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Structure of A Crop and Productivity of a Castor-oil Plant Depending on Periods of Sowing, Norms of Sowing and Seeding Depth

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The research purpose is to study the influence of seeding terms, seeding-down depth and seeding rate on yield value of oil crops.The research object is a castor-oil plant of Don large-trussed variety. On the basis of the research on the study of yield formula and yield value of a castor-oil plant depending on the seeding terms, seeding-down depth, seeding methods, and seeding rates we conclude that: a castor-oil plant is a high-productivity oil crop in desert zones of Almaty Province, and edaphic-climatic conditions are well suited for the growth, development and formation of full seed yield. The highest productivity of a castor-oil plant is taken as a result of heating the soil to 12-14^{0}! in the depth of 0-10 cm with seeding-down depth of 7-8 cm. This option provides the highest field fertility, preharvesting density, which create favorable conditions for the formation of high yield value – 19,1 centner/ha, that is higher than other experiment options to 0,5-9,5 centner/ha or to 2,0-49,0%.The most optimum conditions for growth, development and formation of the highest yield value are created when seeding according to the scheme 90E60 cm, seeding rate of 20 thousand pieces of fertile seeds per 1 ha, that results in 18,8 centner/ha of oil seeds of a castor-oil plant.

Key words: A castor-oil plant, Yield formula, Seeding-down depth, oil seeds, Dry steppe zone, Don large-trussed variety, cultivation technology

These years the agriculture of the Republic of Kazakhstan is being oriented to diversification of planting science, which is about the growth of new agricultural corps, review of structure of planting acreages by means of application of short-term rotations, replacement of traditional corps to alternative ones like bast fiber, mustard, and a castor-oil plant[1].

The program of development of agroindustrial complex of the Republic of Kazakhstan for 2010-2015 considers the expansion of planting acreages of oil crops not only in the north of Kazakhstan, but also in irrigated zone of the south and south-east of the country. By now the planting acreage of oil crops has reached 1,7 million ha, and in comparison to the year 1995 it has grown by 40 times. It was also supported by the fact, that the production of oil seeds is significantly beneficial for agricultural producers comparing to grain crops, as the selling price of oil crop seeds is 3-5 times higher[2].

Thereupon, the most actual problem is the development and application of adaptive technology for cultivation of oil crops under the conditions of short-term rotations, including optimal parameters of agrotechnical methods as the study of yield formula, yield value of a castor-oil plant depending on seeding terms, seeding-down depth, seeding methods, and seeding rates. Programming crops - is the development of complex

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technological methods to ensure optimization of controlled environmental factors to obtain the desired high level of harvest of field crops. It is assumed that all processing methods are qualitatively performed in optimal agronomic terms. Programming allows you to plan the amount of crop on each field and to ensure its receipt by the flexible use of the entire body of knowledge about the cause-and-effect relationships that govern the interaction of elements of agricultural complex field. The methodological basis of programming crop yields of ten principles formulated by academicianShatilov.

The first principle of programming yields is to determine biogidrotermicphytomass productivity index for the arrival of radiation, available moisture, temperature and the amount of vegetation period for a particular geographic area.

Vintage generated by solar energy and carbon dioxide in the atmosphere. Therefore, all agricultural practices are aimed at helping the plant to make better use of solar energy. Knowing the arrival of PAR during the growing season, you can put the task of forming sowing with the assimilation of, for example, 3% PAR, but on the basis of this index to determine the potential crop yield[3, 4, 5].

Consequently, the second principle of programming yield based on the determination of its plants at a rate of use of PAR.

For programmed crops need to know the potential of culture (variety). Under natural conditions, the potential of the same varieties vary depending on the area of cultivation. Such data can be obtained by experiments carried out directly or using materials state varietal plots. With such data, it is possible to make such a selection of varieties, which will allow better use of solar energy during the growing season.

Thus, the third principle of programming is to determine the yield potential of varieties in relation to the conditions where it is supposed to cultivate the brand[6].

The fourth principle of programming yields is to a square occupied by plants, form a photosynthetic potential (FP), which will be able to provide the programmed level of productivity.

Each one thousand units of photosynthetic capacity on average produces 3.4 kg of grain. Therefore, for the harvest of grain crops in the 100 kg / ha is necessary to form the photosynthetic capacity of approximately 3.0 million.Units.

Yields determined not only by the biological characteristics of culture (variety), but also the conditions of its cultivation. When programming yields must be considered and correctly apply the basic laws of agriculture and crop production[7,8].

Thus, the fifth principle - is the need to properly use the basic laws of agriculture and crop production.

The sixth principle of programming yields is to develop a system of fertilizer based on soil fertility and effective needs of plants for nutrients. Fertilizer - a powerful factor in increasing productivity. It is necessary to make a number of fertilizer in a ratio that ensures that yields calculated value with good quality products.

To ensure high efficiency of fertilizer grade or complex agro-technical measures necessary to create an environment conducive for growing culture. Breeding success of recent years predetermined the development agrotechnics as new varieties are characterized by a different course of nutrient and more economical expenditure of moisture on yield formation.

Consequently, the seventh principle of programming harvests - develop a set of management practices based on the specific requirements of the grade[9, 10].

Agricultural science has accumulated a large amount of experimental data on water consumption of different crops. The optimum soil moisture in different phases of development of any kind of field crops. Critical periods are clearly defined in the development of various crops against moisture.

The eighth principle of programming yields is that in irrigated agriculture meet the needs of plants in water in optimal amounts, and under rainfed conditions to determine the level of productivity, based on the prevailing climatic conditions.

In the context of rainfed agriculture is impracticable to determine the probable water regime of plants on the basis of meteorological data and rely on them water balance and level of productivity.

Growing high yields unthinkable without the development of a set of measures to combat plant diseases and pests. For each crop in each zone are designed to perform certain actions to combat pests and diseases of agricultural plants.

Therefore, the principle of the ninth programming yields is to ensure healthy plant cultivation, eliminate their negative impact on the growth and yield of diseases and pests.

Accumulation of reliable experimental data to obtain advance calculated yield provides an approach to mathematical modeling programming productivity[11, 12].

The tenth principle of programming involves the use of crops mathematical apparatus for determining the optimal variant of the complex agricultural practices, the implementation of which will provide the planned harvest.

These principles cover three main aspects - agro meteorological, Agro physical and the agricultural, which is mainly determined by the problem of programming harvest. The main factors of productivity - agro-meteorological, agro, agro-chemical and agro-technical, reasonably taken into account and applied in the complex combination, scheduled for growing crops.

Yield created during photosynthesis in green plants where organic material is formed from carbon dioxide, water and mineral substances. The energy of the solar beam is transformed into energy biomass. The efficiency of the process and, ultimately, the yield depends on the functioning of the photosynthetic system as seeding.

In the field, sowing (cenosis) as a collection of plants per unit area is a complex dynamic self-regulating photosynthetic system. This system includes many components which can be considered as a subsystem; it is dynamic, as is constantly changing its parameters over time; self-regulating, since, despite the variety of effects, crop changes its parameters in a certain way, maintaining homeostasis[13, 14].

Such a system is characterized by new properties compared to the individual plants. So, to increase the area of individual plant nutrition and the associated improvement of light leads to an increase in its seed production, and for important cenosis optimal plant density. Conditions for maximum productivity and individual plant cenosis as systems do not match.

The study of photosynthesis cenosis was dedicated to the International Biological Program. Study of photosynthetic activity of plants in crops is closely related to the theory of high yields and the ability to control the formation of the crop. Methodical bases its study developed by many scientists. Great contribution Nichiporovich A.A.[15, 16].

Management of formation of the crop is very difficult, because the plants in cenosis, changing the course of the growing season, interact with other complex systems - soil microorganisms, pathogens, weeds, pests. Many environmental factors - temperature, rainfall and others - almost impossible to control. However, based on the analysis of climatic factors can choose varieties that are adapted to specific conditions, to develop the technology of their cultivation. Many factors amenable to regulation. You can change the conditions of mineral nutrition, affect the weeds, pests, disease. Managing the process of formation of a crop are based on the systematic control of plant development and direction of travel of the photosynthetic activity of crops in accordance with predetermined parameters[17, 18].

METHOD

The research purpose is to study the influence of seeding terms, seeding-down depth and seeding rate on yield value of oil crops.

The research object is a castor-oil plant of Don large-trussed variety

Field experiments are held with the purpose of studying the main methods of cultivation technology of a castor-oil plant. The field experiments are held according to the following schemes, which are given in Table 1 and Table 2:

The seeding is held at a soil temperature of 12-14^0! at a depth of 0-10 cm, seeding-down depth is 7-8 cm.

The experiments are held according to common methods in the fields of “Kairat” Ltd. The soil is mid sandy loam, three replications; plot areais 50-70 m^2. The location is systematic[19].

RESULTS AND DISCUSSION

The studied seeding terms and seeding-down depth have influenced the yield formula elements and yield value of a castor-oil plant.

The highest number of seed cases – 62,9pieces were taken as a result of seeding in the second term by heating the soil to 12-14^{0}C with the seeding-down depth of 7-8 cm, though the rates of quantity and mass of seeds were not the highest. The highest number of seeds – 446,6pieces and their mass of 180,0 g. were taken as a result of seeding in the first term with the seeding-down depth of 9-10 cm.

However, the given option has provided the lowest level of yield value of oil seeds – 9,6centner/ha, which is explained by the low degree of density (Figure 1).

The highest level of yield value 19,6 centner/ha was taken as a result of seeding in the second term by heating the soil to 12-14^{0}C with seeding-down depth of 7-8 cm. Increasing the seeding-down depth to 9-10 cm decreases the yield value to 22%, and decreasing the seeding-down depth to 5-6 cm decreases the yield value to 19%. Early seeding terms decreases the yield value to 29-49%. Late seeding terms decreases the yield value to 26,0-48,0% depending on the seeding-down depth[3, 5]. Therefore, seeding in the second term and heating the soil to 12-14^{0}C with the

Table 1. Experiment scheme # 1

Seeding term	Experiment options Soil temperature in depth0 - 10 cm, °C	Seeding-down depth, cm
1 term	8-10	5-6
		7-8
		9-10
2 term	12-14	5-6
		7-8
		9-10
3 term	16-18	5-6
		7-8
		9-10
4 term	20-22	5-6
		7-8
		9-10

Table 2. Experiment scheme # 2

Experiment options Seeding method	Seeding rate, thousand pieces/ha
60 × 30	35
60 × 60	28
90 × 30	25
90 × 60	20
90 × 90	12,5
120 × 30	20
120 × 60	14
120 × 90	10
120 × 120	7

Table 3. Yield formula and yield value depending on the seeding methods and seeding rates, 2012-2014 (peasant farm Kairat)

Experiment options		Seed cases per plant, pieces									
Seeding methods, cm	Seeding rate, thousand pieces/ha	Main stem	Stem of the 1st order	Stem of the 2nd order	Stem of the 3rd order	Total, pieces	Number of seeds per plant, pieces	Mass of seeds per plant, g	Mass of 1000 seeds, g	Yield value of seeds, centner/ha	Oil rate of seeds from the main stem, %
60x30	35	11,4	10,8	18,6	16,4	57,2	107,5	43,2	402	13,1	53,5
60x60	28	12,6	11,1	18,9	16,9	59,5	152,3	61,4	403	14,0	53,3
90x30	25	14,2	12,4	16,4	15,9	58,9	186,1	75,2	404	14,5	53,1
90x60	20	14,9	12,9	16,8	16,3	60,9	274,8	111,3	405	18,8	53,8
90x90	12,5	15,0	13,1	17,1	16,8	62,0	347,3	142,0	409	16,3	53,3
120x30	20	14,3	13,2	16,8	17,1	61,4	203,7	82,5	405	14,6	53
120x60	14	14,8	13,6	17,3	17,7	63,4	272,1	110,5	406	13,8	53,3
120x90	10	15,1	14,0	17,5	18,0	64,6	348,4	141,8	407	12,5	53,4
120x120	7	15,5	14,4	18,1	18,3	66,3	397,1	162,4	409	9,9	53,7
NSRO,$_{5centner/ha}$										1,02	

Table 4. Yield formula and yield value of a castor-oil plant depending on the seeding methods and seeding rates, 2012-2014 ("Agrouniversity" scientific-experimental station)

Experiment options		Seed cases per plant, pieces									
Seeding methods, cm	Seeding rate, thousand pieces/ha	Main stem	Stem of the 1st order	Stem of the 2nd order	Stem of the 3rd order	Total, pieces	Number of seeds per plant, pieces	Mass of seeds per plant, g	Mass of 1000 seeds, g	Yield value of seeds, centner/ha	Oil rate of seeds from the main stem, %
60×30	35	12,2	19,5	18,4	14,3	64,4	94,8	381,3	402	11,9	52,7
60×60	28	13,4	20,2	20,1	18,5	72,2	129,1	520,4	403	13,0	52,5
90×30	25	13,1	13,0	14,6	13,3	54,0	146,3	591,2	404	13,5	52
90×60	20	14,0	14,3	15,1	10,5	53,0	227,1	920,4	405	16,5	52,5
90×90	12,5	14,5	16,2	16,0	15,5	64,2	324,3	1320,2	407	15,1	52,9
120×30	20	13,1	17,0	17,3	9,0	56,4	182,8	740,4	405	13,3	52
120×60	14	17,4	20,1	20,3	21,0	78,8	236,5	960,3	406	12,4	52,2
120×90	10	16,0	21,4	21,8	15,9	75,1	285,1	1160,4	407	11,0	52,4
120×120	7	14,5	22,2	23,0	7,6	67,3	339,1	1380,4	407	9,1	52,6

seeding-down depth of 7-8 cm are favorable conditions for formation of optimum degree of density and productivity of each plant. The seeding methods, seeding rates have also significantly influenced the growth, development, structure of yield and yield value of a castor-oil plant (Table 3).

As it is shown in the table, a castor-oil plant reaches the highest productivity of 18,8 centner/ha when sown according to the scheme 90x60 cm with seeding rate of 20 thousand fertile seeds per ha. Increasing the seeding rate to 25 thousand pieces/ha or decreasing to 12,5 thousand pieces/ha decreases the the yield value to 13-22%.

The highest number of seed cases – 66,3pieces, number of seeds – 397,1 pieces, and the mass of seeds –162,4 g.are taken from a castor-oil plants sown with planting width of 120 cm and seeding rate of 7 thousand pieces, however this option presents the lowest number of plants on area unit, which results only 9,9 centner/ha of oil seeds, that is lower than dense plantings to 2,6-4,7 centner/ha.

Therefore, the most favorable conditions for formation of main yield formula elements and yield value are seeding the a castor-oil plant according to the scheme 90x60 cm with the seeding

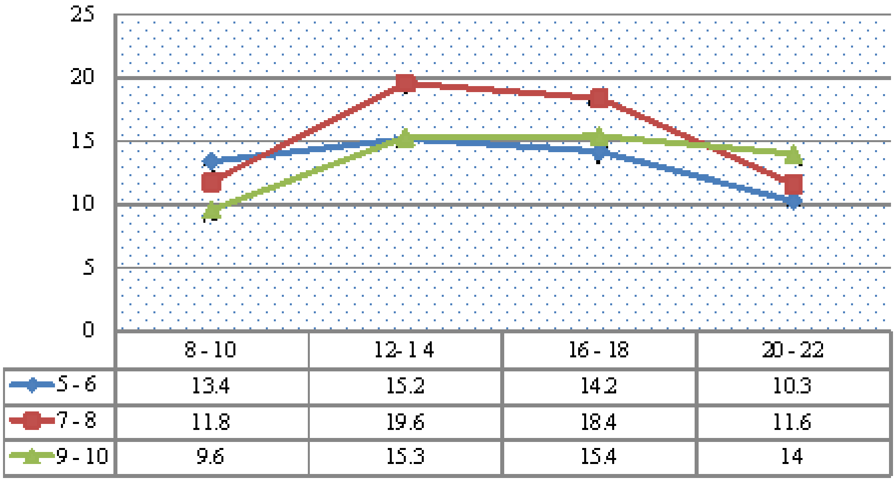

Fig. 1. Yield value of a castor-oil plant depending on the seeding terms and seeding-down depth, 2012 -2014

rate of 20 thousand pieces/ha, that creates the optimum proportion of feeding area and planting density.

We have identified the oil content in a castor-oil plant seeds. We have selected 36 seed samples depending on the seeding terms, seeding-down depth, and seeding schemes. The analysis results have shown that oil rate of seeds of the main stem of a castor-oil plant varies from 50 to 53,9% depending on the agro technical methods. Seeding methods don't significantly influence the oil rate of seeds.

It is worth noting that oil rate of seeds depends on seeding terms and seeding-down depth. Early and late seeding terms decrease the oil rate of seeds to 1,4% comparing to the optimum term. Seeding a castor-oil plant at a temperature of 12-14^{0}! increases the oil rate of seeds to 53,9%. The reason is that the period of intense oil accumulation corresponds to the warm and dry period of the year, which favors the oil accumulation.

The parallel experiment is conducted in the fields of "Agrouniversity" scientific-experimental station in Enbeskshikazakh region of Almaty province, which is engaged in the study of the impact of seeding methods and seeding rates on the features of oil seed formation in a castor-oil plant stems (Table 4).

Seeding terms and seeding rates for this region were studied early in 2009-2011, therefore we didn't repeat it.

As it is shown in the Table 4, the highest level of yield value of 16,5 centner/ha in piedmont zone is taken by seeding scheme of 90x60 cm, seeding rate of 20 thousand pieces/ha of fertile seeds per 1 hectare.

Overcrowding the seeding in planting rows while seeding according to the scheme 90x30 and 60x60 has also resulted less yield value, giving 11,9-13,0 centner/ha of oil seeds, which is less to 21-27%. More wide spacing of 120 cm with decreasing the seeding rate from 20 thousand to 7 thousand pieces of fertile seeds per 1 ha also decreases the yield value to 3,2-7,4 centner/ha, though the indexes of yield formula per plant are more productive, but because of low density the productivity of area is low.

CONCLUSION

On the basis of the research on the study of yield formula and yield value of a castor-oil plant depending on the seeding terms, seeding-down depth, seeding methods, and seeding rates we conclude that: a castor-oil plant is a high-productivity oil crop in desert zones of Almaty Province, and edaphic-climatic conditions are well suited for the growth, development and formation of full seed yield.

The highest productivity of a castor-oil plant is taken as a result of heating the soil to 12-14^{0}! in the depth of 0-10 cm with seeding-down depth of 7-8 cm. This option provides the highest field fertility, preharvesting density, which create favorable conditions for the formation of high yield value – 19,1 centner/ha, that is higher than other experiment options to 0,5-9,5 centner/ha or to 2,0-49,0%.

The most optimum conditions for growth, development and formation of the highest yield value are created when seeding according to the scheme 90E60 cm, seeding rate of 20 thousand pieces of fertile seeds per 1 ha, that results in 18,8 centner/ha of oil seeds of a castor-oil plant[20].

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