GROWING A PEAR WHEN USING AN INTERCALARY INSERT

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About 50 fruit crops are grown in Ukraine, but apple or pear, plum, cherry, etc. predominate in industrial gardens. Soil and climatic conditions of our country are quite favorable for growing deciduous fruit crops. According to information from scientific medical institutions, the total annual consumption of fruit products should be about 100 kg. But Ukraine today does not meet this need, including for pears. The main way to increase the gross fruit harvest is intensification, which is based on the principle of growing orchards from low-growing fast-growing trees with compact low-volume crowns, easy to care for and harvest. The problem of creating modern intensive plantations with fast-fruiting and highly productive trees is solved by growing seedlings in nurseries on dwarf vegetative rootstocks using high-yielding varieties. The concept of intensive garden includes: density (number) of trees per unit area, high-yielding varieties and rootstocks, crown shapes, the presence of supports, irrigation and other technological factors that are constantly changing under the influence of economic factors. Recognizing the undeniable role of increasing the number of trees per unit area as a potential basis for productivity, the concept of intensive gardening should not be considered as synonymous with high-density planting.

Increasing the number of trees per unit area is primarily a means of ensuring the early entry of plantations in the period of commercial fruiting and obtaining a high gross harvest of fruit per unit area. The system of intensive gardening covers a wide range of organizational, economic and technological factors. According to economists, the relationship of the process of intensification in horticulture is the most appropriate to consider in the following sequence: costs - planting land - products. The basis of intensification of the industry is scientific and technological progress, which includes the following groups of factors: biological (rootstock combinations), technological (constructions), technical (mechanization), and organizational ones.

In a market economy, the most important indicators of intensity and perfection of technology are: time of entry of plantations into commercial fruiting, the rate of increase in yield and term of use of plantations, which allows additional income from the use of intensive production technology, and new scientific developments. Therefore, the chosen topic is relevant and has practical significance.

The aim and objectives of the research. The aim of the research is to study and compare the characteristics of growth and development of Williams and Etude pear varieties using intensive and classical production technology.

The object of the research is the productivity of Williams and Etude pear varieties with classical and intensive cultivation technology.

The subject of the research is Williams and Etude pear varieties on seedlings and seedlings with intercalary inserts.

Based on the obtained data, it is possible to establish the efficiency, expediency of using intensive technology of Williams and Etude varieties on seedlings and seedlings with an insert for laying intensive perennials in Sumy district of Sumy region.

At the same time, the transition of Ukrainian horticulture to new technologies, based primarily on new rootstock combinations, the area of industrial use of which is due to climatic conditions, which are characterized by significant differences in Ukraine, determines the need to clarify them.

In addition, new constructions of plantations with a high density of trees per unit area require appropriate retraining of the staff (formation and pruning of trees, irrigation, protection from pests and diseases, etc.).

Assessing the possible risks of commercial fruit production by new technologies, it should be recognized that the greatest risk is not the widespread use of new intensive technologies, but on the contrary, in the case of ignoring these technologies. In that particular situation Ukraine loses the most in economic and social terms (jobs, markets), which makes the country dependent on foreign producers of these products.

For a long time, pear culture around the world has developed extensively. Gardeners followed the rules of obtaining the maximum possible yield from one tree, planting the latter at considerable distances and without limiting the parameters of the crown. The main attention was paid to the formation of durable trees. Early fruiting was seen as a factor in weakening the growth of trees and reducing their longevity, and even provided for the removal of flowers in the first 1-2 years after planting.

Such gardens were grown on vigorous seed rootstocks. Trees were formed on high trunks - 1.5 m or on semi-trunks - 1 m high according to the tier system. Because trees were planted over long distances, the free space between them was used to grow other crops. According to the technology, they were called "inter-row" and were promoted until the late 60's of the last century.

The gardens began to bear fruit at the age of 10-12, entering the period of full fruiting on the 15th-16th year after planting, which is not economically feasible. In addition, this type of plantings had a significant conservatism in changing the range, layout, rootstocks, as the period of their use reached 40-50 years or more.

In this regard, there is no doubt the need to find ways to modernize the technology of cultivation. One of such factors was the revision of the number of trees per unit area in the direction of their increase.

Only in the early 70's of the last century the rectangular system of tree placement was considered more promising, which provided not only reducing the width of rows to 8 m, but also thickened planting of trees in a row - 4 m. Seedlings of resistant cultivars began to be widely used as rootstocks [1,2], and the main type of crown was sparse-tiered. Existing plantations were also compacted [3].

Taking into account the peculiarities of soil and climatic conditions of the regions, in the future the scheme of planting pears on seed rootstocks acquired the following parameters: distance between rows was 5-7 m, in rows - 3-5 m. Changes in the approaches to the formation and pruning of trees were also determined: the number of main branches, tiers, the height of trees, the size of the crown and even their shape - palmettos - decreased in the crown. Flattening of crowns and reducing their size and skeletal part contributed to improved leaf illumination, increased its photosynthetic activity, and as a result - more rational use of assimilation products for fruiting [4,5].

The new technology has reduced the infertile period to 5-6 years, increased yields and fruit quality, reduction the cost of pruning and especially fruit collection. At the same time, it was found that in intensive pear plantations on seed rootstocks (400-600 trees / ha) the greatest harvest of fruits is achieved in the 3-5th five years from the time of planting, and therefore the period of their cultivation is 25-27 years [6]. In a market economy, the most important indicators of intensity and perfection of technology are: time of entry of plantations into commercial fruiting, the rate of increase in yield and term of plantations use, which allows additional income from the use of new scientific developments.

The research was performed in the educational laboratory of horticulture and viticulture of Sumy National Agrarian University. It is located in the north-western part of Sumy in the north-eastern forest-steppe of Ukraine. The land area of the center stretches from west to east for 3.5 km and from north to south - for 12 km and is a low-wave watershed plateau, which is delimited by beams into a number of local wetland watersheds.

The arable lands of the land use of the center are located on the plains, which allows to grow any crops without the threat of washing away the upper fertile layer of the soil.

The soil of the experimental plot is typical deep low-humus medium-loamy, coarse-grained black soil. It has a reaction close to the neutral one. The humus content is sufficient to obtain high yields of crops.

The lands where the center is located are referred to the second agroclimatic district of Sumy region, which is characterized by temperate, continental climate with warm summers and not very cold winters with thaws. There are no large water basins nearby that affect the climate as a whole or its individual elements. According to average long-term data, the coldest months are January and February, and the warmest one is July. The absolute minimum of air temperatures is observed in January, and the maximum in July. The annual sum of temperatures above 10°C ranges from 2500 to 2650°C. The average annual air temperature is 6.5°C, and the amount of precipitation is 531 mm. Most of them are in summer and autumn. The duration of the frost-free period is 275 days. According to long-term data, the first autumn frosts are observed in the second decade of September, and the last spring frosts end in the third decade of April - at the beginning of the first decade of May.

The hydrothermal coefficient for the period with air temperature above 10°C is 1.1-1.2. 30-35% of annual precipitation falls with snow, which under favorable conditions is absorbed by the soil, creating reserves of productive moisture. The height of the snow cover reaches 15 cm, the distribution of snow is uniform. Agrophysical maturity of soil occurs after the transition of temperature through 5°C, on average in the second decade of April. The number of days with an average daily temperature above 15°C is 110 days.

The growing season, limited by the transition from the average daily air temperature of 5°C in spring (April 10) to its transition of 5°C in autumn (October 26), averages 199 days, among which 156 days (from April 26 to September 29) are quite favorable for the development of crops (with temperatures above 10°C).

Meteorological conditions of the years of our research differed from each other and the average long-term data.

Both years were relatively arid, although the deviation from the average long-term data in 2020 was -23.1 mm, and in the following year rains were more than the average of 108.8 mm, although they fell very unevenly.

With the exception of the third decade, May was wet in 2020. However, almost the entire following period was dry. This was especially true in the first decade of June, the first and the third decades of July and the whole August. In the latter, only 6.9 mm of rain fell during the whole month.

A lot of rain fell in May 2019. In the second decade there were almost 2.5 times more rains than in a number of years, and in the third decade - about 2 times. The first decades of June, July and August were extremely dry, with 1.1-7.2 mm of rain. The second decade of August was very rainy. With an average rainfall of 18 mm, 108.9 mm actually fell, which is 6.1 times more, although the first and the third decades were dry.

The aim of our observations was to identify differences in growth and development, and most importantly in yield of Wiliams and Etiud pear varieties by intensive technology, compared to trees of these varieties using classical technology in the laboratory of horticulture and viticulture of Sumy district, Sumy region. The research was conducted in 2018-2020.

The diameter of a trunk was determined with a pole caliper at a height of 10 cm from the inoculation site.

The width of the crown and the height of the tree were measured with a measuring rail: the width as the average between the two dimensions along and across the row, and the height as the difference between the height of the tree and the height of the trunk. Measurements were performed after harvest [7, 14, 15].

The diameter of the crown was measured by lowering the conditional perpendicular to the ground, two notches along and across the row, measuring the distance between them.

The total length of annual increments was measured at the end of the growing season with a measuring tape, taking into account branches at least 5 cm long.

The average length of annual increments was determined by dividing the total length of branches by their number.

The area of the leaf blade was determined by the method of cuttings, selecting from each repetition of 10 leaf blades and weighing them. Then 20 - 25 cuttings with a total area of at least 10 - 20 cm2 were selected. After weighing, the area of the leaf blade was calculated by the formula:

$$S = \frac{M \times S_1 \times n}{m \times N} \qquad (1)$$

where

S is the area of the leaf blade, cm^2;

S_1 - die area (S1 = 0,785 D2, where D is the diameter of the die, cm;

n is the number of cuts;

M - mass of leaves in the party, g;

m - mass of cuts, g;

N - the number of leaves in the party.

The area of the leaf apparatus was determined by multiplying the area of the leaf blade by the number of leaves on the tree. Multiplying the obtained indicator by the number of trees per hectare, we obtained the area of the leaf apparatus (m^2/ha).

The intensity of flowering was determined during its mass phase, counting the number of inflorescences, followed by multiplication by the number of flowers in the inflorescence.

The level of useful ovaries was determined by dividing the number of ovaries left on the tree after June fall by the number of flowers (multiplied by 100).

Yield was calculated by the number of fruits on the tree multiplied by the average weight of the fruit. The latter was determined by weighing 100 apples from each replicate and variant.

Today, in the agricultural sector, it is advisable to use computer technology to process data, calculate and obtain the results of field research, accounting, observation of crop development, and yield. Mathematical processing of the results obtained during the experiments provides an opportunity to perform the calculations we need with considerable accuracy and speed.

The following methods of mathematical statistics were performed during the research: point estimation, interval estimation, one-factor analysis of variance.

Point estimation. An important indicator for point estimation is that the statistical series is characterized by several single summary estimations. The following estimations are used for point estimation of the general population:

μ is the arithmetic mean. It is in the middle of the row and in the ranked row as if dividing it in half.

Σ - standard deviation. It allows you to more or less theoretic frequency to select the area of the ranked statistical series in which there is a particular amount of data. Thus, in the zone $\pm 1\ \sigma$ contains 68.26%, in the zone $\pm 2\ \sigma$ - 95.45%, and in the zone $\pm 3\ \sigma$ - 99.73% of all data.

σ^2 - variance. It is a square of the standard deviation and is convenient in that, if the standard deviation is characterized by standard deviations, it always turns out 0, whatever the variance is, and the variance is always positive (for example, $2^2 = 4$ and $(-2)^2 = 4$) and its absolute value is greater the greater scatter of data is in the statistical series.

In the case where the researcher is dealing with a sample, for convenience, these estimations are replaced by Latin letters:

$\bar{X}$ - sample arithmetic mean;

S-sample standard deviation;

S^2 - sample variance;

$S_{\bar{x}}$ - error of the sample arithmetic mean. One of the main point estimations of the sample is the arithmetic mean. It is based on the formula:

$$\bar{X} = \frac{\sum X_1}{N} \quad (2)$$

where $\bar{X}$ - arithmetic mean,

$\sum X_1$ - the sum of all members of the statistical series;

N - number of members in the statistical series.

One of the main point estimates of the sample is the arithmetic mean. Therefore, to obtain data in our studies, we determined the arithmetic mean of the indicators. There are many requirements for the arithmetic mean in mathematical statistics, and it is very informative. These requirements are as follows:

1. Convincibility, which means that x μ, i.e. the sample mean is approximately equal to the arithmetic mean of the general population. Due to this, when adding new data to the sample, its arithmetic mean almost does not change. On the contrary, such an addition leads to an increasing approximation of the sample average to the general average.

2. Non-bias, which means that the sample mean lies at the very top of the normal distribution curve, dividing it into two equal parts.

3. Efficiency, which assumes that for a given sample the arithmetic mean is such that the variance is minimal, i.e. the scatter of points (values) around the mean is the smallest.

4. Robustness, which means that although the sample deviates slightly from the normal statistical distribution, all estimates for it can be made on the basis of this distribution and will be fair. This feature of the arithmetic mean should be born in mind when interpreting the data.

After performing a series of arithmetic mean calculations in mathematical statistics, we also calculated the standard error of the arithmetic mean.

This indicator was calculated by the formula:

$$S_{\bar{x}} = \frac{S}{\sqrt{n}} \quad (3)$$

Interval evaluation. The method of interval estimation was also used in the calculations, when the statistical series is estimated by some interval "from" and "to", within which are its main typical and statistically significant values. In fact, the arithmetic mean is in the range , $\pm t \cdot S_{\bar{x}}$ where t is the value of the Stiudent's criterion, which depends on the sample size and is tabulated. Confidence estimates were no less informative than point estimates. We illustrated the results of the interval assessment graphically by constructing "mustache boxes".

Also, during data processing we used one-factor analysis of variance, which is one of the most common methods of mathematical statistics in biology and agriculture. It allows you to find the answer to the question whether the influence of a factor is likely. One-way analysis of variance makes it possible to compare several systemically related samples and determine whether there are statistically significant differences between them and what the probability of these differences is.

In all models of analysis of variance the action of some general factor is checked; in our case we use one factor of influence. The factor in the general case is one or another form of influence on the object, as well as the feature or property of the object. When determining the probability of the effect of the presented factor on the object of study, the factor must be divided into types of influence. In analysis of variance as a method of mathematical statistics, these divisions of factors are called levels. Working with one-factor analysis of variance, the accounting procedures of the statistical package automatically selected the correct model from the research data. In general, analysis of variance can only be applied to material that has been properly assembled, and the experiment has been planned in advance for processing by analysis of variance.

It is advisable to lay on the projects in an industrial orchard, regardless of its area, which are developed by garden design and research institutions. The development of the project involves the preparation of feasibility study, careful inspection of land that is planned to be taken under the garden, and survey of the terrain, agrochemical characteristics of soil and subsoil, reclamation works, organization of the garden area, soil preparation, soil selection, selection of species and varieties, their location, garden constructions, 6crowns and their formation, planting, technological maps of the garden and its care before entering into industrial fruiting, estimates for all work [10]. Projects are developed with the aim of the most rational use of land and growing high regular yields of quality fruit based on advanced intensive technologies. When designing an intensive industrial garden, the whole set of organizational, economic, technological and environmental factors is carefully analyzed and evaluated. After all, mistakes made when planting a garden are quite difficult, and often impossible to correct later [7, 8].

Unlike field crop rotations, intensive orchards are planted for up to 20 years, so special care must be taken in site selection and pre-planting soil preparation. First of all, you need to decide on the technology by which you will grow a garden, choose varieties and rootstocks.

The optimal place for planting an orchard is flat or with a slight slope (up to 2-3°) area that has a favorable water regime and is protected from winter winds. Southern exposure of the slope should be avoided, as significant damage to the bark of young trees by sunburn is possible.Iin addition, there is an increased risk of damage to flowers by spring frosts, because the trees develop early in the spring. It is not advisable to plant a garden in the lowlands and valleys, where cold air stagnation is possible. You should begin to prepare the soil for the garden a year before the planned planting. The main task at this stage is to free the area from weeds, increase the content of basic nutrients and create a surface layer with optimal structure.

For planting an orchard, plantation plowing should be carried out to a depth of 45-50 cm to create the optimal water-air regime of the root-containing layer, which is especially important for the growth of young trees. If plantation plowing is not possible, deep plowing should be limited to a plow with a soil deepener [9, 12].

In modern intensive plantations, obtaining an annual harvest with high taste and marketable qualities of fruits is possible only under the conditions of annual active growth processes, during the attenuation of which there is a periodicity of fruiting and deterioration of fruit quality.

The diameter of the trunk.

The trunk circumference or diameter, tree height and crown volume are often used as criteria for tree growth. The growth of trunk diameter is the main indicator of lateral growth of fruit trees, which depends on many factors, including the choice of seedling rootstock. The results of our researches are shown in Table 1. Validation was performed using analysis of variance.

Table 1- The diameter of the trunk of Williams and Etude pear trees depending on the use of the rootstock, mm

Years	Seedling (K)		Seedling with an insert		Before control,%	
	Wiliams	Etiud	Wiliams	Etiud	Wiliams	Etiud
2018	84	86	68	64	81,0	74,4
2019	87	90	70	69	80,5	76,6
2020	90	93	73	69	81,1	75,5
Average for 3 years	87,0	89,7	70,3	67,3	80,8	75,5

The table shows that with statistical probability the diameter of the trunk on the seedling exceeds this figure on seedlings grown with an insert.

Total length of shoots.

The total length of shoots is an important indicator of vegetative growth of trees. The research data were checked for reliability by one-way analysis of variance and are presented in Table 2.

Table 2 - Total length of shoots, m

Years	Seedling (K)		Seedling with an insert		Before control,%	
	Wiliams	Etiud	Wiliams	Etiud	Wiliams	Etiud
2018	275	269	145	153	52,7	56,9
2019	277	273	139	151	50,2	76,6
2020	274	270	146	150	53,3	75,5
Average for 3 years	275,3	270,7	143,3	151,3	52,1	69,7

On average, the total length of annual shoots was most positively affected by the variant using a seedling rootstock, for which this figure is 275.3 m, which is 52.1% more than the variant using a seedling with an insert.

In 2019, the increase in the total length of Wiliams shoots per seedling, compared to 2018, was 2 m, and for seedlings with intercalary insert - 2.5 m. Thus, both the total length of shoots on the tree and the increase in this indicator per year is higher in seedlings compared to seedlings grown using an intercalary insert.

The average length of an annual shoot on a tree.

The average length of an annual shoot on trees with different rootstocks for the years of observation is shown in Table 3. The results were verified by one-way analysis of variance.

Table 3 - The average length of an annual pear shoot depending on the choice of rootstock, cm

Years	Seedling (K)		Seedling with an insert		Before control,%	
	Wiliams	Etiud	Wiliams	Etiud	Wiliams	Etiud
2018	55,1	57,8	46,4	48,2	84,2	83,4
2019	54,6	56,3	46,9	46,5	85,9	76,6
2020	55,3	57,2	46,1	46,8	83,4	75,5
Average for 3 years	55,0	57,1	46,5	47,2	84,5	78,5

The results of the study showed that the average length of a shoot per tree is much longer in trees using seedlings - this length is 55.0 cm in Wiliams and 57.1 cm in Etiud. In trees with seedlings with an insert, this figure is 46,5 cm and 47.2, respectively. It is 14.6% and 17.1% more than in seedling trees with an insert.

The height of the trees.

The height of the plants also depends on the type of rootstock chosen. The results are given in Table 4.

Table 4 - Height of plants on seedlings of Wiliams and Etiud varieties and with intercalary insert, m

Years	Seedling (K)		Seedling with an insert		Before control,%	
	Wiliams	Etiud	Wiliams	Etiud	Wiliams	Etiud
2018	3,67	3,74	3,03	3,38	82,6	90,4
2019	3,82	3,86	3,21	3,49	84,0	76,6
2020	3,97	3,98	3,40	3,65	85,6	75,5
Average for 3 years	3,8	3,9	3,2	3,5	84,1	80,8

According to Table 4 it can be concluded that the height of trees is greatest in control trees, i.e. on the rootstock with intercalary insert - it averages 3.8-3.9 m. Last year the height of trees increased by 12-15 cm. Pears on the intercalary insert have a slightly lower height - on average 3.2 - 3.5 m, the increase in 2020 is 21-16 cm. In percentage correlation trees on seedlings with an insert are less than the control by 16.7% Wiliams and 9.6% Etiud. The reliability of the results was verified by one-way analysis of variance.

Crown width.

The width of the tree crown also depended on the selected rootstock (Table 5). One-factor analysis showed a statistically significant difference between the two variants of the experiment.

Table 5 - The width of the crown of apple trees, depending on the choice of rootstock, m

Years	Seedling (K)		Seedling with an insert		Before control,%	
	Wiliams	Etiud	Wiliams	Etiud	Wiliams	Etiud
2018	3,21	3,03	2,65	2,44	82,6	80,5
2019	3,34	3,16	2,78	2,65	83,2	76,6
2020	3,41	3,21	2,84	2,73	83,3	75,5
Average for 3 years	3,3	3,1	2,8	2,6	83,0	77,5

The largest width of crown in Wiliams and Etiud pear varieties was in the trees, where a seedling was used. It exceeded the width of the crown of trees with intensive cultivation technology by 17.1% and 17.8%, respectively.

Number of leaves per tree.

The productivity of the pear is ensured not only by the receipt of nutrients from the soil, but also by the synthesis of nutrients in the assimilation organs of the tree - the leaves, which are the energy station of the tree, because it undergoes photosynthesis. It receives 95% of organic matter and only 5% from the root system [10]. The results of studies on the number of leaves are shown in Table 6.

Table 6 - Number of leaves on Wiliams and Etiud pear varieties depending on the choice of cultivation technology, pcs / tree

Years	Seedling (K)		Seedling with an insert		Before control,%	
	Wiliams	Etiud	Wiliams	Etiud	Wiliams	Etiud
2018	3324	3277	2432	2280	73,2	69,6
2019	3481	3403	2564	2331	73,7	76,6
2020	3421	3347	2503	2314	73,2	75,5
Average for 3 years	3408,7	3342,3	2499,7	2308,3	73,3	73,9

Thus, according to our research, it was found that the initial estimate of the number of leaves contributed to the variant of growing pears on seedlings, which revised this figure on trees with an insert of 26.59% and 30.96%.

Leaf surface area.

No less important indicator of vegetative growth of the tree is the area of the leaf blade Table 7. After all, the larger the photosynthetic surface of the leaves, the better the yield.

Table 7 - The area of the pear leaf blade, depending on the choice of rootstock, cm^2

Years	Seedling (K)		Seedling with an insert		Before control,%	
	Wiliams	Etiud	Wiliams	Etiud	Wiliams	Etiud
2018	42,1	43,9	41,3	44,7	98,1	101,8
2019	42,4	44,8	42,1	44,9	99,3	76,6
2020	42,9	45,3	42,5	45,6	99,1	75,5
Average for 3 years	42,5	44,7	42,0	45,1	98,8	84,6

The table shows that the largest leaf surface area was in trees using seedlings, which was 45.6 cm in Etiud, in trees grown with ordinary seedlings - 42.9 cm^2 in Williams and 45.3 cm^2 in Etiud.

The total area of the leaf apparatus

The total area of the leaf apparatus of trees Table. 8 depends on the number of leaves Table 6 and leaf surface area of Table 8.

Table 8 - The total area of leaf cover on pears, depending on the choice of rootstock, mI / tree

Years	Seedling (K)		Seedling with an insert		Before control,%	
	Wiliams	Etiud	Wiliams	Etiud	Wiliams	Etiud
2018	1399,4	1438,6	1004,4	1399,4	71,8	97,3
2019	1455,1	1514,3	1028,2	1455,1	70,7	76,6
2020	1456,1	1515,1	1029,3	1455,8	70,7	75,5
Average for 3 years	1436,9	1489,3	1020,6	1436,8	71,0	83,1

Thus, the use of seedlings for growing Wiliams and Etiud pear varieties in the conditions of this farm provides the highest indicators of the total leaf cover of trees, which is a good prerequisite for the formation of a larger fruit crop. Thus, the total area of the pear leaf apparatus on the rootstock with the insert is 1020.6 m^2 / tree in Wiliams and 1436.8 m^2 / tree in Etiud, while on seedling trees - 1436.9 m^2 / tree and 1489.3 m^2 / tree respectively.

Productivity and development of Williams and Etude pear trees.

Pear yields significantly depend on abiotic and biological environmental factors. In modern intensive gardens the right choice of agricultural techniques for the care of plantations, the choice of planting material in advance have a great influence on fruiting.

One of the ways to pre-determine the yield of pear is to calculate its intensity of flowering trees Tab le9. It is on this indicator that conclusions can be drawn about the formation of generative organs, their damage during adverse winter conditions and the ability of trees to form crops.

Table 9 - The number of flowers on Wiliams and Etiud pear varieties depending on the choice of rootstock, pcs / tree

Years	Seedling (K)		Seedling with an insert		Before control,%	
	Wiliams	Etiud	Wiliams	Etiud	Wiliams	Etiud
2018	489	476	354	347	72,4	72,9
2019	503	498	378	370	75,1	76,6
2020	507	504	383	379	75,5	75,5
Average for 3 years	499,7	492,7	371,7	365,3	74,4	75,0

The number of flowers on trees using seedlings is slightly higher compared to trees on the intercalary insert. These values are 496 pcs / tree for Wiliams and 487 pcs / tree for Etiud and 366 pcs / tree and 358.5 pcs / tree respectively.

It Is known that Intensive flowering increases the fruit load on trees and, consequently, yields. Tying fruits as the ratio of the number of laid flowers and the number of formed fruits also has some differences between the two variants of the experiment Table 10.

Table 10 – Tying fruit on Wiliams and Etiud pear varieties depending on the choice of rootstock, %

Years	Seedling (K)		Seedling with an insert		Before control,%	
	Wiliams	Etiud	Wiliams	Etiud	Wiliams	Etiud
2018	18,3	18,8	18	18,6	98,4	98,9
2019	17,8	18,5	19,1	19,3	107,3	76,6
2020	18,3	18,9	18,7	19,4	102,2	75,5
Average for 3 years	18,1	18,7	18,6	19,1	102,6	83,7

On average, in 3 years, the degree of fruit set in apple trees using an intercalary insert exceeded the control (seedling) by 1.63 – 2.83%.

The most important indicator of productivity of pear trees is their yield. Indicators of economic efficiency of fruit growing are calculated on the basis of the yield data [16]. The yield data of fruit trees of the experimental garden are presented in Table 11.

Table 11 - Yields of Wiliams and Etiud trees depending on the choice of rootstock, t / ha

Years	Seedling (K)		Seedling with an insert		Before control,%	
	Wiliams	Etiud	Wiliams	Etiud	Wiliams	Etiud
2018	15,0	13,0	32,0	29,0	213,3	223,1
2019	17,2	16,0	33,0	30,6	191,9	76,6
2020	17,6	16,4	33,1	30,2	188,1	75,5
Average for 3 years	16,6	15,1	32,7	29,9	197,8	125,1

The table shows that there are significant differences between two variants; the yield of pears in both varieties using intensive technology is higher than the control by an average of 213.3% Wiliams and 223.1% Etiud.

Over the years of research, there has been a tendency to increase the yield of pears due to the beginning of the planned entry into fruition.

Conclusions. 1. The growth rates of Wiliams and Etiud plants with intercalary inserts differed from those of seedlings. Stem diameter, leaf area, number of annual shoots, crown width, total number of shoots, length of one annual shoot and plant height were statistically significantly higher in seedlings grown than in intercalary inserts.

2. Indicators of productivity, on the contrary, were higher in plants using seedlings with intercalary. And these are the main indicators of economic feasibility of using a particular cultivation technology.

3. Wiliams and Etiud differed significantly in yield. Seedling yield is much lower.

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