максимального увеличения численности вида у диких растений осуществляется в обычной природной обстановке, не измененной человеком, и направлен на процветание и прогрессивное развитие вида. Естественный отбор в условиях свободного скрещивания и взаимосвязанного влияния природных факторов, способствует появлению многих разновидностей и форм вида в неоднородных условиях внешней среды – важнейшие факторы, определяющие специфические особенности в проявлении основного закона жизни у диких растений.

Ключевые слова: формирование шишек, сосна обыкновенная, созревание семян.

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INFLUENCE OF RESOURCE-SAVING TECHNOLOGY METHODS ON PRODUCTIVITY OF RAPE AGROECOSYSTEMS

Abstract

This article is aimed at studying the ecophytosanitary state and the productivity of the agroecosystem, depending on the effect of resource-saving technologies, such as minimizing soil cultivation, placing rapeseed in a short rotation crop tillage, timing and seeding rates. It is proved that minimization of soil cultivation and optimal location of rapeseed in short rotation crop tillage are the most important biological factors for increasing the ecophytosanitary state of the agroecosystem. Depending on the correct location of the rapeseed crop for the best predecessors and the scientifically-based selection of the time and the seed rate, the eco-phytosanitary condition stabilizes and yields significantly increase.

Keywords: rapeseed, agroecosystem, technology, techniques, agrophytocenosis, weeds, resource-saving technology, productivity.

Introduction

The consequences of rapid technical improvement and technological development of national economy under the modern civilization exacerbate the problems of ecological balance. The consumer attitude of mankind to the environment leads to multiple negative consequences, which dictate the need for rationalization of using natural resources, which shall balance human existence with unharmed natural resources [1, 2]. Agriculture is among the first to undergo these negative anthropogenic changes. Agroecosystem, which is essentially a mechanism for sustainable cultivation of natural resources, is fundamentally different from natural ecosystems and takes a key part in fluctuating ecological equilibrium of this ecosystem [3, 4].

Modern agroecosystem has biological productivity or biological capacity. The population size of certain species included in them fluctuates because of constant changes in abiotic and biotic factors. Factors affecting the density of species' population include competition among species in relation to food and space. Interspecific competition arises in case of different types of identical or similar requirements to environmental conditions. The competition intensifies with increasing shortage of means of subsistence between the components of agrophytocenosis. As a rule, the density of population of various groups of organisms in the agroecosystem is maintained at the optimal level by means of effective techniques of crop cultivation technology

developed by taking into account the specificity of the agroecosystem [5]. At the same time, the modern task of agroproduction is to ensure the existence of agroecosystem with minimal impact on the ecological balance of a particular ecosystem.

Today in our country, just like in the whole world, special interest is directed towards energy-saturated plants, which include rape. It contributes to providing population of the Republic of Kazakhstan with vegetable oil, covering needs of livestock farming with fodder protein, and industrial needs with raw materials, which is the main task of entire agricultural production. Such priority direction of the state policy ensures an increase in the competitiveness of products sold in domestic and world markets. Achievement of this goal depends on correct choice of culture. High-yield products like rape obtained on the basis of the application of effective and new environmentally safe technology, taking into account the optimization of the ecophytosanitary state of the agroecosystem can be offered to the market.

In ensuring the ecophytosanitary state of the agroecosystem we researched the effect of minimal soil cultivation, placement of rape in a short rotational crop tillage, and timing of the seeding rate.

In agroecosystems, cultural and weed plants, adapting to ecological factors of agroecosystem and entering into a certain biotic relationship with each other, form agrophytocenosis [6, 7]. Unlike natural phytocenoses, agrophytocenosis does not possess a homeostatic state and can not be restored without human activity due to the violation of direct and positive reverse connections. The productivity of agrophytocenosis is to the greatest extent characterized by resistance sustainability and stability of the ecosystem that is in agricultural use [8].

Agrophytocenosis consists of two major components - agricultural crops and weeds. The first component is usually represented by one type of cultivated crop culture (single-species crops) and from a mixture of two or three kinds of cultivated plants (multi-sorts crops, mixture of sorts). The second component is represented by numerous agrobiological kinds of weed vegetation. The main feature of dynamics of cultural and weed plants populations in agrophytocenoses consists in the incompleteness of population processes. The result of these relations is the acute nature of competition between plants in crops [7, 8].

The results of many researchers provide evidence that cultural and weed plants in agrophytocenoses inhabiting one territory exert on each other mutually destructive influence, which can be expressed by a decrease in the magnitude and quality of obtained products. Therefore, one of the actual biotic problems is contamination control of agricultural crops, as the high clogging of crops caused by unfavorable abiotic conditions, causes a significant decrease in crop productivity up to 20% or more [9].

In this regard, the need to study techniques, especially resource-saving technology for the formation of agrophytocenosis and productivity of rape groecosystem at the present stage in a specific agroecosystem is a very actual problem. This article is aimed at studying eco-phytosanitary condition and productivity of agroecosystem with application of resource-saving technology, such as minimizing soil cultivation, placing rapeseed in short- rotational crop tillage, timing and seeding rates.

Methods and objects of research

Research work on studying resource-saving technologies in rapeseed agroecosystem was performed on territory of “Agrouniversity” research-and-practice farm located at foothill of northern slope of Zailiysky Alatau mountains at the altitude of 850 m above sea level. This location is a typical area for irrigated foothill zone of the southeast of Kazakhstan. The objects of the research are the unique oilseed crop - spring rape (Myla sort), short-rotational crop tillage. As a control the traditional technology of rapeseed cultivation was used in experiments in

accordance with recommendations of the Agricultural System of the Almaty region [10] and the Practicum on the technique of experimental case in plant protection (V. F. Peresypkin, etc., 1989). Field experiments and experimental studies were carried out by conventional classical techniques: experiment and observation. All the methodological requirements for laying the field experiments are sustained, and were performed according to B.A. Dospehov [11].

Biometric and phenological observations were performed according to the GOS method of cultivating agricultural crops for growing cereals, legumes and oilseeds [12, 13]. The obtained experimental materials were processed by a statistical method [14].

Results of research

Among the branches of social production the greatest impact on biospherical resources is provided by agriculture. Any labor of an agricultural worker is essentially the usage of natural environment to meet human needs. This production continuously uses land, water, biological and energy resources of the ecosystem, which has a greater impact on nature than in any other sector. As a rule agrocenoses are the fundamental parts of agroecosystems. *Agrocenoses* - biocenoses on agricultural land, created with the purpose of obtaining agricultural products, with regularly maintained biotic communities, possessing low ecological reliability, but high productivity (yield) of one or several selected species (varieties, sorts) of plants.

In agriculture, several types of ecosystems are distinguished by the criteria: source and amount of incoming and used energy. Such ecosystems are natural, highly productive ecosystems, agroecosystems, close to natural ecosystems and agroecosystems of an intensive type of ecosystem.

The results of using methods of resource-saving cultivation technology have shown that anthropogenic effects under traditional technology on condition of soil fertility are accompanied by a deterioration in conditions necessary for formation of agrophytocenosis. At the same time, it is necessary to take into account the main shortcoming of the minimal technology such as a significant increase in the contamination of rape crops.

It should be noted that in 2016, due to the high moisture content during the vegetative period of rapeseed development, there was high contamination of fields of the research object. In this ecological situation, the structure of agrophytocenosis is characterized by an increased specific weight of the weed component due to influence of abiotic factors and biological characteristics of weed plants. It was determined that in case of plowing the weediness of rapeseed fields is high, and the amount of weeds reaches 88.4 pieces/m^2 at a mass of 224.1 g/m^2 (Table 1).

Table 1 - Weediness of rapeseed agroecosystem crops depending on the minimization of tillage

Technology, Primary tillage	Quantity of weeds, pcs/ m^2	Mass of weeds, g/m^2	21 days later after using herbicides		Effectiveness by mass of weeds, %	Yield of spring wheat, cwt/ha
			Quantity of weeds, pcs/ m^2	Mass of weeds, g/m^2		
Traditional tillage with depth of 20-22cm	88.4	224.1	-	-	St	14.3
Resource- saving flat-cut for depth of 16-18cm + herbicide	72.4	194.5	33.6	80.6	66.2	15.5
Flat-cut tillage 12-14						

cm + herbicide Impulse k.e. 0.7 l/he	84.0	210.1	24.9	59.7	76.9	16.7
						HCP_{05}, cwt/ha = 1.20 $S_{x,}$ % = 3.38

With resource-saving technology in case of flat-cut tillage for 16-18 cm depth, weeds account for 72.4 pcs/m^2, while with a decrease of tillage depth up to 12-14 cm, the debris are increased to 84.0 pcs/m2. At the same time, in case of flat-cut soil tillage with high contamination additional measures are needed to combat soil contamination. In case of applying the optimal environmentally safe dose of herbicide (Impulse k.e., at a dose of 0.7 L/ ha) the maximum effect takes place 21 days after the application of herbicides reducing the amount of weeds to 24.9-33.6 pcs/m^2 at a mass 59.7-80.6 g/m^2.

Thus, in resisting weediness of the rapeseed agroecosystem, the effectiveness of resource-saving technology with minimal soil cultivation with application of an ecologically safe dose of herbicide amounts to mass of weeds in range of 66.2-76.9%. Minimal soil cultivation and optimal place for rapeseed in short rotational crop tillage are the most important methods of improving the ecofitosanitary state of the agroecosystem. Optimal precursors of rape as a biological factor of weed infestation have an intensely regulating effect on the quantity and kinds composition of the weed component of agrophytocenosis. The precursors of rapeseed along with minimal soil cultivation are the leading agricultural methods for stabilizing phytosanitary status of ecosystem.

Together with the minimization of soil cultivation, we studied the ecophytosanitary state of the agroecosystem depending on the location of the rapeseed planting. The alternation of crops in crop rotation has a special place in regulating the phytosanitary potential of the agroecosystem. The obtained results of the determination of the ecophytosanitary state depending on the location of rapeseed in the short-rotation of fruits and crops testify to the positive role of crop rotation in reducing the weediness of fields. Under the effect of alternating crops, the phytosanitary potential is reduced by a factor of 2 compared to the second crop of rapeseed. The weediness of sowing, depending on the location of rape on various predecessors, has been studied against the background of traditional and resource-saving technologies. The results of scientific research established that with resource-saving technology of crop cultivation the biological function of crop rotation and its phytosanitary role sharply increases.

While studying the weediness of rapeseed crops, it was revealed that rapeseed precursors have a significant effect on the level of weediness. Weediness of rapeseed crops, depending on the minimization of soil cultivation and the location of rapeseed in a short-rotational crop rotation is the most important biological factor for improving the eco-phyto-sanitary state of the agroecosystem. Under traditional cultivation technology, fields' contamination in phase of 4-6 rape leaves, depending on their predecessors, vary between 45.4 and 51.7 pcs / m^2. The greatest contamination (88.4 pcs / m^2) is shown when rapeseed is cultivated on rape on the control version. With resource-saving technology, weediness of rapeseed sowing is significantly lower, especially after good and excellent predecessors, fluctuating between 37.6 and 40.3 pcs / m^2, which is 22.2 and 13.6 pcs / m^2, lower than in case of re-seeding rape, which indicates a sufficient effectiveness of predecessors in resistance against weeds infestation (Table 2).

Table 2 – Weediness of rapeseeds' agro-ecosystems depending on predecessors

Predecessors	Quantity of weeds, pcs/ m^2		Effectiveness of predecessors resisting
	In phase of 4-	Before harvest	

	6 rape leaves		weeds, %
Soil tillage depth of 20-22 cm (PN-5-35)			
Rape after winter wheat	45.4	31.0	51.7
Rape after soy	59.5	42.1	36.8
Rape after rape (control)	88.4	55.0	St
Rape after corn	51.7	23.4	45.4
Flat- cut soil tillage depth 16-18 cm (KPP-2,2)			
Rape after winter wheat	41.1	23.1	33.2
Rape after soy	47.9	28.4	22.3
Rape after rape (control)	61.5	34.8	St
Rape after corn	42.3	28.7	31.4
Flat- cut soil tillage depth 12-14 cm + Impulse in dosage of 0.7 L/ha			
Rape after winter wheat	37.6	24.3	37.1
Rape after soy	40.3	19.2	32.6
Rape after rape (control)	59.8	32.1	St
Rape after corn	39.6	19.7	33.8

The lowest weediness of rapeseed fields is observed when applying Impulse herbicide on predecessors at a dosage of 0.7 l L/ ha, where the amount of weeds is within 37.6 and 40.3 pcs / m^2, which is close to the economic thresholds of weediness of field contamination.

In case of traditional technology, the highest efficiency (51.7% on repelling weeds) is characterized by winter wheat as a precursor of rape.

In case of flat-cut soil tillage onto a depth of 16-18 cm and 12-14 cm, the greatest efficiency is obtained when rapeseed is also cultivated after winter wheat and where the efficiency is 33.2% and 37.1%, respectively.

The obtained results show that in case of traditional technology, the effectiveness of the precursors on weed control is 51.7% after winter wheat and 45.4% after corn. With resource-saving technology in case of flat-cut tillage at a depth of 16-18 cm, the efficiency of the precursors is lower and is 31.4% after corn and 33.8% after winter wheat, at a depth of 12-14 cm it is 33.8% after corn and 37, 1% after winter wheat.

During the growing season, rape is highly susceptible to weeds and its crop is highly contaminated, especially in case of applying traditional technology. Where the use of agrotechnical techniques such as harrowing of seedlings in phase of a 3-4-leaf rosette is inevitable, it is expedient to perform such techniques in the afternoon, when plants take less damage. With resource-saving technology with minimal tillage, additional amount of tillage is not taken into account. Therefore, in the process of repelling high contamination of rapeseed sowing, it is planned to replace agricultural techniques with ecologically safe doses of herbicide. Applying herbicide Impulse- k.e. in a dose of 0.7 L/ha against vegetative annual and perennial varieties of weeds, weed infestation of rapeseed sharply decreases to 37.6 pcs/m^2.

The obtained regularity proves that the weediness of rapeseed sowing, depending on the minimization of soil cultivation and placement of rapeseed in a short rotational crop tillage, is the most important biological factor for increasing the ecophytosanitary state of the agroecosystem. Excellent (winter wheat) and optimal (soybean and corn) precursors of the cultivated rape crop have an intensely regulating effect on the abundance and species composition of the weed component of agrophytocenosis. Due to proper placement of the rapeseed crop for the best predecessors, the ecophytosanitary condition is stabilized in a short rotational crop tillage and the yield is significantly increased. The maximum yield of rape - 14.3-

16.7 centner/ha was obtained after the best predecessors of winter wheat that was placed on top of layer of perennial grasses, soya and corn.

When determining the influence of planting timeframe and rapeseed seeding rates on the ecophytosanitary state of the agroecosystem by weed infestation, we monitored the ecological situation, where the degree of weediness, the species composition of the weeds and the structure of the agrophytocenosis of the rape have been identified. Early rapeseed plants have weak competitiveness and weeds recapture their vital growth factors, nutrients and soil moisture.

The rapeseed plantation is littered with numerous weeds. According to the monitoring that we perfrormed, agrophytocenosis of rapeseed is characterized by a wide spectrum of species composition of weeds. In rapeseeds, the weed component consists of 27 species, represented by various biotypes of weeds and the degree of weediness. Although the floral composition of weeds is quite diverse, only 8 of them are often found. These are such dominant weeds as: wild oats (*Avena fatua L.*), Ragwort ragweed (*Ambrosia artermisiifolia L.*), pink sow thistle, plainary thistle (*Cirsium arvense Scop*), lady's purse (*Capsella bursa pastoris Medic*), field thlaspi (*Tlaspi arvense L.*), common cinder (*Barbarea frvensis*) and field convolvus (*Convolvulus arvensis L)*.

The structure of the weed component of rape, depending on the timing and rate of sowing, has its own peculiarity. Early rapeseeds are contaminated by juvenile weeds up to 66.2%, and the percentage of perennial ones is 31.8% with the largest number of root-offs and has a young-root-cropping type of contamination (Table 3).

Table 3 – Influence of the sowing time and the seeding rate on the eco-phytosanitary state of the agroecosystem and the yield of spring rape in conditions of southeast of Kazakhstan, 2016.

Terms of rape sowing	Seeding rate, mln seeds/ha	Quantity of weeds, pcs/ m^2		Effectiveness in resisting weeds, %	Yield of rapeseeds, cwt/ha
		total amount	amount of perennial weeds from total amount		
Early sowing	2.0	58.0	24.0	-	12.1
	2.5	51.3	21.5	11.6	12.8
	3.0	47. 9	20.2	17.4	12.9
Average term of sowing	2.0	35.5	8.6	38.8	13.4
	2.5	32.6	4.9	43.7	15.9
	3.0	38.9	5.1	34.1	14.7
Late term of sowing	2.0	40.1	20.7	30.9	13.5
	2.5	37.8	18.2	34.8	14.2
	3.0	35.1	18.0	39.5	13.6
					HCP_{05} = 0.97 cwt/ha S_x = 1.11%

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When studying the effect of rapeseed sowing time on the ecofitosanitic state of the rapeseed agroecosystem in southeast of Kazakhstan, we found a high level of contamination in the early stages of sowing, the total amount of weeds is 58 pcs/m^2, of which perennial weeds are 24 pcs/m^2. In the average term sowing part the amount of weeds is reduced to 35.5 pcs/m^2 of them 8.6 pcs/m^2 are perennial weeds, and in case of late term sowing the amount of weeds

increased to 40.1 pcs/m^2 and is characterized by an increased content of harmful long-term weed plants.

Rapeseed plantations have a mixed type of debris for all the sowing periods, with prevalence of one or another kind of annual and perennial weeds. During the growing season, the weeds are quite harmful till the beginning of development phase of 4-6 rape leaves and reduce the yield of rapeseed by 10-20%. After the onset of this phase on average sowing term, the amount of weeds drops sharply to the level of the threshold of harmfulness of juvenile weeds. Therefore, an effective agro-technique in optimizing the ecophytosanitary state of a rape ecosystem is the average term of planting rapeseed, where optimal conditions for resisting the contamination of agrophytocenosis are formed. By the average termof planting rape, there is sufficient time to implement effective and comprehensive measures to control weeds that create the prerequisites for the purity of the agronomist for sowing.

Thus, due to the high moisture content in the initial growing season of rapeseed in 2016, a complex ecophytosanitary situation was observed, the structure of agrophytocenosis was characterized by an increased specific weight of the weed component. A high contamination of the rapeseed plantation was observed in case of traditional technology. With resource-saving technology in case of flat-cut tillage at a depth of 16-18 cm, the contamination is 72.4 pcs/m^2, with a decrease in depth to 12-14 cm, the debris are increased to 84.0 pcs/m^2. Therefore, in case of flat-plan cultivation of soil with high contamination, additional measures of repelling weeds are required including application of the optimal ecologically safe dose of herbicide (Impulse k.e., at a dose of 0.7 L/ ha) which showed the maximum effect, reducing the amount of weeds to 24.9-33.6 pcs/m^2 at a weight of 59.7-80.6 g/m^2. It is proved that with the resource-saving technology of crop cultivation the biological function of crop rotation sharply increases, as well as its phytosanitary role. In case of flat-cut cultivation of soil, the effectiveness of the precursors in the control of weeds is 33.2-37.1% (after winter wheat) and - 31.4-33.8% (after corn). Minimization of soil cultivation and optimal placementn of rapeseed in a short rotational crop rotation is the most important biological factor for increasing the eco-phytosanitary state of the agroecosystem. Due to the proper placement of rapeseed after the best predecessors in the short rotational crop rotation, the ecophytosanitary condition is stabilized and yields are significantly increased. The highest productivity of rape - 14.3-16.7 centner/ha was obtained after the best predecessors of winter wheat which was placed on surface layer of perennial grasses, soya and corn.

When examining the seeding timeframe and seeding rates for rapeseed, it was determined that the optimal time for sowing is the average term of sowing and 2.5 million/ha of seeds that provide optimization of the environmental conditions for growth and development of rape cultivation in specific soil and climatic conditions in southeast of Kazakhstan. This method of resource-saving technology (average sowing term and 2.5 million pcs/ha seeding rate) showed an advantage and ensured an increase in rape yield by 31.4%.

The results of studying the impact of resource-saving rapeseed cultivating methods prove that under the conditions of foothill zone of the southeast of Kazakhstan the ecological basis for rational use of natural resources of the rapeseed agroecosystem is use of resource-saving technologies for its cultivation. The main effective methods of resource-saving technology in improving the ecophytosanitary state of the agroecosystem include the minimization of soil cultivation, selection of a scientifically based precursor culture, the sowing term period and the seeding rate, taking into account the specific soil and climatic conditions of the area, which ensure the optimization and conservation of soil and biological resources with subsequent increase in agroecosystem’s productivity.

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РАПС АГРОЭКОЖҮЙЕСІНІҢ ӨНІМДІЛІГІНЕ РЕСУРСҮНЕМДЕУ ТЕХНОЛОГИЯ ТӘСІДЕРІНІҢ ӘСЕРІ

Аңдатпа

Бұл мақалада ресурс үнемдейтін технологиясының - топырақты минимальды өңдеу, - қысқа ротациялық ауыспалы егіс дақылдарының айналымында орналасу орнын анықтау және - себу мерзімдері мен себу мөлшеріне байланысты зерттеліп, рапс агроэкосистемасының экофитосанитарлық жағдайына және өнімділігіне әсері анықталған.

Агроэкожүйенің экофитосанитарлық жағдайын оңтайлануының негізі рапс егісінің арам шөппен ластнуы екндігі анықталды. Ауыспалы егісте рапсыты оңтайлы алғы

дақылдан кейін орналастырумен қатар агрофитосанитарлық жағдайын арттыруда биологиялық фактор ретінде маңызды фактор болып табылады. Қысқа ротациялы ауыспалы егісте оңтайлы алғы дақылдан кейін рапсты орналастыру оның экофитосанитарлық жағдайғдайын және өнімділігін арттырады.

Кілт сөздер: рапс, агроэкосистема, ресурсүнемдеу технологиясы, агротәсілдер, арам шөп, агрофитценоз, өнімділік.

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ВЛИЯНИЕ ПРИЕМОВ РЕСУРСОСБЕРЕГАЮЩЕЙ ТЕХНОЛОГИИ НА ПРОДУКТИВНОСТЬ АГРОЭКОСИСТЕМЫ РАПСА

Аннотация

Данная статья нацелена на изучение экофитосанитарного состояния и продуктивность агроэкосистемы в зависимости от влияния приемов ресурсосберегающей технологии, как минимализация обработки почвы, размещение рапса в коротко ротационном плодосменном севообороте, сроки и нормы высева. Минимализация обработки почвы и места размещения рапса в коротко ротационном плодосменном севообороте является важнейшим биологическим фактором повышения экофитосанитарного состояние агроэкосистемы. За счет правильного размещения культуры рапса по лучшим предшественникам в коротко ротационном плодосменном севообороте и научно-обоснованного подбора срока и нормы высева стабилизируется экофитосанитарное состояние и существенно повышается урожайность.

Ключевые словаs: рапс, агроэкосистема, ресурсосберегающая технология, приемы, агрофитценоз, сорные растения, продуктивность.

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ЭКОНОМИЧЕСКАЯ ЭФФЕКТИВНОСТЬ ПОЛУЧЕНИЯ ДВУХ УРОЖАЕВ КУЛЬТУР В ГОД

Аннотация

В статье приводятся результаты полевых исследований по возделыванию основных и промежуточных культур и экономические обоснования получения двух урожаев в год.

Ключевые слова: основные и промежуточные культуры, гребни, прямой посев, чистый доход, уровень рентабельности, капельное орошение.

Введение

Президент Республики в своем Послании Народу Казахстана от 31 января 2017 года отметил, что в агропромышленном комплексе необходимо повысить уровень производительности труда и снизить производственные расходы, для чего следует эффективно использовать земли, особенно орошаемые [1]. Поэтому, разработка и внедрение в