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SELECTION OF NON-TRADITIONAL CROPS FOR INTENSIVE USE OF IRRIGATED LANDS DEPENDING ON BIOCLIMATIC POTENTIAL OF GROWING ZONES

Abstract

The article presents the results of research on selection of non-traditional crops for intensive use of irrigated lands depending on bioclimatic potential of growing zones.

Growth and accumulation of above-ground mass of spring main crops - oats and peas is slow compared to winter crops. The bushiness of oats was only 6 pieces, while in winter crops the bushiness reached 15-16 pieces. The average height of triticale at the earing phase was 108 cm, and that of rape 115 cm. The highest accumulation of crude and dry weight (2664, 1243 g) was observed in triticale crop.

The yield of green mass of winter crops in rape averaged 584 kg/ha, in triticale - 554 kg/ha. At joint sowing oats and peas to the beginning of earing and fruiting phase gain sufficient height: oats - 92 cm, peas - 55 cm, as a result they gain good above-ground green mass - 4 230 and 1 490 grams per square metre. Biological yield of green mass of joint sowing of oats and peas was 572 kg/ha.

The main winter crops of triticale, rape and for green mass were harvested on 15 and 17 May and their green mass yields averaged 554 and 584 kg/ha, respectively. Half of the rape and triticale crops were left to ripen to grain. This part of the crops was harvested on 07-10 July, with an average grain yield of 24.5 kg/ha for rape and 62.0 kg/ha for winter triticale. On the control variant, where winter barley crops were sown, the average yield was 56.6 c/ha.

Spring crops of main crops - joint sowing of oats and peas were harvested on 10-12 June, and the total yield of green mass was 579 kg/ha.

Key words: *main crops, drip irrigation, biometrics, yield.*

Introduction

In the southern and south-eastern regions of Kazakhstan a large share in the agricultural sector traditionally falls on medium and relatively small farms.

The basis of agricultural production is irrigated farming, at the same time its potential is not fully utilised. Of the 2.2 million hectares of irrigated land available on the balance sheet, 1.5 million hectares are actually used, and only 312,000 hectares are used with the application of water-saving technologies.

Therefore, the rise of agriculture in these regions is directly related to the efficient use of irrigated lands, introduction of effective water-saving and resource-saving technologies, cheaper production in farms and improvement of their economic condition.

Currently, the agrarian sector of Kazakhstan is characterised by low labour productivity due to low crop yields and productivity of farm animals, the use of outdated technologies, production of low value-added products, and weak innovation activity of industry entities.

Taking into account the world experience, environmental conditions and available resources in Kazakhstan as the optimal approach to the development of innovations in agriculture, the combination of transfer of foreign technologies with own scientific research is determined [1].

The modern period of agricultural development in Kazakhstan is characterised by the increasing role of fodder production as a system-forming branch of the agro-industrial complex, which determines the state of animal husbandry and has a significant impact on improving the efficiency of farming and crop production.

Its importance is determined not only in providing livestock breeding with fodder, but also in solving many problems in the biologisation of farming, preservation and improvement of soil fertility, sustainability of agrolandscapes.

Therefore, studies on selection of non-traditional crops for intensive use of irrigated lands depending on bioclimatic potential of cultivation zones are relevant.

Methodology and materials

Together with SIMMIT scientists, a new wheat cultivation system Bed-planting system was developed, which involves sowing wheat on ridges with the preservation of plant residues, reducing treatments and irrigation along furrows. Irrigation water management is more efficient and less time-consuming using furrows compared to a traditional irrigation system [2].

The technology consisted of 2 or 3 line seeding on ridges, the width of which is 70-90 cm wide at a height of 15-30 cm. For the irrigated conditions of northwestern Mexico, such a ridge width used by farmers for sowing wheat was also convenient for other crops widely grown in grain crop rotations. With 2-line sowing on the ridge, the distance between the rows, as a rule, was 25-40 cm, and with 3-line sowing – 15-25 cm. However, the actual distance between rows and rows in the region was mainly determined by the settings of the seeder.

Raised, permanent ridges heat up faster, which allows for early sowing. The furrows between the ridges also provide drainage to remove excess water after heavy rains and prevent waterlogging [3].

The transition from traditional crop cultivation to ridge cultivation technology involves more effective control of irrigation water and drainage, reduction of weed infestation, improved efficiency of nutrient use, surface treatment, water savings and higher yields while reducing operating costs [4].

Permanent ridges with a certain row spacing help to retain precipitation and, as has been shown, increase the yield of sorghum and corn grains, as well as increase the efficiency of water use [5, 6].

When using permanent ridges with complete preservation of plant residues, there was a 1.4-fold increase in the organic matter content in the 0-5 cm soil layer compared to ordinary sowing [7].

According to Smika, Hobbs and Lafond, comb technology improves the water distribution system and its efficiency. The technology also provides an alternative to weed control when furrowing and reduces the area of their growth, while more light falls on the wheat crop itself. In addition, when cultivated on permanent ridges, the seeding rate is reduced [8, 9, 10].

In the Republic of Kazakhstan, in 2000, the scientific and Production center of agriculture and crop production began research on the comb method of winter wheat cultivation in the south-east of the country.

According to the results of Zh.O.Ospanbayev's research, data were obtained that in conditions of irrigated agriculture, using the comb method of wheat cultivation, it is possible to reduce irrigation water consumption by 30-40%; reduce seeding rates by 2-2.5 times; reduce the number of basic and pre-sowing soil treatments by 1.5-2.5 times; carry out a mechanized method of weed control; effective use of fertilizers due to their local and ridge application [11].

According to the results of research by scientists of the Kyrgyz Republic V.G. Pozharsky, M.Zh. Akimaliev, A.A.Barko, it was revealed that the most responsive wheat variety according to the technology of wheat cultivation on the ridges of all tested varieties was the optional Jamin wheat variety with a grain yield of 55 c/ha and the yield of conditioned seeds of 86%. This yield was provided at a seeding rate of 110 kg/ha with a row spacing of 80 cm and the number of rows of 2 on the ridges [12].

Dzhumshudov, M.Ya. Rzoev, M.G. Akhmedov note that with the comb method of sowing, irrigation efficiency increases, labor costs of irrigators decrease, as well as the area of plant nutrition and the tillering coefficient increase [13].

The advantages of comb-furrow technology with soil and resource conservation with a significant increase in the productivity of winter wheat, mainly due to an increase in the productivity of bushiness were noted in the works of S.B. Kenenbaev, Zh. O. Ospanbaev, D.A. Sydyk, A.T. Babakhodzhaev, Kintsler K.M., Karabaev M.K., Kalashnikov A.A. [14-20].

Thus, the cultivation of agricultural crops by the ridge-furrow method can become the main diversification of the system of irrigated agriculture with *water-resource-saving cultivation technology*. Production testing and introduction of new technology in the conditions of irrigation in the south of Kazakhstan will not only increase the productivity of irrigated lands, but it is of no small importance in environmental protection, in obtaining environmentally friendly and competitive agricultural products.

We studied biological features of crops and soil and climatic conditions of the region. On the basis of these data we selected the following main crops: winter crops - barley, triticale and rape, and for spring sowing - oats, peas and alfalfa.

Research works on intensive use of irrigated lands and creation of green conveyor were carried out on experimental-production station of scientific-production, educational centre of 'Baiserke-Agro' LLP located in the foothill irrigated zone of Ili Alatau on light chestnut soils.

The object of our research was light-chestnut soils, drip irrigation, crops of main crops.

Main crops: winter barley, winter triticale, winter rape, joint sowing of oats and peas and joint sowing of oats and alfalfa.

The total area of the production experiment is 5.0 hectares, the size of the plots is 300 m^2, the repetition is three times.

The solution of the tasks was solved by laying and conducting field experiments and laboratory analyses.

The following calculations, observations and analyses were carried out in the experiments.

Taking into account the density of standing plants by counting the number of plants on an area of 1 m^2 at the beginning and at the end of the vegetation of the studied crops in threefold repetition.

Taking into account the dynamics of the accumulation of plant biomass in the main phases of their development by sampling from each variant in three-fold repetition with the determination of raw and dry mass. (Guidelines for monitoring and processing observations of phases of development of agricultural crops, 1982) [21].

Crop accounting was carried out by direct harvesting and by the method of trial sites. Processing of crop data according to the method of Dospekhov (1985) [22].

Results and discussion

Monitoring the hydrothermal conditions of agro-climatic zones suitable for two harvests in one year

For intensive use of irrigated lands by obtaining two harvests per year, the main factors are the thermal and hydrological conditions of the area, as well as the sum of active temperatures for the maturation of the main and intermediate crops.

In 2021, we conducted monitoring of hydrothermal conditions in the south and south-east of our Republic, where irrigated agriculture is developed.

At the same time, the sum of active temperatures by months during the growing season of the main agricultural crops cultivated on irrigated lands of Kazakhstan was calculated [23]. These data are shown in table 1.

Table 1 – Sums of active temperatures by month during the growing season of agricultural crops

Items investigated	April	May	June	July	August	September	October	Amount	
								IV-X	V-X
Almaty (foothill zone)	315,0	502,2	618,0	722,3	691,3	507,0	294,5	3650,3	Almaty (foothill zone)
Taldykorgan	291,0	489,8	618,0	706,8	663,4	465,0	241,8	3475,8	Taldykorgan
Zhambyl (Taraz)	327,0	517,7	633,0	722,3	663,4	468,0	266,0	3597,4	Zhambyl (Taraz)
Shymkent (southern zone)	387,0	576,6	702,0	815,3	771,9	567,0	353,4	4176,8	Shymkent (southern zone)
Maktaaral (southernmost zone)	429,0	629,0	747,0	822,0	780,0	602,0	408,0	4417,0	Maktaaral (southernmost zone)

We have also calculated the necessary amounts of active temperatures for the maturation of the main crops that are cultivated on irrigated lands (Table 2).

Table 2 – The necessary amounts of active temperatures for the ripening of crops

Agricultural crops		The required amount of active temperatures, in degrees		Number of days
		from	before	
1		2	3	4
Corn for grain		2150	2395	120-130
Corn for silage		1830	1950	70-88
Rapeseed		2534	2845	110-120
Barley		1400	1600	55-111
Oats		1350	1650	70-100
Winter wheat	in autumn	550	580	250-310
	in summer	950	1200	
Winter triticale	in autumn	600	650	250-310
	in summer	1000	1300	

Using these data, any farmer or the head of farms in various regions can choose the right crop, both basic and intermediate, and receive two harvests a year, thereby effectively using irrigated land and receiving high incomes.

Based on these data and the results of the research work carried out by us and other research institutions, approximate recommendations for obtaining two harvests per year by crops and regions will be compiled.

For intensive use of irrigated lands, along with temperature conditions, hydrological conditions, that is, the availability of water resources, are important.

There were 2.3 million hectares of irrigated land in Kazakhstan until 1991. Occupying 5-6% of the total structure of sown areas, they provided up to 35% of crop production. Currently, about 1.4 million people are used in agricultural production hectares of irrigated land, of which about 95% are located in the southern regions of the Republic. Of these irrigated lands, 1.1 million hectares or 79% are watered by surface method, 104 thousand hectares by flooding, and only 200 thousand hectares are watered by water-saving technologies (drip, subsurface, sprinkling), which is 13.5%.

The annual surface water runoff of the Republic is 90-100 km^i, of which only 51 km^i is formed on the territory of the Republic, and the rest of the water flows come from other countries.

Therefore, the sustainable development of irrigated agriculture in the Southern region of Kazakhstan can be achieved by the introduction of water-saving technologies and modern irrigation technology. This will make it possible to effectively use the temperature regime and water resources of the region and intensively use irrigated lands by obtaining two or three harvests per year.

The character of growth and development of the studied main crops. In our field experiments on intensive use of irrigated lands winter barley crops were taken as a control variant, where after harvesting barley for seeds intermediate crops were not sown, the irrigated field was empty until autumn. Along with winter barley, winter crops of triticale and rape were sown as main crops, and from spring crops - joint crops of oats and peas, oats and alfalfa.

The results of observations of growth, development and accumulation of above-ground mass of the main crops showed that from early spring these crops grow intensively and accumulate maximum above-ground mass (Figure 1).

Figure 1 - Observations on growth and development of winter crops: triticale and rape

The results of observations of growth and development of main crops in the tubing phase are given in Table 3.

Table 3 – Growth, development and accumulation of aboveground mass of main crops in the tubulation phase on an area of 1 m² (average data for 2021-2023)

Main crops	Average number of plants, pcs/m²	Average		Weight, gr.	
		Plant height, cm	bushiness of plants, pcs.	raw mass	dry mass
Barley for grain	28	53	15	2 280	1 150
Rapeseed for green mass	62	72	-	3 650	1 540
Triticale per green mass	32	58	16	2 664	1 243
Alfalfa	80	30	-	1 050	520

As can be seen from the data in the table, a very high bushiness of winter crops of barley and triticale was established. Seeding rate of these crops was only 30 kg/ha. The highest accumulation of crude and dry mass (2664, 1243 g) is observed in triticale crop.

Annual observations of growth, development and accumulation of above-ground mass of spring main crops - joint sowing of oats and peas were carried out, the average results of which are shown in Table 4.

Table 4 – Growth, development and accumulation of aboveground mass of spring main crops – joint sowing of oats and peas on an area of 1 m², (average data for 2021-2023)

Crops	Average number of plants, pcs/m²	Average		Weight, gr.	
		plant height, cm	bushiness, pcs.	raw mass	dry mass
Oats	64	32	6	750	367
Peas	52	25	-	330	178

Growth and accumulation of above-ground mass of spring main crops - oats and peas - is slow compared to winter crops. The bushiness of oats was only 6 pieces, while in winter crops the bushiness was up to 15-16 pieces.

In our field experiments, observations on growth, development and accumulation of above-ground mass of main crops in the earing phase were carried out, the results of which are shown in Table 5.

Table 5 – Results of observations on the accumulation of the aboveground mass of winter crops – the main crops in the earing phase on an area of 1 mᵌ (average data for 2021-2023)

Crops	Number of plants, pcs/ m^2	Average		Average		Biological yield of green mass, c/ha
		plant height, cm	plant height, cm	raw mass	dry mass	
Barley (control)	28	92	15	4 672	2 100	467
Rape	62	115	-	5 810	2 510	581
Triticale	32	108	16	5 490	2 140	549
Alfalfa (1st slope)		85	-	1 750	830	175

As can be seen from the data given in the table, triticale in the earing phase gains an average height of 108 cm, and rapeseed 115 cm.

According to the accepted scheme of experiments, winter triticale and rapeseed were harvested annually for green mass on May 15 and 17, and winter barley was left as a control option until the grains ripened. The yield of the green mass of winter rape and triticale crops averaged 584, 554 c/ha, respectively. After harvesting winter triticale and rapeseed for green mass, intermediate crops – corn for grain - were sown in these fields on May 17 and 18.

Field experiments continued to monitor the growth and development of spring main crops of oats and peas (Figure 6). The results showed that joint sowing of oats and peas can be harvested on a green mass on June 10-12 in the phase of earing oats and pea fruit formation. The results of the observations are shown in Table 6.

Table 6 – Results of observations on the development of oat and pea crops (joint sowing) on an area of 1 м^2 (average data for 2021-2023)

Crops	Average (her)			Weight of the mass, gr		Biological yield of green mass, c/ha
	plant height, cm	bushiness, pcs.	number of plants, pcs/ m^2	raw	dry	
Oats	92	6	64	4 230	1 910	423
Peas	55	-	52	1 490	680	149
Total	-	-	-	5 720	2 590	572

With joint crops, oats and peas gain sufficient height by the beginning of the earing and fruit formation phase: oats – 92 cm, peas – 55 cm, as a result, they gain a good aboveground green mass – 4,230 and 1,490 grams per square meter. The biological yield of the green mass of the joint sowing of oats and peas was 572 kg/ha.

After harvesting the joint sowing of oats and peas (12.06-15.06), an intercrop, sorghum, was sown in this field.

Yield of major crops. Yield is the most important performance indicator. It reflects the impact of natural and economic conditions in which agriculture is carried out, the level of agricultural technology and culture of farming, the quality of organisation and management of production. It is through the growth of yields can provide a comprehensive solution to the problem of increasing production volume while reducing the cost of production.

For further development of crop yield increase and preparation of high quality fodder for livestock it is necessary to effectively and intensively use irrigated lands during the whole vegetation period by introducing moisture-saving irrigation methods and innovative crop cultivation technologies.

Bioclimatic potential of southern and south-eastern regions of Kazakhstan, where irrigated farming is developed, is quite suitable for intensive use of irrigated lands from early spring to deep

autumn. With proper selection of sown crops during the vegetation period it is possible to get additional yield of intercrops.

In our field experiments, research works were conducted to establish ways of effective utilisation of irrigated lands by sowing main and intermediate crops on the same field.

As the main crops, according to the scheme of the experiment, we sowed winter barley (control variant), winter triticale and rape for green mass and for grain and joint spring sowing of oats and peas for green mass, oats with sowing of alfalfa.

Intensive growth and accumulation of above-ground mass of main crops influenced their yields, Table 7.

Table 7 – Yield of main crops, c/ha

Cultures		Yield, c/ha							
		grains				green mass			
		2021	2022	2023	average	2021	2022	2023	average
Winter barley (control)		57,6	56,4	56,0	56,6	-	-	-	-
Winter rapeseed		25,2	24,3	24,1	24,5	676	581	495	584
Winter triticale		63,8	62,7	59,5	62,0	648	549	465	554
Joint seeding	Oats	-	-	-	-	473	423	404	433
	Peas	-	-	-	-	153	149	138	146
	Total	-	-	-	-	626	572	540	579

The main winter crops of triticale, rape and green mass were harvested on 15 and 17 May and their green mass yields averaged 554 and 584 kg/ha, respectively. Half of the rape and triticale crops were left to ripen to grain. This part of the crops was harvested on 07-10 July, with an average grain yield of 24.5 kg/ha for rape and 62.0 kg/ha for winter triticale. On the control variant, where winter barley crops were sown, the average yield was 56.6 c/ha.

Spring crops of main crops - joint sowing of oats and peas were harvested on 10-12 June, and the total yield of green mass was 579 kg/ha (Table 7).

Conclusions

Based on the data obtained from the results of research work for 2021-2023 on the intensive use of irrigated lands and literature data, the following conclusions can be drawn:

1. Assessment of hydrothermal conditions in the south-east of Kazakhstan, calculations of crop needs in the sum of active temperatures and the actual sum of positive – active temperatures and the results of field studies have shown that in the conditions of Almaty, Zhetysu, Zhambyl and Turkestan regions, with the introduction of new resource-saving technologies, it is possible to obtain two crops per year;

2. Joint sowing of oats and peas, sown early in spring, creates opportunities for obtaining a high–quality crop of green mass on average - 579 c/ha by June 10-12 and intermediate sowing of sorghum in the same field makes it possible to obtain an additional crop of green mass of sorghum with an average of 629 c/ ha;

3. Winter triticale has been growing and developing intensively since early spring and accumulates 5,490 grams of raw and 2,140 grams of dry mass from 1 m^2 of area during the earing phase. In this phase, the yield of green mass averaged 554 c/ha, and during the full phase of development, the grain yield was 62.0 c/ha;

4. The results of observations of the growth and development of winter rapeseed showed that by May 14-16, it is possible to obtain a high–quality harvest of green mass in the range of – 584 c / ha, and with the passage of the full phase of development - 24.5 c / ha of grain.

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ӨСІРУ АЙМАҚТАРЫНЫҢ БИОКЛИМАТТЫҚ ӘЛЕУЕТІНЕ БАЙЛАНЫСТЫ СУҒАРМАЛЫ ЖЕРЛЕРДІ ҚАРҚЫНДЫ ПАЙДАЛАНУ ҮШІН ДӘСТҮРЛІ ЕМЕС ДАҚЫЛДАРДЫ ІРІКТЕУ

Аңдатпа

Мақалада өсіру аймақтарының биоклиматтық әлеуетіне байланысты суғармалы жерлерді қарқынды пайдалану үшін дәстүрлі емес дақылдарды іріктеу бойынша зерттеулердің нәтижелері ұсынылған. Қазақстанның оңтүстік-шығысының гидротермиялық жағдайларын бағалау, ауыл шаруашылығы дақылдарының белсенді температуралар жиынтығына қажеттілігін есептеулер мен оңтайлы және белсенді температуралардың нақты көрсеткіштері мен далалық зерттеулердің нәтижелері Алматы, Жетісу, Жамбыл және Түркістан облыстары жағдайында ресурсүнемдейтін технологияларды енгізу кезінде бір танаптан ауыл шаруашылығы дақылдарынан жылына екі өнімін алуға болатынын көрсетті.

Жаздық негізгі дақылдар - сұлы мен бұршақтың жер үсті массасының өсуі мен жинақталуы күздік дақылдарымен салыстырғанда баяу өседі. Сұлының бұталары тек 6 дана болды, ал күздік дақылдарында бұталар саны 15-16 данаға дейін жетті. Тритикале масақтану фазасында орта есеппен 108 см биіктікке жетеді, ал рапс 115 см болды. Көк және құрғақ массаның ең көп жиналуы тритикале (2664, 1243 гр.) дақылында байқалады.

Рапс күздік дақылдарының көк масса өнімділігі орта есеппен 584 ц/га, тритикаледе - 554 ц/га құрады. Бірге егілген егістіктерде сұлы мен бұршақтың масақтану пен жеміс түзу кезеңінің басында жеткілікті биіктікке ие болады: сұлы – 92 см, бұршақ – 55 см, нәтижесінде бір шаршы метрден олар жақсы жер үсті көк массасын құрайды - 4 230 және 1 490 грамм. Бірге егілген сұлы мен бұршақтың көк массасының биологиялық өнімділігі 572 ц/га құрады.

Негізгі күздік дақылдары тритикале мен рапсты көк массаға 15 және 17 мамырда орып алынды, яғни олардың көк массасының өнімділігі сәйкесінше орта есеппен 554 және 584 ц/га құрады. Рапс пен тритикале дақылдарының жартысы дәнге дейін пісуге қалдырылды. Дақылдардың бұл бөлігі 07-10 шілдеде жиналды, рапс дәнінің орташа өнімділігі 24,5 ц/га, ал тритикале 62,0 ц/га құрады. Күздік арпа егілген бақылау нұсқасында орташа өнімділік 56,6 ц/га құрады.

Бірге егілген негізгі жаздық дақылдары сұлы мен бұршақты 10-12 маусымда жиналды және жасыл массаның жалпы өнімділігі 579 ц/га құрады.

Кілт сөздер: негізгі дақылдар, тамшылатып суғару, биометрия, өнімділік.

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ПОДБОР НЕТРАДИЦИОННЫХ КУЛЬТУР ДЛЯ ИНТЕНСИВНОГО ИСПОЛЬЗОВАНИЯ ОРОШАЕМЫХ ЗЕМЕЛЬ В ЗАВИСИМОСТИ ОТ БИОКЛИМАТИЧЕСКОГО ПОТЕНЦИАЛА ЗОН ВЫРАЩИВАНИЯ

Аннотация

Представлены результаты исследований подбора нетрадиционных культур для интенсивного использования орошаемых земель в зависимости от биоклиматического потенциала зон выращивания. Оценка гидротермических условий юго-востока Казахстана, расчеты потребности сельскохозяйственных культур в сумме активных температур и фактические суммы положительных, активных температур и результаты полевых исследований показали, что в условиях Алматинской, Жетысуской, Жамбылской и Туркестанской областей при внедрении новых ресурсосберегающих технологий можно получать в год два урожая сельскохозяйственных культур.

Рост и накопление надземной массы яровых основных культур – овса и гороха идет медленно по сравнению с культурами озимого посева. Кустистость овса составила всего 6 шт., тогда как у культур озимого посева кустистость доходила до 15-16 шт. Тритикале в фазу колошения набирает высоту в среднем 108 см, а рапс 115 см. Самое максимальное накопление сырой и сухой массы (2664, 1243 гр.) наблюдается у культуры тритикале.

Урожайность зеленой массы озимых культур у рапса составила в среднем 584 ц/га, у тритикале - 554 ц/га. При совместных посевах овес и горох к началу фазы колошения и плодообразования набирают достаточную высоту: овес – 92 см, горох – 55 см, в результате набирают хорошую надземную зеленую массу – 4 230 и 1 490 граммов с одного квадратного метра. Биологический урожай зеленой массы совместного посева овса и гороха составил 572 ц/га.

Основные озимые культуры тритикале, рапс и на зеленую массу были убраны 15 и 17 мая и их урожайности зеленой массы в среднем составили 554 и 584 ц/га соответственно. Половина посевов рапса и тритикале были оставлены для дозревания до зерна. Эта часть посевов была убрана 07-10 июля, при этом средняя урожайность зерна рапса составила 24,5 ц/га, а озимого тритикале 62,0 ц/га. На контрольном варианте, где были проведены посевы озимого ячменя, средняя урожайность составила 56,6 ц/га.

Яровые посевы основных культур – совместный посев овса и гороха были убраны 10-12 июня, и общая урожайность зеленой массы составила 579 ц/га.

Ключевые слова: основные культуры, капельное орошение, биометрия, урожайность.

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