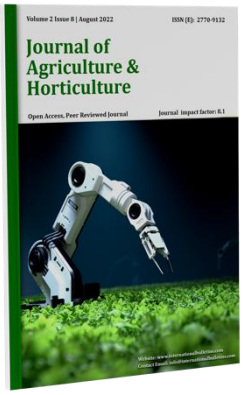

THE EFFECT OF PLUM TREE TRAINING SYSTEMS ON THE BIOLOGICAL AND ECONOMIC PERFORMANCE OF TREES

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Abstract: Several countries, including Chile, China, Romania, United States, Serbia, Iran, and Turkey, are among the world's leading producers of plums. In the fruit-growing sector of Uzbekistan, plum cultivation occupies a significant position. According to 2023 statistics, plum cultivars were grown on 22.8 thousand hectares, yielding 256.4 thousand tons of fruit. Furthermore, the country exported 36.0 thousand tons of dried plums with a total export value of 45.1 million US dollars. These figures demonstrate the economic importance of plum production and highlight the need for improving cultivation technologies, including appropriate tree training and pruning systems.

Keywords: plum fruit, leaves, cultivar register, pruning and training, cultivar.

Introduction. More than 2,000 hectares of new plum orchards are established annually. Although eight plum cultivars are currently included in the State Register for cultivation in the Republic of Uzbekistan, several other promising cultivars have been introduced from abroad and are undergoing adaptation and localization studies.

The beneficial properties of plum are comparable to, and in some respects exceed, those of many other fruits, making it one of the most valuable fruit crops. The great physician **Avicenna (Ibn Sina)** noted that the fruits, leaves, and flowers of plum could be effectively used in the treatment of various diseases. Today, modern medicine and traditional healthcare practices also recommend plum for therapeutic and preventive purposes. In particular, plum is considered beneficial in the treatment of gastrointestinal disorders, enhancing bone strength, regulating blood pressure, reducing the harmful effects of cholesterol in the bloodstream, purifying blood, strengthening the cardiovascular system, supporting kidney function, eliminating excess body fluids, and preventing inflammatory processes.

Scientific studies have demonstrated that plum extracts may be effective in the prevention and treatment of cancer. In addition, numerous scientifically validated findings have confirmed the health-promoting properties of plum fruits and other plant organs. Plum fruits are rich in vitamins A, C, E, PP, B1, B2, B3, B5, B6, and B9, as well as essential minerals such as iron, copper, manganese, zinc, selenium, potassium, calcium, magnesium, sodium, phosphorus, and chlorine, indicating their high nutritional value.

Among stone fruit crops, plum ranks second worldwide in production after apricot. To obtain high yields and premium-quality fruits, it is essential to organize orchard management practices in accordance with established agronomic requirements.

Materials and Methods. Research on summer pruning and training of plum trees was conducted in a four-year-old plum orchard located at the experimental field station of **Gulistan State University**.

a ***b***

Figure 1. General appearance of plum trees

a) tree subjected to spring pruning and training;

b) tree without spring pruning and training.

Following spring pruning and training, new shoots began to emerge from the growing buds retained on the remaining branches as temperatures increased. The formation of new shoots and their vigorous growth were actively observed in the trees that underwent spring training and pruning (Figure 1a).

In contrast, strong annual shoots were scarcely observed on the control trees that were not pruned or trained in spring (Figure 1b).

The primary objectives of summer pruning and training are: (1) to improve the penetration of sunlight into the inner canopy and enhance air circulation through the removal and shortening of shoots; and (2) to regulate shoot growth and nutrient distribution within the tree. Vertically growing shoots are able to utilize nutrients supplied from the root system more efficiently, whereas horizontally oriented or nearly horizontal shoots often experience relatively limited nutrient supply. As a result, vertically growing shoots exhibited more vigorous development, as shown in Figure 2, while shoots growing in lateral or horizontal directions showed comparatively weaker growth, as illustrated in Figure 3.

The fruit weight and size of four-year-old plum trees of the **Leto** cultivar were evaluated by comparing trees subjected to spring pruning and training with unpruned control trees. The results revealed that fruits produced on the trained trees were significantly larger than those from the control trees. The average weight of individual fruits was **37.5 g higher**, representing an increase of approximately **50%** compared with fruits harvested from untrained trees.

a *b*

Figure 2. Immature fruits of the plum cultivar *Leto*

a) Fruits from a plum tree subjected to spring pruning and training;

b) Fruits from a plum tree without spring pruning and training.

Summer training and pruning of the four-year-old plum trees were carried out on **May 31**. Prior to pruning, each tree selected for treatment was carefully inspected and its condition was thoroughly evaluated.

The average number of vigorous one-year-old shoots per tree was **83**. Of these, **41 shoots** were vertically oriented, while **42 shoots** were growing horizontally or at acute angles (Table 1). This distribution indicates that a considerable proportion of the annual shoots were positioned in directions that may negatively affect canopy structure, light penetration, and the efficient allocation of nutrients within the tree. Therefore, summer pruning was performed to optimize canopy architecture, improve light interception, and enhance the overall growth and productivity of the trees.

Table 1. Distribution of One-Year-Old Shoots Before Summer Pruning and Training

№	**Plum cultivar**	Number of vigorous one-year-old shoots (units)	Number of vertically growing one-year-old shoots (units)	Number of non-vertical shoots (units)	Number of fruitful and non-fruitful short shoots
1	Summer	86	42	41	104
2	-	81	40	42	105
3	-	82	41	43	103
average	-	83	41	42	104

During training and pruning, first of all, strong vertically growing annual shoots were removed using pruning shears, cutting them at the ring zone of attachment to the old branch while leaving a 3–5 mm stub. The remaining shoots were shortened by one-third of their length, cutting just above an outward-facing terminal bud (Figure 3).

During summer pruning and training, similar cases were also observed, in which several vigorous and moderately vigorous one-year-old lateral shoots developed from two-year-old side branches that had been previously shortened in spring.

Figure 3. Appearance of plum tree after summer pruning and training

In such cases, one or two shoots with the most appropriate direction and structure are retained, while the remaining shoots are removed (Figure 4). In addition, one-year-old shoots growing toward the interior of the canopy are either completely removed or shortened, leaving 5–7 cm stubs. In some cases, when sufficient space is available within the tree canopy, vertically growing annual shoots are bent and trained in a suitable direction to fill vacant canopy areas and are maintained in this position for one year.

a ***b***

Figure 4. Densely formed one-year-old shoots

a) before pruning and training;

b) after pruning and training.

In the following year, the bent shoot becomes fixed in that position and subsequently fills the vacant space with fruiting branches.

In many plum cultivars, fruit is mainly formed on short fruiting spurs (Figure 5).

Figure 5. Formation of fruit on short fruiting spurs

Therefore, in plum trees, well-formed short fruiting spurs are preferably retained during pruning and training. These retained spurs bear fruit in the following growing season.

Results and Discussion. At the stage of May 31, the average weight of a single immature fruit of the *Leto* plum cultivar subjected to spring pruning and training was **76.3 g**, whereas the average fruit weight of the same cultivar without spring pruning and training was **38.8 g**.

In four-year-old *Leto* plum trees that had undergone spring pruning and training, a total of **83 vigorous one-year-old shoots** were recorded. In contrast, no vigorous one-year-old shoots were observed in the unpruned control trees.

With summer pruning, more than 50% of the vigorously growing shoots were removed, while the remaining shoots were shortened. As a result, the main objective of this agronomic practice—improving light penetration into the inner canopy and ensuring adequate air circulation—was achieved.

In unpruned plum trees, fruits were small in size and of low commercial quality, and the overall physiological lifespan and health condition of the trees gradually declined.

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