Ways to improve the quality of fodder in irrigated agriculture of the Republic of Dagestan

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Abstract

Animal husbandry is the most important branch of the agro-industrial complex of the Republic of Dagestan. Its level of development largely depends on the food supply. The low productivity of animal husbandry in recent years is primarily due to the lack of a sufficient amount of high-quality fodder in the republic. To increase the efficiency of livestock production, urgent measures are needed to improve the fodder base: to upgrade the cultivation technologies for fodder crops, considering the existing economic, environmental, and soil-climatic conditions, to introduce new higher-yielding varieties and hybrids of fodder crops into production to produce a sufficient amount of high-quality fodder, to increase the quality of harvesting and storage of fodder, etc. All this can help to increase the yield of forage crops and their production. The main goals of fodder production in the republic are 1) An increase in the production of a sufficient amount of succulent, coarse, green, and other fodder, 2) Improvement of the quality composition of fodder for an adequate diet, 3) Introduction of resource-saving technologies for the cultivation of forage crops and the highly mechanized and automated production of forage. A sustainable forage base can be created by increasing the utilization efficiency of the forage field, organizing scientifically grounded conveyors for the production of green forage and a raw material base for harvesting hay,

haylage, and silage, preparing grass meal, granules, and briquettes, introducing progressive technologies for harvesting and storing forage.

Keywords: fodder, quality, green conveyor, vegetable protein, sugar sorghum.

1. Introduction

The problem of vegetable protein production is aggravating every year. Protein content in feed per 1 feed unit should be on average 110-115 g. Today in the Republic of Dagestan, this figure is only 60-70 g. Protein deficiency in plant feed leads to a decrease in the productivity of animals, causes overconsumption of feed by 1.5 times, and, as a result, the cost of livestock products increases (Babushkina et al., 2018; Cruz & Soussana, 1997; Fujita et al., 1992; Islamgulov et al., 2019; Mohammed & Ahmed, 2018; Toropova et al., 2013).

This problem in crop production is generally solved by increasing the protein content in plant feed, increasing yields, and dry matter yield (Gerardo-Rodríguez et al., 2021). This requires improving the structure of forage crops, introducing scientifically grounded field and forage crop rotations, increasing the utilization efficiency of organic and mineral fertilizers, widely introducing mixed crops using new high-protein varieties and hybrids of forage crops, implementing a set of measures for agrotechnical, chemical, and especially biological means of protecting plants from pests and diseases (Almodares et al., 2009; Bayu et al., 2006; Ehrmann & Ritz, 2014; Katkar et al., 2011; Muslimov & Shishkhalilov, 2011).

Improving the structure of forage crops. The main suppliers of protein are leguminous crops (peas, rank, soy, etc.). Barley and oats should hold a worthy place among forage crops. The introduction of highly leased corn is also of great importance. Given the arid climate, a special place belongs to the expansion of areas for drought-resistant sorghum crops-sorghum, Sudan grass, sorghum-Sudanese hybrids (Chapagain et al., 2020; Magomedova et al., 2020; Rao et al., 2019; Shkodina et al., 2019; Velkova et al., 2021).

An important reserve for increasing the production of vegetable protein is grass planting, especially alfalfa, sainfoin, and sweet clover. In this regard, perennial grasses should account for 30–40% of the structure of forage lands (Babushkina et al., 2018; Boonman & Mikhalev, 2005; Didur et al., 2021).

An additional source of valuable protein in the arid conditions of the republic can be feeding sunflowers. In addition to protein, its sugar content (protein-sugar ratio) is of great importance as a feed. In this regard, sorghum crops with high sugar content are of great importance. They should occupy a worthy place in the structure of sown areas.

The role of the cultivar in higher plant protein content. Triticale with a high protein content is of considerable interest as a forage crop. New varieties of barley have been created with a protein content of up to 13-16%. Highly leasing lines of maize were obtained with the protein content of 13.9-16.8% and lysine of 4.4-5.0%.

The farms usually grow one variety of each crop. This is the main reason for long intervals between mowing some crops and sowing others. Therefore, it is advisable to use for each crop at least three varieties of different maturity groups (Bulakhtina et al., 2019; Crego et al., 2021; Kapustin et al., 2018; Nasiyev et al., 2020; Rurinda et al., 2014).

2. Materials and Methods

In arid and semiarid countries, reducing agricultural water usage while maintaining or boosting agricultural economic production is a key issue. Irrigated agriculture is a major user of fresh water in many areas of the world, especially in arid and semiarid regions like

Jordan and the Gulf Cooperation Council (GCC) countries. The demand for restricted water resources in these nations is growing with time, both for agricultural and non-agricultural reasons. In recent years, Jordan and the GCC nations, as well as many other nations in the area, have faced acute food shortages for cattle, owing to recurrent droughts and water limitations for irrigation. Many forage-production initiatives have been built in these nations during the last two decades to meet part of their green and dry fodder demands. However, a lack of appropriate freshwater sources may represent a barrier for the field projects' long-term viability, particularly when using groundwater for irrigation, which is utilized in huge volumes in these nations due to high rates of evapotranspiration and soils with limited water retention capacity. As a result, methods and technologies that may help enhance water usage efficiency and production, such as the hydroponic technique, should be given more attention. To study the productivity of some promising varieties and hybrids of sugar sorghum, we conducted our research in the conditions of the plane zone of Dagestan.

3. Results and Discussion

The results showed that the studied varieties and hybrids of sorghum provided high yields of green and dry matter (Table 1). The most yielding hybrid was Zersil, which, on average, over the years of research, formed 61.7 t/ha of green and 17.1 t/ha of dry matter.

Table 1. The yield of varieties of sugar sorghum in the plain zone of Dagestan (average for 2017-2019)

Variety, hybrid	Yield, t/ha		The period from germination to waxy ripeness
	Green matter	Dry matter	
Zernogradskii Iantar	56.2	16.4	102
Debiut	54.1	14.9	90
Zersil	61.7	17.1	101
Severnoe 44	51.0	15.0	87

The effect of fertilizers on the protein content of forage crops. Fertilizers have a significant impact on the quantity and quality of the crop. In particular, nitrogen fertilization can positively influence both the yield and the increase in protein in plants. However, it is necessary to skillfully combine the application of organic and mineral fertilizers, and their doses should be optimal and estimated. Estimated doses of fertilizers contribute to the planned high yields and can improve the quality of products (Amujoyegbe et al., 2007; Artemyev et al., 2019; Nasiyev et al., 2020; Visarada & Aruna, 2019).

We conducted our research on the programmed cultivation of sugar sorghum in the irrigated plane zone of Dagestan. The results showed no significant differences in the chemical composition of sugar sorghum with a balanced application of nitrogen and phosphorus for a given yield (Table 2). The protein content in the absolutely dry matter ranged from 9.47% at a yield of 38.7 t/ha to 9.75 at 80 t/ha of green matter. There were no significant differences in the content of fat, ash, and, especially, the fiber in the dry matter.

Table 2. The chemical composition of sugar sorghum of milky-wax ripeness with the application of mineral fertilizers estimated for nutrient removal with the harvest (average for 2017-2019)

Green matter yield, t/ha		Fertilizer rate for a given yield, kg/ha	Content in absolutely dry mass, %				
planned	actual		protein	oil	ash	fiber	nitrogen-free extractive substances
40	38.7	N_{143} P_{115}	9.47	3.93	6.14	22.31	55.67
60	57.9	N_{220} P_{175}	9.62	4.06	5.67	22.25	55.23
80	78.2	N_{287} P_{235}	9.75	4.14	6.11	22.17	55.01

The role of mixed crops in higher plant protein content. The use of mixed crops of bluegrass and legumes can increase the protein content harvested from each hectare by 15-30%.

Mixed crops of Sudanese grass with vetch and sorghum with soybeans showed to give a higher yield and quality than single-species crops: the content of digestible protein in plants increased to 25-40%. Combined sowing of corn and soy can increase the content of crude protein in plants by 20-25% (Lingle et al., 2012). Intermediate legume-cereal mixtures (vetch + triticale, vetch + oats, vetch + rye, peas + oats, etc.) are highly effective. They increase the yield per unit area, thereby contributing to the intensification of forage production. At the same time, due to the legume component, such mixtures provide food with a high content of vegetable protein (Kashapov et al., 2016; Lingle et al., 2012; Visarada & Aruna, 2019).

Our comparative study of the productivity of sorghum in post-harvest crops and fall sowing in the plane zone of Dagestan showed that post-harvest crops together with the yield of an intermediate legume-cereal mixture (on average 28.5 t/ha) provide a greater amount of green fodder than spring crops (Table 3). This increases the collection of feed units and digestible protein per unit area.

Table 3. Output per 1 ha of sugar sorghum crops in spring and post-harvest crops, t/ha (average for 2017-2019)

Sowing terms	Green matter			Harvesting		Increase	
	Alternate crop	millet	total	fodder unit	digestible protein	green matter	fodder unit
Fall sowing, 20…25.IV	-	61.4	61.4	14.6	1.0	-	-
Postcut, 15…20.V	28.5	58.9	87.6	18.6	2.4	26.2	4.1
Postcut, 10…15.VI	28.5	54.3	82.8	17.6	2.3	21.4	3.1

4. Conclusion

Cereals are widely used for forage production because of their low production costs and ability to produce large amounts of dry matter. Cereals, on the other hand, have low forage quality and nutritional value due to their low protein content. Because high-quality forage is required for optimal animal milk growth and production, the addition of supplements such as protein is required to improve grain forage quality. Cereals mixed with plants of the leguminous family are one of the most common ways to improve forage quality due to the high protein content of legumes. Mixed cultivation, which involves planting dark cereals with legumes, can improve forage quality in the diet.

Cattle mixed breeding, as an agricultural activity involving the simultaneous cultivation of two or more plant species on a plot of land, has a number of advantages over pure cultivation, including better use of environmental resources, reduced pest damage, and reduced labor costs. He cited increased soil fertility as well as improved yield and foraged quality as examples. In one study, it was discovered that growing a mixture of corn and beans improves the protein content of the forage. According to another study, barley mixed cultivation with annual alfalfa is a better alternative to pure barley cultivation when both quality and quantity are considered in forage production.

Thus, the implementation of the above and other measures can contribute to a significant increase in the quantity and quality of fodder for the livestock industry of the Republic of Dagestan and consequently to an increase in the efficiency of livestock production. The irrigated oat-vetch fodder supplemented the fattening sheep's basic diet with high-quality green feed. In addition to irrigated fodder, the study discovered that indigenous tree leaves have the ability to complement agricultural leftovers and improve their feeding value. Increasing the availability and use of such native fodder sources might lower the cost of planted fodder production.

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