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Evaluation of *Cannabis sativa* cultivars in Lithuania

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Abstract

The demand for renewable raw materials is increasing, and many new products processed from strong fibres such as hemp and flax appear all over the world. The industrial hemp (*Cannabis sativa* L.) is currently not grown in Lithuania. The possibilities of acclimatization of this plant in Lithuania, yielding potential, biometrical indices of five hemp cultivars ('Beniko', 'Bialobrezskie', 'Epsilon 68', 'Felina 32' and USO 31) were investigated at the Upytė Research Station of LIA in 2008–2009. The data from 2008–2009 evidenced that plants of industrial hemp cultivars tested could be successfully grown in Lithuania, despite the fact that all those cultivars were developed in the countries more southerly than Lithuania. In 2008, the growing season of hemp cultivar USO 31 was 16 weeks (115 days) and 20 weeks (140 days) for the rest of the cultivars, and in 2009 the growing season of USO 31 was 19 weeks (133 days) and 22 weeks (154 days) for the rest of the cultivars. All cultivars tested were productive, but the highest amount of green over-ground biomass and dry biomass was produced by the plants of the cultivars 'Epsilon 68' and USO 31 (respectively, 36.8–47.7 and 36.2–46.0 t ha^{-1} of green biomass and, respectively, 19.0–22.7 and 16.2–22.6 t ha^{-1} of absolutely dry hemp biomass. The highest hemp plants were those of the cultivars 'Beniko' and 'Epsilon 68' (respectively, 2.45 and 2.42 m in 2008), and in 2009 the plants of cultivar 'Beniko' were as tall as 2.78 m. Plants of 'Beniko' had significantly higher technical stalk length (2.22 m), higher diameter (0.65 m) in 2008. Crop density and its reduction during the growing season were also evaluated.

Key words: biomass, biometrical indices, *Cannabis sativa* L., hemp, cultivars.

Introduction

Hemp (*Cannabis sativa* L.) has been cultivated over a period of many centuries in almost every European country. It once represented a significant raw material source for the production of rope, canvas, textiles, paper, and oil products (Bocsa, Karus, 1998).

Many new products processed from strong fibres such as hemp and flax appear all over the world, because the demand for renewable raw materials is increasing (Pallesen, Eriksen, 2002).

In many countries the cultivation of hemp is banned. According to the content of tetrahydrocannabinol (THC) hemp could be divided into 3 chemotypes (Grotenhermen, Russo, 2002):

1. Drug type (contains 1–20% of THC, has influence on psychoactivity, main products are marijuana and hashish).

2. Intermediate type (contains 0.3–1.0% of THC, can have some influence on psychoactivity).

3. Fibre type (contains <0.3% of THC, has no influence on psychoactivity, main products are fibre, edible oil).

Namely fibre type hemp, also called industrial hemp, or fibre hemp, is legally allowed to be grown in some countries. The main requirement is that hemp plants should have a low THC content (less than 0.3%). Hemp cultivars with a low THC content have been bred, many of them are allowed to be grown in the EU countries. In 2008, 44 cultivars were listed in the Common catalogue of cultivars of agricultural plant species for European Union. In 2009, there were 47 cultivars in the Common catalogue (*Cannabis sativa*…, 2009). The most popular hemp cultivar from this list is 'Beniko', bred in Poland, registered in 4 EU countries.

In our nearest neighbouring country – Poland hemp breeding is carried out, and 5 cultivars of Polish origin were included in the Common catalogue of cultivars of agricultural plant species for European Union in 2009.

The question is which cultivar from the EU list could be best suited for cultivation in Lithuania? The nearest to Lithuania country where industrial hemp is grown and hemp breeding is carried out is Poland, therefore we suppose, that hemp cultivars developed in this country could best suited for Lithuania's pedoclimatical conditions.

Polish cultivars 'Bialobrzeskie' and 'Beniko' are monoecious. Both cultivars are mainly intended for production of cordage, military fabrics, blended yarns (hemp with wool and cotton), fibre board and technical oil products (Meijer, 1995).

'Bialobrzeskie', registered in 1968, is the result of a multiple crossing of dioecious and monoecious strains: [((LKCSD × 'Kompolti') × 'Bredemann 18') × 'Fibrimon 24'], followed by long term plant selection for fibre content. This cultivar warrants the high and stable seed, stem and fibre yield, fibre content under the pedoclimatical conditions of Poland (Rolski et al., 2000). Other sources report on the yielding capacities of this cultivar: a seed yield of 800–1000 kg ha^{-1}, stem yield of 10–12 t ha^{-1}, fibre content of 27–28%, good fibre quality (Bocsa, Karus, 1998).

The most recent cultivar 'Beniko' is a progeny, obtained by individual selection, from the crossing ('Fibrimon 24' × 'Fibrimon 21'). It was registered in Poland in 1985 (Meijer, 1995). The plants of this cultivar produce more seeds and fibre than those of the cultivar 'Bialobrzeskie' (Rolski et al., 2000). Fibre content of 'Beniko' plants is very high (37%), fibre yield can be as high as 3 t ha^{-1} (Bocsa, Karus, 1998).

In Poland, hemp cultivars of Polish origin 'Beniko' and 'Bialobrezskie' were investigated during 1986–1988. Plants of 'Bialobrzeskie' showed higher seed (550 kg ha^{-1}) and stalk (10 t ha^{-1}) yield, but the plants of 'Beniko' produced higher fibre yield (total fibre yield 2.89 t ha^{-1}, long fibre yield 2.67 t ha^{-1}) (Poradnik plantatora…, 1994). Research carried in 2000–2001 suggested that of the 14 hemp cultivars tested in Poland, plants of 'Beniko' and 'Bialobrezskie' had the highest total fibre content (28.5 and 26.9%, respectively) while the highest stalk yield was obtained from plants of 'Hei Bei' (18.9 t ha^{-1}) and 'Kompolti' (18.0 t ha^{-1}) (Rolski et al., 2000).

Meijer (1995) reported that from the 16 hemp accessions tested, 'Beniko' and 'Bialobrzeskie' were the earliest ripening. The most fibrous were 'Beniko' (32.7%), 'Uniko-B' (28.8–30.8%), 'Kompolti' (28.0–29.1%), 'Bialobrzeskie' (29.1–29.5%).

Cultivars from France are bred and commercialized by the Fédération Nationale des Producteurs de Chanvre (FNPC). All French cultivars are either selected directly from 'Fibrimon' (truly-monoecious cultivars), or from cross-progenies of 'Fibrimon' and several dioecious exotic fibre strains (pseudo-monoecious cvs.). French cultivars are monoecious. In France they are grown for pulp (Meijer, 1995).

French cultivar 'Epsilon 68' was registered in 1996, and cultivar 'Felina 32' in 1998 (Weightman, Kindred, 2005).

Ukrainian cultivar USO 31, listed in the National catalogue in 1987, is an early ripening cultivar, producing about 9 t ha^{-1} of stalks, fibre content – 25–26% (Bocsa, Karus, 1998). This cultivar was included in the EU catalogue in 1997 (Weightman, Kindred, 2005).

The industrial hemp (*Cannabis sativa* L.) could be a rather new plant in Lithuania. Why new? Firstly, it is still forbidden to grow any hemp in Lithuania (but it is allowed to grow industrial hemp in the EU countries). Secondly, the references about hemp growing in Lithuania are very few. It is stated that hemp was one of the virgin plants on the territory of recent Lithuania (Lazauskas, 2002; Šalis ta Lietuva..., 2009). There some data indicate that in 1941 the hemp cultivation area in Lithuania was 1500 hectares (Lazauskas, 2002). Some data were found evidencing that hemp was grown and investigated in Lithuania just after the World War II (Kriščiūnas, 1959). But we do not have sufficient information on what cultivars (or landraces) were grown, how productive they were, how well they grew. Besides, new productive cultivars are being developed at the moment; therefore the aim of our investigation was to evaluate the productivity potential of various hemp cultivars under the pedoclimatical conditions of Lithuania. We had some doubts regarding the acclimatization of industrial hemp in Lithuania because all cultivars recommended in the EU list were bred in much more southerly counties than Lithuania.

Materials and methods

Research was carried out in 2008–2009 at the Lithuanian Institute of Agriculture's Upytė Research Station on an *Eutri-Endohypogleyic Cambisol*, *CMg-n-w-eu* (Buivydaitė et al., 2001). The content of available P_2O_5 in the soil plough layer was 225–228 mg kg^{-1}, content of K_2O – 122–171 mg kg^{-1} (determined in A-L extraction), pH_{KCl}

level – 7.5 (potentiometrically), humus content – 2.75–3.62% (by Hereus apparatus). In the field rotation hemp followed winter wheat. Before sowing, 250 kg of complex fertilizers $N_5P_{15}K_{30}$ was applied in 2008 and 300 kg of the same fertiliser in 2009.

The cultivars 'Beniko' and 'Bialobrzeskie' are considered semi-early in Poland, the country of their origin. The cultivar 'Epsilon 68' is late-ripening in France, the cultivar 'Felina 32' (both are of French origin) – semi-late in France and the cultivar USO 31 (of Ukrainian origin) is known as very early in France. The task of our research was to study their performance under Lithuania's conditions.

All tested cultivars are monoecious (male and female flowers are present on the same plant).

The first question was selection of seed rate for the trial. According to some references, the best seed rate when growing hemp for textile purposes is 70–80 kg ha^{-1} (Bocsa, Karus, 1998) while other sources report on 75–80 kg ha^{-1} or even 50–60 kg ha^{-1} (growing hemp for seed and fibre) (Svennerstedt, 2002; Grabowska, Koziara, 2005). Hemp seed rate of 90 kg ha^{-1} gave too thin stalks (Svennerstedt, 2002). Other resources report that hemp biomass and fibre yield was obtained rather similar and did not depend on the seed rate – 30 or 60 kg ha^{-1} (Svennerstedt, Svensson, 2006). Research done in Poland indicated that the highest stalk and fibre yield was obtained when sowing hemp at a rate of 120 kg ha^{-1}, but the best fibre quality was found to be at a seed rate of 90 kg ha^{-1} (Mańkowski, 2003). Following analysed references we chose a seed rate of 70 kg ha^{-1} for our trial. No reference was found indicating hemp seed rate expressed in number of plants per area unit.

The seed of cultivars 'Beniko' (PL), 'Bialobrzeskie' (PL), 'Epsilon 68' (FR), 'Felina 32' (FR) and USO 31 (UA) was sown by a sowing machine SNL-16 at a seed rate of 70 kg per hectare on the 13th of May in 2008 and on the 5th of May in 2009 in the plots of 20 m^2, replicated thrice. A randomised plot design was used. Protective plots of the same size were sown on both sides of the trial.

No pesticides (insecticides, herbicides, desiccants) were used.

Hemp crop density and weed incidence were assessed after full crop emergence and shortly before harvesting.

Hemp was harvested by a trimmer (leaving the stubble of 5–8 cm) when the first matured seed appeared (it was on September 5th (for cultivar USO 31) and 30th of September (for the rest of the cultivars) in 2008 and on the 15th of September (for cultivar USO 31) and 6th of November (for the other cultivars tested) in 2009.

The biometrical indices – hemp stalk height (total length of sawn-off hemp stalk), technical stalk length (the part of the stalk between the soil and the first left leaf is called "technical stem length"), and diameter in the middle of the stalk (an average of 10 pulled plants per plot) – were measured at harvesting. Also the duration of the growing season was estimated, yield of green and dry biomass (overground mass) was evaluated.

The data were analysed by *Anova* (Tarakanovas, Raudonius, 2003), and means of LSD at $P = 0.05$ are presented.

Meteorological conditions (Table 1) during the experimental years were diverse, but both growing seasons were abundant in rainfall which differed only at hemp growing stages.

In 2008, the period for hemp seed emergence was favourable, but later on a lack of precipitation occurred (3rd ten-day period of May and 1st ten-day period of June). Then conditions for hemp growing and developing were favourable (2nd and 3rd ten-day periods of June). The weather in July was slightly cooler than that of the long-term period, but the rainfall was sufficient for hemp growing. The weather in August was warm and rainy, September was cooler and dryer.

In 2009, the period for hemp seed emergence was semi-favourable – the shortage of precipitation occurred in the 2nd ten-day period of May, but the weather was warm. Later on the weather was warm, and the rainfall was sufficient for hemp growing and development. Warm weather and especially abundant precipitation in July and August delayed and prolonged hemp flowering period, delayed seed ripening period. In September it was still warm and rainy, seed maturity came late.

Results and discussion

Observations. In 2008, hemp emerged within a few days after sowing, and reached growth stage 1002 (first pair of true leaves) (Mediavilla et al., 1998) in one week after sowing (on the 21st of May). We did not notice any significant differences between the seedlings of different cultivars. In 2009, hemp started emerging a few days later than in 2008, but the stage 1002 (first pair of true leaves) was reached on the 20th of May because of the unfavourable weather conditions.

Nevertheless in 2009 hemp was growing more rapidly. On the 4th of June 2008, hemp plants were already 10 cm in height, had 3–4 pairs of true leaves (growing stages 1006–1008). At the same time in 2009, hemp plants were taller 16–20 cm.

Table 1. Meteorological conditions during hemp growing season
Upytė Experimental Station, 2008–2009

Month	Ten-day period	Mean air temperature ºC			Rainfall mm		
		2008	2009	Long-term average	2008	2009	Long-term average
May	I	8.5	12.1	11.0	16.1	10	16.0
	II	11.8	15.3	12.6	12.5	2.1	16.0
	III	13.4	17.6	13.5	0.1	10.5	18.0
	Average	**11.2**	**15.0**	**12.4**	**28.7**	**22.6**	**50.0**
June	I	17.0	16.3	14.4	0	57	22.0
	II	15.0	17.3	15.3	32	21	23.0
	III	15.4	21.3	16.2	56	7.5	24.0
	Average	**15.8**	**18.3**	**15.3**	**88**	**85.5**	**69.0**
July	I	16.8	21.9	17.2	9.5	37.5	25.0
	II	17.9	20.5	18.0	41	55	25.0
	III	17.4	18.5	18.0	15.5	30	26.0
	Average	**17.4**	**20.3**	**17.7**	**66.0**	**122.5**	**76.0**
August	I	17.1	17.6	17.2	47.5	0.0	28.0
	II	19.9	17.6	16.1	44.5	28.5	29.0
	III	16.1	15.8	15.0	21.1	45.0	28.0
	Average	**17.7**	**17.0**	**16.1**	**113.1**	**73.5**	**85.0**
September	I	16.9	16.6	–	4.5	17.0	–
	II	8.3	14.0	–	5.0	21.0	–
	III	10.7	15.0	–	2.0	10.0	–
	Average	**12.0**	**15.2**	–	**11.5**	**48.0**	–

In the middle of June in 2008, hemp plants were about 40 cm, in 2009 45–50 cm. At the end of June, 2008 the height of hemp plants reached 1 m, and in 2009 they were taller 1.4–1.5 m.

In 2008, the first flowering plants (growing stage 2300) in the plots of cultivar USO 31 appeared only at the end of July while in 2009 it happened on the 17th of July. The tallest plants were 2.2 m. On the 3rd of August, 2009 first flowers on plants of the cultivars 'Beniko', 'Bialobrzeskie', 'Epsilon 68' and 'Felina 32' were noticed on the margins of the plots, but first flowers inside the plot appeared by one week later. Significant differences in flowering time between cultivars were not noticed, except for the cultivar USO 31, which started flowering earlier than other cultivars. At the end of August, the height of the tallest hemp plants reached 2.5 m.

Flowering period was long in both years, we were carefully checking for the first hard seed (growing stage 2305, which means the beginning of maturity), but we were unlucky to find any. Later on (at the end of August) we noticed the birds coming to the hemp crop (in the plots of cultivar USO 31) and eating the seeds.

In 2008, at the beginning of September plants of 'Beniko', 'Bialobrzeskie', 'Epsilon 68' and 'Felina 32' were still flowering, but in the plots of USO 31 we found some hard seeds, thus decided to harvest the plants from the plots of this cultivar. Hemp plants in the plots of other cultivars were flowering throughout all September (the birds were common guests in the field), only at the end of the month we were lucky to find some hard seeds and decided to harvest the crop.

In 2009, the first hard seeds in the plots of USO 31 were found in the middle of September; plants of other hemp varieties were flowering all September and were harvested on the 6th of October.

We should point out that birds were eating seeds very actively so this might have had some influence on the date when the first matured seeds were found. Therefore, in 2008 the growing season (from sowing date till the first matured seed was found) of hemp cultivar USO 31 was 16 weeks (115 days) and 20 weeks (140 days) for the rest of the cultivars, and in 2009, the growing season of USO 31 was 19 weeks (133 days) and 22 weeks (154 days) for the rest of the cultivars.

In the case of hemp growing solely for fibre (not for seed production), it would be possible to harvest hemp much earlier, therefore, growing season could be shorter. Growing hemp for seed is risky in our country because of late seed ripening and the attacks of birds. Only early cultivars, such as USO 31, could be recommended. But for biomass purposes hemp (all tested cultivars) was promising, late harvesting increased biomass yield.

Crop density. In 2008, the established crop density was between 256–317 plants m^{-2} while in 2009 it was very similar between 265–353 plants m^{-2} (Table 2). The lowest crop density was recorded for the plots of cultivars 'Beniko' and 'Epsilon 68', but the differences were not significant. We guess that crop density at the beginning of the growing season was different between cultivars because of the difference in 1000 seed weight. The data averaged over the period 2008–2009 showed plant density in 'Beniko' plots to be significantly lower, and in the plots of cultivar 'Bialobrzeskie' significantly higher than in the plots of other cultivars.

Crop density at harvesting was 226–241 plants m^{-2}, and it was much lower than that at the beginning of the growing season. It is likely that part of the plants did not stand the competition (plants were not sick or visibly damaged by insects) and died.

The reduction of hemp plants in the crop was in average 44 plants m^{-2} in 2008 and in average 83 plants m^{-2} in 2009. This finding suggests that seed rate used in our trials (70 kg ha^{-1}) could be partially lower, because about 15–26% of growing plants died, but the rest of the survived plants produced sufficiently high biomass yield.

Table 2. Hemp crop density after full emergence, at harvesting, and reduction of plants m^{-2} Upytė Experimental Station, 2008–2009

Cultivar	Crop density after full emergence, plants m^{-2}	Crop density at harvesting, plants m^{-2}	Reduction, plants m^{-2}
2008			
'Beniko'	256	207	47
'Bialobrzeskie'	311	264	47
'Epsilon 68'	269	232	37
'Felina 32'	318	261	57
USO 31	274	241	33
Average	285.2	241.1	44.1
LSD_{05}	41.03	36.58	21.55
2009			
'Beniko'	266	223	41
'Bialobrzeskie'	353	246	107
'Epsilon 68'	274	231	43
'Felina 32'	329	219	108
USO 31	325	211	114
Average	309.2	226.1	83.1
LSD_{05}	44.17	44.61	41.39
2008–2009			
'Beniko'	260	215	45
'Bialobrzeskie'	332	255	77
'Epsilon 68'	271	231	40
'Felina 32'	323	240	83
USO 31	229	226	73
Average	297.2	233.6	63.6
LSD_{05}	27.26	30.94	26.41

Biomass yield. In 2008, hemp produced sufficiently high amount of green over-ground mass (stalks, leaves and panicles) (Table 3). Plants of 'Epsilon 68' and USO 31 produced significantly higher amount of green mass (36.8 and 36.2 t ha^{-1}, respectively) than the other cultivars tested. In 2009, the green biomass yield was even higher (in average 41.0 t ha^{-1}) than that in 2008 (in average 33.6 t ha^{-1}). The highest amount of green biomass was produced by the cultivars 'Epsilon 68' and USO 31 (47.7 and 46.0 t ha^{-1}), but the differences between the cultivars were not significant. In 2008–2009, the lowest productivity of the tested cultivars was exhibited by 'Felina 32' (30.5 and 33.0 t ha^{-1}, respectively). Statistical evaluation showed that the year as a factor had an influence on the results of green (and dry) biomass; therefore, the results averaged over two years cannot be presented.

The yield of absolutely dry hemp biomass was calculated according to the data of hemp green biomass and its moisture content at harvesting. In both years the moisture content in green biomass was close to 50 percent (an average was 52%). The lowest moisture content in 2008 was found in the plants of USO 31 (about 47.4%) and the highest 56.0% was identified in the plants of 'Epsilon 68'. In 2009, plants of 'Felina 32' were dryer (49.9%) and those of 'Beniko' were more succulent (53.2%), but the differences between the cultivars were not significant.

Table 3. Green over-ground biomass yield (kg ha^{-1}), its moisture content (%), and dry biomass yield (kg ha^{-1}) of hemp crop

Upytė Experimental Station, 2008–2009

Cultivar	Green biomass kg ha^{-1}	Moisture content in green biomass %	Absolutely dry mass kg ha^{-1}
	2008		
'Beniko'	33 143	53.9	15 299
'Bialobrzeskie'	31 476	53.9	14 512
'Epsilon 68'	36 762	56.0	16 170
'Felina 32'	30 524	52.2	14 589
USO 31	36 190	47.4	19 016
Average	33 619.0	52.7	15 917.4
LSD_{05}	1 822.4	2.32	1 299.9
	2009		
'Beniko'	40 762	53.2	19 063
'Bialobrzeskie'	37 714	51.8	18 111
'Epsilon 68'	47 714	52.4	22 731
'Felina 32'	33 048	49.9	16 452
USO 31	46 000	50.7	22 633
Average	41 047.6	51.6	19 798.1
LSD_{05}	7 304.7	1.47	3 393.5
	2008–2009		
'Beniko'	–	53.6	–
'Bialobrzeskie'	–	52.8	–
'Epsilon 68'	–	54.2	–
'Felina 32'	–	51.1	–
USO 31	–	49.0	–
Average	–	52.15	–
LSD_{05}	–	1.19	–

In 2008, plants of the tested hemp cultivars produced close to 16.0 t ha^{-1} of dry over-ground biomass and 19.8 t ha^{-1} in 2009. In the experimental years the most productive were plants of 'Epsilon 68' and USO 31 – respectively, 19.0 and 16.2 t ha^{-1} of absolutely dry hemp biomass was produced in 2008, and 22.7 and 22.6 t ha^{-1}, respectively, in 2009. The differences were significant in 2008, but not significant in 2009. The lowest, but still sufficiently high productivity (14.5–18.1 t ha^{-1}) in 2008–2009 was exhibited by the cultivars 'Felina 32' and 'Bialobrzeskie'. Statistical evaluation showed that the year as a factor affected dry biomass results; therefore, the results averaged over two years cannot be presented.

Fibre production of the tested cultivars was also evaluated (from 2.0 to 5.5 t ha^{-1}), but the results will be presented in other articles.

Morphological indices. We were right sowing protective plots around the trial, because the differences in plant height and branching were visible (Picture). Because of better nutrition and light conditions hemp plants at the margins of plots developed more rapidly and were more luxuriant.

In the years of investigation, plant height exceeded three meters at the margins of the trial, but within the record plot (where the samples for morphological evaluation were taken from) plants were shorter (Picture).

Picture. Hemp plants were taller at the margins of protective plots (on the left), and shorter within the record plots (on the right) (the pictures were taken in 2008)

The tallest sawn-off hemp plants (Table 4) in 2008 were those of the cultivars 'Beniko' and 'Epsilon 68' (2.45 and 2.42 m, respectively). In 2008, the differences between cultivars were not significant. In 2009, again the plants of the cultivar 'Beniko' were the tallest 2.78 m (differences significant). Although the total length of hemp stalks was above 2 meters (2.11–2.34 m), significant differences in plant height between other cultivars were not found, but it can be noted, that plants of 'Epsilon 68' and 'Bialobrzeskie' were taller (2.68 and 2.64 m, respectively), and plants of 'Felina 32' and USO 31 shorter (2.47 and 2.49 m, respectively). The same tendency was noted in 2008.

Plants of 'Beniko' had significantly taller technical stalk length (2.22 m), higher diameter (0.65 cm). The fact is that our sowing rate of 70 kg ha^{-1} gave the result – quite thin hemp stalks – in average 0.58 cm in 2008 and in average 0.78 cm in 2009. In 2008, significantly thinner stalks (0.52 cm) were found in the plots of cultivar 'Felina 32', significantly thicker stalks (0.65 cm) in the plots of cultivar 'Beniko'. In 2009, hemp stalk diameter was between 0.70–0.84 cm, the differences between the tested cultivars were not found.

Table 4. Total length of sawn-off hemp stalk (m), technical stalk length (m) and stalk diameter (cm) Upytė Experimental Station, 2008–2009

Cultivar	Total stalk length m	Technical stalk length m	Stalk diameter cm
2008			
'Beniko'	2.45	2.22	0.65
'Bialobrzeskie'	2.34	2.16	0.54
'Epsilon 68'	2.42	2.15	0.60
'Felina 32'	2.18	1.98	0.52
USO 31	2.17	1.95	0.60
Average	2.31	2.09	0.58
LSD_{05}	0.142	0.115	0.052
2009			
'Beniko'	2.78	2.34	0.84
'Bialobrzeskie'	2.64	2.28	0.70
'Epsilon 68'	2.68	2.27	0.80
'Felina 32'	2.49	2.11	0.76
USO 31	2.47	1.99	0.81
Average	2.61	2.20	0.78
LSD_{05}	0.147	0.148	0.088

Statistical evaluation showed that the year as a factor had an influence on the results of total length of hemp stalk, technical stalk length and stalk diameter, therefore, the results averaged over two years cannot be presented.

Conclusions

1. The trial carried out in 2008–2009 enables us to maintain that the plants of the industrial hemp cultivars tested 'Beniko', 'Bialobrzeskie', 'Epsilon 68', 'Felina 32' and USO 31 could be successfully grown in Lithuania, despite the fact that all those cultivars had been developed in the more southerly countries.

2. In 2008, the growing season of the hemp cultivar USO 31 was 16 weeks (115 days), and 20 weeks (140 days) for the rest of the cultivars, and in 2009, the growing season of USO 31 was 19 weeks (133 days), and 22 weeks (154 days) for the rest of the cultivars.

3. All cultivars tested were productive, but the highest amount of green over-ground biomass and dry biomass was produced by the plants of the cultivars 'Epsilon 68' and USO 31 (respectively, 36.8–47.7 and 36.2–46.0 t ha^{-1} of green biomass and 19.0–22.7 and 16.2–22.6 t ha^{-1} of absolutely dry hemp biomass.

4. The highest stem length of the hemp plants was measured for the cultivars 'Beniko' and 'Epsilon 68' (respectively, 2.45 and 2.42 m in 2008), and in 2009 plants of cultivar 'Beniko' were as tall as 2.78 m. The plants of 'Beniko' had a significantly higher technical stalk length (2.22 m) and a higher diameter (0.65 m) in 2008.

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Sėjamosios kanapės (*Cannabis sativa* L.) veislių įvertinimas Lietuvoje

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Santrauka

Pasaulyje nuolat didėja natūralių ir atsinaujinančių produktų poreikis. Vis daugiau produktų gaminama iš stipraus linų ir kanapių pluošto.
Sėjamoji kanapė (*Cannabis sativa* L.) Lietuvoje kol kas yra neauginama. Lietuvos žemdirbystės instituto Upytės bandymų stotyje 2008–2009 m. buvo ištirtos šių augalų auginimo Lietuvoje galimybės, įvertintas produktyvumas ir biometriniai rodikliai. Tyrinėti sėjamosios kanapės penkių veislių – ʻBeniko' (lenkiška), ʻBialobrezskie (lenkiška), ʻEpsilon 68' (prancūziška), ʻFelina 32' (prancūziška) ir USO 31 (ukrainietiška) – augalai. 2008–2009 m. tyrimų duomenys leidžia teigti, jog visų bandymo metu tirtų veislių kanapių augalai gali būti sėkmingai auginami Lietuvoje, nepaisant to, jog visos šios veislės yra sukurtos šalyse, esančiose kur kas piečiau nei Lietuva. Ankstyviausia tirta veislė buvo USO 31 – jos vegetacijos laikotarpis 2008 m. buvo 115 dienų, 2009 m. – 133 dienos. Kitų veislių augalų vegetacijos laikotarpis tyrimų metais nesiskyrė: 2008 m. jis buvo 140 dienų, 2009 m. – 154 dienos. Nesiekiant gauti sėklų, augalus būtų galima nuimti anksčiau ir vegetacijos laikotarpis būtų trumpesnis. Visos tirtos veislės buvo produktyvios, tačiau didžiausią žalios ir absoliučiai sausos masės derlių užaugino veislių ʻEpsilon 68' ir USO 31 augalai (atitinkamai 36,8–47,7 bei 36,2–46,0 t ha^{-1} žalios antžeminės biomasės ir 19,0–22,7 bei 16,2–22,6 t ha^{-1} absoliučiai sausos masės). Ilgiausi buvo veislių ʻBeniko' ir ʻEpsilon 68' augalų stiebai (2008 m. – atitinkamai 2,45 ir 2,42 m, o 2009 m. veislės ʻBeniko' augalai buvo 2,78 m). Taip pat įvertintas augalų pasėlio tankis, nustatytas pasėlio tankio sumažėjimas vegetacijos pabaigoje.

Reikšminiai žodžiai: biomasė, biometriniai rodikliai, *Cannabis sativa* L., sėjamoji kanapė, veislės.