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## **TECHNICAL AND TECHNOLOGICAL MEASURES TO LAY DOWN ENERGY PLANTINGS OF SWITCHGRASS IN WOODLANDS OF UKRAINE**

*There are results of the research of technological operations for ground preparation, two methods of planting and caring for plants in the first year of the establishment of energy plantings of switchgrass.*

**Keywords:** *research, switchgrass, technology, hardware, planting machines.*

**Introduction.** Ukraine is only partially equipped with traditional primary energy and therefore it is forced to import them from other countries. In this connection, the issue of energy security is very important for our country.

One of the solutions to energy independence may be the use of alternative renewable fuels, including biomass. Biomass waste and energy crops are renewable local environmentally friendly fuel.

One of the most common energy crops is switchgrass. However, production of the plant in has not yet become widespread due to the lack of crop and economic justification. Current switchgrass growing technology in soil and climatic zones of the state was not much studied.

The problems associated with switchgrass growing are shown in the publications [1-6]. These works provide a brief description of switchgrass requirements for growing conditions. Theoretical foundations and methodological approaches to assessing the economic efficiency of switchgrass in Ukraine were generalized [1]. There are shown the results of studies on the characteristics of growth, development and productivity of different varieties of switchgrass in Eastern and central part of Woodlands of Ukraine [2-4]. Agronomic and environmental aspects of growing perennial grasses for the production of second generation of biofuels was analyzed [5]. Energy plants that are grown for solid fuels were characterized; their practical use and energy value were assessed [6].

However, currently the issue of switchgrass growing technology in soil and climatic conditions of Woodlands of Ukraine had not being studied and discussed in scientific publications.

**The purpose of the research.** The aim was to study the technical and technological measures to lay down the switchgrass plantations in soil and climatic conditions of Woodlands of Ukraine.

**Research Methodology.** Indicators of performance of technical means were determined according to the standardized methods for testing the group of vehicles.

The research was conducted at the experimental fields of the Lviv branch of the UkrNDIPVT (Ukrainian Scientific and Research Institute for Prognosis and Testing of Machinery and Technologies for Agricultural Production) named after L. Pohorilyi in the soil-climatic zone of Small Woodlands of Ukraine. The test site lies on sod-podzolic loamy soils that are the most common for this area and are characterized by depth of humus horizon about 5.7 cm, acidity 7.2 mg-ekv./100 g, humus content is 2.97, containing batteries and mobile compounds - nitrogen 82.2 mg, 194.3 mg of phosphorus and content of potassium is 66.5 mg per kilogram of soil.

Soil preparation consisted of flaky stubble by BDVP-3,6 disk harrow to a depth of 15 cm, plowing with PLN-4-35 plow to a depth of 25 cm, cultivation by

KPSP-4 cultivator at a depth of 10 cm with simultaneous harrowing and preplant tillage with LK-4 combined unit to a depth of 5 cm (Fig. 1).



a

b

c

**Fig. 1 Preparing of the soil for sowing switchgrass seeds**

a - plow plowshare PLN-4-35 in the unit with the tractor T-150K B;

b - KPSP-4 cultivator in the unit with the MTZ-82 tractor;

c - LC-4 combined aggregate for preplant tillage in the unit with the T-151 tractor.

Thus, for the preparation for soil tillage were used national tillage machines for general purposes.

We sown switchgrass seeds of Kartryadzh variety and Keyvn-in-rock variety. For the sowing of switchgrass seeds were used two seeding rates and two types of planters. The experimental field was divided into two sections. In the first section we used PCA -12 universal cultivator seeder, the seed rate was 5.5 kg/ha. On the second area was used SZ- 3, 6 seeder, the seeding rate was twice higher and consisted 11 kg/ha. Row spacing was 45 cm. For sowing with such spacing some receiving holes of SZ- 3,6 sowing machines were closed ( Structural row spacing of the drill is 15 cm). Switchgrass sowing was performed with 1 kg/ha of fertilizer. Seeding machine was equipped to MTZ- 82 tractors (Fig. 2).



a



b

**Fig. 2 Switchgrass seeds sowing**

a – STS-12 with sowing machine equipped to MTZ-82 tractor;

b –with SZ-3,6 sowing machine aggregated to MTZ-82 tractor.

After planting was conducted crumpling of soil using KKSH-6rollers.

To kill the first wave of weeds were introduced selective Prima herbicide with the dose of 0.5 l/ha. After germination and formation of lines combating crops weeding was carried out mechanically using milled rotary CF-5 4 cultivator (Fig. 3).



**Fig. 3. Switchgrass cultivation between rows with cultivator SF - 5.4 aggregated to the tractor MTZ-82**

In areas was conducted 3 inter-row cultivations at intervals of 8-10 days between them. After switchgrass plants reached height of over 30 cm the cultivation was not carried out.

Research results. Applied Soil hardware satisfactorily prepared the ground for sowing. After manufacturing operations superficial soil layer characterized with fine grog structure (presence of lumps up to 25 mm was 96.4 %), which conforms to the conditions of sowing small seeded crops, in this particular case the switchgrass. Fuel consumption for the preparation of the soil was 42 kg/ha. Quality and operational and technological performance indicators tillage manufacturing operations are shown in Table 1.

*Table 1*

**Results of the research of technological operations on soil tillage**

Indicators	Indicators value			
	БДВІІ-3,6	ІІІІ-3-35	КПСП-4	ЖК-4
Working width, m	2,6	1,05	4,0	4
Operating speed, km / h.	8,1	8,0	7,2	8,2
Depth, cm	15	22	10	5
Soil frengibility,% - Size of fractions is up to 25 mm	46,6	57,7	81,9	96,4
Roughness of the field surface, cm	4	5,2	2,0	2
Productivity per hour of an alternating time ha	81,1	100	89	-
Trimming weeds%	1,7	0,6	2,1	3,0
Specific fuel consumption at various time, kg / ha	12,3	18,7	5,3	5,8

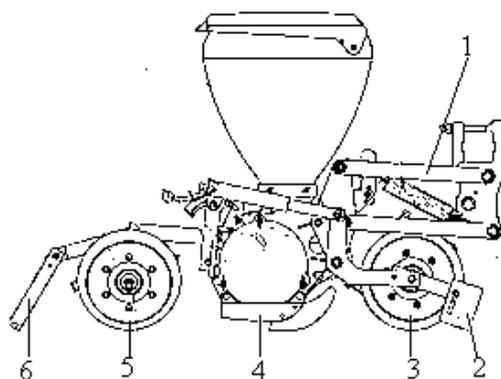
The agro technical evaluation found that the PCA-12 drill sowed seeds to a depth of 2 cm with a coefficient of variation of depth wrapping of 3.6%, while SZ-3,6 drill sowed seeds to a depth of 3 cm with a coefficient of variation of 18.9%. Plant density was 55 pcs. /p.m. at the site after sowing with SPS-6 while with SZ-3, 6 it was 68 pcs. on the site after sowing. The results of planting two types of drills are given in Table 2.

The difference in terms of quality depth of seeding primarily depends on structural features of the wrapping device of used planters.

### Indicators of technological operation of sowing

Indicators	Value	
	UPS-12	SZ-3,6
Operating speed, km / h	6,1	9
Seeding rate kg / ha	5,5	11
Seeding depth, cm	2	3
The coefficient of variation of depth of seeding, %	3,6	18,9
Row spacing, cm	45	45
The average number of plants in a row after emergence, pcs./p.m	55	68
Productivity, ha/h.	2,2	2,4
Fuel consumption, kg/ha	4,1	3,8

The main hub of the PCA-12 cultivator drill, which determines the quantity and quality of seeding indicators, is seed module (Fig. 4). To ensure copying the open field surface the seed module is attached to the frame by means of parallelogram mechanism and is based on two rollers: front of lump lay off and V-shaped back packer. The module is equipped with tract shoe, which cuts through the groove, forming dense seedbed. The V-shaped seed packer roller wraps and seals the soil on either side of the seed furrow leaving no compacted layer of soil that promotes the flow of water, creating a favorable air regime and increase seed germination of field.



**Figure. 4. Sowing Seed module PCA-12:**

- 1 - Parallel, 2 – lumps lay off, 3 - wheel bearing;  
4 – drill, 5 - packer roller, 6 - roller



**Indicators of quality of inter-row cultivation of switchgrass crops.**

Indicators	Value
Working width, m	5,4
Working speed, km/h	3
Cultivation depth, cm	4-6
Width of protection zone in a row, cm	10
Width of treated band, cm	35
Weeds trimming, %	98
Plants damage, %	1,8
Productivity, ha/h	1,1
Fuel consumption, kg\ha	6,3

Milling cultivator ensure satisfactory performance quality of the process. Weeding between rows was 98% with small (up to 1.8%) damaged switchgrass plants.

With this switchgrass growing technology in Small Woodlands of Ukraine plant height in the first year of vegetation during the full maturity of seeds was to 165 cm (Fig. 6).



**Fig. 6. Plant height in the first year of vegetation**

Contrastive characteristics of switchgrass plants is shown in Table 4.

### Characteristics of switchgrass plants

Indicators	Value	
	Area 1	Area 2
Plant height, cm	125-165	120-156
Number of productive stems per one plant, pcs	2-6	2-6
Number of leaves, pcs	5-9	4-7
Panicle length, cm	25-44	23-40

Plant height at sites did not differ, in some places the plants of the first area (sowing with the PCA-12) were 5-8 cm higher than the other plants (sowing with the SZ-3, 6).

**Conclusions.** Switchgrass (by its biological characteristics) may be cultivated in Woodlands of Ukraine as soil and climatic factors provide the conditions for growth and development of plants.

Using row precision seed planters for planting allows you to get the required density of standing plants with small seeding norms.

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#### ***Анотація***

***Думич В.В., Журба Г.І., Курило В.Л.***

***Техніко-технологічні заходи для закладання енергоплантацій свічграсу в умовах Полісся України***

*Наведено результати досліджень технологічних операцій підготовки ґрунту, двох способів сівби і догляду за рослинами в перший рік створення енергетичних плантацій свічграсу.*

***Ключові слова:*** дослідження, свічграс, технологія, технічні засоби, сівалки.

#### ***Аннотация***

***Думич В.В., Журба Г.И., Курило В.Л.***

***Технико-технологические мероприятия для закладывания энергоплантаций свитчграса в условиях Полесья Украины***

*Приведены результаты исследований технологических операций подготовки почвы, двух способов посева и ухода за растениями в первый год создания энергетических плантаций свитчграса.*

***Ключевые слова:*** исследования, свитчграс, технология, технические средства, сеялки.