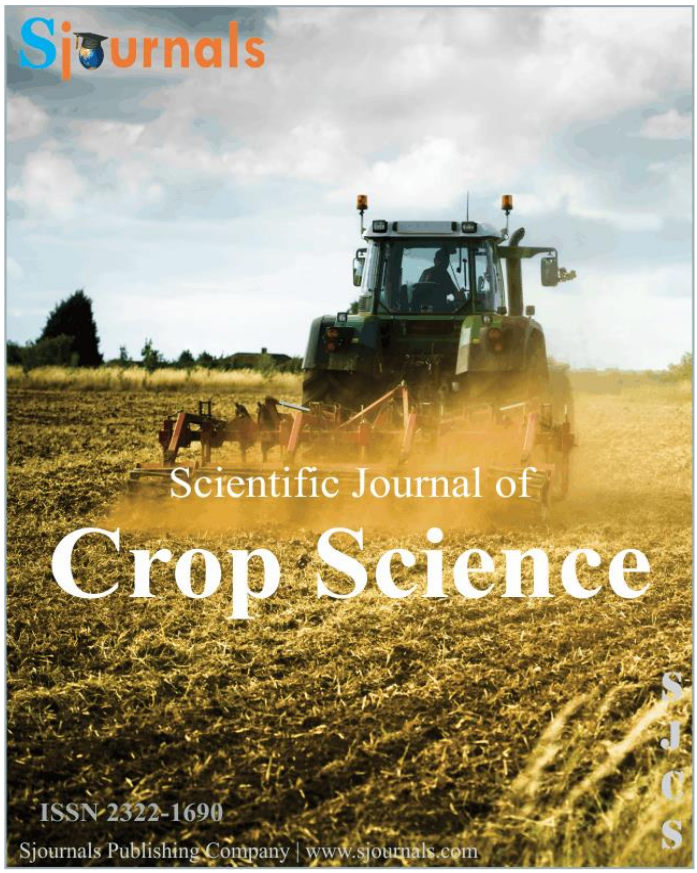

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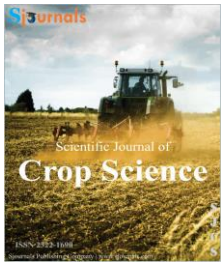

Original article

Selection works on oilseed safflower in Krasnovodopad breeding experimental station

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ABSTRACT

The article presents data on safflower breeding at the Krasnovodopad breeding station. Safflower is adapted to the conditions of a sharply continental climate and is one of the most drought-resistant plants in terms of its demand for moisture. This is due to the high concentration of cell sap and, as a result, economically consumes soil moisture. However, during the seed germination period, a sufficient amount of moisture in the soil is required. One of the main issues of safflower breeding, which largely determines the success of breeding work, is the organization and use of collection material. The studied materials are 280 numbers and varieties of safflower from XI, PSI, KP and Collection. 43 rooms with high productivity and relative resistance to ramularosis were selected.

1. Introduction

Safflower (*Carthamus tinctorius L.*) belongs to*the Compositae*family. The genus *Carthamus*. It includes 19 species, of which 1 is a cultural species. 15 species of annuals, 1 biennial and 3 perennials (Ya.Momot). All types

except one (*C). helentoioles*) have spikes on the leaves and inflorescences. Among the varieties of cultivated safflower, mutants without thorns have been identified. All types contain a significant percentage of fatty oil in the seeds, and some of them are highly oily. Safflower has been studied as a valuable oilseed crop. The oil produced from the seeds of this plant is identical in its fatty acidic and beneficial properties to the more expensive olive oil (Imantaev et al., 2012).

Saflor is a drought-resistant oilseed crop (Prozorov, 2012). The biological and botanical features of safflower as an oilseed crop are described, and the yield and moisture content of safflower are compared with other oilseeds (Prozorov, 2012). In terms of safflower production, Kazakhstan has been among the top five world leaders since 2000, and in 2010, with a harvest of 122.24 thousand tons, it became the second after the Indies. In addition to these countries, safflower is also actively grown in China, Uzbekistan, Ukraine, Australia, the United States, Mexico, Argentina, Ethiopia, and Tanzania. Safflower can well replace sunflower as an oilseed crop in arid steppe regions. And if earlier safflower was grown mainly in the southern regions of Kazakhstan, now this plant, due to its unpretentiousness and drought resistance, is gaining more and more areas in the northern and western regions.

Safflower in its importance ranks in the world after sunflower, flax, ginger mustard. Safflower oil is widely used directly in medicine, in cooking and for making margarine, its delicious quality is similar to that of sunflower oil. Safflower oil is also used for technical purposes in the production of white paints and enamels that have whiteness and the coloring agent (cartamine) contained in flowers. Its cake is bitter, but in small quantities it is suitable for feeding cattle, 100 kg of cake corresponds to 44 feed units in terms of nutritional value.

Cultivation is relevant: The cultivation of a relatively new and unconventional safflower oilseed, which has an increased characteristic of drought resistance, is relevant. Its seeds contain 28-38% of light yellow semi-drying oil, which is not inferior in taste to sunflower oil, and the content of essential amino acids and vitamins is close to olive oil (Давидян et al., 1979).

Diversification of crop production by introducing and expanding the range of competitive drought-resistant oilseeds solves the problems of increasing the profitability of production and increasing demand in the vegetable oil market. Safflower is a drought-resistant crop, which is due to the xeromorphic structure and shape of the root system, and due to the high concentration of cell juice, it economically consumes watered moisture. Kultura has spread south cultivation of the sunflower cultivation zone, adapted to the conditions of a sharply continental climate (Pustovoit, 1967).

With the zoning of a new safflower variety "Nurlan", "Akmai", these problems were easily solved: the yield increased to 16 centners / ha, oil content to 38.1 % and labor productivity in harvesting, seed cleaning and oil harvesting. Therefore, the creation of new varieties of high-oil safflower resistant to extreme climatic conditions during its cultivation is very relevant (Medeubayev and Konyrbekov, 2010). Plants are distinguished by a powerful root system and a high concentration of cellular juice. The content of semi-drying oil in the seeds reaches 33-39% (in the kernel up to 50-56%). The composition of the oil is represented by linoleic (88.3%), oleic (7.6%), palmitic (5.5%), stearic acid (0.65%), linolenic (0.2%) fatty acids (Laser et al., 2013). Safflower is characterized by an early spring type of development. Seeds begin to germinate at a soil temperature of 2-3 °C (the optimal temperature is 6-8 °C). Safflower seedlings withstand short frosts up to -4 ... -6 °C. The best conditions for obtaining seedlings are a gradual increase in temperatures and the presence of moisture. The resistance of plants to a decrease in temperature after the formation of a rosette of leaves decreases and subsequently a sufficient amount of heat is needed for development (Minkevich, 1939).

1.1. Assessment of ценка the current state of knowledge of the problem

The country has taken a course to saturate the market with vegetable edible oil of its own production by expanding the area and increasing the productivity of oilseeds. The domestic market with the demand of 137-140 thousand tons of oil is provided by only 36%, the rest is imported from Russia, Ukraine and Iran.

Currently, breeding work is being carried out in other research institutes, but 5 varieties of oilseed safflower have been bred at the Krasnovodopad Agricultural Farm, of which 4 varieties are zoned across Kazakhstan and 1 variety is being tested in the GSI. Breeding and seed production of oilseed safflower is new and promising, similar works are being carried out in foreign countries, for example, with the help of the international organization CIMMIT, collection materials from Mexico were obtained, and several samples will be from China.

Breeding work has been started at the station since the 40s-50s, so methods for cultivation technology have been developed and seed production of oilseed safflower has been organized. In the structure of world production, the main types of oils are: soybean (30%), palm (26.9%), rapeseed (14.6%), sunflower (9.4%).

Selection of oilseeds, especially rapeseed, safflower, flax, etc. - a new direction of research in Kazakhstan. The genetic potential of sunflower and soybean, although many varieties and hybrids have been created, is also not fully used, so the continuation of breeding these crops as a continuous process is an objective necessity.

1.2. Soil and climatic characteristics of the study area

The territory of the South Kazakhstan region, which is 121.51 thousand square kilometers, is located in the foothill desert-steppe zone of the Tien Shan, which is significantly removed from the sources of atmospheric moisture - the oceans, and therefore the climate is characterized by a pronounced continentality. The average annual precipitation amounts to 200-700 mm, which is why the rainfed lands of the region are conditionally divided into three zones:

- ✓ Unsecured bogara (300-450 m. above sea level) with precipitation of 250 mm
- ✓ Semi-protected bogara (height 450-600 m) with precipitation of 400-600 mm
- ✓ Provided bogara (altitude 600-1500 m) with precipitation of more than 600 mm

Climate-as a factor of soil formation has a direct impact on the biological, chemical and physical properties, as well as to a large extent on the water-thermal regime of the soil cover. By data Krasnovodopad grometeostation average annual air temperature is 14.1^0C, the sum of temperatures above 10^0S-3800^0S, SCC-0.3-0.5. The average annual precipitation is 421mm, and they are distributed very unevenly by season. So, the greatest amount of precipitation falls in winter and spring periods-78%, in autumn-18% and in summer-only 4% of the annual rate.

1.3. Soil

The soil cover is represented by ordinary gray soils of heavy loamy mechanical composition, characteristic of the entire zone of semi-secured bogara. Humus content 0.8-0.9%, gross nitrogen 0.08-0.1%, gross phosphorus 0.1-0.15%, potassium 25.00 mg / kg, soil volume weight 1.15-1.30 g /cm^3, salt extract pH 7.1.

These soils have relatively good water-physical, chemical, and physico-chemical properties. The main attention should be paid to agricultural techniques of cultivation, development of crop rotations, preservation and accumulation of atmospheric moisture, etc.

1.4. Novelty of the topic

For the first time, new varieties are created and introduced into production that meet the quality requirements of processing enterprises;

For the first time, a new resource-saving technology for cultivating safflower on the bogar of Southern Kazakhstan is being developed.

During the project implementation, we plan to sign contracts with producers of commercial safflower grain and major buyers. On our part, we will provide seed material, consulting services for the cultivation of safflower and its implementation. The resulting profit will be used to maintain seed material, pay royalties to breeders, conduct research on marketing and create the necessary varieties of safflower.

2. Materials and methods

The nursery of the first year of study is grown in the most optimal conditions. Individual selection is carried out in the second or fourth years of study. Selected plants are marked directly in the field before harvesting, according to important biological and economically valuable characteristics: precocity, drought and heat resistance, productivity, resistance to pests, etc.

Friendship of flowering - simultaneous flowering of 3-4 boxes no later than 2 days after flowering of the central box.

Ocular (visual) assessment of productivity: high-yielding – at least 15 large-sized boxes (basket diameter of 3 cm or more) or 18 medium-sized boxes (basket diameter of about 2 cm) in laboratory and field conditions for the size of baskets for 60 seeds, average size of at least 40 seeds. Absence of diseases and pests in the flowering phase. The color of the flowers is preferably red.

3. Results and discussion

3.1. Collection nursery

In the reporting year, 160 numbers were studied in this nursery. As of 2021, 50 numbers from Mexico are 94n-1 and 4-19. Of these 9 rooms, the most productive was exceeding the standard by 18%.

In the collection nursery, 16 foreign numbers and samples of early maturation distinguished themselves. A field assessment was carried out on a 5-point scale for disease resistance.

Hybridization (10 combinations) by INCUCT and 10 self-pollinating combinations. Stress resistance (drought resistance, seed shedding) was determined in 150 lines and numbers in field hospitals. Harvest standard varieties Nurlan this nursery in average of 5.1t/ha number 94n-8, LC-81, LC-58, BJ-4501,LC-63, BJ-1810, 80/131/BS, BJ-4501 exceeded standard for1,2-3,4 kg/ha or 23.5-66.6% (Table 1).

Table 1
Grain yield of selected safflower numbers in a collection nursery.

Grade, number	Yield, c / ha	+ - to the standard	
		c / ha.	%
Nurlan, article	5,1	0,0	0,0
94-8	8,5	3,4	66,6
LC-81	6,1	1,0	19,6
LC-58	5,9	0,8	15,6
LC-63	6,3	1,2	23,5
LC-42	7,2	2,1	41,1
LC-52	7,0	1,9	37,2
K-340	7,4	2,3	45,0
K-178	8,5	3,4	66,6
BJ-1810	7,6	2,5	49,0
80/131/BS	5,8	0,7	13,7
BJ-4501	7,2	2,1	41,1
LC-4	6,2	1,1	21,5
LC-7	8,0	2,9	56,8
LC-12	8,1	3,0	58,8
LC-35	7,2	2,1	41,1
Nsr 0.5			

3.2. Hybrid nursery

Synthetic polyhybrid populations, hybrid population. For example: No. 23-consists of yellow seeds, in shape, size corresponds to the cultural form. Seeds contain oils at the level of high-oil biotypes of safflower breeding numbers. - pas were split into red and orange colors.

As a result of phenological observations, 4 numbers were identified in the stemming phase, 1-2 days ahead of the standard. In the budding phase, 6 rooms were 2-3 days ahead of the standard. According to precocity, 10 numbers AT-103, P-1-21, K-515 446, 1-2p, 03A020-19, 03A058-9, P were allocated-2-8, № 70-7, №63, P-2-9. they were 2-3 days ahead of the standard. Standard variety Nurlan entered the mass flowering phase in this nursery on June 11. The harvest was completed on July 29. The harvest was recorded. The yield of the standard Nurlan variety in this nursery averaged 5.9 centners / ha. Numbers 03M53, 09M17-4, 8N-25, No. 19, 94N-16, I-3-4, 89-8k, I-20-2 exceeded the standard by 1.2-1.5 c / ha or 13-21%.

3.3. In the control nursery

41 numbers of safflower of selective selection were studied. Sowing was made on March 28. Friendly shoots were received on April 8-9. Phenological observations were made and the stemming phase was observed on April

21-23, the branching phase on April 30-31, and the budding phase May 15-17, mass flowering phase June 24-25, ripeness phase July 14-17.

As a result of phenological observations, 26 numbers were identified in the stemming phase, 1-3 days ahead of the standard. In the budding phase, 18 rooms were 2-4 days ahead of the standard. On precocity was allocated 14 rooms LC-42, LC-63, 03A068-9-3, at -105, P-1-22 etc. ahead of the standard 2-3 day, and late-And-17, 94n-4, P-1-12, P-1-23, P-1-13, №24, 80-1C, Lc-43, has entered a phase of mass flowering 2-3 day later. The standard Nurlan variety entered the mass flowering phase in this nursery on June 14. The harvest was completed on July 22. The harvest was recorded. The yield of the standard Nurlan variety in this nursery averaged 5.5 c / ha. Rooms 8n-5-2, LC-2, LC-45, LC-8, LC-51, 03A01-7, 03A068-9-8, LC-70, p-2-11, K-515446, AT-107-70, which exceeded the standard on the 2.5-2.7 t/ha or 28.4-30.6 per cent (Table 2).

Table 2
Grain yield of selected safflower numbers in the control nursery.

		+ - to standard	
Selection number	**Yield c / ha**	**c / ha**	**%**
Nurlan, st	5.5	0,0,0	0,0,0
8n-5-2	8.0	2.5	45.4
LC-2	7.3	1.8	32.7
LC-45	6.8	1.3	23.6
LC-8	7.1	1.6	29.0
LC-51	9.0	3.5	63.6
03A01-7	8.2	2.7	49.0
03A068-9-8	7.0	1.5	27.2
LC-70	7.4	1.9	34.5
p-2-11	7.2	1.7	30.9
K-515446	6.8	1.3	23.6
AT-107-70	7.3	1.8	32.7

3.4. Nursery of preliminaryro variety testing

In the nursery of preliminary variety testing, 21 numbers of oil-bearing safflower were studied. Sowing was made on March 28. Friendly shoots were received on April 7-8. Phenological observations were carried out and the stemming phase was observed on April 21-20, the branching phase on April 29-30, and the budding phase May 15-17, mass flowering phase June 23-25, ripeness phase July 14-16.

As a result of phenological observations, 6 numbers were identified in the stemming phase, 1-3 days ahead of the standard. In the budding phase, 5 rooms were 2-4 days ahead of the standard. On precocity was allocated 7 No. 52, 3pcs, No. 63, Lc-79к, 80-12-28, etc. ahead of the standard 2-3 day, and mid and late To-001183-10-11, №53, Lc-8, 24pcs-5, 3pcs, 03A045-6 rooms has entered a phase of mass flowering 2-3сутки later. The standard Nurlan variety entered the mass flowering phase in this nursery on June 13. The harvest was completed on July 22. The harvest was recorded. The yield of the standard Nurlan variety in this nursery averaged 5.7 centners / ha. Room Lc-78, Lc-75, 3PC, 03A01-10, 92-53-28K, N49, 03A01-10K,U-15-3-3, Lc-55, 03A045-6,N53, K-001183-10, which exceeded the standard on-0,9-2,0 kg/ha or 15.7 - 35,0% (Table 3).

3.5. Nursery of competitive variety testing

In the nursery of competitive variety testing, 24 numbers of oil-bearing safflower were studied. Sowing was made on March 28. Friendly shoots were received 6-8. Phenological observations were made and the stalk phase was observed on April 16-18, the branching phase on April 21-23, the budding phase on June 9-11, the mass flowering phase on June 21-24, and the ripeness phase on July 12-15.

As a result of phenological observations, 7 numbers were identified in the stemming phase, 1-3 days ahead of the standard. In the budding phase, 5 rooms were 2-4 days ahead of the standard. On precocity were allocated room 8 K-286, 24pcs-4, AND 13, 03A045-17, 76пс etc. ahead of the standard 2-3 day, and mid and late at-80 03A045-6-4, 80-12-40, 79n, K-001183-10-13, 03A01-9K, etc. the room has entered a phase of mass flowering 2-3

day later. The standard Nurlan variety entered the mass flowering phase in this nursery on June 13. The harvest was completed on July 22. The harvest was recorded. The yield of the standard Nurlan variety in this nursery averaged 6.0 centners / ha. Numbers U-19, 94p-1, 03A01-9k, AT-80, 5-3kz, 01A045-6-4 which exceeded the standard by 0.9-2.1 c/ ha or 15-35% (Table 4).

Table 3
Safflower yield in the nursery of preliminary variety testing.

		+ - to standard	
Selection number	**Yield c / ha**	**c / ha**	**%**
Nurlan, art	5,7	0,0	0,0
K-001183-10	7,7	2,0	35,0
3pcs	7,6	1,9	33,3
03A045-6	7,5	1,8	31,5
03A01-10	6,0	0,3	5,2
Lc-78	6,1	0,4	7,0
Lc-75	6,6	0,9	15,7
N53	6,2	0,5	8,7
U-13-3-3	6,8	1,1	19,2
Lc-6	7,0	1,3	22,8
Lc-79to	6,7	1,0	17,5
$NSR_{0.05,05}$	0.54		

Table 4
Safflower yield in the nursery of competitivero variety testing.

		+ - to the standard	
Selection number	**Yield c / ha**	**c / ha**	**%**
Nurlan, art	6,0	0,0	0,0
94n-1	8,1	2,1	35
U-19	8,1	2,1	35
94p-1	7,8	1,8	30
03A01-9k	7.5	1.5	25
AT-80	7,5	1,5	25
5-3kz	7,2	1,2	20
01A045-6-4	6,9	0,9	15
NSR		0.5	

3.6. Outputs

Phenological observations were carried out in all nurseries, as a result, 54 numbers of oil-bearing safflower were studied. Friendly shoots were received 6-8. Phenological observations were made and the stalk phase was observed on April 16-17, the branching phase on April 21-24, the budding phase on June 9-11, the mass flowering phase on June 20-24, and the ripeness phase on July 12-15.

As a result of phenological observations, 15 numbers were identified in the stemming phase, 1-3 days ahead of the standard. In the budding phase, 12 rooms were 2-4 days ahead of the standard. According to precocity, 15 numbers Lc-79k, 80-12-28, etc. were allocated ahead of the standard by 2-3 days, and medium-and late-maturing numbers 53, Lc-8, 24pc-5.3pc, K-001183-10-11, 03A045-6 numbers entered the mass flowering phase 2-3 days later. The standard Nurlan variety entered the mass flowering phase in this nursery on June 13. The harvest was completed on July 29.

Crops were taken care of, row paths were cleared of weeds and mixtures were treated with herbicides, nurseries were fed on an area of 0.1 hectares. Selected parent pairs for crossing 10 combinations. The resistance of 15 reproduced hybrids to powdery mildew and leaf spot was determined. Phenological observations were made

in the branching and flowering phases, and 5 varieties and hybrids were identified by precocity. Morphological descriptions of the bush shape and flower structure were performed, and 14 samples were isolated. Drought tolerance and precocity were determined, and 12 samples and lines were identified.

Post-harvest processing of seed material of 40 samples was carried out. It wasprovided that sheaves were threshed manually through a threshing machine to determine the mass of seeds. Biometric analysis was performed among 14 plants studied in the laboratory. A structural analysis of safflower was performed. Morphological description made 8 samples of safflower according to the shape of the bush and the structure of flowers and identified5 numbers of safflower.

3.7. Immunological assessment

A visual assessmentof the resistance to diseases and pests of 25 samples of safflower in an ecological nursery was carried out, 23 numbers of safflower were identified for resistance to ramulariosis, the disease manifests itself in the form of spots on the leaves, 2 numbers were allocated, the development of pests does not exceed the quarantine norm. The degree of damage to plants by pests, smut and other types of diseases is 10%. 10 hybrid combinations were crossed in the breeding nursery. The knotting rate of hybrid grains was 33.2 %.

3.8. Performing structural analysis

Number of baskets per 1 bush. The diameter of the central and primary baskets, large 3 cm or more, the number of seeds per 1 basket per 1 plant. Weight of 100 seeds.

Определено The germination rate of seeds and germination energy of 100 samples were determined in laboratory conditions. The germination rate of the standard Nurlan variety was 92%, the best indicators are samplesLC-84, LC-55 and 4 hybrids obtained from crossing by crossing the Nurlan and Akmai varieties, which have a germination rate of 92-96%.

The degree of damage to seeds by pests was determined, 10 samples with the lowest number of damaged seeds 1-2 pieces per 1000 grainswere selected. номера The LC-44,LC-48 and LC-52 sizes were selected for sowing according to pest resistance. 12 constant pure safflower numbers were isolated from the hybrid material. Crops were taken care of, treated with herbicides, mineral fertilizers on an area of 0.1 hectares.

Resume

In 2021 studied in competitive trials sample safflower studies have been conducted at the agronomic characteristics, which samples the U-19, 94p-1, 03A01-9K, at-80, 5-3кз, 01A045-6-4 was significantly increased yield of 0.9 and 2.1 t/ha than the standard Nurlan. Seeds of 24 varieties and hybrids were cleaned. The weight of 1000 grains, natural weight, and pest damage to seeds were determined. The weight of 1000 grains of the standard Nurlan variety was 37.8 g. Samples LC-34 and LC-3 were isolated7, which had a mass of 40 and 41 g., respectively. The nature of grain of the standard Nurlan variety was 554 g / l, samples were selectedIirkas natura 583 g / l and LC-28 natura 581 g/l. The damage rate of seeds did not exceed 1-3%. The research was funded by the Ministry of Agriculture Republic of Kazakhstan(subject: "Creating highly productive varieties and hybrids of oilseeds and cereals based on the achievements of biotechnology, genetics, plant physiology, and biochemistry for their sustainable production in various soil and climatic zones of Kazakhstan" BR10765017).

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