UDC 633.81 (477.60)

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Svitchgras (Panicum virgatum L.) - a promising introduced plant for the production of biofuels in the forest-steppe zone of Ukraine

Switchgrass (Panicum virgatum L.) is a promising plant for introduction in the forest-steppe zone of Ukraine that can be used as raw material for biofuel production. Presented are findings on the introduction of switchgrass in Ukraine. Found was that all tested varieties can be well cultivated in a forest-steppe zone of Ukraine.

Keywords: *switchgrass, varieties, rating scale, diseases resistance.*

Introduction. Ukraine is an energy-dependent country. Its domestic resources cover only 53 % of the energy demand with 75% of the required amount of natural gas and 85% of oil and petroleum products being imported. Therefore, production of fuel from renewable resources is of highly importance here. Soil and climate conditions in most regions of Ukraine are favourable for growing plants able to accumulate much biomass but our special interest is in crops that can grow on degraded lands [1].

According to statistics, there are from 3 to 5 million hectares of land taken out of crops rotation in Ukraine. Growing energy crops on these lands would prevent humus layer of soil from erosion, contribute to the development of flora, fauna, and improve environmental and energy situation in the country in general [2].

One way to solve these problems can be the introduction of new alternative plants characterized by large ecological plasticity, resistance to adverse weather conditions, weeds, pests and diseases, high yield, and other valuable features. The preference should be given to perennial species, such as switchgrass *(Panicum virgatum L.).*

Perennial species provide high productivity of cultivated land, allow minimising tillage. Featured with massive root system and unpretentiousness to growing conditions, they have great prospect for cultivation on eroded and reclamated soils [3].

Research objectives. Introduction of switchgrass based upon integral estimate, biological features of growth, and yield of such varieties of switchgrass as Cave-in-Rock, Forestburg, Sunburst, Shelter, Alamo, and Kanlow.

To achieve this goal following tasks were performed:

- Efficiency assessment of perennial plants introduction;
- Calculation of integral estimate of switchgrass varieties;
- Establishing the relation of switchgrass biomass with varietal composition.

Material and methods. Studies on the peculiarities of cultivation and adaptation of switchgrass varieties were conducted during 2009-2012yrs in the test plots at the Institute of Bioenergy Crops and Sugar Beet NAAS of Ukraine. The subjects of the study were switchgrass varieties created in the USA: Cave-in-Rock, Forestburg, Sunburst, Shelter, Alamo, and Kanlow. The soil of test plots was slightly acid light-gray forest, with pH 5,4 and very low nitrogen and potassium content (3,5 and 60mg/100g of soil, respectively). Agtotechnics was typical for this type of plants, without watering. Studying biology of the plants development was conducted according to the methods of phenological observations, yield estimates were done by measuring of above-ground part of plants (wet mass and dry matter), an integrated assessment of the introduction effectiveness of the perennial grasses was performed according to the method developed by V. Berezkina (which characterizes the ability of plants to propagate itself in generative and vegetative ways), their resistance to lodging, falling, diseases, pests, drought, and frost. While assessing the following groups were isolated: promising (P) 21-24 scores, less promising (LP) 16-20 scores, unpromising (UP) 8-15 scores.

Results and discussion. Here we have presented the characteristics of switchgrass varieties under study based upon generalization of the literature sources and researches carried out in 2011y at the Institute of Bioenergy Crops and Sugar

Beet by scientists S.M. Petrychenko, O.V. Herasymenko, H.S. Honcharuk, V.V. Lytvyniuk, and S.M. Mandrovska (Table 1).

Table 1

Description of switchgrass varieties [4]

Variety	Ecotype	Ploidy	Term of ripeness
Cave-in-rock	upland	oktaploid	mid-late
Forestburg	upland	tetraploid	early
Sunburst	upland	tetraploid	middle
Shelter	upland	oktaploid	middle
Alamo	upland	tetraploid	very late
Kanlow	upland	tetraploid	very late

Results have shown that all the varieties under study have the highest drought and frost resistance, resistance to diseases, pests, lodging, and falling and that they are unpretentious about soil fertility (Table 2).

Table 2

Integral estimate of switchgrass introduction efficiency in the experimental plots (average), 2009-2012yrs.

Variety	Seed reproduction	Drought resistance	Frost resistance	Resistance to				Demands to soil fertility	Scores	Prospects
				deseases	pests	fall	lodging			
Cave-in-rock	3	3	3	3	3	3	3	3	24	P
Forestburg	3	3	3	3	3	3	3	3	24	P
Sunburst	3	3	3	3	3	3	3	3	24	P
Shelter	3	3	3	3	3	3	3	3	24	P
Alamo	3	3	3	2	2	3	2	3	21	P
Kanlow	3	3	3	3	3	3	3	3	24	P

Note: P - promising

Observation on the growth and development of switchgrass during the growing season allowed determining that a full crop of dry matter one can have on the 3rd year of growing, i.e. it forms itself within 150-170 days. The best term of harvesting is after air temperature stabilizing within 0-5°C. This helps reducing the costs for drying.

Dry matter yield for 2009-2012yrs when harvesting at full fruiting phase amounted to 11,9–11,7t/ha. The highest yield has Cave-in-rock variety (17,9t/ha), the lowest has Shelter (11,7t/ha) (Fig. 1). Statistical analysis of the results has shown that for the $LSD_{0,5}$ =1,3 a significant difference in yield was observed between following varieties: Cave-in-Rock, Forestburg and Kanlow; Kanlow, Shelter and Sunburst (Fig. 1).

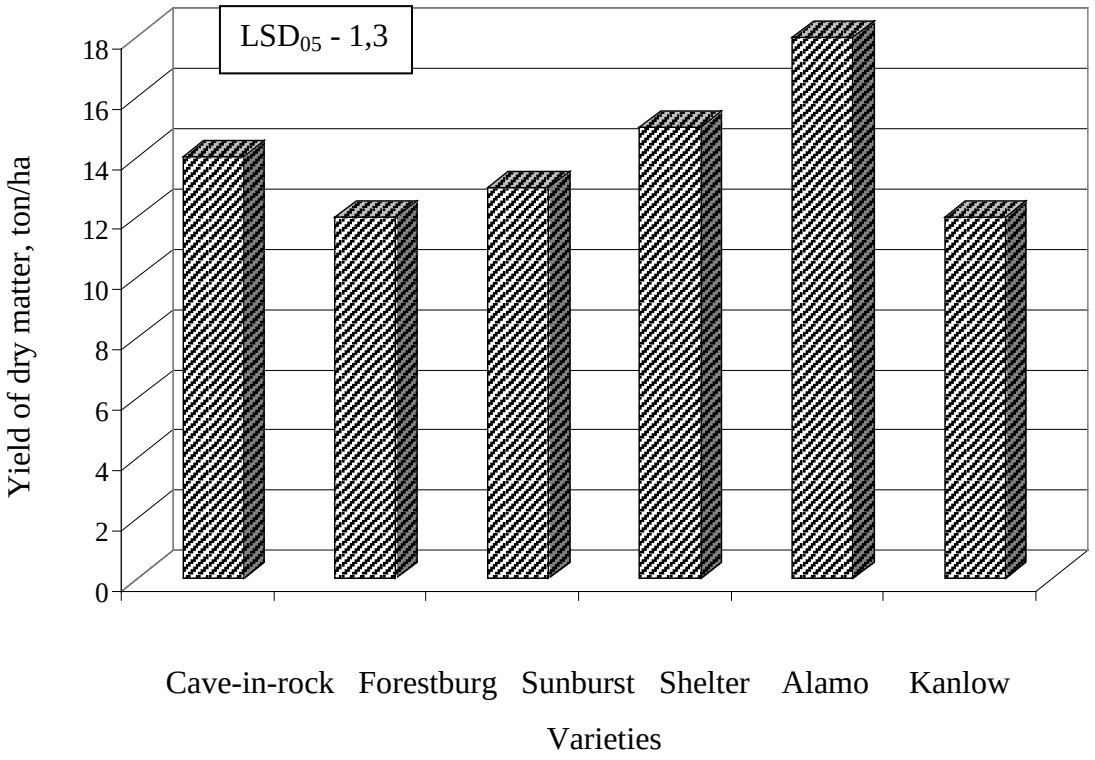

Fig.1. Yield of dry matter of switchgrass depending on varietal features (average), 2009-2012y

Conclusions

Climate and soils conditions in forest-steppe of Ukraine are favourable for cultivation of switchgrass as an alternative energy source. Based on integrated estimate of the introduction effectiveness conclusion can be made, that all the switchgrass varieties under study (Cave-in-Rock, Forestburg, Sunburst, Shelter,

Alamo, and Kanlow) are suitable for cultivation in climate conditions of forest-steppe of Ukraine. Biomass productivity depends greatly on variety composition. The highest yield of 17,9t/ha has been reached by Cave-in-Rock variety.

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Анотація

Мандровська С.М.

Світчграс (panicum virgatum L.) – перспективний інтродуцент для виробництва біопалива в Лісостепу України

Наведені результати досліджень щодо інтродукції світчграсу (проса лозовидного) в Україні. Встановлено, що всі досліджувані сорти придатні для вирощування в умовах Лісостепу України.

Ключові слова: *світчграс, сорти, шкала оцінки, стійкість до хвороб*

Аннотация

Мандровська С.Н.

Свитчграс (Panicum virgatum L.) – перспективный интродуцент для производства биотоплива в Лесостепи Украины

Приведены результаты исследований по интродукции свитчграса (проса прутьевидного) в Украине. Установлено, что все испытываемые сорта могут выращиваться в условиях Лесостепи Украины.

Ключевые слова: *свитчграс, сорта, шкала оценки, устойчивость к болезням*