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PROSPECTS OF INTRODUCTION OF HIGHLY PRODUCTIVE HYBRIDS OF SACCHARINE SORGHUM IN BIOENERGETICS

The review of alternative sources is inspectedfor providing of energysecurityof Ukraine. A saccharine sorghum is studied, as a strategic crop in providing of bioenergetics with raw materials and reclamation of the degraded soils. Assignment of tasks for selection is made taking into account the requirements of production of bioenergetics raw material from a saccharine sorghum. Adduced technological indexes are common to the ideally adapted bioenergetic hybrids of saccharine sorghum of bioenergeticfield. Described advantages of new hybrid ofbioenergeticfieldof usage.

Keywords. *Selection, saccharine sorghum, hybrid, phytoenergetics, bioenergetics, raw material, alternative sources, bioenergetic crop rotation*

Introduction. Now all society of the round word is disturbed by the state of energetic safety. Mineral resourcesthat areextracted from the bowels of the Earth are limited. In the conditions of present time a requirement in energy sources has a tendency to the rapid growing. Therefore appears a question in the complex providing of population energy from sources that can constantly renovate. There plenty sources on Earth that can be used for providing of power demand of population. It is necessary to expose properly possibilities ofhydro energetics, energy of the wind, solar energyand phytoenergetics. Yet long-ago our ancestors learned to use water and wind to receivethe necessary energy. Wind mills and water mills arthe classic examples of it. In Ukraine from all possible alternative sources used only

hydroenergetics, but also not in best of its ability. In our time the electric energyreceived from wind generatorsbecoming more and more actively used. For example, in Spain over 40 percent of consumed electric power obtained exactly in this method. However, wind generators take away part of kinetic energy of the movable air masses thatslow down speed of their moving. Mass usage of such deceleration can render measurable influence on local climatic terms. Therefore a concentration of wind turbines must be scientifically reasonable, taking into account possible consequences. At certain occasions the high concentration of wind turbines will be reasonable, these generators will counteract to wind erosion of soils, and in other regions it is appropriate to use a middle or subzero stresslevel.

The most attractive energy source is a sun light. One of methods of accumulation of solar energy is the usage of solar batteries (photo-electric transformers) – it is possible to set them on the body shell of car, wings of airplane, flashlights (a decision of problems is with illumination of streets) and houses. For 30 years of exploitation of element with content 1 kg of silicon (material for the production of solar batteries) can be received so much electric power, as from 100 tons of petrol at the thermal station.

The natural accumulator of the solar energy is plants. With increasing of thepower crisis the role of plants as a transformer of solar energy to the organic substance (biomass) acquires all greater weight. Recentlysolution of a problem of introduction of plant energy in the power system is discussed both in Ukraine and in the entire world. The wastes received from theburning duringprocessing and production of energy from plant products areuptakingby an ecosystem, not causing any harm to it [1]. Nature specifies to us a way for the decision of our problems, and a decision as usual lies on a surface. We need to detect alternative energy sources for providing of all needs of humanity with aiming for the century forward.

Bioenergetics is diversified and can provide the production of biogas, biodiesel, bioethanol, butanol and solid biofuel [2]. Silk grass, switchgrass, sorghum and othersbelong to the perspective grain crops. The main requirement to the cultures that areused in bioenergetics is product cost and providing of stable source of raw

materials. The crop able to provide bioenergetics with raw material for all it industrieson all territory of Ukraine is a sorghum [3].

Purpose. The purpose of work is a studying and selection of the parent materialfor creation of high-yield hybrids of saccharine sorghum of bioenergetics field of usage.

Materials and methodology of researches. Research works were realized during three years (2010-2012) on Synelnykoveselection research station of Institute of agriculture of steppe zone of NAAS of Ukraine thatlocated in the Dnepropetrovsk region and belong to north subzone of Steppe of Ukraine. For breeding were used 17 sterile lines of sorghum with four testers and it was received 62 hybrids of saccharine sorghum. Experiment was runin triple replication, area of sections was 25 square meters each. Hand harvest was gatheredwith the further weighing. For determination of content of dry substance it was token 3 weighed quantity 50 gramseach from two incompatible replications, that weighed before and after rough-dry in a drying closet at a temperature 100–105 C to permanent mass. Then on the basis of these data's calculated content of dry substance inpercent.

Results of researches. Sorghum – one of the most heat-resistant and drought-resisting crops in world agriculture. During the thousands of yearsit was adapting to the conditions of semiarid climate. The rootsystem of sorghum gets to soil up to 2–2,5 m and provides the use of moisture to other plants. A sorghum is able normally to develop even on saline lands and in the process of the vital functions to influence on the structure of soil, assisting to the phytomelioration in salinelands.

Due to highphotosynthetic potential and low consumption of the water (significantlyless than a corn, barley, rice, wheat) saccharine sorghum is one of the most highly-energetic and cost-effective cropsamong one-year grain cereals. On creation of one unit of dry substance sorghum consuming 300 parts of water, corn – 338, wheat – 515, barley – 543, peas – 730

The amount of Ukrainian lands outputed from agricultural crop rotations that with success can be used for bioenergetics calculating up to 5 million. These soils need recultivation. They are presented in a varying degree, by both ordinary soils,

polluted with heavy metals, and practically fully degraded alum earthswith high salinity. A task with such land development will be not only a receiving of biomass for phytoenergetics but also land-oriented recreation, improvement of the ecological state of technogenic region, increasing of workplaces. At the proper use, taking into account all above-mentioned aspects, soils can gradually go back into an agricultural crop rotation. Process of land-oriented recreationis long lasting, that is why to go back to the use they can only in 30–100 years, depending on their condition. For providing of society in the future with energy, requirements in biomass will increase, that is why the reasonable system of its production is needed. Now this type of fuel looks unlimited, but it needs carefulappealing to it, not to exterminate its source – land. Consequences of exhaustion of this source will be worse, than consequences of lack of oil and gas [1, 4]. For the effective use of land with the aim of stable harvest of biomassreceiving it is necessary to create bioenergetic crop rotations in which will be involved both the grain andbean cultures. A sorghum, due to itsalt-endurancemust be the first crop in a bioenergetic crop rotation – domesticated culture. Only on condition of fertilizer distribution in full dosespossible achievement of desirable positive effect both on soils and on a receiving of raw material.

For providing phytoenergetics with raw material creation of high quality base of sorghum is needed, specially oriented forgrowing inbioenergetic crop rotations. From all kinds a sorghum most valuable for phytoenergetics is a saccharine sorghum that is able to form from 15 to 100 tons per hectare green mass depending on the terms of growing. Main direction of the use of saccharine sorghum was forage production, that is why basic breeding work is realized in this direction. For forage production hybrids and sorts of saccharine sorghum must be with the marked absence of cyanide in plants, succulence, high percent of leaves and grain in general mass, high nutrient availability and so on.

During the orientation of selection for bioenergetics task will be a bit different. Analyzing requirements in the receivingraw-materials for a solid fuel, along with the high crop yieldthe model of ideal hybrid must have such inherent technological characteristics:

– an unpretentiousness, providing of stable harvest in tough conditions of growing on the technogenic degraded soils;

– dryness of culm (it will decrease expenses on drying at processing of raw material on a hard fuel);

– high maintenance of sugar in juice (it provides the greater energy outputat burning process).

Thereforethe task before a selection isto create the new technologically adapted hybrids of saccharine sorghum and apply them in industry.

Despite on modern technologies it ismore and more difficult to protect our sowing from negative influence of harmful organisms and we are spending more and more efforts and energy for it, thatcan be explained by rapid adaptation of harmful organisms to the certain changes. Due to permanent influence on the ecosystem of the field we improve immunityof harmful organisms and reduce it at domestic plants.On this basis, on the modern stage crop protection must be based on the selection of genotypes tolerantly tothe field persistence of crops that is provided by the studying of their biological features and by the certain selection. Therefore the choice of hybrids and sorts of bioenergetic direction it is necessary to orientate not on the maximal receiving of products from unit of area, but on ability of industry providing with raw material with minimum energetic and economic charges.

For introduction of hybrids of bioenergetic direction it is necessary creating of parent materialoriented on solving of problems of this industry. On creation of new parent materialofbioenergetics direction it is needed not less than 5–8 years, 3–5 years is needed on creation and test of the hybrid. That is why now in Institute of agriculture of steppe zone of NAAS of Ukraine at the same time such selection works are started:

– analysis of existing parent material for suitable using in creating of bioenergy hybrids;

– development of methods forimprovement of the parentmaterial;

– creation of new original material in bioenergetical direction;

– creating maximum parsimony to an ideal model of bioenergetic hybrids, their improvement and transfer to the state testing.

Table 1

Economic indexes of the best hybrid combinations during 2010–2012 years.

№ (sequence num.)	Hybrid	Productivity, tons per hectare		Content of sugars in juice, %
		green mass	Green mass (in conversion on dry substance)	
1	Silosne 42 St	36,2	18,2	13,7
2	Nizkorosle 81c xSilosne 42	46,8	25,3	11,2
3	Dn 71c x Karlikove 45	59,6	26,7	11,1
4	Dn 5c x Silosne 42	32,2	17,5	9,7
5	Dn 31c x Silosne42	37,6	16,4	10,9
6	Kaf. kor. 186 c x Silosne 42	39,1	24,6	15,7
LSD 0,05		0,90	0,49	0,31

In a table 1listed the indexes of the best hybrid combinations of saccharine sorghum. Significant exceeding above a standard for three years of studying observed in three hybrid combinations. The main index of the productivity of hybrids of saccharine sorghum is a harvest of green mass and harvest of green mass in a dry substance that more exactly specifies onapossible output of solidfuel product from one hectare. Most attractive in this case was a hybrid of Dn 71c x Karlikove 45, that exceeded a standard on 23,4 tons per hectare of green mass and on 8,5 tons per hectare of dry substances. It is accepted to divide the sorts of saccharine sorghum on dry and juicy types of culm. Visually it is possible to divide by the color of central vein on the leaf: if it has the clearly expressed white color, then we are facing the plant of dry culmtype, and if it is green or gray-white color then juicy type. As for hybrid of Dn 71c x Karlikove 45, then it belongs to dry culmtype of hybrids. By the content of sugar in juice it yielded to standard on 2,5%, but this index plays a considerable role only for planning of hybrid for production an alcohol or syrups, and raw materials production for solid biofuels is insignificant.

Such level of exceeding above a standard in new hybrid combination is provided due to the phenomenon of heterosis [5].

The best effect of heterosis is observed at the interspecific crossing, due to fact that forms differ by their qualitative composition. Therefore in a selection process for the achievement of desirable result it is appropriate to involve pairs taking into account a species diversity [6]. As a pollinator for new hybridwas used sort of technical (besom type) sorghum Karlikove 45, that was involved in a selection process with a purpose of creation exactly of hybrids of bionergetic direction.

Conclusions.

1. Saccharine sorghum as a deserving bioenergetic culture capable to form the high and stable harvests of raw material in the extreme terms of growing, advantageously differing in drought-resistance, salt-tolerance, the economy expense of moisture and can provide a stable base for bioenergetics in the extreme cconditions of Steppe.

2. Scientific researches in field of selections, both fundamental and applied, are the basis of already realized and manyfuture achievements. Adapted high-productive hybrids of saccharine sorghum are the most economically and energetically expedient from measures for providing with raw material industry of bioenergetics.

3. Selected new hybrid of Dn 71c x Karlikove 45, that advantageously differ from the standard by the productivity and technological effectiveness. Also studied out value of sort Karlikove 45 as pollinator during the creation of hybrids for a solid biofuel.

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Анотація

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Перспективи впровадження високопродуктивних гібридів цукрового сорго у біоенергетику

Проведено огляд альтернативних джерел для забезпечення енергетичної безпеки України. Розглянуто цукрове сорго, як стратегічну культуру в забезпеченні сировиною біоенергетики та освоєнні деградованих ґрунтів. Враховуючи вимоги виробництва біоенергетичної сировини з цукрового сорго ставляться завдання для селекції. Наведені технологічні показники притаманні ідеально адаптованим біоенергетичним гібридам цукрового сорго біоенергетичного напрямку використання. Описані переваги нового гібриду біоенергетичного напрямку використання.

Ключові слова*. Селекція, цукрове сорго, гібрид, фітоенергетика, біоенергетика, сировина, альтернативні джерела, біоенергетична сівозміна.*

Аннотация

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Перспективы внедрения высокопродуктивных гибридов сахарного сорго в биоэнергетику

Проведен обзор альтернативных источников для обеспечения энергетической безопасности Украины. Рассмотрено сахарное сорго, как стратегическую культуру в обеспечении сырьем биоэнергетики и освоении деградированных почв. Учитывая требования производства биоэнергетического сырья из сахарной сорго ставятся задачи для селекции. Приведенные технологические показатели присущи идеально адаптированным биоэнергетическим гибридам сахарного сорго биоэнергетического направления использования. Описанные преимущества нового гибрида биоэнергетического направления использования.

Ключевые слова: *селекция, сахарное сорго, гибрид, фитоэнергетика, биоэнергетика, сырье, альтернативные источники, биоэнергетический севооборот.*