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BACKGROUND OF ELEMENTS OF GROWING TECHNOLOGY OF SAFFLOWER IN WESTERN STEPPES

The paper presents the results of studies of the impact of placement of plants per unit area, namely, row spacing and number of plants per linear meter on safflower seed yield. It is also shown the dependence of yield on the method of collection and use of plant growth regulators for seed treatment before sowing and spraying plants in the vegetative phase of leaf rosettes.

Keywords: *row spacing, number of plants, method of harvesting, yield, growth regulator*

Introduction. Safflower is grown usually as oilseeds. Its seeds contain 25-37% (46-60% in the nucleus) of half drying oil and 12% of protein. The oil extracted from the kernels of seeds of safflower, which is comparable in taste with sunflower, it is used in food purposes, in particular for the manufacture of margarine of high quality. Oil is derived from a seed, has bitter taste, it is used as a technical [1]. Glycosides, kartamin, izokartamin, kartamidin-5-glucoside, luteolin 7-glucoside [2] are found in safflower flowers. Safflower oil is an excellent source of magnesium, vitamins (B1, B2, PP, E, B-tocopherol), it also contains carotenoids, linoleic acid. Qualitative fatty acid composition of safflower oil is similar with sunflower, but the percentage of acids varies greatly. The content of linoleic acid in safflower oil reaches 90% (Grade Omega- 6), and it is essential for the human body [3]. Healthcare experts claim that safflower oil has emollient, nourishing and firming effect on human skin, normalizes cell functions, improves blood circulation, has also anti-inflammatory effect, moisture holding up and moisture control ability and well absorbed by any type of skin, softening it perfectly. Due to these properties and the ability to instantly penetrate the skin, safflower oil is highly valued by pharmacists and cosmetologists around the world. Unfortunately, in Ukraine the plant is not so much in demand, primarily due to the lack of technologies of getting oil from the seeds and core technologies of oil for medicinal creams, ointments, shampoos, lotions, etc. [4].

Analysis of recent publications. Analysis of recent studies have shown that culture is involved more in the steppe zone , primarily due to high drought tolerance , heat endurance of plant and overall simplicity to growing conditions.

Results of studies conducted in RSSV «Askaniyske» indicate that dark chestnut weakly saline soils the optimal width is hung with rows 12.5 cm and seeding rate that provides 210-240 thousand of plants/ha [5]. Adamen F.F, Proshin I.A. have studied effect of herbicides on growth, development and yield of safflower in non-irrigated conditions in southern Ukraine. Thus, the researchers show that the highest yield of safflower ensure application of herbicides GOAL 2E – 1.5 t/ha, Stomp 330-1.48 t/ha, and Gezagard 500-1.46 t/ha [6]. The Institute of Oilseed NAASU studied the effect of stand density of plant on yield of safflower. So, the highest yield of sowing was provided at 45 cm with stand density of plant 280 thousand units/ha compared with a width of 70 cm between rows and plant stand density 240 thousand plants/ha. Safflower varieties Sunny and Zhyvchyk, originator of which is the Institute of Agrarian Sciences of oilseeds in the south of Ukraine in stand density plant of 280 thousand units/ha can generate productivity at 15-18 kg/ha [4]. Questions of sowing of safflower are engaged in irrigation in southern part of Ukraine. According to Fedorchuk M.I. and Filipova E.G. it is found that sowing of safflower in southern Ukraine should be performed in early spring periods (third decade of March and the second decade of April) for high levels of plant productivity. Delay of sowing according to scientists, can lead to a significant shortage of crop productivity and reduce seed per hectare. [7].

Foregoing demonstrates the importance of culture as oil and medicinal plant. Considering the demands of safflower to heat, especially in the phases of flowering and grain filling (fall in

June-July months) in the current and projected climate change (in Europe by 2030 increasing of temperature by 1-4°C, the number of predicted sediment trend towards more dry summer), it is possible to grow this crop in the Western Forest.

The purpose and objectives of the research. The purpose of the research was to justify the basic principles of plant growth and development, yield formation, depending on the particular ways of sowing, harvesting and impact of biogenic factors in the Western Forest.

Materials and methods. Researches were carried out during the 2009-2013 years. Two experiments were laid. Three factors have been studied in the first experiment: A – row spacing (15, 30, 45 and 60 cm) , B – number of plants per linear meter (9-10, 7-8, 5-6, 3-4 units), C – collection methods (direct harvesting, separate collection). Two factors have been studied in the second experiment: A – growth regulator (control (water) Agroemistim-extra (15 ml/t) (20 ml/ha), Ivin (15 ml/m) (20 ml/ha), Vermystym D (8 l/t), (10 l/ha)), B – method of processing (processing of seeds, crop spraying). All counts, observations and analyzes were performed according to conventional methods.

Results and discussion. Medicinal raw materials safflower oil is mainly contained in the seed, so the cultivation of crops for medicine or for food purposes farming practices should aim to maximize the number of seeds and moisture content of the fat. In addition, the use of chemical action is desired.

In average for years of research yield of safflower seed depending on the influence of factors distributed as follows : the smallest values 1,23-1,24 t/ha obtained by sowing with a width of 60 cm between rows and the number of plants 3-4 units per linear meter, whereas the highest productivity within 3,17-3,19 t/ha was provided by the variants of wide row crops by 45 cm with the number of plants 7-8 plants per linear meter, excess of control on these variants was 0,82-0,80 t/ha.

In assessing the factor B – number of plants per linear meter, there was a tendency to reduce yield of safflower seed with decreasing of plants density in all ways of sowing.

Table 1

Yield of safflower depending on the location of plants per unit area, t/ha

Row spacing, cm (A)	Number of plants per linear meter, units (B)	Years of research					Average for the 2009-2013 years	± to control
		2009	2010	2011	2012	2013		
Separate collection (C)								
15	9–10	2,93	2,91	2,47	2,79	2,25	2,62	+0,25
	7–8	2,84	2,81	2,50	2,78	2,22	2,63	+0,26
	5–6	3,03	2,99	2,57	2,89	2,37	2,77	+0,40
	3–4	2,18	2,13	1,94	2,06	1,69	2,00	-0,37
30	9–10	3,08	3,12	2,84	3,33	2,68	3,01	+0,64
	7–8	3,07	3,05	2,65	3,14	2,49	2,88	+0,51
	5–6	2,54	2,50	2,18	2,63	1,95	2,36	-0,01
	3–4	1,80	1,72	1,56	1,74	1,38	1,64	-0,73
45	9–10	3,19	3,20	3,01	3,23	2,87	3,10	+0,73
	7–8	3,40	3,38	3,03	3,25	2,89	3,19	+0,82
	5–6	2,52	2,49	2,27	2,46	2,16	2,38	+0,01
	3–4	2,23	2,12	1,90	2,15	1,85	2,05	-0,32
60	9–10	2,46	2,40	2,31	2,58	2,25	2,40	+0,03
	7–8	2,46	2,43	1,98	2,25	1,93	2,21	-0,18
	5–6	2,15	2,12	1,64	1,96	1,63	1,90	-0,47
	3–4	1,36	1,35	1,07	1,34	1,03	1,23	-1,14

Direct harvesting (C)								
15	9–10	2,89	2,82	2,45	2,81	2,28	2,65	+0,28
	7–8	2,84	2,86	2,48	2,79	2,23	2,64	+0,27
	5–6	2,97	2,97	2,59	2,88	2,39	2,76	+0,39
	3–4	2,23	2,15	1,77	2,04	1,56	1,95	-1,22
30	9–10	3,27	3,20	2,81	3,35	2,67	3,06	+0,69
	7–8	3,05	2,93	2,66	3,13	2,48	2,85	+0,48
	5–6	2,56	2,56	2,19	2,62	1,97	2,38	+0,01
	3–4	1,73	1,70	1,55	1,72	1,35	1,61	-0,76
45	9–10	3,26	3,21	3,00	3,22	2,86	3,11	+0,74
	7–8	3,35	3,30	3,04	3,26	2,90	3,17	+0,80
	5–6 (к)	2,53	2,50	2,26	2,41	2,15	2,37	-
	3–4	2,22	2,21	1,92	2,16	1,84	2,07	-0,30
60	9–10	2,51	2,49	2,32	2,57	2,26	2,43	+0,06
	7–8	2,39	2,37	1,99	2,26	1,94	2,19	-0,18
	5–6	2,08	2,01	1,65	1,94	1,62	1,86	-0,51
	3–4	1,40	1,34	1,09	1,36	1,01	1,24	-1,13
$LSD_{0,05}$,t/ha:								
A	0,12	0,13	0,14	0,15	0,11			
B	0,12	0,13	0,14	0,15	0,11			
C	0,08	0,09	0,10	0,11	0,08			
AB	0,23	0,26	0,29	0,30	0,22			
AC	0,17	0,18	0,20	0,21	0,15			
BC	0,17	0,18	0,20	0,21	0,15			
ABC	0,33	0,32	0,40	0,42	0,30			

The dependence of the yield of the studied factors was analyzed by Duncan criterion.

Table 2

The dependence of the yield of safflower seed on the row spacing by direct harvesting (Duncan criterion)

Row spacing, cm	Yield, t/ha	Homogeneous groups	
		I	II
15	1,93		***
30	2,47	***	
45	2,50	***	
60	2,68	***	

The data in table 2 shows little difference in the yield of crops in wide rows with a width of 30, 45 and 60 cm, so the values are in one homogeneous group , and the second homogeneous group contains variants with wide row spacing of 15 cm, which received the lowest yield – the average 1,93 t/ha. The other distribution on homogeneous groups is referred to analysis of productivity depending on the number of plants per linear meter. Thus, the first group includes variants of a given plant density of 3-6 units per linear meter, to the second – with number of plants 9-10 units and the third with a density of 7-8 plants per linear meter of the row.

In separate collection of seed losses were not observed due to a rash of baskets, as they are closed type in safflower and can store up to threshing, insignificant losses have been noticed only due to the mechanical nature of dual use technology.

Table 3

The dependence of the yield of safflower seed on the number of plants per linear meter (Duncan criterion)

Number of plants per linear meter, units, cm	Yield, t/ha	Homogeneous groups		
		I	II	III
15	1,93		***	
30	2,47			***
45	2,50	***		
60	2,68	***		

The share of influence of row spacing (factor A) on the seed yield of safflower was 27,4%, while the specified number of plants per linear meter (factor B) was 64,0% (*figure 1*).

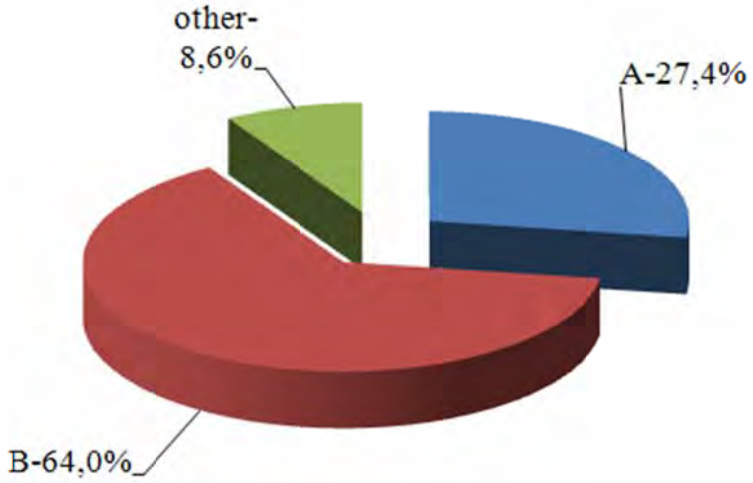

Fig. 1. The share of influence of factors on yield of safflower seed

Studies of the effect of plant growth regulators on seed yield of safflower were performed during 2010-2013 years. If we consider the yield in terms of years, it was higher in 2010 and 2012, the rate ranged from 2,92-3,47 t/ha (table 4).

Among the studied agents Agroemistim-extra was the best growth regulator, preliminary treatment of seed yield increase in average years of studies was 0.46 t/ha, while crop spraying – 0,60 t/ha, as a percentage of these values were, respectively: 16,8 and 21,8. Agents Ivin and Vermystym D provided much less allowances than Agroemistim-extra, when spraying of vegetative plants the effect was somewhat larger and excess control was respectively: 0,16 and 0,15 t/ha or 5,8 and 5,4%.

Our counts confirmed the results of number of researches of some scientists that studied the effect of growth regulators on other cultures, as to effectiveness of agents in adverse weather conditions. Thus, in a preferred embodiment of the Agroemistim -extra allowances in safflower yield in more favorable 2010 and 2012 were within 11,9-16,4 %, whereas in less favorable in 2011 and 2013 – in the range 19,6-30,6%. A similar trend was observed for any and all ways.

Table 4

Yield of safflower depending on the application of plant growth regulators, t/ha

Years	Seed treatment				Spraying of crops			
	Control (water)	Agroemistim-extra	Ivin	Vermystym D	Control (water)	Agroemistim-extra	Ivin	Vermystym D
2010	2,93	3,28	3,07	3,04	2,95	3,36	2,98	3,02
$LSD_{0,05}$: A – 0,30; B – 0,21; AB – 0,42								
2011	2,49	2,98	2,67	2,68	2,51	3,28	2,75	2,74
$LSD_{0,05}$: A – 0,29; B – 0,21; AB – 0,42								
2012	2,92	3,34	2,97	3,02	2,98	3,47	3,14	3,09
$LSD_{0,05}$: A – 0,17; B – 0,12; AB – 0,23								
2013	2,58	3,16	2,69	2,74	2,56	3,29	2,77	2,75
$LSD_{0,05}$: A – 0,16; B – 0,12; AB – 0,23								
Average for the 2010-1013 years	2,73	3,19	2,85	2,87	2,75	3,35	2,91	2,90

Conclusions. Placing of plants per unit area and plant growth regulators influenced the yield of safflower. The greatest yield 3,17-3,19 t/ha was provided by 45 cm row spacing and number of plants per linear meter of 7-8 units, allowances to control of these variants were 0,82-0,80 t/ha. An increase in yield of 0,6 t/ha (21,8%) was received on the variant with crop spraying of growth regulator Agroemistim-extra.

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Анотація

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Обґрунтування елементів технології вирощування сафлору красильного в умовах Лісостепу західного

В статті наведено результати досліджень з вивчення впливу розміщення рослин на одиниці площі, а саме: ширини міжрядь та кількості рослин на метр погонний на урожайність насіння сафлору красильного. Показано також залежність урожайності від способу збирання та застосування регуляторів росту рослин для обробки насіння перед сівбою і обприскування вегетуючих рослин у фазі розетки листків.

Ключові слова: *ширина міжрядь, кількість рослин, спосіб збирання, урожайність, регулятор росту*

Аннотация

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Обоснование элементов технологии выращивания сафлора красильного в условиях Лесостепи западной

В статье приведены результаты исследований изучения влияния размещения растений на единице площади, а именно: ширины междурядий и количества растений на метре рядка на урожайность семян сафлора красильного. Показана также зависимость урожайности от способа уборки и применения стимуляторов роста растений для обработки семян перед высевом и опрыскивания вегетирующих растений в фазе розетки листьев.

Ключевые слова: *ширина междурядий, количество растений, способ уборки, урожайность, стимулятор роста*