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AGRO-ECOLOGICAL ZONING OF SUNFLOWER HYBRIDS IN PENZA REGION, RUSSIA

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Abstract

The paper presents the materials obtained as a result of the environmental assessment of sunflower hybrids. This rating is used for recommendations for optimal cultivation regions and active introduction of sunflower varieties and hybrids into production. As a rule, environmental assessment is carried out on the basis of the parameters of environmental plasticity and stability. The aim of the research was the agro-ecological zoning of the following sunflower hybrids NK Roki (Syngenta) – St; NK Kondi (Syngenta); NK Brio (Syngenta); Sumiko (Syngenta); ES Amis (Euralis); ES Florimis (Euralis); P64LE25 (Pioneer); P64LE20 (Pioneer); P64LE99 (Pioneer) in the conditions of the Penza region. The soil of the experimental plot is leached chernozem, heavy loamy in terms of granulometric composition. Humus content - 6%, nitrogen 82-86 mg per1 kg soil, phosphorus - 80-110 mg and potassium 110-140 mg per1 kg soil, pH-6.0-6.2. The predecessor of sunflower is spring wheat, after its harvesting, disk stubble plowing was carried out, then autumn plowing was carried out to a depth of 28-30 cm. The weather conditions during the research were different. The amount of precipitation during the growing season ranged from 92.3 mm up to 217.1 mm, and the sum of positive temperatures (above +10ºC) ranged from 2115.9ºC (HTC = 1.0) to 2365.1ºC (HTC = 0.39). The duration of the growing season is 119-135 days, field germination ranges from 90.1% to 92.7%. The sparseness of sunflower crops is 1.7-5.2%. The highest yield was recorded in the hybrid NK Roki-St (2.48 t/ha), and the lowest in the hybrid P64LE25 (2.35 t/ha). Oil content in sunflower hybrids ranged from 49.9% to 50.7%, *with a profitability level of 42.7% (hybrid NK Rocki-St) to 29.1% (hybrid P64LE25).*

Key words*: sunflower, hybrids, agro-ecological zoning, productivity, oil content.*

INTRODUCTION

To date, the most urgent problem is the supply of food to the population, because the population is growing rapidly. In solving this problem, oilseeds occupy a priority place. (Bruniard et al., 2001; Balov, 2003; Gromov et al., 2006; Belyakov et al., 2008; Fernandez-Martinez et al., 2008; Joita-Pacureanu et al., 2010; Gorshenin et al., 2012; Kaya, 2014; Gryazeva et al., 2020; Koryagin et al., 2020; Koryagin, Kulikova et al., 2020).

The main oilseed crop grown in Russia is sunflower. Sunflower is the main crop for the production of vegetable oil, belongs to the group of the most valuable and highly profitable crops, which plays an important role in creating a strong economy for agricultural enterprises. Sunflower belongs to the type of crops in which the entire above-ground mass is used as a raw material for such industries as oil and fat, food, chemical, pharmaceutical, paint and varnish, soap and others. Sunflower seeds contain up to 50-55% fat and 20-25% protein. The vegetable oil obtained from them has nutritional advantages. High-quality margarines, vegetable fats, mayonnaises, paints and varnishes are obtained from it. Sunflower oil contains semi-saturated fatty acids, vitamins (A, D, E) and other biologically active, substances vital for human health. Sunflower cake and meal, by-products of seed processing, are valuable animal feed. Sunflower baskets can be used as additional feed for livestock. Sunflower is used as a silage crop. Its nutritional value is average. Sunflower is a good honey plant that could give 20-30 kg of honey per hectare. The center of sunflower origin is the steppe part of North America (Fomin et al., 2001; Rymar et al., 2004; Kolomeychenko, 2007; Pleskachev et al., 2013; Khaibullin et al., 2013; Makoveev et al., 2015; Stolyarov et al., 2015; Chudakov, 2015; Pirogovskaya et al., 2016; Puzikov et al., 2016; Gryazeva et al., 2020).

In Russia, its main areas (80%) are concentrated in the North Caucasus, in the Rostov

region, the Central Black Earth region, the Middle and Lower Volga regions. On a small scale, it is cultivated in the Urals. As early maturing varieties and hybrids are obtained, new methods of agricultural technology are developed, sunflower is gradually moving into the Non-Chernozem regions, as well as into Eastern Siberia and the Far East (Shekhovtsov et al., 2012; Gulidova et al., 2016; Depar et al., 2018; Detsyna et al., 2019; Suvorov, 2019).

Due to the wide use of sunflower, its crops are located on a vast territory of the globe and in Russia. Worldwide, sunflower areas now amount to more than 27 million hectares. In the Russian Federation, the area under crops is more than 6 million hectares. The yield of this crop in the world is 17.8 c/ha, in Russia 12.3 c/ha (Alabushev, 2011; Kholghi, 2011; Gulidova et al., 2016; Khan, 2017; Depar et al., 2018; Volgin et al., 2019; Detsyna et al., 2019; Suvorova, 2019).

The purpose of the work is an agronomic assessment of hybrids from various manufacturers: Syngenta, Eurolighting, Pioneer and their technological advantages (yield and oil content) in the soil and climatic conditions of the Penza region.

MATERIALS AND METHODS

The research was carried out by organizing experiments in 2017-2019 in the conditions of the agricultural entity "Kamenskoye" in the village Mochaleyka of the Penza region (Russia). In the current research, the following sunflower hybrids NK Roki (Syngenta) – St; NK Kondi (Syngenta); NK Brio (Syngenta); Sumiko (Syngenta); EC Amis (Euralis); EC Florimis (Euralis); P64LE25 (Pioneer); P64LE20 (Pioneer); P64LE99 (Pioneer).

The soil of the experimental plot is leached chernozem, heavy loamy in terms of granulometric composition. Humus content - 6%, nitrogen 82-86 mg per 1 kg of soil, phosphorus - 80-110 mg and potassium 110-140 mg per 1 kg of soil, pH-6.0-6.2.

The predecessor of sunflower was spring wheat, after its harvesting, disk stubble plowing was carried out, and then autumn plowing was carried out to a depth of 28-30 cm. In the spring, at the onset of the physical ripeness of the soil, harrowing was carried out. Further, pre-sowing cultivation was carried out to the depth of sowing and sowing with a seeding rate of 70 thousand seeds per hectare, to a depth of 6-7 cm. Row spacing -70 cm, butt spacing 70 cm (+/- 5cm). Sowing was carried out in 2017 - April 26, in 2018 - May 3, in 2019 - April 28. In sunflower plants grown according to the classical technology, inter-row cultivation was carried out with row cultivators. Sunflower plants grown using the Clearfield technology were subjected to Eurolighting herbicide treatment with a rate of 1.2 l/ha in the phase of two pairs of true leaves, and sunflower plants grown using the Express technology were subjected to one herbicide treatment with a rate of 50 g/ha. Sunflower harvesting was carried out at a seed moisture content of no more than 10-12%, i.e. at the onset of technical ripeness of seeds on a daily basis with subsequent weighing of grain. Yield data were processed by the mathematical method of disperse analysis and according to the methodology of the state variety testing of agricultural crops (Methodology of state variety testing of agricultural crops/State Commission for Variety Testing of Agricultural Crops under the Ministry of Agriculture of the USSR, 1983; Kulikova et al., 2019; Koryagina et al., 2020; Koryagin et al., 2021).

RESULTS AND DISCUSSIONS

The weather conditions during the research period (2017-2019) were different. In 2017, during the growing season of sunflower, 217.1 mm fell (98.5% of the norm), which is 3.2 mm below the norm. Precipitation during the growing season was unevenly distributed (Table 1).

In May, they fell out (since the 2nd decade) - 23.1 mm, which is 4.9 mm below the norm. In June, 56.8 mm fell, which is 8.2 mm below the norm (87.3% of the norm). In July, 83.9 mm fell, which is 24.9 mm higher than the norm (142% of the norm), which had a favorable effect on the growth of sunflower, given that at that time it was in the budding-flowering phase. In August, 11.7 mm fell, which is 39.3 mm below the norm (22.9% of the norm). In September (1st decade), 41.6 mm fell, which is 24.3 mm higher than the norm.

Table 1. Precipitation for the period 2017-2019 (mm)

Years	Decades	Months					
2017	1	15.2	2.2	14.1	55.8	1.8	41.6
	2	22.6	16.9	19.1	14.2	0.3	6.9
	3	16.0	6.2	23.6	13.9	9.6	2.6
	∑ per month	53.8	25.3	56.8	83.9	11.7	51.1
2018	1	12.0	3.0	7.4	42.3	13.3	0.0
	2	10.9	0.8	0.0	12.1	0.0	1.0
	3	43.0	6.7	0.0	6.7	3.0	20.6
	∑ per month	65.9	10.5	7.4	61.1	16.3	21.6
2019	1	10.0	10.6	2.6	18.8	55.0	2.0
	2	6.0	4.3	0.9	21.3	1.8	19.3
	3	0.0	12.0	20.0	5.0	2.0	11.7
	∑ per month	16.0	26.9	23.5	45.1	58.8	33.0

Source: own calculations

In 2018, during the growing season of sunflower, 92.3 mm fell, although the distribution of precipitation by months was uneven. In June, the amount of precipitation amounted to 7.4 mm, which fell in the 1st decade of June, the 2nd and 3rd decades of the month were without rain. The amount of precipitation was below the norm by 57.6 mm, which negatively affected the growth of sunflower. In July, 61.1 mm fell, which is 2.1 mm higher than the norm, which created favorable conditions for the growth of sunflower, although the distribution of precipitation over decades was uneven, in the 1st decade 42.3 mm fell, in the 2nd 12.1 mm, and in the 3rd decade 6.7 mm. In August, a total of 16.3 mm of precipitation fell, which is 34.7 mm below the norm (31.9% of the norm). There was no precipitation in the first decade of September.

2019 was characterized by uneven distribution of precipitation. During the growing season of sunflower, the amount of precipitation amounted to 145.7 mm, which is below the norm by 74.6 mm or 66.1% of the norm. In June, the largest amount of precipitation fell in the 3rd decade - 20.0 mm, in the 2nd decade - 0.9 mm, in the 1st decade - 2.6 mm. As a result, the amount of precipitation in June amounted to 23.5 mm, which is 41.5 mm below the norm. (36.1% of the norm). In July, 45.1 mm fell, which is 13.9 mm below the norm. The greatest amount of precipitation fell on the 2nd decade of July 21.3 mm, on the 1st decade 18.8 mm, and in the 3rd decade only 5.0 mm of precipitation fell. The largest amount of precipitation during the growing season of sunflower was characterized by August, where 58.8 mm of precipitation fell, which is 7.8 mm above the norm. The bulk of precipitation fell in the 1st decade of August, in the amount of 55.0 mm, which had a beneficial effect on sunflower, because at this time it was in the flowering phase. The least and insignificant amount of precipitation fell in the 2nd and 3rd decades in the amount of 1.8 and 2.0 mm. In September (1st decade), 2.0 mm fell, which is 15.3 mm below the norm.

In 2017, during the growing season of sunflower, the sum of positive temperatures was 2115.9°C, which is quite favorable. In May, the average monthly temperature was 13.9°C, which is -0.4°C below the norm. Of the summer months, August was characterized by the highest average daily temperature, where the average daily temperature was +20.3°C, which is +2°C above the norm. The lowest average daily temperature in June was +15.8°C, which is 2.7°C below the norm. In July, the average daily temperature was +19.5°C, which is almost normal. In September (1st decade), the average daily temperature was +14.3°C, which is 1.8°C above the norm.

In 2018, the sum of positive temperatures during the growing season was 2365.1°C. In May, the average monthly temperature was +16.6°C, which is +2.3°C above the norm. In June, the average monthly temperature is + 17.8°C, which is 0.7°C below the norm. (Table 2).

Table 2. Temperature for the period 2017-2019 (°C)

Years	Decades	Months					
2017	1	4.6	16.2	13.8	17.2	21.4	14.3
	2	5.6	10.4	16.2	20.1	20.6	16.7
	3	8.8	15.3	17.5	21.4	19.0	8.2
	∑ per month	6.3	13.9	15.8	19.5	20.3	13.0
2018	1	3.5	17.6	13.2	21.5	21.2	18.9
	2	6.7	17.2	16.7	22.5	19.8	17.2
	3	7.2	15.1	23.6	21.7	19.1	11.7
	∑ per month	5.8	16.6	17.8	21.9	20.0	15.9
2019	1	4.2	15.2	21.1	18.0	14.7	14.5
	2	8.0	18.5	20.3	19.0	20.2	13.1
	3	11.3	18.0	20.2	20.0	16.6	5.9
	∑ per month	7.8	17.2	20.5	19.0	17.1	11.1

Source: own calculations

The 3rd decade of June was characterized by the greatest amount of heat, where the temperature was +23.6°C, and the 1st decade was marked by a lower temperature of

+13.2°C. July was characterized by the highest average monthly temperature, +21.9°C, which is +1.5°C above the norm. The average monthly temperature in August was also above the norm and amounted to +20.0°C, which is 1.7°C above the norm. In September (1st decade), the average temperature for the decade was +18.9°C, which exceeds the norm by 6.4°C.

In 2019, the sum of positive temperatures during the growing season was 2267.9°C. In May, the average monthly temperature was +17.2°C, which is 2.9°C higher than the norm. In June, the average daily temperature was +20.5°C, which is +2°C higher than the norm; the 3 decades of June are characterized by the absence of sudden temperature changes. In July, the largest amount of heat fell on the 3rd decade of July, where the average temperature was +20°C, which corresponds to the norm, and the least amount of heat fell on the 1st decade, where the average temperature was +18°C. July is characterized by a gradual increase in temperatures from +18°C in the 1st decade of the month, +19°C in the 2nd decade, and +20°C in the third. As a result, the average monthly temperature was +19.0°C, which is 1.4°C below the norm. In August, the average monthly temperature was +17.1°C, which is +1.2°C below the norm. August is characterized by sharp temperature drops in decades, from +14.7°C (average) in the first decade. The main heat fell on the second decade of the month +20.2°C. The third decade occupied an intermediate position in the temperature regime, +16.6ºC. In September, the 1st and 2nd decades were not characterized by sharp drops, but did not correspond to the norm +14.5 °C +13.1°C, which is below the norm by +3.8 and +5.2°C. And in the 3rd decade, the average air temperature dropped to +5.9°C. As a result, the average September temperature was +11.1 °C, which is +1.4°C below the norm which is below the norm by +3.8 and +5.2°C.

Thus, over the 3 years of the study, 2017 was characterized by the largest amount of precipitation during the growing season and amounted to 217.1 mm, and the sum of positive temperatures (above +10°C) was 2115.9°C (HTC=1.0).

In 2018, the amount of precipitation was the lowest in 3 years of research: 92.3 mm, and the sum of positive temperatures was 2365.1°C (HTC = 0.39)

In 2019, it occupied an intermediate position in terms of the amount of precipitation, which amounted to 145.7 mm during the growing season, and the sum of active temperatures was 2267.9° C (HTC = 0.64).

Research on the phenology of sunflower crops showed that the growing season of sunflower for three years of research ranges from 119-135 days. In 2017, the shorter growing season was characterized by the hybrids ES Amis - 124 days and NK Roki - 124 days, and the longest growing season was observed in the hybrid P64LE99 - 135 days.

In 2018, the longest growing season was observed for sunflower hybrids P64LE20 - 128 days and P64LE25 - 129 days, and the shortest growing season was for hybrids ES Amis - 118 days and NK Roki - 117 days.

In 2019, the shortest vegetation period was characterized by the ES Amis hybrid - 125 days and the NK Roki hybrid - 124 days, and the longest vegetation period was for sunflower hybrids P64LE20 and P64LE99 - 131 days and 132 days, respectively.

For three years of research, the average duration of the interphase period for cultivated sunflower hybrids from sowing to germination was 10 days, and only for hybrids ES Amis and NK Roki - 11 days. The duration of the interphase period from seedlings to the first pair of true leaves was 7 days, and for hybrids ES Amis and P64LE25 it was 6 days (Table 3).

The duration of the interphase period from the first to the seventh pair of leaves in the studied hybrids ranged from 32 to 37 days. The shortest period was characterized by hybrids: ES Amis, NK Roki, P64LE25 - 32 days, and the longest period was observed in hybrids: P64LE99 and P64LE20. For other hybrids, this interphase period was: 34-35 days. The duration of the interphase period from budding to flowering in all evaluated sunflower hybrids ranged from 18 to 21 days. The shortest interphase period of 18 days was recorded in the following hybrids: ES Amis, ES Florimis, Sumiko and P64LE25, and the longest interphase period of 20 days was typical for hybrids: NK Kondi, P64LE20 and P64LE99. The length of time between the flowering phase and the economic ripeness of sunflower is characterized by the longest

interphase period for it, which ranged from 52 to 57 days. The following hybrids had the shortest interphase period: NK Roki - 52 days, and the longest hybrid P64LE99 - 57 days, and in the rest of the studied sunflower hybrids this period ranged from 55 to 56 days.

Table 3. Duration of interphase periods of plants of sunflower hybrids

Sunflower hybrids	Length of interphase periods (days)						
	sowing-seedlings	seedlings - 1 pair of leaves	1st pair of leaves-7pair of leaves	7 pair of leaves-budding	budding-blooming	flowering - economic ripeness	sprouts - economic ripeness
NK Rocki-St	11	7	32	1	19	52	122
NK Kondi	10	7	34	1	20	54	126
NK Brio	10	7	35	1	21	55	128
ES Amis	11	6	32	1	18	56	124
ES Florimis	10	7	34	1	18	55	125
Sumiko	10	7	34	1	18	55	125
P64LE25	10	6	32	1	18	56	123
P64LE20	10	7	37	1	20	56	131
P64LE99	10	7	37	1	20	57	132

Source: own calculations

As shown by our research on the study of field germination (Table 4), that during the period of research presented in the table of hybrids of sunflower plants, the average percentage of field germination ranged from 90.1 to 92.7%.
The lowest field germination was in the EC Florimis hybrid (90.1%) and the P64LE99 hybrid (90.1%), and the highest field germination rate was in the NK Amis hybrid - 92.7%, in the remaining hybrids the field germination was within 90.4-91.9%.

Table 4. Completeness of seedlings and percentage of plants preserved for harvest

Sunflower hybrids	Germination (%)		plant density (thousand pieces/ha)		Thinness (%)
	laboratory	field	in the germination phase	before cleaning	
NK Rocki-St	96.8	90.5	58.374	57.399	1.7
NK Kondi	96.7	91.6	59.316	56.254	5.2
NK Brio	97.8	91.3	58.951	56.882	3.6
ES Amis	96.7	92.7	59.810	57.594	3.8
ES Florimis	97.2	90.1	58.175	56.968	2.1
Sumiko	97.8	90.6	58.450	56.930	2.7
P64LE25	96.8	91.9	59.332	57.870	2.5
P64LE20	97.5	90.4	58.349	56.857	2.6
P64LE99	96.9	90.1	58.125	56.485	2.9

Source: own calculations

The analysis of the standing density of sunflower plants in the germination phase showed that the highest plant density was recorded in the hybrid NK Amis - 59.810 thousand/ha, and the lowest density in the hybrid P64LE99 - 58125 thousand/ha, in other studied hybrids of sunflower plants, the density of standing ranged from 58.175 thousand/ha to 59.316 thousand/ha. The lowest standing density of sunflower plants in the phase before harvesting was in the P64LE25 hybrid - 57.870 thousand/ha, and the highest in the NK Kondi hybrid - 56.254 thousand/ha.
Our studies on the study of morphological features in sunflower hybrids in the phase of flowering and economic ripeness showed that the diameter of the basket in sunflower hybrids at the end of the budding phase was 8.2-8.8 cm, and at the end of the flowering phase it reached 19.9-21.0 cm hybrid NK Brio - 19.9 cm (Figure 1).

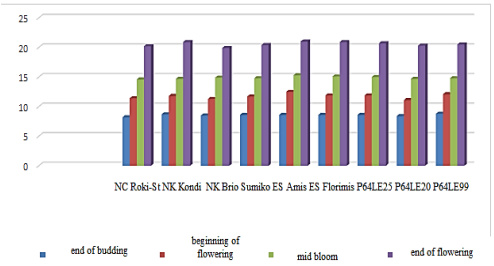

Figure 1. Budding growth dynamics

The total number of seeds in one bud in sunflower hybrids ranged from 870 pcs in a hybrid NK Rocky-St up to 906 pcs in a hybrid P64LE25 (Figure 2).

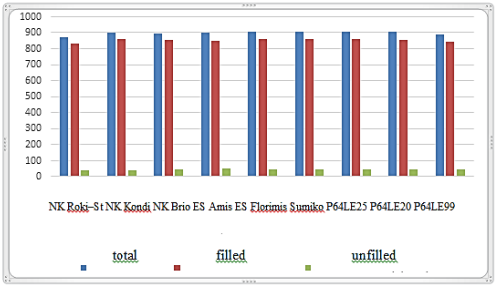

Figure 2. The number of seeds in one bud

The number of filled (fulfilled) seeds in one basket ranged from 829 pcs at the hydride NK Rocky - St before 861 pcs at the hydride Sumiko. The largest number of unfilled (empty) seeds in one basket was recorded in the following sunflower hybrids ES Amis (50.0PCS.), P64LE20 (47.0 pcs.) and P64LE99

(47.3 pcs.), and the smallest quantity is 39.3 pcs and 41.0 pcs in hybrids NK Kondi and NK Roki - St, respectively.

The average maximum weight of achenes per basket was 56.2 g in the Sumiko sunflower hybrid, and the smallest in the NK Roki sunflower hybrid was 53.3 g. In other sunflower hybrids, the weight of achenes from one basket was 55.2-56.0 g. The highest mass of 1000 seeds was in the sunflower hybrid Sumiko - 62.2 g, and the smallest in the sunflower hybrid NK Kondi - 60.9 g.

Increasing the yield of agricultural crops by a single increase in sown areas is not advisable, but should be carried out in search of new ways to increase the yield of sunflower. To do this, introduce into production sunflower hybrids with high yields. On average, over the three years of our research, the highest yield was recorded for the hybrid NK Roki St - 2.48 t/ha, and for other sunflower hybrids, the yield was 0.2-0.13 t/ha lower.

The highest yield over the three years of research has a hybrid - NK Roki - 2.48 t/ha, slightly lower in the hybrid NK Brio - 2.46 t/ha In 2019, the yield of the hybrid NK Amis compared to 2017 is higher by 0.06 t/ha, and in comparison with 2018 more by 0.12 t/ha. In 2019, the yield of the ES hybrid Florimis is higher by 1.1 t/ha compared to 2017, and lower by 0.01 t/ha compared to 2018. The yield of the NK Rocki hybrid in 2019 was higher by 0.03 t/ha compared to 2017, and compared to 2018 by 0.02 t/ha. The yield of the NK Kondi hybrid in 2019 is higher by 0.01 t/ha compared to 2017, and by 0.09 t/ha higher than in 2018. The yield of the hybrid NK Brio in 2019 is lower by 0.01 t/ha compared to 2017, and compared to 2018 is higher by 0.04 t/ha. The Sumiko hybrid had a maximum yield in 2019 - 2.52 t/ha, and the lowest in 2017 is 2.40 t/ha.

Thus, the yield of sunflower hybrids in 2019 was higher compared to 2018 and 2017.

The main product obtained from sunflower is vegetable oil, the quality of which depends on the oil content of the seeds. The oil content in sunflower, depending on the hybrids, ranged from 47-55%.

The average oil content in sunflower hybrids over the years of research was 49.9-50.5%. The following hybrids NK Rocky and ES Florimis had the highest oil content - 50.5%. The lowest oil content in the process of assessing sunflower hybrids was found in hybrids P64LE20 and P64LE99 - 49.9%.

The end result of growing agricultural products is economic efficiency, which is an indicator of the effectiveness of the measures taken in the cultivation of agricultural products. The efficiency of agricultural production is directly related to costs. Therefore, the efficiency of the resulting products will be high, only at low costs, and the final result that determines economic efficiency is always the level of profitability (Kholghi, 2011; Chalova, 2011; Titovskaya et al., 2018; Gryazeva et al., 2020).

Calculations of the economic efficiency of growing sunflower hybrids for seed oil of various manufacturers in the soil and climatic conditions of the Penza region showed that the highest conditionally net income was 16844.0 rubles/ha for the sunflower hybrid NK Rocki-St at a profitability level of 42.7%. The smallest conditionally net income (12015.0 rubles/ha) and the level of profitability (29.1%) were obtained from the P64LE25 sunflower plant hybrid, thus, compared with the hybrid NK Rocki-St, the conditionally net income was lower by 4829.0 rubles/ha at a profitability level of 13.6%.

CONCLUSIONS

When conducting an agronomic assessment of the cultivation of sunflower hybrids on the seed oil of various producers in the soil and climatic conditions of the Penza region, the following conclusion can be made that the duration of the growing season for hybrids was 119-135 days, field germination ranged from 90.1% to 92.7%. The highest field germination was recorded in the sunflower hybrid - ES Amis, and the lowest in the sunflower hybrid - Florimis. The sparseness of sunflower plantings was in the range of 1.7-5.2%. The smallest sparseness was in the sunflower hybrid - Rocki-St, which amounted to - 1.7%, and the highest sparseness of sunflower plantings in the hybrid - NK Kondi - 5.2%. The highest yield on average over three years of research was 2.48 t/ha for the sunflower hybrid Roki-St, and the lowest for the P64LE25 sunflower hybrid was 2.35 t/ha. The oil content in sunflower hybrids ranged from 49.9% to 50.7%. The highest oil

content of sunflower achenes in the hybrid NK Kondi (50.7%), and the lowest oil content of achenes were recorded in the sunflower hybrid P64LE20. - 49.9% The highest net income was when growing sunflower hybrid Roki-St which amounted to 16844.0 rubles/ha, and the lowest net income was obtained from sunflower hybrid P64LE25, in the amount of 12015.0 rubles/ha. At the same time, the level of profitability for the sunflower hybrid Roki-St was 42.7%, and for the sunflower hybrid P64LE25 - 29.1%.

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