зависимы от различных условий внешней среды. Именно условия внешней среды влияют на их активность в почве.

В данной работе описываются показатели ферментативной активности залежных почв в зависимости от способов их обработки. Почвенно-экологические исследования нацелены на отслеживание изменений по биологической активности, происходящих в почве под воздействием агротехнологических мероприятий таких как глубокая вспашка, плоскорезная обработка и мелкое рыхление. Для характеристики общей ферментативной активности почвы изучались наиболее распространенные ферменты, свойственные подавляющему большинству почвенной микрофлоры – каталаза, инвертаза, уреаза. Выявлена зависимость между нарастанием ферментативной активности почв и способами обработки направленных в сторону улучшения их физико-химических свойств.

RESUME

Currently, the deterioration of technological disipline and intensive use of land cause a decrease in land fertility and deterioration of their agrophysical properties. Environmentally sound farming systems are needed to ensure an increase in their biological indicators. To maintain and reproduce fertility, it is necessary to dynamically monitor the state of soil microflora and, accordingly, enzymes that, taking part in the destruction of various types of residues (plant, animal, microbial), increase fertility. Enzymes by their nature are very active, have a strict nature of action, they are highly dependent on various environmental conditions. It is the environmental conditions that affect their activity in the soil.

This paper describes the indicators of enzymatic activity of fallow soils, depending on the methods of their treatment. Soil-ecological studies are aimed at tracking changes in biological activity that occur in the soil under the influence of agrotechnological measures such as deep plowing, flat-cutting processing and fine loosening. To characterize the overall enzymatic activity of the soil, the most common enzymes characteristic of the vast majority of soil microflora – catalase, invertase, urease-were studied.

The dependence between the increase in the enzymatic activity of soils and the methods of treatment aimed at improving their physical and chemical properties is revealed.

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USE OF SUDANESE GRASS IN MIXED CROPS

Abstract

An important factor in increasing the efficiency of crop diversification in West Kazakhstan and reducing the dependence of crop productivity on weather conditions is the expansion of crops most adapted to unsustainable humidification of plants such as chickpeas, Sudan grass, sorghum, corn and sunflower. One of the ways to increase the productivity of Sudanese grass is to use its mixed crops with chickpeas, sunflower, corn and sorghum. Mixtures due to the best quality indicators of feed provide the maximum yield of feed units and digestible protein. The article presents research data on the study of mixed crops of Sudanese grass with annual crops in the conditions of the 1st dry-steppe zone of Western Kazakhstan. A comparative test of mixed crops by yield from digestible protein area units revealed the most nutritionally valuable mixtures. So, in the research of 2018-2020, the largest yield for digestible protein was obtained on the variant using sunflower for silage mixed with Sudan grass (1.65 c/ha), slightly lower on the versions of using a mixture of Sudan grass and corn for silage (1.58 c/ha) and a mixture of sorghum and Sudan grass for silage (1.55 c/ha). The use of mixed crops of Sudan grass with annual fodder crops is an important reserve for the production of fodder, while mixtures with the participation of Sudan grass are advisable to be used both for the production of green fodder (Sudan grass + chickpeas) and for the provision of animals with silage mass (Sudan grass + sorghum, Sudan grass + corn, Sudan grass + sunflower).

Keywords: *Sudan grass, mixed crops, green fodder, haylage, silage, yield, feed value*

Solving the problem of animal husbandry development is closely related to strengthening the feed base. Weak and unstable food supply is a widespread phenomenon in the West Kazakhstan region. In field forage production, the acreage was significantly reduced, and the yield of forage crops decreased. The set of crops has been narrowed to forage crops (barley, oats, wheat forage). In the structure of arable land, up to

76% is monoculture wheat, barley accounts for 20.2% of arable land, millet and winter rye account for 2.1 and 1.3%, respectively, and the remaining grains (including forage) occupy 0.4%. To date, the production of feed using advanced technologies has actually been discontinued. As in previous times, the creation of a reliable, balanced feed base and a sharp reduction in feed loss during harvesting is largely determined by the correct organization of feed production and harvesting [1, 2].

Creating a valuable feed base for livestock development depends on both the correct set of crops and the biological characteristics of these crops. Therefore, in accordance with the purpose of our research, we studied the biological features of growth and development, formation of productivity of various crops in the conditions of zone 1 of the West Kazakhstan region.

One way to increase the productivity of Sudan grass is to use mixed crops with chickpeas, sunflower, corn and sorghum. Mixtures due to the best quality parameters of the feed provide maximum yield of feed units and digestible protein. The use of mixed crops makes it possible to reduce the intensity of field work and obtain high-quality feed in a longer period of time in the green conveyor system, as well as harvest them for green feed, hay, haylage and silage. The high efficiency of mixed crops of Sudan grass with corn, Sudan grass and chickpeas, Sudan grass and sunflower was determined on the experiments of many scientists from near and far abroad [3, 4].

The research is carried out on the experimental field of Zhangir Khan West Kazakhstan Agricultural and Technical University. (Republic of Kazakhstan, Uralsk).

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The area of plots during cultivation of fodder crops is 50 m^2, repetition is three times, location of plots is rendomized.

Zoned varieties of fodder crops were used in the experiments. The norm for sowing seeds of studied crops is recommended for the dry-steppe zone of West Kazakhstan region. The system of soil treatment for fodder crops adopted in the 1st zone of West Kazakhstan. Nitrogen and phosphorus mineral fertilizers were used in the research on fodder crops in the recommended doses for the region.

During field tests, accounting, observation of the beginning of phenological phases and growth of Sudan grass were carried out according to generally accepted methods [5]. Photosynthetic activity of Sudan grass crops was studied according to the generally accepted method [6]. Harvesting and registration of crops is performed by continuous method.

Based on the results of chemical analysis of green mass of Sudan grass, bioenergetic evaluation of the studied methods was carried out according to the accepted method [7]. Statistical processing of the study results was carried out by the method of dispersion analysis [8], statistical graphs were constructed using the program Statistica 6.0.

According to the morphological features of genetic horizons of the profile and agrochemical indicators of arable soil layer, soils of the experimental sites are characteristic for 1 dry-steppe zone of West Kazakhstan.

In the process of studying mixed crops of annual crops, we observed the duration of the phases of growth and development of their components. Phenological observations during the years of research showed that the duration of the phases of development of cultures varies depending on their species and biological characteristics.

As the data of our research of 2018-2020 show, in the studied crops of mixed crops, the duration of mowing period is different. The different duration of mowing ripeness of mixed crops allows you to create a conveyor for the uninterrupted supply of fodder products throughout the spring-summer season for the production of green feed, haylage and silage.

The denseness of plants and their survival during vegetation are important indicators that largely determine the level of productivity of agrocenoses.

Studies show that, on average, over the years of research, the actual density of plants in mixed crops of Sudan grass and annual fodder crops was close to the target one. In the mixed crops of Sudan grass and chickpeas during full seedlings, the actual density of Sudan grass was 715 thousand pcs/ha, and chickpeas 37.6 thousand pcs/ha. In the mixed crops with Sudan grass during full seedlings, the actual density of corn and sunflower crops was 29.16 thousand pcs/ha, respectively. By the beginning of vegetation, the density of sown sorghum crops together with Sudan grass was 29.60 thousand pcs/ha.

For the production of harvest, the preservation of crops is of great importance. During vegetation, under the influence of various factors, partial plant outburst is observed. The percentage of preserved plants

in relation to the come up makes it possible to assess the preservation of plants. At the same time, the preservation of plants depended both on the species composition of the components and on the timing of harvesting agrophytocenoses, as well as the prevailing weather conditions during vegetation.

In our research of 2018-2020 in the dry steppe zone, the preservation of Sudan grass plants in mixed crops with annual fodder crops for the vegetation period with 1 harvesting period ranged from 80.50 (sowing with sorghum) to 80.71% (mixed crops with corn).

Annual fodder crops sown together with Sudan grass when harvesting for green fodder (chickpeas) and haylage (sorghum, corn, sunflower) were not equally influenced by Sudan grass. At the same time, when sowing together with Sudan grass, the greatest preservation of plants was noted in sunflower - 86.70%. Corn crops sown in a mixture with Sudan grass are in second place in terms of safety - 84.11%. Sorghum withstood the least competition from Sudan grass (safety 80.70%) as well as chickpeas (safety 83.46 %).

With a further delay in the harvesting period of mixed crops until the flowering-pouring phase of Sudan grass grains, there is a fall of plants from plant formation. At the same time, the relatively high preservation of plants was noted in sunflower 84.21%, as well as in corn - 77.27%. Relatively more plant fallout during the vegetation period during harvesting for silage was determined at sorghum (safety 69.90 %).

On average for 3 years of research (2018-2020), when cultivated for silage, the highest safety of Sudan grass was noted in joint crops with sorghum (75.86%). When harvesting mixed sowing with sunflower for silage, the safety of Sudan grass plants is 74.68%. The least safety when harvesting for silage was determined in plants of Sudan grass sown with corn (72.98%), which is associated with great competition from corn.

Thus, it can be noted that in the mixture of the culture of Sudan grass, sorghum and chickpeas are well combined with each other and do not have a restraining effect in mixed sowing.

When harvesting for silage, sunflower is the largest competitor to Sudan grass. When sown in the mixture, Sudan grass also experiences higher competition from corn. At the same time, the competition of plants increases with a delay in the harvesting period for silage.

In the research of 2018-2020 on the study of mixed crops, the following data were obtained on the productivity of agrophytocenoses: the yield of green mass on the option of joint sowing of Sudan grass and chickpeas was 65.01 c/ha, which in terms of dry mass was 12.10 c/ha. On average for 3 years, on the option of joint sowing of Sudan grass and corn when harvesting for haylage, the productivity of green mass was 77.36 c/ha, dry mass 13.90 c/ha. The harvest of green mass during harvesting of joint crops of Sudan grass and corn for silage increased to 121.61 c/ha, and the harvest of dry mass was 22.54 c/ha. On average for 2018-2020, on the version of sowing Sudan grass + sunflower, these indicators when harvesting for haylage were 86.24 and 15.22 c/ha and 129.93 and 24.40 c/ha when harvesting for silage. On the sowing of a mixture of Sudan grass and sorghum at early harvesting for haylage, the green mass harvest was 71.93 c/ha at a dry mass yield of 13.09 c/ha. Joint sowing of Sudan grass and sorghum during harvesting on average for 2018-2020 ensured green mass yield at the level of 111.21, dry mass - 20.28 c/ha (Table 1).

Thus, in the research of 2018-2020, the greatest yield of both green and dry mass was noted on the version of joint sowing of Sudan grass and sunflower.

In general, the weather conditions of 2018-2020 had a positive impact on the growth processes of plants of mixed agrophytocenoses. By the time of harvesting for silage, the components of the mixed crops were able to form a productive plant formation.

On average for 3 years, when harvesting mixed agrophytocenoses for silage, the trend set during harvesting for haylage also remains. At the same time, the highest harvest of green (129.93 c/ha) and dry mass (24.40 c/ha) was obtained when cultivating Sudan grass in a mixture with sunflower. The productivity of the mixture of Sudan grass and sorghum for harvesting green and dry mass was at 111.21 and 20.28 c/ha. When harvesting for silage, the intermediate position in terms of productivity is occupied by a mixture of Sudan grass and corn - 121.61 c/ha green mass, 22.54 c/ha dry mass.

A comparative test of mixed crops by yield from digestible protein area units revealed the most nutritionally valuable mixtures. So, in the research of 2018-2020, the largest yield for digestible protein was obtained on the variant using sunflower for silage mixed with Sudan grass (1.65 c/ha), slightly lower on the versions of using a mixture of Sudan grass and corn for silage (1.58 c/ha) and a mixture of sorghum and Sudan grass for silage (1.55 c/ha). On average for 3 years, when using mixed crops of Sudan grass and sorghum when harvesting for haylage and silage, the productivity of agrophytocenoses at the yield of digested protein was at 1.12 and 1.55 c/ha. In the early harvesting of the mixture of Sudan grass with chickpeas for green food, the harvest of digested protein reaches 1.24 c/ha. When using joint crops of corn

and Sudan grass, depending on the harvesting time, the productivity of crops for harvesting digested protein ranges from 1.08 (haylage) to 1.58 c/ha (silage).

Table 1 – Productivity and feed value of mixed crops of fodder crops depending on harvesting time in the 1st zone of West Kazakhstan, average for 2018-2020

Options of mixed crops	Green mass, c/ha	Dry matter, c/ha	Digestible protein harvesting, c/ha	Collection of feed units, c/ha	Exchange energy output, GJ/ha	Provision of feed units with protein, g
1 harvesting period						
Sudan grass + chickpeas for green food	65,01	12,10	1,24	10,89	11,93	114
Sudan grass + sorghum for haylage	71,93	13,09	1,12	11,07	12,64	101
Sudan grass + corn for haylage	77,36	13,90	1,08	11,90	12,85	91
Sudan grass + sunflower for haylage	86,24	15,22	1,07	12,67	14,07	84
2 harvesting period						
Sudan grass + sorghum for silage	111,21	20,28	1,55	16,84	19,49	92
Sudan grass + corn for silage	121,61	22,54	1,58	18,85	20,80	84
Sudan grass + sunflower for silage	129,93	24,40	1,65	19,76	22,52	83

Assessment of fodder and energy advantages of crops was carried out on the output of fodder units and exchange, as well as on the availability of fodder units with protein. On average, in the first version of the harvesting period, according to these indicators, the productivity of the mixture of Sudan grass and sunflower was relatively higher: 12.67 c/ha of feed units and 14.07 GJ/ha of exchange energy, while the supply of feed units with protein was 84 g.

When harvesting for haylage, the collection of feed units from mixed crops of Sudan grass with sorghum and corn was 11.0 and 11.90 c/ha, with an exchange energy output of 12.64 and 12.85 GJ/ha. In the first term of harvesting, the highest supply of feed units with protein was obtained on the version of the mixture of Sudan grass and chickpeas for green feed - 114 g. On this version, on average for 2018-2020, the yield of feed units is at the level of 10.89 c/ha, exchange energy 11.93 GJ/ha.

In terms of productivity and fodder value, early harvesting of mixed crops of Sudan grass with annual fodder crops is inferior to later harvesting for silage use, according to the research in 2019-2020. When harvesting for silage, the largest collection of feed units was obtained on the version of use as a component of mixed sowing of Sudan grass and sunflower - 19.76 c/ha. This two-component mixture, in comparison with other versions of mixed crops, provided a maximum collection of exchange energy of 22.52 GJ/ha.

When using mixed crops of Sudan grass and sorghum for silage, the collection of feed units and exchange energy was minimal and amounted to 16.84 c/ha and 19.49 GJ/ha, respectively. When harvesting for silage for fodder and energy value, the intermediate position is occupied by a mixture of Sudan grass + corn - 18.85 c/ha fodder units and 20.80 GJ/ha exchange energy. On average for 3 years when harvesting for silage, a relatively high level of protein supply of feed units was noted on Sudan grass version in combination with sorghum (92 g). For mixed crops, Sudan grass + corn and Sudan grass + sunflower were 84 and 83 g, respectively.

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ТҮЙІН

Батыс Қазақстанда өсімдік шаруашылығын әртараптандыру тиімділігін арттыру мен дақылдар өнімділігінің ауа райы жағдайларына тәуелділігін азайтудың маңызды факторы нұт, судан шөбі, құмай, жүгері және күнбағыс сияқты жауын-шашын, ылғал тұрақсыздығына төзімді өсімдіктер егістерін кеңейту болып табылады.

Судан шөбінің өнімділігін арттыру жолдарының бірі оны нұтпен, күнбағыспен, жүгерімен және құмаймен араластырып егу болып табылады. Бұл аралас егістер мал азығының керемет сапасы есебінен мал азығы бірлігінен мейлінше мол өнім және сіңімді протеин алуға мүмкіндік береді. Мақалада Батыс Қазақстанның 1 құрғақ дала аймағы жағдайында біржылдық дақылдар мен судан шөбінің аралас дақылдарын зерттеу деректері келтірілген.

Зерттеулер Жәңгір хан атындағы Батыс Қазақстан аграрлық-техникалық университетінің тәжірибелік танаптарында қабылданған әдістемелерге сәйкес жүргізілді. 2018-2020 жылдардағы аралас егістерге қатысты зерттеулерде агрофитоценоздардың өнімділігі бойынша жасыл масса мен құрғақ массаның ең үлкен шығымы 2018-2020 жылдардағы зерттеулерде судан шөбі мен күнбағыстың аралас егісінен алынды.

Бір жылдық жем-шөп дақылдарымен судан шөбінің аралас егістіктерін пайдалану жемшөп өндірісінің маңызды резерві болып табылады, бұл ретте судан шөбінің қатысуымен қоспаларды жасыл жемшөп өндіру үшін де (судан шөбі+ноқат), сондай-ақ суыл шаруашылығы жануарларын пішендік және сүрлемдік массамен (судан шөбі+құмай, судан шөбі+жүгері, судан шөбі+күнбағыс) қамтамасыз ету үшін де пайдаланған орынды.

РЕЗЮМЕ

Важным фактором повышения эффективности диверсификации растениеводства в Западном Казахстане и снижения зависимости продуктивности культур от погодных условий является расширение посевов наиболее приспособленных к неустойчивому увлажнению растений, таких как нут, суданская трава, сорго, кукуруза и подсолнечник.

Одним из путей увеличения продуктивности суданской травы является использование смешанных ее посевов с нутом, подсолнечником, кукурузой и сорго. Смеси за счет лучших качественных показателей корма обеспечивают максимальный выход кормовых единиц и переваримого протеина. В статье приводятся данные исследований по изучению смешанных посевов суданской травы с однолетними культурами в условиях 1 сухо-степной зоны Западного Казахстана.

Исследования проводились на опытном поле Западно-Казахстанского аграрно-технического университета имени Жангир хана согласно принятых методик. В исследованиях 2018-2020 годов наибольший выход как зеленой, так и сухой массы отмечен на варианте совместного посева суданской травы и подсолнечника.

Использование смешанных посевов суданской травы с однолетними кормовыми культурами является важным резервом производства кормов, при этом смеси с участием суданской травы целесообразно использовать как для производства зеленого корма (суданская трава+нут), так и для обеспечения с.х. животных сенажной и силосной массой (суданская трава+сорго, суданская трава+кукуруза, суданская трава+подсолнечник).