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SYSTEMS FOR SHAPING AND PRUNING OF PLUM TREES USED IN BULGARIA

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Abstract

The article presents an overview of the formation systems that have been imposed in the plum production in Bulgaria. Crowns and pruning systems are directly related to the intended use of the fruit production, the planting density, the degree of mechanization of the planting processes and harvesting. For fresh consumption (manual harvesting), at stem height 50 -60 cm and planting distances are 5.0-5.5 m between the rows and 4.0 - 4.5 m in the rows, the trees are formed as oblique palmette trees or fruit hedge (free palmette). For fruit processing such as dried, marmalade, mousse, juice etc., mechanized harvesting requires stem height 90 - 100 cm at planting distances 6.5-7.0 m between the rows and 4.5-5.0 m in the rows, trees are formed as modified central leader, semi-flat free crown and applying contour pruning. For brandy and fruit spirit - the peculiarities of formation and pruning are described.

Key words*: plum, pruning, forming systems.*

INTRODUCTION

Plum is an economically valuable fruit species with traditions of production in our country. It occupies the second place after sweet cherry, which is 6,705 ha, or 18 % of areas under permanent crops in our country (MAF, 2017).

Pruning and pruning systems in Bulgaria are constantly evolving, due to the necessity to increase yield and increase the quality of fruit production (Bozhkova 2006; Djouvinov and Vitanova, 2002; Djouvinov et al., 2012; Iliev et al., 1977; Vitanova et al., 2010).

The shaping and pruning of plum trees depends on the variety and rootstock growth characteristics, the application of fruit production (for fresh consumption or processing), and the need to adapt the crown to some of the mechanized agro-technical activities (soil treatments, pruning, harvesting, etc.) (Djouvinov et al., 2012; Domozetov et al., 2014; Petrov et al., 1979; Velkov, 1965; Vitanova et al., 2010).

The shaping and pruning of plum trees in the production plantations must facilitate mechanized harvesting of fruit and contour pruning (Djouvinov and Vitanova, 2002; Petrov et al., 1979; Sotirov et al., 2015).

The purpose of the currant study is to present the most widely used systems for shaping and pruning plum trees in Bulgaria.

MATERIALS AND METHODS

An in-depth analysis of the shaping and pruning systems used in Bulgaria was made.

Documents and literary, agrobiological and technological sources have been researched in order to provide more complete information about the applied system formations in Bulgaria.

A parallel is made between the systems used for shaping and pruning and are presented the most suitable for our country depending on the way of harvesting and the purpose of the obtained fruit production.

RESULTS AND DISCUSSIONS

Different types of crowns are known in practice, which are divided into 3 main groups, depending on the purpose of the resulting fruit production:

Hand fruit harvesting is used for fresh consumption. The trees are formed as oblique palmette trees or fruit hedge (free palmette) and the planting distances are 5.0 to 5.5 m between the rows and 4.0 to 4.5 m in the rows.

For processing fruits such as dried, marmalade, mousse, juice etc., mechanized harvesting is

recommended, which requires a height of the stem 90-100 cm. Trees formed as modified central leader, semi-flat free crown and applying contour pruning. Planting distances are 6.5-7.0 m between the rows and 4.5-5.0 m in the row.

For brandy production and the production of fruit spirit - the shaping and pruning of trees for these production lines are related to the simplification and reduction of the cutting operations in order to low quality requirements of the resulting fruit production.

Plum trees used for the production of fresh fruit in our country are formed as oblique palmette trees or fruit hedge (free palmette). These are semi-flat and flat crowns, which are suitable for dessert varieties, the orientation of the skeleton branches is in a plane in the direction of the row or with very little deviation from it. The total height of the tree is 3.5-4 m and the stem 60-70 cm.

For manual harvesting the planting distances are 5.0-5.5 m between the rows and 4.0-4.5 m in the row. Different systems of tree formation are used. Formation and pruning of oblique palmette plum trees. It is a flat artificial crown with a leader on which 2-3 floors are formed. Each floor consists of two scaffold branches located opposite that are directed in the direction of the row (Figure 1). Thus, a continuous wall of scaffold and lateral wood with a width of about 1.5-2 m is formed in the row.

The distances between the scaffolds and the number of branch set groups are determined depending on the growth of the trees and the growing wood. In the case of highly growing trees, three floors are formed at 110-120 cm apart.

Figure 1. Oblique palmette plum trees

Scaffold branches of the oblique palmette tree formed only subscafold wood, evenly located sideways and outwards.

It is used in varieties grafted on dwarf rootstocks. This system requires a lot of manual work, strong pruning and the cost of materials to build a supporting structure. It provides better crown lightening, more effective plant protection, convenient for harvesting of high quality fruit.

First dormant pruning (pruning after planting). Newly planted trees are cut to 80-90 cm above the soil surface. Two opposing early twigs are selected to form the first floor, the strong ones cut to 15-20 cm and the weak to 4-5 buds.

In the first year, young trees should be grown so that the leader and scaffolds grow longer than the inter-floor distance.

Second dormant pruning. Suitable for scaffolds are opposite branches. It is desirable for scaffolds to select shoots aligned in length, thus saving extra measures to balance their growth. Scaffolds are not abbreviated during the second dormant pruning, as well as throughout the formation period. Head back leader to form the second floor. Cut at a height of 10-15 cm longer than inter-floor distance. If the leader has not reached that height by more than 10 cm, he does not shorten.

Third dormant pruning. Two strong and aligned lengths for scaffolds on the second set of branches are also choosen. Starters that make a larger angle with the leader are preferred, and their competitors are eliminated. The other lower ones on the leader, with slight and moderate growth, are not cut.

The leader shorten to 120-130 cm to form third set of scaffolds.

The scaffolds on the first floor tilt if they are not inclined, the competitors are removed as well as the stronger vertically growing branches.

Next pruning to complete the formation. In next years trought the summer and dormant pruning the third floor is shaped and the growth of the already formed scaffolds is guided.

After the formation of the last floor, the leader is not shorten. It is left without prunning for a few years until the fruit grows, and growth is significantly reduced, then reduced to 50-60 cm above a moderately growing lateral branch with fruit buds.

Until the trees come into full fruiting, the pruning must be as weak as possible. Primary the

competitors of the leader ans scaffolds are removed. Some very strong and upright growing branches, grown from the inside side of scaffolds, are also removed. Forming is easier and faster when unnecessary shoots is done by summer pruning. Shortening of one-year-old twigs is not recommended except for the length of the leader to obtain branches for scaffolds.

Pruning for shaping and growing of fruit hedge (free palmette). This system is a free palmette with a larger volume of the skeletal part. It is used with moderate rootstocks.

First dormant pruning (pruning after planting). Trees cut down to 80 cm above the soil surface. Weak twigs are shortened to 5-6 buds and the strong ones to 15-20 cm, and those in the stem area are cut to the base.

Second dormant pruning. Slight pruning is done. Oppositely, disposed branches are selected, with wide angle of deflection (above 45°) and grow in the direction of the scaffolds.

There is a head back the leader to form the second floor. Cut at a height of 10-15 cm greater than the specified inter-floor distance. If the leader don't exceeded this height by more than 10 cm, it won't be shortened.

Upright and upward-facing shoots are removed. For branching varieties ('Gabrovska', 'Pop Hariton' etc.), the leader and scaffolds are not cut, and those with weak branching ('Stanley' etc.) Require a moderate reduction in length.

Next pruning to complete the formation. Using summer and dormant pruning in the following years the remaining floors are formed and the growth of the already formed scaffolds is guided.

After the formation of the last floor, the leader is not abridged. It is left un pruned for a few years until the fruit grows, and growth is significantly reduced, then reduced to 50-60 cm above a moderately growing lateral branch with fruit buds.

After the 5^{th}-6^{th} year, crown regulation is performed, which can be done manually on contours or mechanized with RAC-6, in 2-3 years.

Contour pruning can only be on the top, on both sides, with a triangular contour accompanied by a slight manual pruning even in the middle years.

The aim is to keep width of 3.0-3.5 m and a height of 4.0-4.5 m of fruit hedge.

For mechanized harvesting of plum fruits, the trees are formed as modified central leader, semi-flat free crown. The planting distances are 6.5-7.0 m between the rows, 4.5-5.0 m in the row and the height of the stem 90-100 cm.

Modified central leader is a naturally rounded crown with a leader and 4-6 scaffolds, the first three forms the first floor and the next are located individually on the leader (Figure 2). It is easy to create, the trees are vital and give very high yields.

Figure 2. Modified central leader

First dormant pruning. The trees is cut to 100-130 cm. Premature twigs in the area of floor formation are shortened - weak to 4-5 buds, and strong to 15-20 buds and lower located on the stem part are removed to the base.

Second dormant pruning. Appropriate twigs are selected for the main skeleton parts and the branches of the main floor, observing the basic principles of pruning. The best-developed and centrally-occupied twig is chosen as leader. From the sprouts grown under it, three scaffolds are selected which will form the floors which must be subordinate to the leader, well developed and symmetrically located around the central axis, have a suitable angle of deflection (45-55º) and, if possible be proportionate. The remaining twigs are removed to the base. Selected for scaffold branches are shortened in length (60-70 cm) from the base, above the outer or lateral bud. If their length is shorter, no pruning is done. The leader cuts down in the area on the second floor, if reached such a height. When there are no suitable branches for skeletal ones or if the present ones are weak and the leader is stronger, it is shortened by 15-20 cm

above the level of the scaffolds to dominate over them.

Third dormant pruning. One or two scaffolds on the leader on 80-90 cm are selected and the first subscaffolds on the scaffolds of the first floor are determined. The leader is qoosen. Its competitors are removed. Choose a suitable branch for a scaffold, which should be well developed, grow at a wide angle from the leader and grow over one of the interstices of the floor branches. The remaining strong branches around them are removed, and the weak, growing at right angles, are left over for growing wood.

The three scaffolds of the floor are chosen to continue and their competitors are removed. On each scaffold is selected for one branch for the first subscafold. For subscafolds, strong branches are used that grow sideways and out of the scaffolds. Scaffolds are reduced to an outer bud of 70-80 cm above the selected first skeletal branches so that they remain at one level. After headed back the leader continues to dominate over the scaffolds.

The newly selected scaffold is shortened to 60-70 cm from the base to obtain the first subscaffold. In the third dormant pruning, only strong branches are removed, which are competitors of the leader, the selected scaffolds and branches, and shorten their lengths to obtain new scaffolds and subscafolds. Pruning should be limited.

Other pruning to complete the crown formation. In the fourth and at the latest the fifth year, the formation of the crown is finished, leaving the leader with 1-2 scaffolds, 20-40 cm apart, and on the scaffolds - another 1-2 scaffolds spaced apart 60-70 cm from the first, located on the other side of each scaffold. Annually, scaffold and one subscaffold are left.

With the growing wood, the competitors of scaffolds and the strong branches, growing in the crown, the damaged and broken, are removed. During the formation of the crown, neither a severe reduction nor a strong dilution should be made in order not to cause excessive growth and the fructification period to be delayed.

Another mechanism used for mechanized harvesting is a semi-flat freely formed crown (Figure 3).

First dormant pruning. The trees are cut to 130-140 cm from the soil surface. Premature twigs in the crown formation area are shortened to 15-20 buds and removed in the stem area.

Figure 3. Schematic arrangement of the scaffolds and subscaffold in semi-flat freely formed crown

Second - fifth dormant pruning. There is very little pruning, the strong and upright growing and branches in the intersection are removed.

Trimming of the crown is done in two ways - manually and mechanically.

Pruning fruiting trees. The balance between growth and fruiting is good when the average length of the trees of the fruit trees is not less than 20-25 cm, and the young - 50-60 cm.

It is achieved as 1-2 years of pruning and partial rejuvenation.

Contour pruning is done to limit crowns to space between rows and height.

It can be done manually or mechanically with RAC-6 trimming. It can be carried out simultaneously as a one-, two- or three-sided contour. It can be held consecutively for 2-3 years. Depending on the crown, the physiological state of the trees in a given plantation determines the strength and the way of pruning.

For the successful application of industrial technologies and especially for the mechanization of harvesting the crowns of the trees should not exceed 4-4.5 m high and 4.5-5 m wide. After the contour pruning the trees get the shape of a cone by providing a free stripe for passage of the servicing technique (Figure 4).

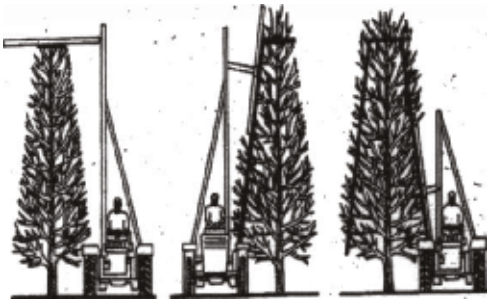

Figure 4. Contour pruning scheme

Along with the contour pruning in the fruit-bearing plantations, different sanitary, enlightening and detailed pruning can be carried out, taking into account varietal combinations and their growth and reproduction.

Formation and pruning of trees for brandy production and fruit spirit. Particularities related to this particular trend are the more freely formed crowns, by reducing cutting operations and reduced fruit requirements. After the plum tree is fully harvested, the pruning is minimized, but the fruit-bearing wood has to be periodically rejuvenated. For 4-5 years, a contour pruning is performed, which is supplemented with a low manually pruning for shaping the crown.

CONCLUSIONS

Systems for shaping and pruning plum trees in our country are differentiated according to the purpose of the fruit production, which determines the different height of the stem and the different degree of mechanization of the working processes for cultivation of the plum plantation.

For manually harvesting the fruit, the trees are formed as flat and semi-flat crowns such as oblique palmette trees or fruit hedge (free palmette), as annual and high yields are obtained.

In mechanized harvesting, trees are formed as modified central leader, semi-flat free crown and applying contour pruning that is easy to create, trees are vital and yields are very high.

For brandy production and fruit spirit - tree pruning is weaker and crowns are formed more freely to facilitate mechanized cultivation and harvesting processes.

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