 2.5-3.5 m
 1,0 m 3.2-3,5 m x 0,8-
 ADAMS
 [Erwinia amylovora (Burnill)]
 [Cacopsilla piry
 (L.)],
 (Radivojevi et al., 2017a).
 -
 -
 5-6 m,
 3-4 m.

of about 3% of pollinizers in the plantation.

The flowering crabapples, such as 'Professor Springer', 'Golden Gem', 'Crimson Gold', 'Everest', 'Red Santinel' and 'Hillary' are used as pollinizers, because they generally have slightly earlier and longer flowering time than main cultivars, and also there is no confusion about what to pick at harvest. This orchard design provides easier protection against diseases and pests, as well as thinning and fruit harvesting (Keserovi et al., 2017).

In recent apple plantations, the planting has been standardized with planting space 3.20 m to 3.60 m between rows, and 0.60–0.65 m in-row spacing for spur types and 0.75–0.80 m for standard cultivars. The number of plants per hectare varies from 3,900 to 5,200.

Intensification of pear and quince production is limited by the rootstock selection. Depending on the rootstock used, the space in pear plantations varies from 4.5–5 m x 2.5–3.5 m in case of wild pear seedling, up to 3.2–3.5 m x 0.8–1.0 m if the ADAMS or MA quince is used as the rootstock. Establishing of high-density plantings is not recommended in the Republic of Serbia, because they involve high investments with uncertain outcome, primarily due to difficult control of the fireblight [*Erwinia amylovora* (Burnill)] and pear psyllid [*Cacopsilla piry* (L.)], as well as vigour control and insufficient knowledge of specific growing technology (Radivojevi et al., 2017a). Newer orchards of quince are based on a somewhat larger planting space in relation to apple and pear. The distance between rows is 5–6 m, while in-row spacing is 3–4 m.

Training system. When choosing a training system in modern plantations, there is a tendency to bring young trees into production early, actually to develop

a strong tree architecture that can support crop loads. The most represented training system in intensive apple plantations in the Republic of Serbia is spindle and some of its modifications, while in older orchards there is a presence of spindle bush, pyramidal crown and open vase crown. In recent pear orchards in our country in the case of grafting of cultivars on the rootstocks of poorer vigor, the spindle has been used.

Spindle bush, pyramidal crown and palmetto are used as a training system, if rootstock is the seedling of wild pear. The most commonly used training system for quince is open vase crown, although experience has shown that good results are achieved in case of the use of pyramidal crown as well.

Crop load management. Pome fruit species are known as very demanding in terms of growing technology. The standard in apple production in the Republic of Serbia is a high-density planting with anti-hail nets and irrigation systems simultaneously set up with the plantation establishment. Anti-frost systems have been sporadically installed too. These reduce the risk of negative impacts of certain meteorological circumstances on yield (Veli kovi and Golijan, 2015). The use of anti-hail nets and installation of irrigation systems in pear and quince plantations in our country is a rare case. In order to achieve regular and high yields accompanied by appropriate fruit quality, regular and timely application of appropriate agro- and pomo-technical measures is necessary such as: winter and summer pruning, irrigation, fertilization, anti-hail protection, frost protection, chemical thinning, etc.

Golijan, 2015).

(Veli kovi and

Pruning is certainly one of the most important pomological measures applied in plantations. It aims at proper formation and maintenance of the crown, productivity and vigour regulation, high quality of fruits and a long life of trees. Nowadays, in apple plantations in Serbia, short pruning is being replaced by the so-called long pruning, where two-year branches are not shortened. In this way, the vigor of fruit trees is decreased, the formation of flower buds is stimulated, and thus chemical thinning of fruits facilitated, resulting in better coloration of fruits and a decrease in their fall-off.

Introduction of modern growing systems brought the inevitability of using green pruning. During vegetation period, within pruning, the two key terms are distinguished. The first, at the time of the intense growth of the shoots and is directed towards the formation of a type of crown by selecting the necessary and removing unnecessary and competitive shoots. The second term is after the intensive growth of shoots has been completed and, in addition to some corrective actions directed towards the formation of the crown form, it mainly refers to the stimulation of differentiation of flower buds for the next year, stimulation of the fruit development and coloring, contributing to better protection against diseases and pests.

The issue of regulating the vigor of trees is especially evident in pear plantations. Apart from the reduction of nutrition and irrigation, cutting of the root system is also applied during the period of dormancy. Application of growth regulators is possible as well, and in our country, 'Regalis', which represents prohexadione-calcium[®], has been registered for these purposes (Radivojevi et al., 2017b).

Besides regulation of tree vigor, some growth regulators have been used in modern plantations of pome fruit

® (Radivojevi et al., 2017b).

(Keserovi et al., 2009; Luki et al., 2012a, 2012b; Luki and Mari, 2013), (ATS), (Mili et al., 2011). (NAD), (NAA) 6- (BA). (3 GA₄₊₇) (Radivojevi et al., 2017b). NAA, AVG (MCP ()) MCP AVG + NAA (Yuan and Li, 2008).

species for flowers and fruits thinning, to prevent the differentiation of generative buds, to stimulate germination of partenocarp fruits and to prevent the fruit drop before harvest. From the aforementioned, in apple plantations in the Republic of Serbia, plant growth regulators are used for thinning of flowers and fruits. Based on intensive research conducted in our country (Keserovi et al., 2009; Luki et al., 2012a, 2012b; Luki and Mari, 2013), chemical thinning has been introduced into regular practice. Flower thinners are mostly based on ammonium thiosulphate (ATS), which is considered user, environment and consumer safe (Mili et al., 2011). Naphthalene acetamide (NAD) preparations, -naphthylacetic acid (NAA) and 6-benzyladenine (BA) are used for fruit thinning.

Pear and quince flower and fruit thinning is not common in developed countries. Treatment with gibberellins (A₃ or GA₄₊₇) is recommended for the purpose of forming partenocarp fruits in pears.

Some apple cultivars, which are at the same time most represented in our country, such as 'Idared', 'Jonagold' and 'Red Delicious' groups, and to some degree the cultivars from the 'Golden Delicious' group, are characterized by high ethylene production and tendency to pre-harvest fruit drop (Radivojevi et al., 2017b). Such fruits have no optimal colour, maturity and size and cannot be used accordingly. In order to prevent these significant losses in apple orchards, NAA, AVG (amino ethoxy vinyl glycine) and MCP (methylcyclopropene) are recommended to be used alone or in combination AVG + NAA, or MCP and AVG+NAA (Yuan and Li, 2008).

One of the most important agro-technical measures in modern plantations of pome fruit species is fertilization.

and Large, 1977). (Ankerman and Large, 1977). (Miši , 1994). (Miloševi and Miloševi , 2015). (Jivan and Sala, 2014). (Nikoli et al., 2012).

Fertilization provides compensation of certain nutrients in the root system zone of plants enabling their normal life cycle. The quantities of certain elements that need to be put into the soil are specified according to the determined fertility of the soil (Ankerman and Large, 1977) and delivering nutritional elements necessary for vegetative growth and fruiting of the trees (Miši , 1994). Fruit nutritional state and determination of the specific needs for certain nutritive elements is most likely to be defined by leaf analyzing (Miloševi and Miloševi , 2015), which is not a common practice in our country. Different systems of fertilization in the orchards of pome fruit species (soil application of granular fertilizers or fertigation through drip emitters) in the Republic of Serbia are applied.

In modern plantations, foliar nutrition is applied too, compensating that way less lacking quantities of nutrients in leaves and fruits. The type and rate of the applied nutritives is defined according to soil and climatic conditions, vegetation stage, orchard management practices, i.e. irrigation (Jivan and Sala, 2014).

In the most developed fruit growing countries, the concept of Integrated fruit production has been applied in practice to 90% and more of the surface (Nikoli et al., 2012). In this production concept, the regulations prescribe all agro-technical measures (protection, fertilization, irrigation, thinning, land maintenance, harvesting, storing, etc.). According to the respective programme, a special attention is given to the choice of means for protection against diseases and pests, with holding period and application methods according to possible side effects, preventive and biological measures. This concept implies filing for inclusion in the integrated production mode, acceptance of the obligation to comply with the prescribed technology and its control from the competent service and finally, marketing that

"AGRIOS"
(Keserovi et al., 2007;
2012)

(Keserovi et al., 2017).

ú.

(CA),

1 % ((ULO),

(DCA),

"Fitomag",

"SmartFresh®"
1-

2011

2016

- provides a more favorable market position. Based on the "AGRIOS" model from South Tyrol, in some apple plantations in Vojvodina, development of the Integrated Production Model in the Republic of Serbia has begun (Keserovi et al., 2007; 2012) and in the upcoming period, the transition of conventional to integrated fruit production is necessary to be done in modern apple orchards (Keserovi et al., 2017).

Harvesting and storing fruits. The quality of fruits is a basic precondition for successful marketing largely conditioned by the harvest time and storage conditions. The greatest progress in the Republic of Serbia has been made in the modern apple storage technologies.

- An ever-increasing number of apple growers, with the aim of properly determining the harvest time have been increasingly using methods such as iodine-starch test, firmness of fruit and soluble solids content, while being decreasingly reliant on experience and subjective evaluations such as fruit coloration.

- Following the increase of apple production, the number and capacity of modern controlled atmosphere (CA) storages has also been increasing. Most commonly, these storages have the possibility of reducing oxygen and carbon dioxide levels below 1% (ULO), while Dynamic Controlled Atmosphere (DCA) technology, which allows the keeping of fruits at very low oxygen concentrations, has also been used in some storages.

- Synthetically produced quality enhancers of apple fruit, such as 'SmartFresh®' and 'Fitomag', which contain 1-MCP, have been registered in the Republic of Serbia since 2011 and 2016, respectively.

- These quality enhancers are capable of

-
(Magazin et al., 2010; 2017).

(Magazin and urovi , 2017).

MCP-

inhibiting ethylene action and positively affect the firmness and juiciness of fruits, longer retention of the skin green colour preventing the occurrence of scalds in susceptible cultivars (Magazin et al., 2010; 2017).

- In order to further intensify the storage technology of apple fruits, more attention should be paid to adequate application of agro- and pomo-technical measures in the orchard, which primarily refers to proper nutrition, irrigation and application of bioregulators and calcium (Magazin and urovi , 2017).

- On the other hand, most of the pear production is being processed and smaller share is intended for table consumption, therefore the longer storing of fruits is rare. Based on the experience from other developed countries, the fruits of 'William's Bon Chrétien', as well as the fruits of other autumn and winter pear cultivars, can be successfully kept in CA storages over a longer time period.

1- Treatment with 1-MCP-based quality enhancers is recommended. Apart from that, the quality of classification and packaging of pear fruits must be significantly improved which are basic preconditions for their recognition in the international market. Since the fruit of quince is planned for processing, keeping the fruit in regular cold storages is just a temporary measure applied in some cases.

CONCLUSIONS

- During the last few years, the following major changes in the production of pome fruit species in the Republic of Serbia (especially apple) have been made: new cultivars and clones of old ones, as well as new rootstocks of poorer vigour, are being introduced in modern plantations; high quality nursery trees are

used for planting; growing technology is intensified by: increasing the number of plants per unit area, introducing many new agro- and pomotechnical measures, and increasing area with installed irrigation systems and anti-hail nets; controlled atmosphere storage technology is being used for long-term storage in order to maintain good fruit quality and extend shelf life of fresh fruits.

Further activities aiming to intensify apple, pear and quince production are based on the aforementioned measures. In addition, it is also important to emphasize the support of the state in production modernization through enabling favorable loans and subsidizing establishment of plantations, procurement of appropriate irrigation systems, anti-hail and anti-frost protection, procurement of agricultural machinery, and building of storage capacities.

In order to achieve international standards in terms of fruit quality and to increase competitiveness in the market, further association of growers is required to bring substantial improvement in leading, supporting, coordinating, representing and promoting the pome fruits production in the Republic of Serbia.

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