Conclusions

The ranking among the different catch crops according to the nitrogen content in the biomass was: red clover > white mustard > oil radish = cocksfoot > Italian ryegrass. The N_2 fixation rate of red clover was 128 kg ha^{-1}. The biomass of catch crops (C:N ratio = 17.0-25.7) - oil radish, white mustard and red clover incorporated into the soil at the flowering stage and that of cocksfoot and Italian ryegrass incorporated at the heading stage increased the organic carbon content (4.0 – 5.6 %). Legume catch crops biomass ploughed in as green manure significantly increased the spring barley yield.

References

1. Farthofer R., Friedel J.K., Pietsch G., Rinnofner,T., W. Loiskandl, Freyer B. (2004) Plant biomass nitrogen and effects on the risk of nitrate leaching of intercrops under organic farming in Eastern Austria. In: Prüeß, A. (eds.) Eurosoil. Conference Proceedings, Freiburg, Germany; 58-63.
2. Kavdir Y., Smucker A.J.M. (2005) Soil agregate sequestration of cover crop root and shoot-derived nitrogen. Plant and Soil, 272, 263-276.
3. Macdonald A.J., Poulton P.R., Howe M.T., Goulding K.W.T., Powlson D.S. (2005) The use cover crops in cereal-based cropping systems to control nitrate leaching in SE England. Plant and Soil, 273, 355-373.
4. Magid J., Luxhoi J. and Lyshede O.B. (2004) Decomposition of plant residues at low temperatures separates turnover of nitrogen and energy rich tissue components in time. Plant and Soil, 258, 2, 351-365.
5. Maiksteniene S., Arlauskiene A. (2004) Effect of preceding crops and green manure on the fertility of clay loam soil. Agronomy Research, 2, 1, 87-97.
6. Rinnofner T., Farthofer R., Friedel J.K., Pietsch G., Loiskandi W., Freyer B. (2005) Nitrogen uptake and yield of catch crops and their impact on nitrate content in soil under the conditions of organic farming in the pannonic climate region. In: Heß J., Rahmann G. (eds.) Ende der Nische. Beiträge zur 8. Wissenschaftstagung zum Ökologischen Landbau Kassel, Germany, 249-252.
7. Stadler C., Heuwinkel H., von Tucher S., Gutser R., Scheu-Hekgert M. (2005) Beeinflusst der Boden die N-Freisetzung aus pflanzlichen Dünger? In: Heß J., Rahmann G. (eds.) Ende der Nische. Beiträge zur 8. Wissenschaftstagung zum Ökologischen Landbau Kassel, Germany, 217-219.
8. Tarakanovas P., Raudonius S. (2003) Agronominių tyrimų duomenų statistinė analizė taikant kompiuterines programas ANOVA, STAT, SPLIT-PLOT iš paketo SELEKCIJA ir IRRISTAT, Akademija, Lietuva, -57.
9. Tripolskaja L. (2005) Organinės trąšos ir jų poveikis aplinkai. Akademija, Lietuva, 146-153.
10. Velička R., Rimkevičienė M., Marcinkevičienė A., Kriaučiūnienė Z. (2006) Sausųjų medžiagų, organinės anglies ir azoto pokyčiai augalų liekanose pirmaisiais jų skaidymosi metais. Žemės ūkio mokslai, 1, 14-21.

BIO-MORPHOLOGICAL PECULIARITIES OF NEW CULTIVARS OF FODDER GALEGA (*GALEGA ORIENTALIS* LAM.)

Baležentienė L.
Lithuanian University of Agriculture, Studentų 11, Akademija, Kaunas distr. Lithuania, LT-53361
phone: +3708 37 752202, e-mail: ligita.balezentiene@lzuu.lt

Abstract

The first Lithuanian fodder galega (*Galega orientalis* Lam.) high-yielding cultivars: ‘Vidmantai’, ‘Laukiai‘ and ‘Melsviai‘ were bred in 1986-2000 at the Research Station of the Lithuanian University of Agriculture by applying group and individual selection of progeny from the wild populations. A good adaptability to Lithuanian agro-climatic conditions wee established for the new fodder galega cultivar ‘Vidmantai’, ‘Laukiai‘ and ‘Melsviai‘. ‘Vidmantai’, ‘Laukiai‘ and ‘Melsviai‘ creating early, heavy, protein-rich yields and high resistance to phytopathogens and pests. The cultivars ‘Vidmantai’, ‘Laukiai‘ and ‘Melsviai‘ were tested in competitive variety trials during the period of 1996-2001. The aim of this research was to investigate and compare the characteristics of new bred Lithuanian cultivars with improved, economically–valuable cultivar characteristics.

The average DM yield data after 3 years of cultivar competitive experiments varied from 12.1 up to 13.9 t ha $^{-1}$ in depending on the cultivar and climatic conditions. A stable yield of seeds (0.58-0.61 t ha $^{-1}$) was established. The protein content on average consisted of 219.0 g kg^{-1}.

Fluorescence can be used to estimate the intensity of photosynthesis and is related to biosynthetic activity and biomass yield. The maximum level of fluorescence was that of the 2nd and the 3rd leaf ranks. The indices of fluorescence (Ft in steady-state light and maximal Fm fluorescence, quantum yield of electron transport Y and electron transport rate ETR) values significantly increased with increasing leaf age up to 3rd leaf rank and decreased from the 4th leaf rank in all the examined varieties. Measurements of photosynthetic efficiency for genotype comparison should be performed on the 3rd leaf rank. The greatest influence of leaf rank on Ft, Fm, Y and ETR was observed for 'Melsviai'. 'Laukiai' produced the biggest seed yield and had the highest Y (0.290) and ETR (104.9) value.

The cultivars 'Vidmantai', 'Laukiai' and 'Melsviai' were registered in Lithuania in 2001. The breeders of 'Vidmantai', 'Laukiai' and 'Melsviai' are L. Baležentienė, V. Spruogis, O. Kažemėkas and J.Levinskas. These cultivars have been sent for DUS testing in 2006.

Key words
Fodder galega, morphology, cultivars, fluorescence

Introduction

Fodder galega (*Galega orientalis* Lam.) belongs to the family of leguminous (*Fabaceae* Lindl., ISO 5526-1986), genus of galega (*Galega* L.). Fodder galega is an especially valuable perennial and productive crop with a unique chemical composition. That is why galega is a very promising crop in Lithuania and in other countries with similar geo-climatic conditions (Raig, 1982; Adamovics, 2000). Fodder galega is characterizing by good adaptability to growing conditions (Baležentienė *et al*., 1998; Lunan, 1998; Nadiožkin *et al*., 1999; Prokofieva *et al*.,1999; Radenovič, 1996). It can grow in all types of soil except waterlogged ones (Šlepetys, 2003). Galega is more resistant to high water-levels than lucerne. Galega can be used for ecological proposes: to improve soil fertility by accumulating nitrogen, enriching with organic matter and increasing the amount of humus, to decrease soil permeability, erosion and for soil preservation (Raig, 1982; Adamovics, 2000; Šlepetys, 2003).

Galega is excellent quality forage for all kinds of livestock and poultry (Radenovič, 1996; Baležentienė, et al., 2003). It is mainly used as one of the fast and the last component of green fodder conveyor. Galega is valuable for making silage, haylage, and hay, leaf protein concentrate and grass meal.

The period of the ripening of the galega seed lasts only 102-112 days in case of accumulated temperatures of 1800^0 C (41.9 MJ m^{-2}) (Baležentienė *et al*., 1998). By yield this crop successfully surpasses traditional leguminous fodder crops.

Kinetics parameters of chlorophyll fluorescence induction can find application in plant breeding as a way to assess varieties photosynthetic activity and production potential (S. Khanizadeh, J.R. DeEll, D. Rekika, 2004).

The main task of this research was to investigate and compare characteristics of new bred Lithuanian cultivars with improved, economically– valuable cultivar characteristics and to determine the differences in fluorescence parameters among galega (*Galega orientalis* L.) varieties at different leaf age. As one of the physiologic advantages between cultivars, the fluorometry for a new crop galega and its new cultivars had not been investigated before.

Materials and Methods

Fodder galega breeding was carried out in the Research Station of the Lithuanian University of Agriculture. The collection accessions and breeding nurseries were studied in 1986-1995, competitive trials of tested cultivars were carried out in 1996-2001 on sandy moraine loam humic horizon of *Calcari-Epihypogleyic Luvisol*, LVg-p-w-cc (Buivydaitė *et al*., 2001). 'Laukiai' and 'Melsviai' were compared to the 'Vidmantai'.

The new cultivars 'Vidmantai', 'Laukiai' and 'Melsviai' belong to *Galega orientalis* Lam., whose specific English name is fodder galega (reg. No 70972, ID 495682-1). *Galega orientalis* is included in the 'ISTA List of Stabilized Plant Names' (1988). The cultivars of fodder galega 'Vidmantai', 'Laukiai' and 'Melsviai' were bred by applying group and individual selection of progeny from the populations of wild ecotypes collected in different natural habitats (Baležentienė *et al*., 1999; Collen *et al*., 1999). The initial material was obtained from the Estonian Research Institute of Agriculture. In order to study and select valuable genotypes from the collection and nurseries the accessions were planted by seedlings (20 x 30 cm) in 2 replications. Seeds of the selected plants the following year were tested in F_1, later- in F_2, F_3 and F_4 of the selection population's nurseries, control nurseries and in replicated yield trials. Before sowing the seeds were inoculated with *Rhizobium galegae*, containing the active strain 740 R (Lapinskas, 1998).

Chlorophyll a fluorescence was measured *in situ* at the flowering stage in 4 replications for every leaf rank. The steady-state fluorescence yield (Ft) in the light and maximum fluorescence yield (Fm) during the light flash were recorded by chlorophyll a fluorometer diving-PAM-200 and used to determine the quantum yield of electron transport (Y) (Schreiber, 1997).

Plants in the nurseries of selection populations were observed for development stages and biometrical data. The chemical composition of the cultivar's dry matter (DM) was analysed at the Agrochemical laboratory by near infra-red rays (NIR) computer analyzer (PSCO/ISI IBM-PC 4250). The level statistical confidence, interactions between the initial Ft, Fm and estimated Y and ETR data were calculated by the methods of variance and regression analysis using the statistical package STATISTICA of StatSoft for Windows standards.

Results and Discussion

The stem height of cultivars was different and ranged between 118-130 cm (Table 1). The leafy stems grow upright, have 8-17 nodes with compound odd-pinnate leaves, made of 4-6 pairs of egg-shaped leaflets. 68-82 distinct lilac flowers are clustered into raceme. Full flowering starts in the second year of growth. Hanging pods are indehiscent, stride, a little crooked, sharp ended, yellowy brown with a green shade, 4.0 x 0.3 cm size. There are 4-5, 5 and 7-8 seeds in a pod of 'Vidmantai', 'Melsviai' and 'Laukiai' respectively.

Table 1. Morphological characteristics of the cultivars 'Vidmantai', 'Laukiai' and 'Melsviai'

Indices	'Vidmantai'	'Laukiai'	'Melsviai'
Leaflets	Egg-shaped, , inferior side with short lie tomentum	Wide, egg-shaped, inferior side with short lie tomentum	Narrow, egg-shaped, with short lie tomentum only on veins
Leaves	Odd-pinnate with 5 - 6 leaflet pairs and two stipule, petiole with short lie tomentum	Odd-pinnate with 4-5 leaflet pairs and two stipule, petiole with short lie tomentum	Odd-pinnate with 5 - 6 leaflet pairs and two stipule, slightly glossy lower side
Stem	124 cm, upright, with short lie tomentum, with 8 nodes	118 cm, upright, without tomentum, with 10 nodes	130 cm, upright, without tomentum, with 17 nodes
Flores	68-70 bluish violet flores clustered into cluster	77-80 bluish violet flores clustered into cluster	78 – 82 distinct violet flores clustered into cluster
Pod	Average 15 pods per plant with 4-5 seed	Average 36 pods per plant with 7-8 seed	Average 46 pods per plant with 5 seed
Seeds	3.5 – 4.0 mm, oblong greenish brown	3.6 – 4.1 mm, oblong greenish brown	3.6- 4.1 mm, oblong greenish brown

The highest average weight 8.13 g of 1000 seeds was determined of 'Melsviai' (Table 2). Cultivars fodder galega as distinct from lucerne had a significant quality to crop stable seed yield in the agro-climatic environment of Lithuania. The shortest duration of seed yield ripening lasted for 'Vidmantai' on average 110 days, but the vegetative growth season is long (April-October).

Fodder galega is distinguished by rich leafy: 'Vidmantai' – 47, 'Melsviai' – 51 and 'Laukiai' – 57 % that guarantee a stable and heavy DM and GM yield. The highest content of DM -12.66 t ha $^{-1}$ was determined in the 'Melsviai', the least –12.10 t ha $^{-1}$ of 'Laukiai'.

The new forage cultivar 'Vidmantai' with medium stem high (127.3) in comparisan with 'Laukiai' and 'Melsviai' produce of the least yield of green material (51.6 t ha^{-1}). 'Melsviai' grow the tallest stems therefore had the largest number of nodules as well as leaves and the highest yield of GM (60.4 t ha^{-1}) and DM (139.9 t ha^{-1}).

The average plant height - 127.3 cm, high resistance to plant lodging (4.1 point) and seed scattering (9.0 point) as well as winterhardness (8.8 point) of 'Vidmantai' have been established.

Table 2. Agrobiological features of fodder galega cultivars

Parameter	Cultivars	1998	1999	2000	Average	LSD_{05}
GM yield, t ha^{-1}	'Vidmantai '	51.7	56.9	54.6	51.6	5.91
	'Laukiai'	56.4	60.2	58.1	58.2	6.84
	'Melsviai'	58.6	62.6	60.3	60.4	5.12
DM yield, t ha^{-1}	'Vidmantai '	12.1	12.0	12.2	12.1	1.01
	'Laukiai'	13.1	13.3	13.2	13.2	0.94
	'Melsviai'	13.5	14.3	13.8	13.9	0.98
Seed yield, t ha^{-1}	'Vidmantai '	0,59	0.61	0.60	0.60	0.023
	'Laukiai'	0.61	0.62	0.62	0.61	0.019
	'Melsviai'	0.59	0.58	0.57	0.58	0.021
Weight of 1000 seeds, g	'Vidmantai '	7.98	8.11	8.10	8.06	0.687
	'Laukiai'	6.83	6.61	7.14	6.86	0.641
	'Melsviai'	8.29	7.97	8.14	8.13	0.635
Crude protein, g kg^{-1}	'Vidmantai '	215.8	221.3	216.0	218.3	20.08
	'Laukiai'	211.7	220.4	216.1	220.1	19.69
	'Melsviai'	249.6	223.6	257.3	243.5	20.10
Maturity, day	'Vidmantai '	112	110	109	110	6.32
	'Laukiai'	114	112	110	112	5.94
	'Melsviai'	115	113	112	113	6.03
Plant height, cm	'Vidmantai '	126	129	128	127	9.03
	'Laukiai'	118	117	120	119	8.76
	'Melsviai'	137	138	136	137	8.68
Lodging resistance (1-5 score)	'Vidmantai '	4.6	3.8	4.0	4.1	0.85
	'Laukiai'	4.7	4.5	4.3	4.5	0.79
	'Melsviai'	4.3	4.0	4.2	4.2	0.91
Scattering resistance (1-9 score)	'Vidmantai '	9.0	8.9	9.0	9.0	0.84
	'Laukiai'	8.7	9.1	8.9	8.9	0.79
	'Melsviai'	8.9	9.0	8.9	8.9	0.86
Winterhardness (1-9 score)	'Vidmantai '	8.1	9.5	8.7	8.8	0.74
	'Laukiai'	8.0	9.4	8.8	8.5	0.68
	'Melsviai'	8.0	9.4	8.9	8.8	0.81

The dry matter of fodder galega 'Vidmantai' is distinguished by high protein content. Crude protein content averages 219.0 g kg^{-1}. The content of other important chemical substances, feed units (average 0.85 un. kg^{-1}) and digestible protein (average 174.8 g kg^{-1}) established high rates also. The chemical composition of others cultivars is similar.

The newly created cultivars of fodder galega are a universal type of cultivar. They can be grown for all kinds of forage, green manure used for the preservation and improvement of soils. 'Vidmantai', 'Melsviai' and 'Laukiai' are tap-rooted herbs which spread and propagate in a vegetative way as well as by seeds. The cultivars are highly resistant to diseases and pests.

According to the Tukey HSD test statistically significant differences between the Y and ETR were in 'Laukiai' and 'Melsviai' (p=0.01011), but after the Fisher LSD test statistically significant differences were determined among Melsviai and other cultivars: 'Vidmantai' (p=0.04364) and 'Laukiai' (p=0.00189). The average mean of Ft (0.421) and Fm (0.613) were determined for the cultivar Vidmantai, Y (0.290) and ETR (104.9) – of Laukiai. Statistically significant influence of leaf ranks on Ft and Fm mean values confirm both applied tests. Ft, Fm, Y and ETR increased with leaf rank up to the 3rd. The older leaves (the 4th – 6th rank) begun to wither, necrotic lesions

emerged, and this can explained by reduced metabolic activity and PAM fluorescence. The greatest influence of leaf rank on Ft, Fm, Y and ETR was observed for 'Melsviai'.

Applied regression analysis of fluorescence parameters revealed a strong and statistically significant parabolic relationship ($0.78145 \leq \eta \leq 0.97385$) with leaf rank. The second degree parabola regression model was chosen to describe the estimated function between leaf rank and Ft, Fm, Y and ETR (Fig. 1). Leaf rank explained variations of Ft by 60.3-86.0 %, Fm by 67.2-84.9 % and Y and ETR by 62.5-94.8 %.

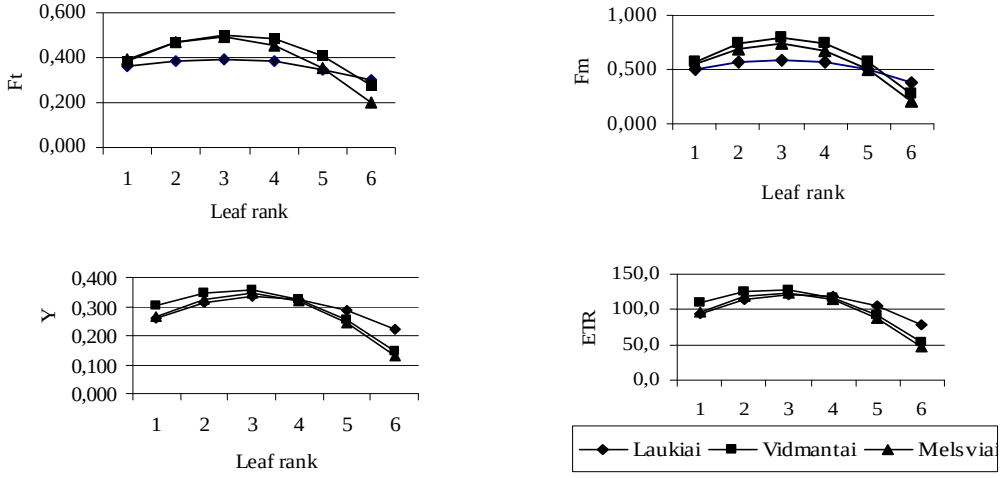

Figure 1. Fluorescence parameters of galega' cultivars

Since 2000 'Vidmantai', 2001 'Melsviai' and 'Laukiai' have been included in the National Variety List (2001; 2002) and have been sent for DUS testing in 2006.

Conclusions

During period 1986-2000 the new cultivars 'Vidmantai', 'Melsviai' and 'Laukiai' of fodder galega with valuable agrobiological peculiarities were bred in Lithuania and included in the National List from 2000 and 2001. The cultivar 'Melsviai' due to the tallest stems (137 cm) has the highest yield of GM (60.4 t ha^{-1}) and DM (13.9 t ha^{-1}). The least productive of medium height cultivars was 'Vidmantai'. The smallest cultivar 'Laukiai' produced the highest number of seed per pod and seed yield (0.61 t ha^{-1}). Winterhardness for the best is 'Laukiai'. 'Vidmantai' is the earliest ripening cultivar compared with 'Laukiai', and 'Melsviai'. Its maturity average lasts 110 days. The content of crude protein of 'Vidmantai' is 2.2 g kg^{-1} higher than 'Laukiai', but 0.9 g kg^{-1} less than 'Melsviai'.

It was established that a strong and statistically significant parabolic curve of different leaf ranks depends on fluorescence indices. Their mean values significantly increased with increasing leaf age up to the 3rd leaf rank and decreased from the 4th leaf rank of all the examined varieties. Measurements of photosynthetic efficiency for genotype comparison should be performed on the 3rd leaf rank. The greatest influence of leaf rank on Ft, Fm, Y and ETR between cultivars was observed for 'Melsviai'.

References

1. Adamovics, A. (2000) Research on Productive Longevity and Photosynthesis Activity in Fodder Galega–grass Mixture. In The Results of Long–term field Experiments in Baltic States, Jelgava, 11–18.
2. Baležentienė, L., Spruogis, V., Bėčius, V. (1998) Fodder galega- new valuable crop in Lithuania. Biologija, 1, 11-12.
3. Baležentienė, L., Spruogis, V. (1999) Bio-morphological evaluation of fodder galega (Galega orientalis Lam.) F_4 selection populations// Biologija, 3, 17-19.
4. Baležentienė, L., Spruogis, V., Juknevičius, S. (2003) Rytinių ožiarūčių (Galega orientalis Lam.) pašarinės vertės tyrimas, Vagos, 59 (12), 23-29.

5. Buivydaitė, V.V., Vaičys, M. (2001) Naujoji Lietuvos dirvožemių klasifikacija: Monografija. -V.: Lietuvos mokslas, 32, 281-331, 1075-1085.
6. Collen, A. M., Jarl, C. I. (1999) Comparision of different methods for plant regeneration and transformation of the legume Galega orientalis Lam. (goat's rue), Plant cell rep.-Berlin, 19 (1), 13-19.
7. Khanizadeh, S., DeEll, J.R., Rekika, D. (2004) Potential use of chlorophyll fluorescence in fruit breeding. ISHS Acta Horticulturae 663: XI Eucarpia Symposium on Fruit Breeding and Genetics, Angers, France.
8. Lapinskas, E. (1998) Biologinio azoto fiksavimas ir nitraginas, Vilnius, 218.
9. Lhunan, T. (1998), The value of clover and other forage legumes in Norway, Planterforsk, 1/98, 13-17.
10. Nadiožkin, S.M., Kšnikatnika, A.N., Galiullin, A.A. (1999), Dinamics of organic compound and biological activity of galega, Agroch., 2, 26-30 (in Russian)
11. Prokofieva, I., Zaitseva, T. (1999) Galega variety Antei, Buletin informative, Respublic Moldova, 6,1-4.
12. Radenovič, B. (1996) Galega orientalis Lam. variety Gale new legume protein and perennial fodder crop in FR Yugoslavia, 16th General Meeting of the European Grassland Federation, Grado, 2-5.
13. Raig H. (1982) Experience with a newly introduced fodder plant - Galega orientalis Lam. - in the Estonia SSR, Tallinn, 15.
14. Schreiber, U. (1997) Chlorophyll fluorescence and photosynthetic energy conversion, Walz, 73.
15. Šlepetys, J. (2003) Rytinių ožiarūčių ilgaamžiškumas auginant juos pašarui ir sėklai nukastoje žemapelkėje, Žemdirbystė, 4, 84.

MELNO GRAUDU (IER. *CLAVICEPS PURPUREA*) EPIDEMIOLOĢIJA
EPIDEMIOLOGY OF ERGOT (CAUSED BY *CLAVICEPS PURPUREA*)

[1]**Bankina B.**, [2]**Priekule I.**, [3]**Kokare A.**, [3]**Kronberga A.**, [1]**Lapiņš D.**
[1]Latvijas Lauksaimniecības universitāte, Augsnes un augu zinātņu institūts, Lielā -2, Jelgava.
Tel: +371 3021985 e-pasts: Biruta.Bankina@llu.lv
[2]Latvijas augu aizsardzības pētniecības centrs, [3]Valsts Priekuļu laukaugu selekcijas institūts

Abstract

Ergot of triticale and rye is caused by *Claviceps purpurea* (Fries: Fries) Tulasne; anamorph *Sphacelia segetum.*

Voluminous observations were done in commercial fields of rye in Latvia (2005 – 2006). Agroecological factors – vegetation in surrounding areas, crop rotation, sowing density and others factors were described. Peculiarities of *C. purpurea* development were clarified in semi-field trials.

Statistically significant infection levels were observed in various field location. More sclerotia were found near a field margin (> 1 m) in comparison with zones more deep in the field (at least 30 m from field margin). The density of pollens, the accumulation of natural sources of infection determine "side effects". Separate harvesting of field borders (3-4 m zone) could significantly decrease ergot admixture in the yield. Delayed development of side tillers is a very significant factor increasing the incidence of sclerotia. Optimal crop management is important to avoid ergot occurrence in rye and triticale. Density of sowings affects disease development. Rye pre-crops affected the ergot infection level.

Significant differences between cultivars (testing in natural and artificial infection conditions) were not established. Higher ergot incidence was observed in hybrid and tetraploid cultivars; this is due to the different morphology of pollens and the peculiarities of their development.

Sclerotia germination was noted in the beginning of May, but peritheciums with asco spores developed considerably later. The release of the first mature asco spores was observed only in the middle of June (2006) therefore the infection period is a loge one - from the end of May till the end of June.

Key words

Rye, triticale, ergot, incidence