ВЛИЯНИЕ НА СЕИТБЕНАТА НОРМА ВЪРХУ РАЗВИТИЕТО И ПРОДУКТИВНОСТТА НА МАСЛОДАЙНИЯ ЛЕН В ЮГОИЗТОЧЕН КАЗАХСТАН
EFFECT OF THE SOWING RATE ON THE DEVELOPMENT AND PRODUCTIVITY OF OILSEED FLAX IN SOUTHEASTERN KAZAKHSTAN

Серик Оразбаев[1], Радка Иванова[2]*, Ялкунжан Абдрахманов[1]
Serik Orazbaev[1], Radka Ivanova[2]*, Yalkun Abdurakhmanov[1]

[1]Казакстански национален аграрен университет – Алмати
[1]Kazakh National Agrarian University – Almaty
[2]Аграрен университет – Пловдив
[2]Agricultural University – Plovdiv

***E-mail: radka@yahoo.com**

Резюме

Експериментът е заложен в Учебно-експерименталната база на Аграрния университет в Енбекшикахския район на Алматинска област през 2012-2013 г. със сорта Казар. Опитът е заложен по метода на дробните парцели в 4 повторения с големина на опитната парцелка 15 m^2. Ленът се засява на междуредово разстояние 45 cm с гъстота на посева 350; 400; 450 растения на m^2. Отчетени са: фенофазите на развитие, брой растения на m^2, полска кълняемост, структурни елементи на добива и добив от семена. От проучването може да се направят следните изводи: вегетационният период през 2012 г. е по-къс в сравнение с 2013 г.; независимо от гъстотата на посева фазите на развитие протичат почти едновременно, но се забелязва тенденция на повишаване на вегетационния период с намаляване на гъстотата на сеитбата; при вариантите с по-голяма гъстота поникват по-голям брой растения; най-ниска кълняемост на семената е отчетена при гъстота на сеитба 450 растения/m^2 (87,25%; 87,50%), а най-висока – при гъстота на посева от 350 растения/m^2) (93,75%; 94,80%); при вариантите с гъстота на посева 400 и 350 растения/m^2 се получават по-високи добиви в сравнение с първия вариант – 450 растения/m^2.

Abstract

This experiment was conducted in the Research and Experimental base of the Agricultural University of Enbekshi - Kazakhstan, in the Almaty region during the period 2012-2013. The subject of the experiment was oilseed flax, *Kazar* variety (Kazakhstan). The experiment was performed by applying the method of the fragmented land plots, with 4 replications, the size of the experimental land plot being 15 m^2. Flax-seeds were sown in rows, the distance between the rows – 45 cm; the sowing density – 350; 400; 450 plants per square metre. The following features were recorded: development phenophases, number of plants per square metre, field germination, structural elements of the yield and seed yield. The following conclusions could be made as a result of the study: the vegetation period during the 2012 year was shorter compared with the one in 2013; regardless of the sowing density the development phases happened almost simultaneously, however, there was a tendency towards a longer vegetation period when reducing the sowing density. In the variants with a larger density a larger number of plants grew, the lowest germination rate of the seeds was recorded for the variant with sowing density of 450 plants/m^2 (87.25%; 87.50%), whilst the highest germination rate was achieved with the variant with sowing density of 350 plants/m^2 (93.75%; 94.80%), In the variants with sowing density of 400 and 350 plants/m^2 we achieved higher yields compared with the first variant, i.e. 450 plants/m^2.

Ключови думи: маслодаен лен, гъстота на сеитба, добив от семена, развитие на растенията.
Key words: oilseed flax, sowing density, seed yield, development of the plants.

INTRODUCTION

Flax-seeds serve as raw material for the chemical, food processing, and perfumery industry and for medical purposes as well. They contain from 29 to 45% oil.

Flax-seeds, as well as flax-seed oil contain omega-3 fatty acids, of which alpha-linolenic acid is of highest significance. The essential fatty acids cannot be synthesized by the human organism, but they play a big role in the building of the membranes of the nucleus and the cell; in the regulation of the functions of the immune system; regulation of the inflammations and the communication of the cells in the nervous system. Flax-seed oil reduces inflammations, prevents some cardiac diseases due to its capacity to reduce the quantity of the bad cholesterol. It reduces the risk of diabetes and cancer.

This is exactly why in the recent years globally, including Kazakhstan as well, the interest towards this plant rises. In order to obtain higher yields and high-quality production it is necessary to develop technologies specific for each country and region. One of the important elements of these technologies is sowing or more specifically the density of sowing. Various authors of some research works recommend different sowing density of the oilseed flax. (Mojaev, 1979; Vavilov et al., 1979; Iskakov, 2000; Ivanova et al., 2002; Slabush et al., 2006; Begalina, 2007; Grishanov et al., 2009).

In northern Kazakhstan, with regards to diversification, scientist also develop technologies for growing oilseed crops, including oilseed flax, but researches related to these technologies lack for Southeastern Kazakhstan.

Therefore, we set ourselves the goal to develop suitable technology for growing oilseed flax in Southeastern Kazakhstan, and particularly, to find out the maximum sowing density which provides good development of the plants and achievement of high yields.

MATERIALS AND METHODS

This experiment is placed in the Research and Experimental base of the Agricultural University of Enbekshi - Kazakhstan of Almaty region. The experiment is placed during the period 2012-2013. Subject of the experiment is oilseed flax, variety Kazar (Kazakhstan).

The experiment is performed according to the method of the fragmented land plots, repeated 4 times, with size of the experimental land plot – 15 m^2. Flax-seeds is sown in rows, with distance between the rows – 45 cm; density of sowing – 350; 400; 450 plants per square m. The experiment is performed on maroon meadow soils, with humus content in the upper level (4,38%), which gradually lessens in deeper layers. The content of the total nitrogen and phosphorus is high (0,258%; 0,211%).

Flax-seed is sown after precursor - ordinary winter wheat. After harvesting the precursor a deep ploughing is applied at depth – 25-27 cm, with harrowing. Before sowing the land is cultivated and harrowed.

Before harvesting the production, we analyze 30 plants from each repeat. The following characteristics are recorded: developmental phenophases, number of plants per square meter, field germination, structural elements of the yield and seed yield.

The experiment includes years with different meteorological conditions, which naturally affects the growth, development, structural elements of the yield and the yield of flax-seeds.

The main climatic factors influencing mostly the growth and development of the oilseed flax in Southeast Kazakhstan are the average 24-hour temperatures of the air and the quantity of rainfalls and their distribution during the period of vegetation.

During both years of the experiment there are no considerable deviations from the value of the average 24-hour temperatures in the region of Southeastern Kazakhstan, compared to the requirements of the crop (Fig.1). The data in the figure show that during the period of germination-buttoning during the year 2013, they are with 1-2 ^{0}C lower compared to the year 2012, whilst during the period of blossoming-ripening, a slight prevalence in this respect is given to the year 2013 (Fig. 1).

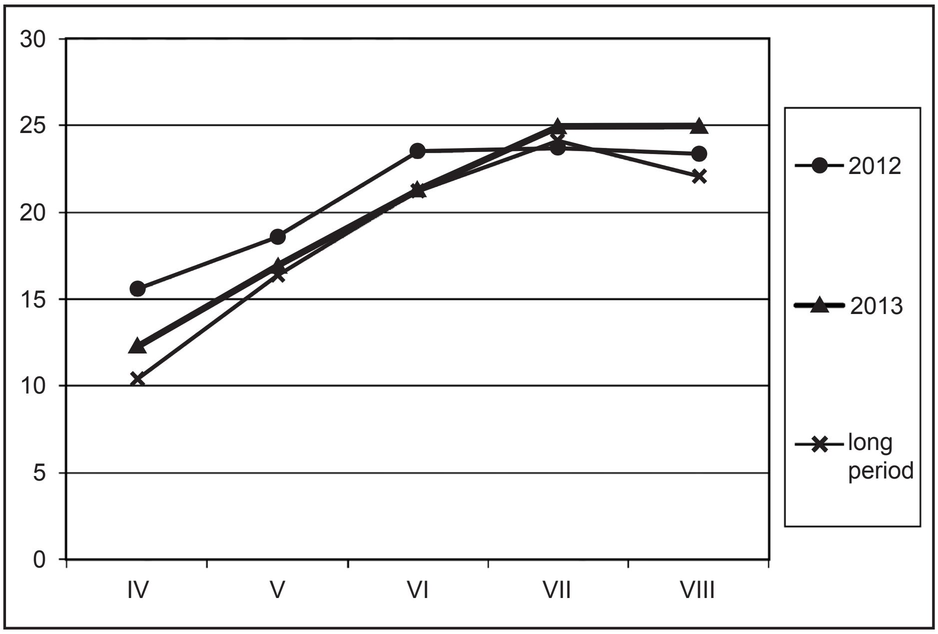

***Fig. 1.** Mean month temperature, ^{0}C*

During both years of the experiment the rainfalls during the vegetation period are evenly distributed, however the year 2013 is characterized with twice bigger quantity of rainfalls (369,1 mm), compared to 2012 (127,8 mm), which later affects the achieved production (Fig. 2).

The rainfalls for the long-term period are with 92,1 mm more than these of 2012, and with 149,2 mm less than these of the year 2013.

The data is processed mathematically according to them method ANOVA and the multi ranking test of Duncan (1953).

RESULTS AND DISCUSSION

The results from the phenological observations of the oilseed flax during the period 2012-2013, for the different sowing density are presented in Table 1. The data shows that the development of the plants is affected both by climatic factors and by the sowing density. The less rainfalls during the sowing period of the oilseed flax in 2012 is the reason for the seeds of the different variants to spring up for 6 to 9 days, whilst in 2013 for 4 to 7 days. During the year 2013 from tree phase to the blossoming phase the plants develop faster compared to these in 2012.

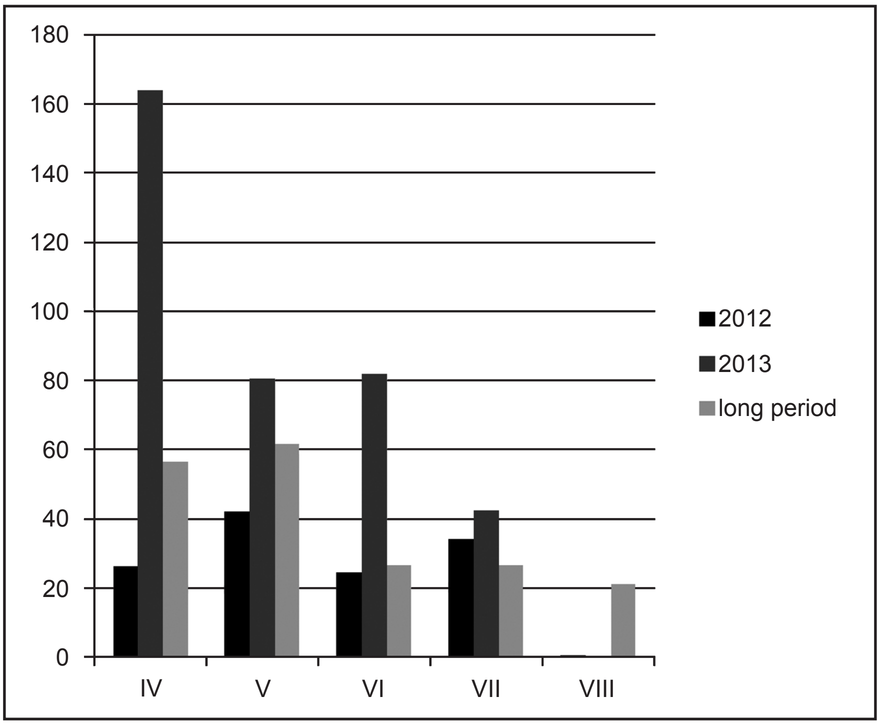

Fig. 2. *Quantity of rainfalls, mm*

Table 1. Phenological observation of different density of sowing - 2012/2013

Phenological observation	Density of sowing/m^2					
	450		400		350	
	2012	2013	2012	2013	2012	2013
Sowing	23.04	24.04	23.04	24.04	23.04	24.4
Spout	29.04	28.04	30.04	29.04	02.05	01.05
Alder	16.05	13.05	18.05	15.05	19.05	17.05
Bud stage	18.06	14.06	21.06	16.06	22.06	19.06
Full flowering	01.07	30.06	05.07	01.07	08.07	03.07
Fullmaturity	06.08	07.08	09.08	09.08	12.08	13.08
Vegetation period	99	101	100	103	101	105

In the phase of complete ripeness their development is almost equalized. The larger quantity of rainfalls in the period of blossoming – ripening of the seeds in 2013, prolongs this period, as well as the whole vegetation period with 2 to 6 days.

During the year 2012 the vegetation period varies from 99 to 101 days, while during the year 2013, from 101 to 105 days.

Regardless of the sowing density, the phases of development happen at almost one and the same time, but there is a tendency towards longer vegetation period, in the case of less sowing density, with 2 to 4 days.

The calculated interphase periods given in Table 2, confirm this relation between the years, but it can be seen that the interphase periods buttoning – blossoming and blossoming – complete ripeness in 2012 happen before these phases in 2013, which is due to the less rainfalls during their periods. There can be noticed a slight tendency of more rapid growth of the plants with higher sowing density.

The data in Table 3 shows the number of grown plants, % of germination of the seeds and number of harvested plants. The better moisture supply in the period of sowing – springing up of the seeds in 2013 creates preconditions for larger number of grown plants compared to 2012. The variants with bigger density lead to larger number of plants, and vise-versa.

For both years, the lowest germination rate is recorded for sowing density of 450 plants/m^2 (87,25%; 87,50%), while the highest rate is in the case of sowing density of 350 plants/m^2 (93,75%; 94,80%). It can be concluded that reducing the sowing rate leads to higher germination rate of the seeds, which can be explained with the fact that by increasing the sowing rate (number of seeds) more water is needed for swelling and springing up of the seeds.

Table 4 shows data regarding the height of the plants and the values of the structural elements of the yield. It is found out that during both years of the experiment there are no differences in the development of the plants. Depending on the sowing density the differences between the variants are more strongly emphasized. In the case of the lowest sowing rate we detect height of 60.8 cm, while for the highest sowing rate – 64 cm, i.e. by increasing the sowing rate the plants grow higher, which is due to the bigger competition between the plants, as a result of which their stems become thinner and longer.

During the two years of the experiment we can see that the differences also between the values of the structural elements in 2012 and 2013 are insignificant. They become more expressed depending on the sowing density.

Analyzing the results, we can observe that in the case of lesser sowing density/350-400 plants/m^2, the structural elements have almost the same values. The plants with higher density are characterized with lower values of the structural elements.

Table 2. Period between phase/number day

Density/m^2	Period between phase									
	Sowing - Spout		Spout - Alder		Alder- Bud stage		Bud stage- I flowering		Flowering- Maturity	
	Years									
	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013
450 Control	6	4	17	15	33	32	13	16	36	38
400	7	5	18	16	33	32	14	15	35	40
350	9	7	17	17	34	33	15	14	35	41

Table 3. Influence of the density of sowing on seed germination, 2012/2013

Density/m^2	Number of/plants at germination		Polish germination, %		Number of/plants at harvesting	
	2012	2013	2012	2013	2012	2013
450 Control	393	394	87,25	87,50	370	361
400	371	376	92,75	94,00	349	359
350	328	332	93,75	94,80	300	319

Table 4. Structural analysis of yield elements, 2012/2013

Density/m^2	Height/ plant/cm		Capsules/ plant, number		Seeds/ Capsules, number		Seeds/plant, number		Mass of the seeds/plant g		Mass/1000 seeds, g	
	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013
450 Control	64,1	64,5	14,4	14,5	6,4	6,4	92,1	93,2	0,54	0,54	5,9	5,9
400	61,6	62,3	16,7	16,8	6,4	6,5	106,8	107,9	0,63	0,64	5,9	5,9
350	60,8	60,8	16,8	16,9	6,4	6,4	107,5	106,5	0,63	0,62	5,9	5,9

Table 5. Yield of seeds kg/da, 2012/2013

Density/m^2	Yield, c/ha					
	2012		2013		Average	
	c/ha	%	c/ha	%	c/ha	%
450 Control	19,6	100	16,1	100	17.85	100
400	23,5	119.9	24,8	154.0	24,15	135.2
350	19,4	98.9	23,8	147.8	21.6	121.0
LSD $_{5\%}$	2.20		0.73			

Table 6. Analysis of variance for grain yield for the period 2012–2013

Source of Variation	Sum of Square	DF	Mean Square	Sig of F	η^2
Variants	166.84	2	83.42		95
Years	3.23	1	3.23	.025	25
2- Way Interactions	57.21	2	28.61	.000	86
Residual	9.66	18	0.54		

The yield of flax-seeds for the experimental variants is different during the years of the experiment (table 5). It is relatively higher in the year 2013, except for the variant with higher sowing density. The variants with sowing density of 400 and 350 plants/m^2 lead to higher yields compared to the first variant/450 plants/m^2. For both years, and averagely for the period of the experiment, it is proven that the highest yield of seeds is achieved from the variant with density 400 plants/m^2 (24,15 c/ha).

Averagely for the period of the experiment, the variant with sowing density of 400 plants/m^2 exceeds the variant with density of 450 plants/m^2 with 35,2%. Despite the almost equal values of the structural elements of the yield in the variants with less sowing density, due to the larger number of harvested plants, for the variant with 400 plants/m^2 we achieve higher yield of seeds. Despite the larger number of harvested plants in the variant with highest sowing density, the recorded yield is the lowest (17,85 c/ha). This is due to the considerably lower values of the structural elements of this sowing variant. The dispersion analysis made of the yield of seeds shows very strong statistically proven influence of the implemented variants (95%) and the strong interaction between the two factors (86%). Less, however proven impact have the experimental years as well (25%) (table 6).

CONCLUSIONS

The vegetation period during the year 2012 is shorter compared to the one in the year 2013.

Regardless of the sowing density the developmental phases happen almost at one and the same time, however there is a tendency towards longer vegetation period when reducing the sowing density, with 2 to 4 days.

In the year 2013 larger number of plants grow compared to 2012.

In the variants with larger density larger number of plants grow, and vise versa.

During both years the lowest germination rate of the seeds is recorded for the variant with sowing density of 450 plants/m^2 (87,25%; 87,50%), whilst the highest germination rate is achieved with the variant with sowing density of 350 plants/m^2 (93,75%; 94,80%).

During both years of the experiment it can be seen that the differences also between the values of the structural elements in 2012 and in 2013 are insignificant. They become more emphasized depending on the sowing density.

In the variants with sowing density of 400 and 350 plants/ m^2 we achieve higher yields compared to the first variant, i.e. 450 plants/m^2.

It can be noticed a very strong statistically proven influence of the implemented variants (95%) and the strong interaction between the two factors (86%). Less, however proven impact have the experimental years as well (25%).

LITERATURE

Ivanova, R., Zh. Terziev., T. Georgieva, 2002. Ustanovyavane na optimalna gastota na seitba pri razlichni sortove len otglezhdan za semena. Nauchni trudove, tom XLVII, KN. 1, 2002, 365-370.

Mozhaev, N., 1979. Polevie kulyturi Severnogo Kazahstana. – Almati.: Kaynar, 1979. – S. 226-227.

Vavilov, P., 1979. Rastenievodstvo. – M., Kolos, 1979, 458-459.

Iskakov, K., 2000. Maslichnie kulyturi. – Kostanay, 2000,19-20.

Begalina, A., V. Vinokurov, 2007. «Vliyanie sposobov poseva na zasorennosty i urozhaynosty lyna maslichnogo v Akmolinskoy oblasti» zh. «Issledovanie, rezulytati» Almati, №1, 2007g, 89-91.

Steblinin, A. N., V. Kozlov., 2001. Proizvodstvennoe znachenie semyan lyna // Agrarnaya nauka.-2001. - № 12. – 10 s.

Sagalbekov, U., V. Vinokurov, 2000. Tehnologia vozdelivania lyna maslichnogo v Severnom Kazahstane. – Kokshetau, 2000, 45-49.

Dunkan, V., 1995. Multiple - range and multiple F - test. Biometrics.

Статията е приета на 14.01.2014 г.
Рецензент – проф. д-р Борис Янков
E-mail: bjankov@au-plovdiv.bg