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Prospects for Non-Traditional Plant Species Cultivated for Forage in Lithuania

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Abstract

The changing climate and increasing number of animal species raised, especially in the organic farming systems, require a new approach to the expansion of the range of plant species grown for forage. In Lithuania's agroclimatic conditions, such plant species as amaranth (*Amaranthus spp*.), proso millet (*Panicum miliaceum*), foxtail millet or chumiza (*Setaria italica*) can be successfully grown for grain and produce almost the same yield and even better chemical composition than conventional oats or barley. In 2006-2007, two trials were conducted at the Lithuanian Institute of Agriculture, where one amaranth, three proso millet, two foxtail millet and some other species' cultivars and accessions were grown for green mass and dry matter yield. Using almost the same agrotechnics as for spring cereals, two cuts were taken annually. Green mass, dry matter yield and chemical composition showed that many of the tested cultivars and accessions of the non-traditional plants for our agroclimatic region in both dry 2006 and wet 2007 year produced rather high yield and can be used as forage for many animal species as green mass, hay or silage.

Keywords: amaranth, proso millet, foxtail millet, yield, chemical composition

Introduction

About 1800 plant species grow on Lithuania's territory, of which 400 are cultivated, however only a few dozens are used on wider scope. Intensive anthropogenic effect results in consistent reduction in the diversity of habitats suiTab. for flora and fauna (Vilkonis, 2001). On the other hand, the changing climate, increasing number of animal species reared, especially in ecological farming systems, require a new approach to the expansion of the range of plant species grown for food and fodder.

Various collections of plant species have been tested at the Lithuanian Institute of Agriculture for several decades. As a rule they used to be obtained from the former All Union Plant Production Institute in St. Petersburg, Forage Institute in Moscow and later from other institutions. During the last 15-20 years we have tested cultivars and breeding lines of the following plant species: amaranth – 20, common millet – 3, foxtail millet – 27, soya – 5, buchwheat – 7, paiza – 4 and some other plant species. Most of them were tested for seed yield. The best performing cultivars and breeding lines are repeatedly tested, multiplied on a larger area and selected.

Miliary crops (common millet, foxtail millet, paiza, sorghum etc.) and amaranthus are grown in many countries for food and forage (Anderson, 1999; Nalborczyk *et al*., 1999). Only common millet is sown on 65 million hectares in the world (Skorniakov, 1985). For many years, miliary crops have been tested and bred in Lithuania, as well as amaranth and other species for seed production (Svirskis, 2005, 2007). In many southern countries miliary crops and amaranth are grown for green grass, hay and silage and are good forage for livestock. This paper presents the data of vegetative mass yield of some non-traditional plant species.

Materials and methods

Collections of some non-traditional plant species in 2006-2007 were sown in the six-course perennial grass breeding crop rotation in the second and fourth fields after ploughed – in first year clover. The soil of the experimental site was light and medium heavy loam. Its arable layer at the 25-30 cm depth contained pHKCl 6.7-7.5, humus 1.7-3.6 per cent, total nitrogen 0.15-0.26 per cent, mobile phosphorus and potassium 201-270 and 101-175 mgkg-1 of soil respectively. The soil in spring was harrowed and prepared by "Germinator". The soil was rolled before and after sowing. Experiments were sown by a hand operated sowing machine "Senjor" into seed beds made by marker, with 50 x 50 cm inter-rows. Each plot was a two-row band, 7 m in length, with a 1 m distance between the bands. The trials involved 3 replications. After the rows of emerged plants became visible, the soil was 1-2 times loosened by a four-row rototiller. Weeds were pulled out by hand in rows. In the trials, we did not use any pesticides, only 30-40 kg ha^{-1} N.The Lithuanian climate varies between maritime and continental. The warm period in Lithuania (mean daily temperature above 0°C) lasts from 230 to 270 days, and the period with mean temperature of +5°C lasts for 187-198 days. The weather conditions during the 2006-2007 period

were diverse and had a different impact on non-traditional plant species growth and yield.

Results and Discussion

The results regarding non-traditional plant species and cultivars tested for their vegetative mass yield and chemical composition in 2006-2007 are presented in Tab. 1 and 2.

The year 2006 was very dry, while 2007 was normal. All the tested cultivars, except for canary grass (*Phalaris canariensis* L.) 'Judita', fodder mallow (*Malva verticillata* L.) 'Dolina' from Czech R. and Persian clover (*T. resupinatum* L.) are bred in Lithuania. The earliest ripening amaranth cultivar was 'Geltonukai', used as Control variant. Herbage and dry matter yield data presented in Tab. 1 suggest that both in the droughty and normal year most of the tested species and cultivars produced rather satisfactory green material and dry matter yield. Although in the normal year 2007 the yield was higher, but in the droughty year when conventional barley was severely affected by the drought the plants tested survived the drought better. A good trait of the miliary crops is good recovery after lodging. All the plant species were cut twice in the experiment. The highest dry matter yield was produced by the fodder mallow 'Dolina', amaranth 'Geltonukai', common millet 'Juosvės', 'Gelsvės' and 'Rudes', foxtail millet 'Rudukės' and 'Auksės' and traditional oats 'Migla' (in 2007). In 2006, the spring wheat 'Marant' was included in the trial, which germinated poorly and almost disappeared. Rather good yield was of Persian clover and seradella 'Neris'. Unexpectedly, low yield was produced by canary grass, which is a valuable plant and in many countries is grown as annual timothy.

The data on the chemical composition of dry matter presented in Tab. 2 shows a great variability of the yield and good quality of the tested cultivars. Miliary crops are expected to spread in Lithuania both in conventional and organic farming systems and will supplement forage base both for conventional and unconventional animals. It is noteworthy that threshed straw of seed millet according to chemical composition were nearly identical with conven-

Tab. 1. Herbage and DM yield of the cultivars of non-traditional plant species, Dotnuva, 2006-2007

Species and cultivar name	Grass				DM t ha^{-1}		annual			
	1st cut		2nd cut				grass		DM	
	height (cm)	tha^{-1}	height (cm)	tha^{-1}	1st cut	2nd cut	tha^{-1}	%	tha^{-1}	%
2006	(August 2)		(October 10)							
Amaranth, 'Geltonukai'	100	21.0	80	13.3	1.85	2.56	34.3	100.0	4.41	100.0
Fodder mallow 'Dolina'	60	7.3	190	51.3	0.67	9.24	58.7	170.9	9.91	224.9
Canary grass	60	3.3	20	4.7	0.57	0.79	8.0	23.3	1.37	31.0
Seradella, 'Neris'	20	3.7	40	13.3	0.59	2.24	17.0	49.5	2.83	64.0
Persian clover	20	4.0	36	8.0	0.57	1.47	12.0	34.9	2.04	42.3
C. millet, 'Rudės'	40	5.3	50	8.3	0.75	1.57	13.7	39.8	2.31	52.5
C. millet, 'Gelsvės'	60	7.0	60	8.0	0.76	2.13	15.0	43.7	2.88	65.4
C. millet, 'Juosvės'	60	5.3	66	8.0	0.53	1.50	13.3	38.8	2.04	46.2
F. millet, 'Rudukės'	50	7.0	45	4.3	0.92	0.81	11.3	33.0	1.74	39.4
T. millet 'Auksės'	60	4.3	60	9.3	0.49	1.57	13.7	39.8	2.05	46.6
LSD_{05}		1.8		0.34	0.21	0.55	3.3	-	0.58	-
2007	(July 19)		(October 1)							
Amaranth, 'Geltonukai'	80	16.3	60	10.70	5.22	2.25	27.0	100.0	7.47	100.0
Fodder mallow, 'Dolina'	120	24.2	120	32.0	7.73	5.96	56.2	208.2	13.70	183.4
Canary grass	42	4.9	36	1.1	2.34	0.21	6.0	22.2	2.55	34.1
Seradella, 'Neris'	45	6.5	50	22.1	2.20	3.62	28.6	105.9	5.82	77.9
Persian clover	64	9.3	46	14.2	2.24	2.72	23.5	87.0	4.96	66.4
C. millet, 'Rudės'	90	13.0	60	3.5	4.16	0.74	16.5	61.1	4.90	65.6
C. millet, 'Gelsvės'	90	15.0	58	4.2	5.11	0.90	19.2	71.1	6.01	80.5
C. millet, 'Juosvės'	118	16.6	64	5.5	5.65	1.15	22.1	81.8	6.80	91.0
F. millet, 'Rudukės'	98	12.3	50	3.3	6.89	0.72	15.6	57.8	7.61	101.9
F. millet, 'Auksės'	100	12.5	54	5.1	5.73	1.21	17.6	65.2	6.94	92.9
Oats 'Migla'	64	13.9	40	3.1	6.66	0.73	17.0	45.9	7.39	98.9
LSD_{05}		2.4		8.0	0.93	1.7	9.0	-	2.12	-

Tab. 2. Chemical composition of DM (%) of the cultivars of non-traditional plant species, Dotnuva, 2006-2007

Species and cultivar name	Crude protein	Fibre	Digesti-bility in vitro	NDF*	MADE**	VTA***
1st cut, August 1, 2006						
Amaranth, 'Geltonukai'	26.8	13.4	70.0	22.2	14.4	4.76
Fodder mallow, 'Dolina'	26.4	17.1	77.8	22.7	16.2	6.15
Canary grass	15.0	32.6	56.8	63.2	33.0	6.89
Seradella, 'Neris'	20.3	25.4	67.8	32.8	25.1	9.21
Persian clover	20.9	23.2	74.4	28.1	20.2	8.89
C. millet, 'Rudes'	14.3	35.6	52.2	65.3	30.8	7.26
C. millet, 'Gelsves'	15.3	28.7	50.5	60.0	25.3	9.29
C. millet, 'Juosves'	12.6	28.0	49.4	61.9	26.1	11.39
F. millet, 'Rudukes'	11.4	32.6	57.8	64.2	31.6	11.09
F. millet, 'Aukses'	9.5	33.3	47.8	68.8	31.5	9.26
2nd cut, October 2, 2006						
Amaranth, 'Geltonukai'	26.0	23.8	62.2	25.5	19.8	8.23
Fodder mallow, 'Dolina'	21.7	29.8	70.0	40.3	30.0	8.42
Canary grass	25.5	25.0	63.9	44.8	24.2	8.03
Seradalla, 'Neris'	12.4	33.2	60.9	40.1	32.7	10.6
Persian clover	17.4	26.5	73.2	29.7	26.0	15.69
C. millet, 'Rudės'	14.7	28.8	76.9	53.5	28.0	9.18
C. millet, 'Gelsvės'	20.2	29.1	49.4	55.2	27.6	5.84
C. millet, 'Juosves'	16.8	30.9	44.7	55.2	28.5	7.08
F. millet, 'Rudukes'	17.3	33.1	41.5	48.0	29.7	4.76
F. millet, 'Aukses'	15.8	28.4	46.2	52.3	33.1	4.99
Threshed straw, 'Aukses'	9.3	34.3	27.1	71.4	37.0	4.93
Threshed straw, 'Gelsves'	9.4	37.6	33.7	70.3	38.7	4.19
Threshed straw, 'Juosves'	11.3	33.2	32.0	68.6	34.8	4.80
1st cut, July 16, 2007						
Amaranth, 'Geltonukai'	19.7	23.5	83.7	26.7	22.3	1.71
Fodder mallow, 'Dolina'	20.5	25.4	67.2	33.2	25.2	8.64
Canary grass	19.0	30.6	61.6	55.4	27.4	6.97
Persian clover	24.3	29.5	85.8	30.0	19.6	8.08
Seradella, 'Neris'	11.8	36.2	66.2	39.9	28.3	11.1
Oat, Migla	16.8	32.7	59.9	59.0	30.5	8.33
C. millet, 'Rudes'	17.7	30.7	55.5	58.6	28.3	6.70
C. millet, 'Gelsves'	19.6	29.5	62.2	56.6	26.9	8.06
C. millet, 'Juosves'	15.7	29.8	48.4	65.2	33.1	4.55
F. millet, 'Rudukes'	18.2	34.3	59.5	62.0	31.2	4.92
F. millet, 'Aukses'	15.5	35.6	55.9	58.4	31.3	6.63
2nd cut, September 27, 2007						
Amaranth, 'Geltonukai'	17.0	23.5	64.8		Not done	
Fodder mallow, 'Dolina'	19.6	25.4	82.0	-	-	-
Canary grass	15.8	30.6	49.1	-	-	-
Persian clover	14.0	29.5	70.8	-	-	-
Seradella, 'Neris'	14.4	36.2	60.6	-	-	-
Oat, 'Migla'	13.9	32.7	35.6	-	-	-
C. millet, 'Rudes'	15.1	30.7	41.9	-	-	-
C. millet, 'Gelsves'	13.9	29.5	42.4	-	-	-
C. millet, 'Juosves'	13.4	29.8	42.8	-	-	-
F. millet, 'Rudukes'	11.8	34.3	38.7	-	-	-
F. millet, 'Aukses'	11.2	35.6	38.4	-	-	-

* NDF –Neutral deterget fibre; **MADF – Modified acid deterget fibre; ***VTA – water soluble carbohydrates; Analyses were done at LIA chemistry laboratory

tional hay, since their stems with leaves remain green until seed harvesting. The cultivars of amaranth and miliary crops developed in Lithuania are characterised by early maturity, disease resistance, are adapted to long day and produce satisfactory dry matter yield. These cultivars are already being tested in Sweden and some Baltic countries.

In conclusion, amaranth, miliary crops, fodder mallow and some other plant species can be successfully grown for food and fodder in Lithuania's agroclimatical conditions on organic and conventional farms.

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