



KAPITEL 8 / CHAPTER 8⁸

PRODUCTIVITY OF CUCUMBER HYBRIDS UNDER DRIP IRRIGATION IN THE SOUTH OF UKRAINE

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Introduction

Providing the country's population with quality products that meet the requirements of a balanced and nutritious diet is a basic task of agricultural production. One of the most challenging issues in this area is ensuring a regular supply of vegetables and fruits. Vegetable growing as an industry plays a very important role in solving this problem [1].

Among vegetable crops, cucumber is one of the most widespread crops both in Ukraine and abroad. It is a widely consumed vegetable with high taste in both fresh and processed form [2, 3]. It is traditionally a familiar crop grown by both industrial farms and private households, mainly in open ground, but also quite commonly in closed ground.

The list of varieties approved for cultivation in Ukraine includes varieties and hybrids for universal use, salad consumption, and for pickling and canning. In Ukraine, there is a great demand for such products and therefore there is a need to significantly increase the production of organic cucumber for fresh consumption and for canning, as this not only extends the period of fresh consumption but also forms exports to developed economies [2]. Ukraine has quite favorable conditions for growing cucumbers. These include fertile soils, a favorable climate or irrigation, significant experience in vegetable growing, and scientific and production potential for the development of technologies and breeding [4, 5].

In terms of organizational and economic approaches in vegetable production, there are open and closed ground production. In Ukraine, field production is dominant, as 98.7% of the total harvested area is accounted for by open-ground vegetables, which causes extreme seasonality, while the share of closed-ground vegetables is more stable

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and uniform - only 1.3%. However, the share of greenhouse vegetable production in the overall structure of vegetable production has almost doubled in recent years. Interest in the development of greenhouse intensive vegetable production is growing every year and is gaining more and more innovative and industrial features. This is in line with the European principles that Ukraine needs to take into account in order to maintain and expand its segment in the international vegetable market [6, 7].

Implementation of a scientifically and economically sound approach to growing vegetables, including specialization of the location of growing zones, introduction of innovations in cucumber growing technology, taking into account specific soil and climatic conditions of the farm, delivery time, variety and market requirements for types of products. Growing specialty products according to the needs and preferences of consumers or processing enterprises [7, 8, 9].

The introduction of new intensive technologies is based on the variety and its purpose. Varieties and hybrids for open field cultivation must simultaneously possess a set of valuable economic traits, be stress-resistant, tolerate day and night temperature changes, extreme moisture, and not be vulnerable to diseases and pests [8]. In the open field, the threat of rapid development and spread of diseases and pests is much greater. Their harmfulness is also higher, so genotypes must have high resistance to biotic factors [8-14].

According to the group of marketable ripeness, which is defined as the duration of the period from germination to the first harvest, the objects of selection are divided into ultra early (up to 40 days); early (41-45 days); medium early (46-50 days); medium ripe (51-55 days); medium late (56-60 days); late ripe (over 60 days).

In contrast to the ripening period, the size is of great technological importance. According to the size, the fruits are divided into the following three groups: zelenets with a length of 9.1-12.0 cm in the open field and 9.1-30.0 cm in the closed field; gherkin with a length of 5.1-9.0 cm; and pickle with a length of 3-5 cm.

The technical maturity of the greens also varies. For bee-pollinated varieties and hybrids, depending on weather conditions and the intensity of plant fruiting, ripeness occurs in 8-10 days in the open field, 5-10 days after pollination in the closed field, and



1-3 days in the pickle. This necessitates sampling in 1-3 days.

The following features are often decisive for the choice of a trait or hybrid and for meeting market needs.

Place, methods and methodology of research

The aim of our research was to study the productivity and compare two promising cucumber hybrids Kibria F1 and Madeira F1 in the conditions of the Southern Steppe zone of Ukraine under drip irrigation.

The experiments were conducted during 2020-2021 on the basis of the experimental field of the educational and research center of Mykolaiv National Agrarian University. The soils of the experimental farm are represented by southern low-humus, slightly saline, heavy loamy black soil on loess. The soil profile of the experimental field is represented by the following arrangement of horizons [15-20].

The lowest moisture capacity of 0-70 cm of the soil layer is 22.0%, the wilting moisture content is 9.7% of the dry soil mass, and the density of the soil is 1.40 g/cm. The content of humus in the topsoil is 2.9-3.2%, mobile phosphorus is 38%, and exchangeable potassium is 332-525 mg/kg of soil. The soil contains 0.20-0.25% of gross nitrogen and 0.12-0.14% of phosphorus. The soil absorbing complex is saturated mainly with calcium and magnesium. The reaction of the soil solution of the upper horizons is close to neutral or slightly alkaline (pH = 6.8-7.2), increasing down the profile. By its characteristics, the soil of the experimental field is typical for the chernozem of the southern steppe zone of Ukraine and is suitable for growing most of the main field crops. The humus horizon of 47-52 cm is dark gray with a chestnut tint, characterized by salinity and a narrow ratio of Ca^{2+*} and Mg^{2+} (2.5-2.8) [15-20].

The experimental scheme included the following variants:

I. Hybrid (factor A)

1. Kibria F1;
2. Madeira F1.

II. Selection (factor B)

1. Small size (SS) pickle;
2. Cornichons Large size (LS);



3. Green herbs Trial (TR).

The experimental variants were systematically arranged in quadruplicate, and the plot area was 72 m² (6x12 m).

Agricultural technology for growing cucumber hybrids was provided by Bayer for vegetable crops in the Southern Steppe of Ukraine. After harvesting the predecessor (winter wheat for grain), stubble was disked to a depth of 10-12 cm. Shelf plowing was carried out to a depth of 20-22 cm, where mineral fertilizers were applied with a SZ-3.6 seeder at a rate of N60P60K30. Nitroammophoska was used as the main application. In order to further destroy weeds and level the soil, continuous cultivation was performed to a depth of 12-14 cm. In the spring, when the soil was physically ripe, harrowing with BZSS-1.0 was carried out, and before planting the seedlings, 2 cultivations were carried out to a depth of 8-10 cm, before planting, they were compacted with a roller.

Cucumbers were planted with seedlings at a soil temperature of 12-13 °C with a row spacing of 1.20 m, the distance between plants in a row was formed based on the norm of 26.5 cm in order to form 20.3 thousand plants/ha. The planting depth was 10-12 cm. After planting, the field was watered. During planting, fertilizers were applied at a rate of N20P20K20, and nitroammophoska was used.

Weeds in the rows of plants were removed simultaneously with planting. After weeding, the aisles were cultivated with a KRN-4.2 cultivator. The depth of the first cultivation is 3-4 cm, and the subsequent ones - 6-8 cm.

During the accounting, all fruits (marketable, deformed, damaged, overgrown) were collected with subsequent sorting. No fruit was allowed to be skipped as this reduces ovary formation, as nutrients are redistributed by the plant towards large fruits for seed formation.

After planting, cucumber plants were fertilized by fertigation. We applied ammonium nitrate, calcium nitrate, phosphoric acid, magnesium sulfate, calcium sulfate and Vuxal. The fertilizer rates for fertigation were distributed over three periods of cucumber cultivation: 1st - from planting; sowing to the growth of sufficient vegetative mass; 2nd - from the beginning of flowering to the beginning of fruit setting;



3rd - the period of mass fruiting, until the end of harvesting.

The experiments were accompanied by observation of plants, as well as meteorological and weather conditions. All records and observations were made in duplicate on two non-contiguous replications [21-22].

Sowing density was checked twice during the growing season at the same sites, which were fixed after germination. The first count was carried out 10 days after planting (for seedling survival), and the second - before harvesting. The second count was used to determine plant survival during the growing season.

During the vegetation cycle, plant height was measured with a measuring ruler along the main shoot to the top of the plant from 10 plants per variant. Linear plant growth was determined and calculated on fixed sites in two non-contiguous replications.

Harvesting was carried out by the method of continuous harvesting with an interval of two days. The harvest data were evaluated and statistically processed using analysis of variance, correlation, and regression analyses.

8.1. Cucumber fruit yield formation

To be used in modern technologies, cucumber hybrids must meet the following requirements: high yield, good taste and marketability; high photosynthetic and transpiration capacity of the leaf apparatus; resistance to low temperatures and light. The most important indicators in production are primarily yield and early maturity, which mainly determine the feasibility of growing a particular cucumber hybrid.

Unlike other field crops and some vegetables, cucumbers are characterized by a constant growth of fruits over a certain period, while others form a one-time harvest. The more marketable fruits are harvested and the longer the fruiting period, the higher the overall yield. Given the predominantly downward trend in fruit prices and the dynamics of demand for products by processing companies, yield dynamics is of great importance.

Our research involved determining the number of fruits. For the harvesting of



Small size (SS) pickles, 22 samples were made, for Large size (LS) gherkins and Trial (TR) greens, 20 and 18 samples, respectively (Table 1).

Table 1: Number of cucumber fruits in individual samples from the accounting plot (average for 2020-2023)

Indicators	Pickles Small size (SS)	Cornichons Large size (LS)	Zelentsy Trial (TR)
Hybrid Kibria F1			
Number of samples, times	21	21	20
Total number of fruits	4068	2096	1630
Average number of fruits (\bar{X}), pcs./sample	193,7	99,8	81,5
Hybrid Madeira F1			
Number of samples, times	22	21	21
Total number of fruits	4761	2405	1884
Average number of fruits (\bar{X}), pcs./sample	216,4	114,5	89,7

The largest number of fruits in the Kibria F1 hybrid was collected according to the standard Pickle Small size (SS) 3637 pcs, Gherkin Large size (LS) and Zelenka Trial (TR) less by 2.2 and 2.7 times. The same is true for the Madeira F1 hybrid. The fruits of the Small size (SS) standard were collected 4182 pcs/plot, and the Large size (LS) and Trial (TR) gherkins were 2.1 and 2.8 times less.

At the same time, on average, 193.7, 99.8 and 81.5 pieces of fruit of the Kibria F1 hybrid were collected per sample, respectively, and 216.4, 114.5 and 89.7 pieces of the Madeira F1 hybrid.

However, during the individual samples, fruit collection varied significantly, as evidenced by statistical indicators. Thus, the largest variance and, accordingly, the scattering of values was in the hybrid Kibria F1 compared to the hybrid Madeira F1.

For 21 samples of the hybrid Kibria F1, 72.4 kg of Small size (SS) pickles were collected, 15.8 kg more of Large size (LS) gherkins for the same number of samples, and 35.3 kg more of Trial (TR) greens (Table 2). The productivity of the Madeira F1 hybrid was slightly higher. When sampling the fruit of the Small size (SS), 83.3 kg of fruit was collected from the accounting plot. And the size of Large size (LS) gherkins was 14.8 kg more and Trial (TR) greens 36.0 kg more.

**Table 2 - Fruit weight in individual samples and yield of cucumbers**

Indicators	Pickles Small size (SS)	Cornichons Large size (LS)	Zelentsy Trial (TR)
Hybrid Kibria F1			
Number of samples, times	21	21	20
Total fruit per plot, kg	72,4	88,2	107,7
Yield, t/ha	63,4	77,3	94,4
Hybrid Madeira F1			
Number of samples, times	22	21	21
Total fruit per plot, kg	83,3	98,1	119,3
Yield, t/ha	73,0	86,0	104,5

Thus, the productivity of hybrids in harvesting Large size (LS) gherkins provides an increase in productivity by 17.8 and 21.8% more, and the Trial (TR) group of greens by 43.2 and 48.8% more. Thus, this difference should be taken into account in the cost of the fruit.

The supply of fruit to processing plants requires the formation of consistently large batches. Therefore, the factor of productivity fluctuations in individual samples is important. In terms of fruit weight, the largest fluctuations were observed when harvesting Trial (TR) greens (5.82 and 6.29), respectively, Large size (LS) gherkins (3.57 and 3.29), and Small size (SS) pikulas (3.06 and 4.45). If the hybrid Kibria F1 had higher stability of productivity when sampling fruits of Small size (SS) pickles, then the hybrid Madeira F1 had higher stability of productivity in relation to Large size (LS) gherkins.

The hybrid Madeira F1 was characterized by slightly higher stability in terms of fruit yield. The standard deviation of the fruits of Small size (SS), Large size (LS) gherkins, and Trial (TR) greens was 1.75, 1.89, and 2.41 kg, while in the Kibria F1 hybrid it was slightly higher at 2.1, 1.81, and 2.51 kg.

To assess the significance of the difference in fruit weight in individual samples, it should be borne in mind that the confidence interval for the Madeira F1 hybrid is 0.81, 0.87 and 1.11 kg of fruit, and the Kibria F1 hybrid, respectively, for fruits of certain sizes is 0.97, 0.84 and 1.16 kg.



There is a close direct correlation between such indicators as the number of fruits and the weight of fruits per plot in individual samples. The correlation coefficient for the Madeira F1 hybrid was $R=0.84$, 0.96 and 0.97 for Small size (SS) cucumbers, Large size (LS) gherkins and Trial (TR) greens, respectively, while for the Kibria F1 hybrid it was $R=0.82$, 0.97 and 0.98 , respectively. That is, the closeness of the relationship is quite high and almost functional dependence was manifested (Tables 3 and 4).

Table 3 - Mathematical models of the process of average daily growth of fruits of cucumber hybrid Kibria F1 of different types of sample

Model typofunction	Pickles Small size (SS)	Cornichons Large size (LS)	Zelentsy Trial (TR)
polynomial	$y = -0,0096x^2 + 0,2884x - 0,3453$ $R^2 = 0,8959$	$y = -0,002x^2 - 0,0566x + 2,4793$ $R^2 = 0,5805$	$y = -0,0084x^2 + 0,0429x + 2,7128$ $R^2 = 0,659$

According to our data, fruit was sampled systematically, with an interval of 2-3 days. Some deviations were caused by non-working days and precipitation, which did not allow for sampling and accounting. In this regard, the average daily samples of cucumbers were calculated for the entire period and mathematical models of this process were built.

Table 4 - Mathematical models of the process of average daily fruit growth of cucumber of Madeira F1 line of different types of samples

Model typofunction	Pickles Small size (SS)	Cornichons Large size (LS)	Zelentsy Trial (TR)
polynomial	$y = -0,0113x^2 + 0,3351x - 0,4929$ $R^2 = 0,7358$	$y = 0,0002x^2 - 0,114x + 3,0808$ $R^2 = 0,6453$	$y = -0,0137x^2 + 0,1508x + 2,7384$ $R^2 = 0,731$

The sample of Small size (SS) pickles had a general upward and downward trend. Gherkins Large size (LS) by fruit weight tended to gradually decrease during the samples, and Zelenka Trial (TR) showed a more pronounced gradual decrease at the final stage of fruiting. Information on such trends is of practical importance, as it allows planning fruit production volumes in relation to the needs of processing enterprises.

When taking into account the harvested fruits of the Madeira F1 hybrid, the Small



size (SS) pickle most closely corresponded to the actual values of the polynomial model, with the value of approximation reliability being $R^2 = 0.7358$. For the sample of Large size (LS) gherkin fruits, the approximation reliability reached the highest values when building a polynomial model and was at the level of $R^2 = 0.6911$, and when harvesting greengage fruits, it was Trial (TR) $R^2 = 0.731$.

The application of the developed models for cucumber of hybrids Kibria F1 and Madeira F1 allows to predict with a sufficiently high level of accuracy the change in the dynamics of growth of fruits such as small size (SS) pickles, large size (LS) gherkins and Trial (TR) greens. The accuracy of these models ranges from 59 to 74% for the Madeira F1 line and 65-89% for the Kibria F1 hybrid.

The application of the developed models for cucumber of Kibria F1 and Madeira F1 hybrids allows predicting with a sufficiently high level of accuracy the change in the dynamics of fruit growth of Small size (SS) pickles, Large size (LS) gherkins and Trial (TR) greens. The accuracy of these models ranges from 59 to 74% for the Madeira F1 line and 65-89% for the Kibria F1 hybrid.

Simpler linear models in some cases had a fairly high level of reliability, or at the level of other types of models, but this does not accurately reflect the dynamics of the process of productivity change. Given the greater stability of fruit growth of the Kibria F1 hybrid, as evidenced by the results of the statistical analysis made earlier, the models for this line are characterized by higher accuracy in relation to the Madeira F1 hybrid.

According to the results of the accounting, the yield of the hybrids subject to the study was determined, it was at a high level of 83.1 t/ha on average in the experiment, and significantly changed by experimental variants (Figure 1).

The highest yield was 87.8 t/ha on average for the Madeira F1 hybrid, which is 12% higher than for the Kibria F1 hybrid. According to the type of fruit sampling, the highest white yield was 99.5 t/ha when harvesting Trial (TR) greens, while when harvesting Large size (LS) gherkins, the yield was 17.9% lower and Small size (SS) piquas 31.5% lower (Figure 2).

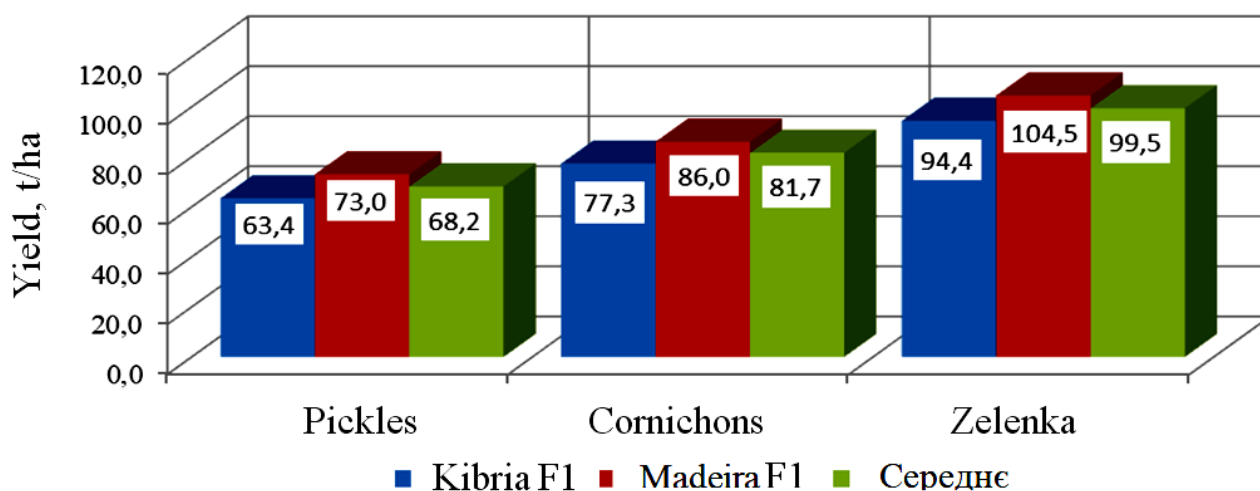


Figure 1 - Yield of cucumber hybrids depending on on the phases of sampling (average for 2020-2023), t/ha

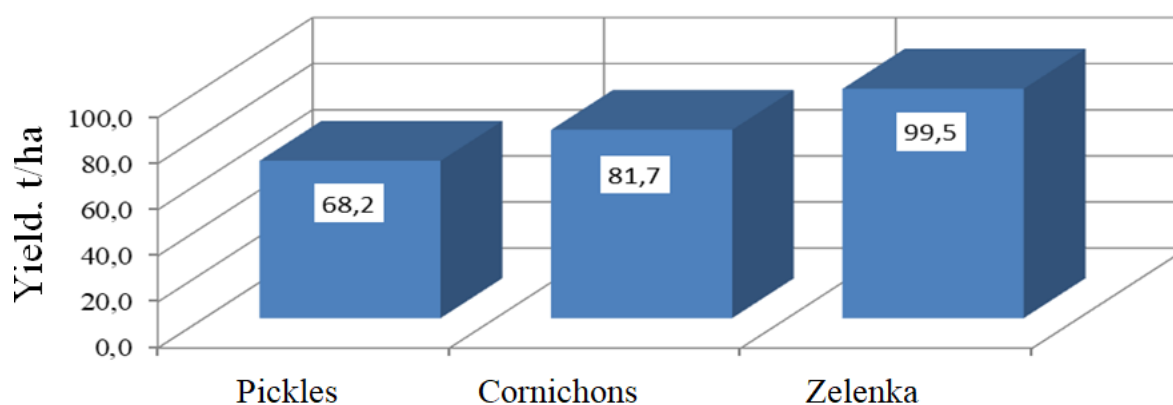


Figure 2 - Average yield of cucumber in the experiment depending on the sampling phase (average for 2020-2023), t/ha

When using the Kibria F1 hybrid, when changing the type of fruit from Small size (SS) to Large size (LS) gherkins and Trial (TR) greens, the yield significantly increased from 63.4 to 77.3 and 94.4 t/ha. For the Madeira F1 hybrid, the yield increased from 73.0 to 86.0 and up to 104.5 t/ha, respectively.

8.2. Qualitative characteristics of cucumber hybrids

We carried out biometric measurements of fruits, accounting of total and marketable yield, and product quality assessment. The yields of pickle cucumber and



gherkins and greens were harvested and recorded in two to three days. According to the requirements of the current standard DSTU 3247-95 "Fresh cucumbers. Specifications", all fruits were divided into standard and non-standard parts. The results of the analysis of the average fruit weight are presented in Table 5 and Figure 3.

During the harvesting of Small size (SS) pickles, 21 samples were made on the Kibria F1 hybrid and 22 on the Madeira F1 hybrid. During the harvesting of Large size (LS) gherkins, 21 samples were made and Trial (TR) greens, respectively, 20 and 21 samples.

Table 5 - Average weight of cucumber fruit

Indicators	Pickles Small size (SS)	Cornichons Large size (LS)	Zelentsy Trial (TR)
Hybrid Kibria F1			
Number of samples, times	21	21	20
Average fetal weight, g	17,9	44,9	70,7
Limit of fluctuations	9-30	40-54	66-93
Hybrid Madeira F1			
Number of samples, times	22	21	21
Average fetal weight, g	17,7	41,7	63,1
Limit of fluctuations	8-31	34-55	58-80

The average fruit weight between hybrids for individual fruit size groups was within 1.11, 7.67, and 12.04 %, respectively, for Small size (SS) pickles, Large size (LS) gherkins, and Trial (TR) greens (Figure 3). According to individual samples, the average weight of Small size (SS) gourds ranged from 9 to 30 g for the Kibria F1 hybrid and from 8 to 31 g for the Madeira F1 hybrid. For Large size (LS) gherkin fruits, this variation was 40-54 and 34-55 g, and for Trial (TR) gherkins 66-93 and 58-80 g, respectively. The variance among the fruits of Small size (SS) pickles, Large size (LS) gherkins and Trial (TR) green fruits was lower in the Madeira F1 hybrid.

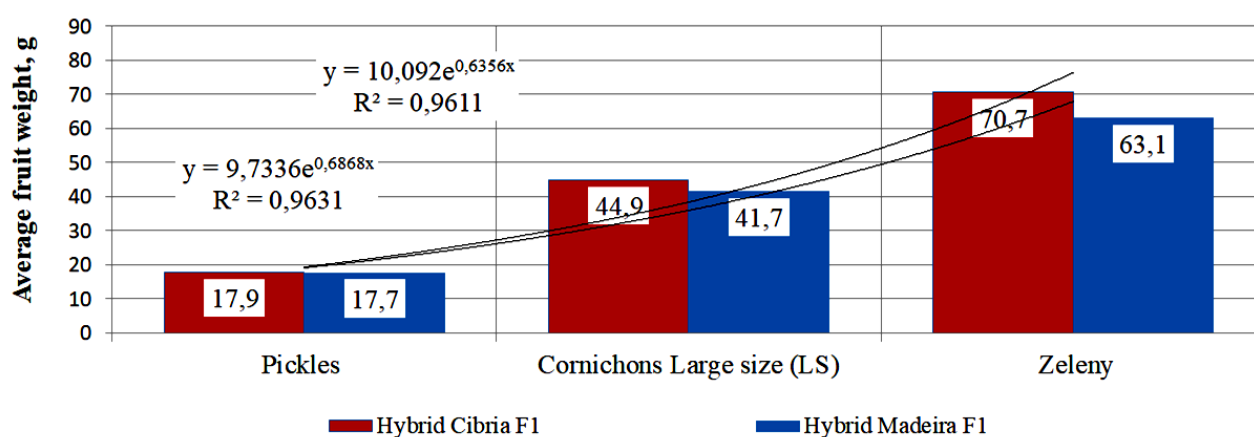


Figure 3 - Fruit weight of cucumber hybrids depending on the sample (average for 2020-2023)

The trend line and the value of the approximation reliability for the samples and the studied factors indicate their effectiveness (Figure 3). The average weight of fruits for the Madeira F1 hybrid was 17.7, 41.7 and 63.1 g, and for the Kibria F1 hybrid, respectively, 17.9, 44.9 and 70.7 g, depending on the sampling phases. Fruit samples for analysis were taken at three times - June 25, July 7 and July 22 (Table 6).

The length of the Small size (SS) fruits ranged from 3.61 to 4.38 cm, and the diameter was 1.28-1.51 cm. The length of the fruits of Large size (LS) gherkins was 8.54-9.01 cm, and the diameter was 3.14-3.28 cm. For Zelenka Trial (TR), the length was 9.63-10.21 cm and the diameter was 2.9-3.8 cm. This indicates a violation in the technology of fruit sampling, and that more frequent sampling is needed. The length index decreases significantly only when sampling in the Green Trial (TR) phase - 1.72 - 1.86 against 2.80-2.93 for Small size (SS) and 2.64-2.80 for Large size (LS) gherkins.

Linear dimensions are also important. According to GOST 1726-2019, the requirements for cucumbers for canning are that the fruits must be fresh, whole, healthy, not contaminated, without mechanical damage, without stalks, with a shape and color typical of the botanical variety.

For cucumbers to be tasty, well-presented, and crispy when pickled, you need to grow hybrids and varieties that have sweet and dense flesh and thin but strong skin. The fruits of such varieties do not form voids and remain crisp after processing. They are well suited for pickling gherkin-type varieties.



**Table 6 - Biometric parameters and fruit quality
(average for 2020-2023)**

Measurement time	Linear dimensions, cm			Fruits with voids, %
	length	diameter	length index	
	L	D	L/D	
Hybrid Kibria F1				
Small size (SS) picks				
III д. June	4,15	1,48	2,80	0
I д. July	4,38	1,51	2,90	0
III д. July	4,21	1,50	2,80	0
Cornichons Large size (LS)				
III д. June	8,67	3,28	2,64	0
I д. July	9,01	3,30	2,73	0
III д. July	8,86	3,28	2,70	10
Greenery Trial (TR)				
III д. June	10,03	5,83	1,72	0
I д. July	10,21	5,58	1,83	10
III д. July	9,65	5,42	1,78	10
Hybrid Madeira F1				
Small size (SS) picks				
III д. June	3,61	1,28	2,82	0
I д. July	3,95	1,35	2,93	0
III д. July	3,92	1,38	2,84	0
Cornichons Large size (LS)				
III д. June	8,54	3,20	2,67	0
I д. July	8,94	3,25	2,75	8
III д. July	8,80	3,14	2,80	0
Greenery Trial (TR)				
III д. June	9,63	5,35	1,80	8
I д. July	10,00	5,38	1,86	0
III д. July	9,91	5,33	1,86	9

Fruits of the Small size (SS) pickle size of the Madeira F1 hybrid were 3.61-3.95 cm long and of the Kibria F1 hybrid 4.15-4.38 cm long, indicating a higher growth rate in the latter hybrid. Their diameter was in the range of 1.28-1.38 and 1.48-1.51 cm, respectively. Accordingly, the maturity index exceeded the prescribed limits and amounted to 2.82-2.93 and 2.80-2.90. This indicates that the fruits of the Madeira F1 hybrid are more elongated. This suggests that the fruits thicken during ripening. Moreover, the Madeira F1 hybrid has a higher coefficient than the Kibria F1 hybrid,



which means that the fruits are more elongated and have a better shape.

Cucumber fruits should not contain voids in the middle. There were no significant differences in the studied hybrids for this indicator, although there was a difference in fruit groups. In the fruits of Small size (SS) cucumbers, no fruit voids were found during the entire period of determination. In Large size (LS) gherkins, there were up to 10% of such fruits over time, while in Trial (TR) gherkins there were 10 in two determinations. Such a ratio between the fruits of cucumbers of the pickle group and the green cucumbers may be a feature of fruit growth. The hybrids were similar in other varietal traits (Table 7).

Table 7 - Evaluation of plants and fruits of cucumber hybrids by quality indicators (average for 2020-2023)

Indicators	Small size (SS) picks		Cornichons Large size (LS)		Greenery Trial (TR)	
	Madeira F1	Kibria F1	Madeira F1	Kibria F1	Madeira F1	Kibria F1
The power of growth	7	7	5	5	5	5
The presence of stepsons	8	8	6	6	6	6
Plant health	8	8	4	4	5	5
The size of the leaves	6	6	6	6	6	6
Flowering	7	6	4	3	5	5
Regeneration of plants	8	8	5	5	6	6
Defeat by peronosporium	8	7	4	4	5	5
General condition	8	8	5	5	5	5
Wall shape	6	7	6	7	7	8
Density of the fruit	7	7	6	6	8	8
The presence of voids	1	1	3	3	4	4
The shape of the fruit	7	6	6	7	7	7
Length	7	7	5	5	7	7
Uniformity	7	7	5	5	6	6
Color of the fruit	8	6	8	7	7	6
Color of the fruit nose	7	6	7	6	6	5
Number of thorns	8	7	7	6	7	7
General evaluation	7	7	6	6	7	7

Notes: 1 - minimum; 9 - maximum feature

Frequent sampling of fruits of the Small size (SS) group stimulated the growth vigor of plants the most, and therefore the index was 2 points higher on these variants. This can also explain the better plant health and enhanced formation of stepsons, respectively, by 3-4 and 2 points.



Leaf size was stable and independent of the frequency of sampling. However, flowering was more intense in the Small size (SS) sample with 7 points compared to the Large size (LS) sample with 4 points and the Trial (TR) sample with 5 points.

Enhanced plant regeneration could also be due to harvesting fruits in an earlier state, and the advantages were 3 and 2 points, respectively.

Higher resistance to downy mildew at the level of 4 and 3 points was observed in both hybrids when harvesting Small size (SS) pickles. When harvesting Trial (TR) greens, the damage was the highest. As a result, the general condition of the plants in the sample of Small size (SS) pickles was conditionally at the same level - 8 points against 5 points in the variants of Large size (LS) gherkins and in Trial (TR) green.

There were some differences in fruit quality indicators. Fruits of the Small size (SS) type of pickles had advantages in all traits except for "fruit density", where they were inferior to the Trial (TR) greens in both hybrids. Large size (LS) gherkins and Small size (SS) gherkins had the highest score for the trait "fruit color", and the hybrid Kibria F1 had the advantage.

The fruits of the Trial (TR) green beans of both hybrids stood out with the highest scores for fruit density, wall shape, shape and length.

As a result, the overall score of Small size (SS) and Trial (TR) gherkin fruits of the first and second lines was slightly higher, 7 points against 6 points for Large size (LS) gherkins. This feature was identified in both hybrids.

8.3. Economic efficiency of growing promising cucumber hybrids under drip irrigation

Vegetable growing is one of the most profitable sectors of the agricultural sector. At the same time, the cultivation of gherkin-type cucumbers provides very high profits with appropriate technologies [23-27]. This is confirmed by our calculations. We determined the indicators of economic efficiency based on the calculation of the technological map. The prices for seeds and products of both lines were taken to be the



same as of the summer of the current year. The cost of Small size (SS) pickles was taken at 18 UAH/kg, Large size (LS) gherkins at 11 UAH/kg, and Trial (TR) greens at 8 UAH/kg.

Growing cucumbers on drip irrigation requires significant costs - in the range of 417.81 - 601.2 thousand UAH/ha (Tables 8 and 9).

The cost of grown cucumbers ranges from 6.19-6.59 UAH/kg of Small size (SS) cucumbers to 5.99-6.24 UAH/kg of Large size (LS) cucumbers and 5.75-6.08 UAH/kg of Trial (TR) cucumbers. The lower limit of the cost value was set for the Madeira F1 hybrid, while the cultivation of the Kibria F1 hybrid cost on average 5.7% more expensive, which is mainly due to the yield.

Table 8 - Indicators of economic efficiency of growing cucumbers hybrid Kibria F1 (average for 2020-2023)

Indicators	Sampling phase (factor B)			The average value
	Small size (SS) picks	Cornichons Large size (LS)	Greenery Trial (TR)	
Yield, t/ha	63,4	77,3	94,4	78,4
Sales price, thousand UAH/kg	25,00	18,00	14,00	19,00
Cost of gross production, thousand UAH/ha	1585,00	1391,40	1321,60	1432,67
Cultivation costs, thousand UAH/ha	417,81	482,35	573,95	491,37
Pro forma net profit, thousand UAH/ha	1167,19	909,05	747,65	941,30
Cost of production, UAH/kg	6,59	6,24	6,08	6,30
Level of profitability, %.	279,4	188,5	130,3	199,4

The cultivation of the hybrid Kibria F1 led to the formation of products with a total value of 1321.6 thousand UAH/ha to 1585.0 thousand UAH/ha with a maximum value (1585.0 thousand UAH/ha) in the variant with picking of picks Small size (SS), which had a lower cost of growing, but they were lower due to the reduction of the use of mineral fertilizers, not the cost of picking. It was the cost of mineral fertilizers that was the decisive factor in the increase in costs in the Large size (LS) and Trial (TR) variants.

The maximum rate of profitability of cultivation of the Kibria F1 hybrid (279.4%)



was formed by cucumber crops harvested in the pickle phase. Sampling of gherkins or greens led to a sharp decrease in profitability to 188.5 and 130.3%, respectively. An inverse relationship was observed in the variants of the experiment in terms of the cost of grown products, so for the sample of Small size (SS) pickles the indicator was 6.59 UAH/kg, Large size (LS) gherkins - 6.24 UAH/kg and Trial (TR) greens - 6.08 UAH/kg. When growing cucumber of Madeira F1 hybrid, the following economic indicators of cultivation were noted.

The cultivation of Madeira F1 hybrid resulted in the formation of products with a total value of 1463.0 thousand UAH/ha to 1825.0 thousand UAH/ha with a maximum value (1825.0 thousand UAH/ha) in the variant with a sample of picks Small size (SS), which had a lower cost of growing it, but they were lower due to the reduction of the use of mineral fertilizers, not the cost of sampling. It was the cost of mineral fertilizers that was the decisive factor in the increase of the cost part of the variants Large size (LS) and Trial (TR), as in the previous hybrid.

Table 9 - Indicators of economic efficiency of growing cucumbers of Madeira F1 hybrid (average for 2020-2023)

Indicators	Sampling phase (factor B)			The average value
	Small size (SS) picks	Cornichons Large size (LS)	Greenery Trial (TR)	
Yield, t/ha	73,0	86,0	104,5	87,8
Sales price, thousand UAH/kg	25,00	18,00	14,00	19,00
Cost of gross production, thousand UAH/ha	1825,00	1548,00	1463,00	1612,00
Cultivation costs, thousand UAH/ha	451,70	515,30	601,20	522,73
Pro forma net profit, thousand UAH/ha	1373,30	1032,70	861,80	1089,27
Cost of production, UAH/kg	6,19	5,99	5,75	5,98
Level of profitability, %.	304,0	200,4	143,3	215,9

The maximum rate of profitability of cultivation of the hybrid Kibria F1 (304.0%) was formed by cucumber crops harvested in the pickle phase. Sampling of gherkins or greens led to a sharp decrease in profitability to 200.4 and 143.3%, respectively. The inverse dependence was observed in the variants of the experiment in terms of the cost

of grown products, so for the sample of Small size (SS) pickles the indicator was 6.19 UAH/kg, Large size (LS) gherkins - 5.99 UAH/kg and Trial (TR) greens - 5.75 UAH/kg. The cultivation of Small size (SS) pickles in the experiment forms the cost of production (1705.0 thousand UAH/ha), while Trial (TR) pickles are the least expensive (1392.3 thousand UAH/ha). The difference between these groups is 312.7 thousand UAH/ha, or 22.4% in favor of the picks. The replacement of the Kibria F1 hybrid with the Madeira F1 hybrid in the cultivation technology has a slight effect on costs, about 6.4%, but the cost of production increases quite significantly by 15.7% (Figure 4).

The lowest profit was when growing Trial (TR) greengage fruits at 747.65 and 861.8 thousand UAH/ha. However, even in this variant, the profitability was high 130.3 and 143.3%, respectively, for the first and second of the studied hybrids.

Among the variants of different fruits, the most profitable is the cultivation of Small size (SS) and Large size (LS) gherkins, compared to Trial (TR) gherkins In this series, the profit decreased by 1.16 (1.14-1.16) and 1.22 (1.20-1.25) times.

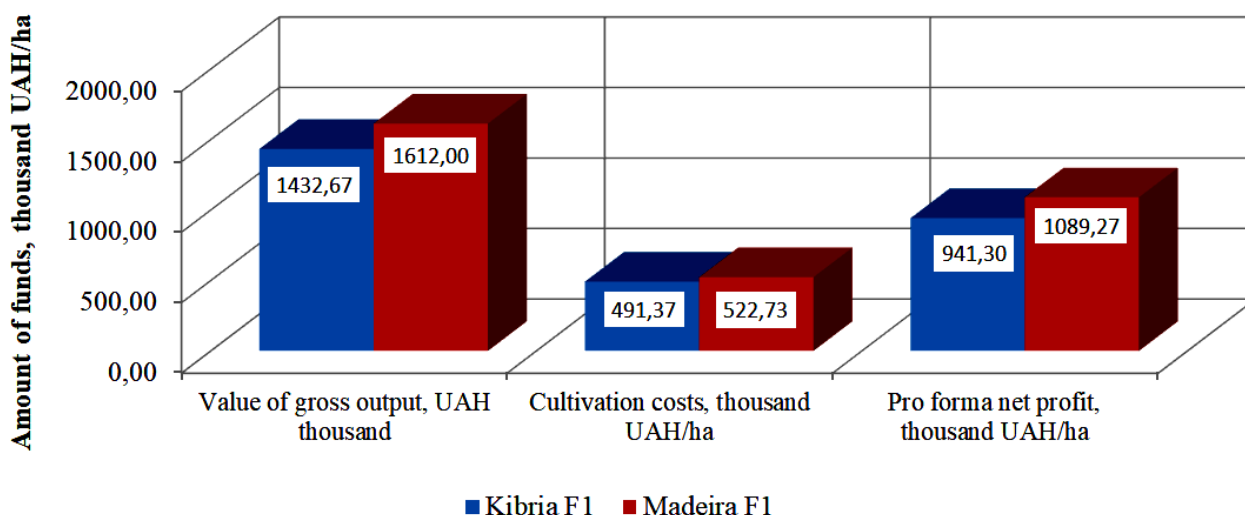


Figure 4 - Economic indicators of growing hybrids cucumber hybrids in the experiment (average for 2020-2023)

The highest profit in the experiment of 442.7 thousand UAH/ha was provided by the cultivation of the Madeira F1 hybrid on the Small size (SS) pickle, where the highest profitability of 304% was obtained. The cultivation of the Madeira F1 hybrid in the experiment formed an average profitability level of 215.93%, which was 16.57%



higher than the Kibria F1 hybrid (Figure 5).

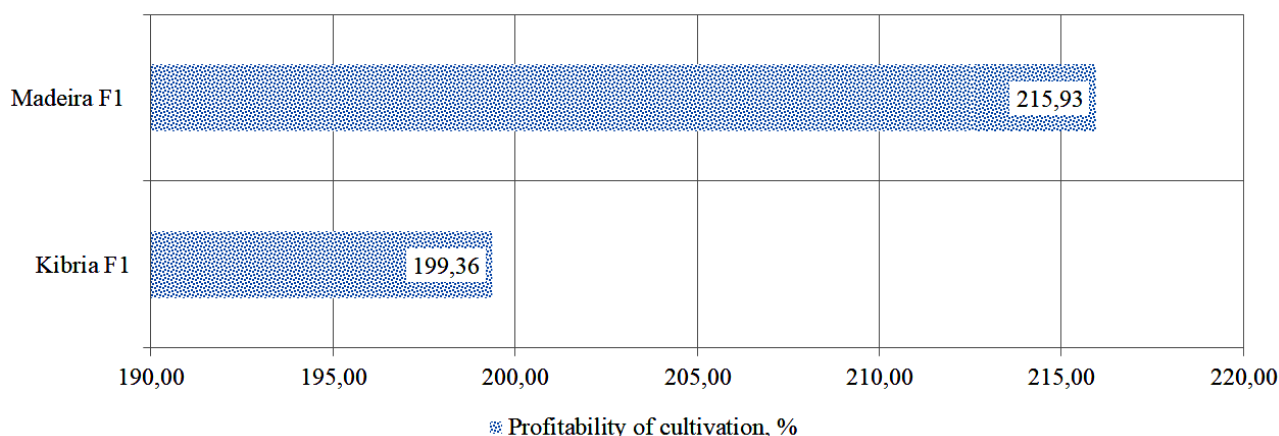


Figure 5 - The level of profitability of growing hybrids cucumber hybrids in the experiment (average for 2020-2023)

Based on the economic analysis of the experiment, it can be stated that for the cultivation of cucumber in the NSCC of the MNAU, Mykolaiv district, Mykolaiv region, under drip irrigation, the best option is to use the Madeira F1 hybrid with a sample of Small size (SS), which will allow the farm to obtain a fruit yield of 73.0 t/ha, providing a gross production value of 1825.0 thousand UAH/ha, a conditional net profit of 1373.3 thousand UAH/ha and a profitability level of 304.0%.

Conclusions

Thus, farms in the South of Ukraine, after compliance with the requirements and appropriate registration, need to sow the Madeira F1 cucumber hybrid to obtain gherkin-type fruits. When used to produce Small size (SS) cucumbers, the yield will be 73.0 t/ha, which will provide a conditional net profit of 1373.3 thousand UAH/ha. This option will form the highest possible gross production value (1825.0 thousand UAH/ha) with an extremely high level of profitability (304.0%).