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Biochemical Features of Perspective Forage Plants in the Conditions of Southern Part of Aral Sea

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Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

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Case Study

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ABSTRACT

Biochemical features of nontraditional plants such as Columbus grass, Apple Earth, were studied on Southern Aral Sea's conditions. Changing of important organic matters concentration in those plants were studied and monitored. Also specific characters, appearance and constitution of studied plants were listed and photos of those were given as well.

Keywords: Southern aral sea; gumbo; sunfleck; columbus grass; earth apple; amaranth; crotalaria; soya; nitrogen-free extractive fraction.

1. INTRODUCTION

Enrichment of assortment of agricultural crops is one of actual problems of agriculture. Academician N.I. Vavilov noticed that a hallmark of agriculture intensity is not only high efficiency of separate classes and kinds, but also diversity of cultivated plants [1-3], which are able to satisfy requirements of the person and inquiries of a national economy.

New and nonconventional plants' introduction gets an important role in the Southern Aral's condition, which has the tendency of

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desertification and the secondary salinization, where irrigable lands are salted in various degrees. The last 30-40 years we observe that ecological conditions [4-6] in lower reaches of Amu Darya [7] stably retrogress due to a salinization, flooding and degradation the soils, water deterioration. The excessive use of agrochemicals, repeated flushing of the grown have washed away humus and trace substances, reduced number of helpful entomofauna and polluted soil by plant growing products.

Consequently, in the conditions of extreme continental climate of Southern Aral Sea and limitation of irrigation hectare, rational using lands under crops is extremely important. Nonconventional plants [8] which efficiency and nutrient value does not concede and even surpasses traditional kinds, researching and introduction this in practice of agriculture will allow us to successfully solve the whole complex of agrological and social problems.

As precocious, steady against unfavorable factors of environment, perspective cultures for Sothern part of Aral Sea are: an amaranth, the African millet, fodder chick pea, sunn, a sugar sorghum, Columbus's grass, earth apple, etc. These plants promote to increase fertility of lands thanks to the biological features.

It is known that, at introduction plants at the first stages basic researches in developmental biology, photosynthesis and biochemical composition of new plants and their possibility of acclimatization in the conditions of new region of growth have the greatest value. It is necessary to notice also that the insufficient knowledge of chemical potential of a plant and absence of the conforming technologies complicate wide use studied introdients and products of their processing. Thereupon we studied biochemical features of perspective forage plants in is soil-environmental conditions Southern Aral Sea.

2. METHODS AND RESEARCH TECHNOLOGIES

Experiences were made on experimental base of Khorezm Academy named after Mamun and in a plot of the Karakalpakstan State University. Carrying out of experiences, selection and analyses of samples of solid and plants, phenological supervision were carried out with UzNIHI's method [4]. Standard technologies used for cultivation introducents the taking into account biological features of studied plants. Water content and dry matter definition in vegetative samples made the standard weight method. Biochemical analyses made in laboratories ZEF/UNESCO at Urgench State University and the Khorezm Academy named after Mamun on procedures of Institute of Plant Industry [9,4]. Statistical data processing made on B. A. Dospehov [2] with using a package of applied STATISTICS programs.

Within the limits of the yielded report we will briefly review the received results.

3. RESULTS

3.1 Amaranth (*Amaránthus)*

A Amaranth (*Amaranthus tricolor*)-Thanks to high adaptable potential and efficiency Amaranth Became a plant of universal use. In Uzbekistan Amaranth was propagated as fodder culture that could grows up in local soil-environmental conditions and possibility to cultivation that were found in number of kinds of Amaranth. The crop of its green mass from a hectar compounds 600-900 centers. Amaranth is able to give three hay-crops for year, every of three can yield for a

Fig. 1. Flowering Amaranth

season 1800 center or more green mass. Seed production of a grain amaranth compounds 28-60 centers per hectares.

Typical cultural plant with 21-35% of proteins in leaves, protein percentage reaches 26-37% in caulises and 12-17% for dry basis contain. The highest maintenance of protein in leaves were noticed in blooming phase. The protein maintenance in leaves sharply drops in seeds maturing period. Solid basis varies from 16% to 23% depending on Amaranth kind. *A. cruentus* consists 23%, at K-342, K-343 samples belonged to *A. hypochadriocus*). In caulises there are 20-22% and in Amaranth and in inflorescenses it is 21-25% of dry matter contain on the average. The maintenance of carotin crude mass of leaves varies from 2,35 to 10,8 milligram for percent, in dry mass – from 12,8 to 64,5 milligram per percent. In inflorescences contain 5-7 times less carotin, than in leaves. The quantity of sugars in Amaranth plants varies from 0,87 to 5,38 percent on leaves's dry mass, from 0,6 to 4,2 percent - in inflorescences and from 1,2 to 7,4 percents in caulises. Rather high maintenance of Saccharums among the studied kinds differs *A. edulis*. The highest maintenance of sugars among the studied kinds was *A. edulis*.

As a result of analyses specific distinctions in solid basis, a protein, carbohydrates, crude fat, leach are found. It is necessary to notice that biochemical composition of green mass of Amaranth essentially varies on phases of an ontogenesis and depending on cultivation conditions.

3.2 Gumbo (*Hibiscus esculenthus L.*)

A perennial plant from Malvaceae family (in culture - annotinous). Gumbo grows in all warm countries, it descends from tropical Africa.

The growing season of the studied samples of gumbo in the conditions of Southern Aral Sea has compounded 150-180 days depending on a genotype and cultivation conditions. The crop of green mass varied from 38,5 to 56,0 ts/hectares, seed production – 17,6-22,4 ts/hectares.

Clear-cut distinctions were found while observing biochemical composition of the studied samples of gumbo from India, Cuba, Pakistan and Palestine. The maintenance of a crude protein varies about 17,6 to 22,3%, crude fat – 17,0-19,6 %, sugars – 7,7-11,4 %, crude cellulose – 5,9-6,2 %, nitrogen-free extractive fraction – 39,8-41,3 %, crude ashes – 4,1-4,2%. Green mass of gumbo contains 9,2-10,8% of a crude protein,2,2-3,1% of crude fat, 10,1-13,5% of sugars, 18,7-24,2% of crude cellulose, 32,1-37,4 nitrogen-free extractive fraction and 8,3-11,2% of crude leach. Gumbo is fodder, nutritive and medicated herb. Its green mass is used in animal husbandry as a highly nourishing forage. Stems used to produce coarse fibre. Fruits of gumbo in fresh and dried form used as nutrition. Decoction from fruits helps at cold and cough. Gumbos seeds use as a coffees substitute.

It is known that in Ancient Egypt gumbo grew in two thousand years B.C. In India, Nigeria and other countries gumbo is grown for fibre. The greatest indexes of seed production are showed by samples of gumbo from India and Cuba (20-21 ts/hectares). Weight of 1000 seeds gumbo studied samples varied from 53,1 till 67.

3.3 Sunfleck *(Guizotia abyssinica)*

(L.F.) Cass – an annotinous plant from Asteraceae family. Sunfleck grows in India, Bangladesh, Nepal, Ethiopia, it is widely used as a forage plant and in green manure quality,

Fig. 2. Gumbo's solitary flower

Fig. 3. Gumbos' flowers buds

raising fertility of lans. The crop of green mass is reached by 520-700 ts/hectares, seed production – 7-10 ts/hectares. Duration of a growing season in the conditions of Southern Aral Sea – 170-190 days.

Its green mass has 7,8-12,0% of a crude protein, 2,4-3,2% of crude fat, 10,3-12,2% of sugars, 21,6-25,3% of crudecellulose, 39,2-50,7% nitrogen-free extractive fraction and 9,1-12,3% of crude leach contain.

At biochemical analysis of seeds *Guizotia* abyssinica it is shown that the maintenance of a crude protein varies within 10,3-11,5 %, crude fat – 16,5-29,8%, sugars – 8,1-9,3%, crude. cellulose – 4,1-5,6%, nitrogen-free extractive fraction 39,6-49,1%, crude ashes of 5,9-6,8%

3.4 Crotalaria

In its green mass the maintenance of a crude protein varies in limens from 9,4 to 13,5%, sugars – 8,2-11,3%, crude fat – 2,4-3,7%, crude cellulose –from 22,5 to 28,9% and could earn from 33,7 to 41,2%, crude ashes are from 10,5 to 15,3%. Crotalaria's seeds have about 9,2 to 12,8% of sugars, 6,9 to 9,3% of crude fat, 5,5-6,4% of crude cellulose, 40,3-45,7 nitrogen-free extractive fraction and 6,4-8,1% of crude leach contain from 15,1 to 24,3% of a crude protein. Thanks to a symbiosis with nodule bacteriums crotalaria raises fertility of growth, the long blooming period represents significant interest for beekeeping.

3.5 Soya

Plants with high stems and oily culture. The majority kinds Soya — the perennial climbers propagated in tropics and subtropics from Africa, Southern Asia and Australia to Ocenia. However so far as concerns Soya routinely mean the most known kind — a soya cultural soya sometimes named "soybeans" - the widespread food stuff known still in the third millenium BC, the Soya often name "wonderful plant" — partly thanks to the high maintenance of phytalbumin on the average compounding about 40% from mass of a seed, and at separate kinds of reaching 48—50 %, in much similar to an animal, partly thanks to rather high productivity.

Nevertheless, the soya is a part of some forage for animals. As a result of the made researches it is shown that rates of increase and developments of the studied kinds of a soya variety depending on a genotype and cultivation conditions. The season of vegetation of early-ripe kinds of a soya Orzu and Genetik has compounded 85-90 days, early-ripe kinds (Uzbekskaja-2, Dustlik) – 110-120 days, a late-ripening kind of Uzbekskaja-6 – 130-135 days. Seed production of a kind of a soya of Orzu have compounded 20,1-22,2 centner/hectares, kinds of Uzbekskaja-2 – 21,5-24,3 centner/hectares, Dustlik kind – 20,7-24,6 centner/hectares, kinds of Uzbekskaja-6 – 19,6-24,6 centner/hectares.

Biochemical composition of soybean seeds depending on varietal features and growth conditions also essentially differs. Depending on varietal features and cultivation conditions it can contain 17-28% of oil and 18-22% of carbohydrates in seeds and 30-51% of protein. Decrease in efficiency of seeds of the studied kinds of a soya in soil-environmental conditions of Southern Aral Sea is caused by a bedrock salification, high temperature and low air humidity.

3.6 Earth Apple

Is also a plant of universal using. Depending on specific features and cultivation conditions in

Fig. 4-5. Flowering sunfleck

Fig. 6. Crotalaria is blooming

Fig. 7-8. Soya's leaves

many countries it is widely used as fodder, edible, medicinal and an adornment plant. Earth Apple particulate preserves earths drying from lifting of ground waters and a salification. Earth Apple's cultivation has great value in ecological aspect for our region and allows us to receive biologically new production.

At the analysis of biochemical composition of Earth Apples, grown in the various it is soil-environmental conditions it is shown that the maintenance of a crude protein varies from 5,8 to 6,2%, crude fat – from 2,7 to 2,9%, sugars – from 14,7 to 16,5%, crude cellulose – from 10,8 to 12,2%, anazotic extractives – from 52,1 to 55,1 %, crude leach – from 6,1 to 7,1% counting on dry matter (Table 1). The main value of earth apple is inulin. Inulin and the fructose of earth apple are materials for production of important medical products, edible and other valuable materials.

In green mass of earth apple in a blooming phase it has 7,8-8,2% of a crude protein, from 2,1 to 2,4% of crude fat, from 12,1 to 16,8% of sugars, from 20,4 to 22,7% of crude cellulose, from 31,3 to 35,1%, from 11,2 to 13,8% of crude leach (Table 2) contain. A high-quality grassy flour and a silo are made by its green mass. Economic valuable biological feature of earth apple is its productivity. The hay crop of above-ground mass was made by us to two terms: the first hay crop - in first half of July, and the second hay crop - in the end of September. At two hay crops productivity of earth apple reached 620-750 centner/hectares, tubers – 310-350 centner/hectares. The combination of a crops green mass and tubers increases fodder value of Earth apple.

3.7 Columbus Grass (*Sorghum aldum* Parodi)

the perennial fodder culture, comes from *Sorghum* families of cereals (*Graminea*). The native land of Columbus grass is Argentina where it has been described for the first time by Argentinas botanist L.R. Parodi in 1943 [8]. Columbus's grass surpasses in productivity and nutritiousness the basic fodder culture – corn. Its growing season more than at corn, owing to high productivity it can be used during all green mass growth period on, hay and a silo. The potential of

Table 1. Biochemical composition of studied plants

Plant kind	Crude protein	Sugar	Crude fat	Crude cellulose	Nitrogen-free extractive fraction	Crude leach
Amaranth	10,0- 13,2%	3,9- 7,4%	2,47- 3,04%	23,42-28,12%	36,98- 42,00%	5,40-9,54%
Gumbo	9,2- 10,8%	10,1- 13,65%	2,2- 3,1%	18,7-24,2%	32,0- 37,3%	8,3- 11,2%
Sunfleck	7,8- 12,0%	10,3- 12,2%	2,4- 3,2%	21,6- 25,3%	39,2- 50,7%	9,15-12,3%
Crotalaria	9,38-13,5%	8,2-11,3%	2,39-3,71%	22,5-28,9%	33,7-41,2%	10,5-15,3%
Columbus's grass	2,9- 7,2%	10,4-13,	0,5-0,8%	15,6-24,8%	29,6-42,55%	8,4-11,0%
Earth Apple	7,8-8,2	12,1-16,8%	2,1-2,4%	20,4-22,7%	31,3-35,1%	11,2-13,8%

Table 2. Percentage of organic components in green mass of studied plants

Plants sort	Crude protein	Sugar	Crude fat	Crude cellulose	Nitrogen-free extractive fraction	Crude leach
Amaranth	16,5- 28,4%	11,3-15,0%	5,8- 9,2%	4,3- 5,6%	42,1- 51,2%	3,4- 4,1%
Gumbo	17,8- 22,1%	7,7-11,4%	17,0-19,6%	5,9- 6,9%	39,8- 41,3%	4,1- 4,9%
Sunfleck	10,3- 11,5%	8,1- 9,3%	16,5- 19,8%	4,1- 5,6%	39,6- 49,1%	5,9- 6,8%
Crotalaria	15,1- 24,3%	9,2- 12%	6,9- 9,3%	5,5- 6,4%	40,3- 45,7%	6,4- 8,1%
Soya	38,8- 43,8%	18.8-20.3%	20,1- 28,6%	4,9- 6,8%	25,9- 30,8%	5,4- 6,3%
Columbus's grass	10,1- 12,5%	16,0-16,8%	3,9- 5,2%	9,2- 10%	47,1- 51,0%	3,6- 4,2%
Earth Apple (tubers)	5,8- 6,2%	14,7-16,5%	2,7- 2,9%	10,8-12,2%	52,1- 55,1%	6,1- 7,1%

a grass of Columbus is huge – to 2000 centner/hectares of green mass for 3 hay crops on the reflux earths at application of fertilizers.

In different years of cultivation of Columbus grass in a ear formation phase panicles in green mass solid basis varied within 16,3-21,9%, a crude protein – 2,9-7,2%, crude fat – 0,5-0,8%, sugar- 10,4-13,7%, crude cellulose – 15,6-24,8 %, nitrogen-free extractive fraction– from 29,6 to 42,5%, crude ashes –varies from 8,4 to 11,0% (Table 1)

Its seeds have 16,0-16,8% of sugars, 3,9-5,2% of crude fat, 8,2-10,3% of crude leach (Table 2) contain from 10,1 to 12,5% of a crude protein.

4. STUDIED PLANTS RESULTS TABLES

Biochemical composition of studied plants-

Table that showing concentration of important organic components for dry mass of plants is given in Table 2.

Biochemical composition of studied plants seeds *in % from dry mass.*

5. DISCUSSION

Biochemical composition of the studied plants during an ontogenesis undergoes essential changes depending on a genotype and cultivation conditions.

Thereupon it is interesting to observe influence of mineral fertilizers on the maintenance of carbohydrates in leaves and seeds studied plants. It is revealed that the maintenance of carbohydrates depends on a phase of development and conditions of a mineral food of plants. The maintenance of carbohydrates in the plants grown without fertilizings essentially less, than with fertilizings. The maximum maintenance of carbohydrates in leaves is observed in blooming period.

6. CONCLUSION

In the conditions of sharply continental climate of Southern Aral Sea and limitation of irrigation hectare extremely important rational use of areas under crops. For successful introduction in agricultural production of new and nonconventional plants all-round studying and selection of plants is necessary, fittest to aboriginal is soil-environmental conditions,

building of seed fund plants, working out of elements zonary agricultural technicians of their cultivation, working out of modern technologies of processing of a biomass plans and a rational path of their use, building of collection fields and recruitment of a gene pool of perspective plants.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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