Agronomy Research **4**(Special issue), 327–330, 2006

Resistance of red clover to diseases and pests under different growing conditions

R. Repšienė[1] and R. Nekrošiene[2]

[1]Vezaiciai Branch, Lithuanian Institute of Agriculture, Gargzdu 29, Vezaiciai LT-96216 Klaipeda distict, Lithuania; e-mail: regina@vezaiciai.lzi.lt
[2]Botanical Garden of Klaipeda University, Kretingos 92, LT-92327 Klaipeda, Lithuania; e-mail: bot.sodas@one.lt

Abstract. Experiments were carried out in the Vėžaičiai Branch of the Lithuanian Institute of Agriculture (West Lithuania region) in 1998−1999 and 2005. The aim of this research was to estimate the incidence of diseases and pests of red clover in soils with different agrochemical characteristics. The soil acidity varied from 3.9-6.7, available P_2O_5 from 47–317, available K_2O from 100–360 mg kg^{-1}, amount of humus from 1.71–2.36%. Ecological conditions of soils contained differing amounts of lime, mineral and organic fertilizers.

Common leaf spot (agent *Pseudopeziza trifolii* (Biv.-Bern:Fr.) Fuskel) had a 1.3−1.7 greater incidence on the red clover growing in the soil with pH_{KCl} 3.9−4.9 in comparison with those grown in the soil with pH_{KCl} 5.7−6.7, and with intensively damaged red clover which grew in soils with fewer nutrients. Increasing the quantity of nutritious materials increased the incidence of powdery mildew (agent *Erysiphe polygoni* DC.) in 1999 and 2005 but reduced the incidence of clover seed weevil in soils with pH_{KCl} 5.7−6.7 in those years.

Key words: red clover, pest, disease, incidence, soil acidity, amount of nutrients

INTRODUCTION

Red clover (*Trifolium pratense* L.) is the most important legume crop. However, red clover is infected by several fungal pathogens affecting its growth, persistence and overwintering capacity (Wallenhammar et al., 2006). Crop rotation, growing conditions, etc, influence the spread of any fungi and pests (Salonen et al., 2001; Sigvald, 2000). It was generally assumed that P and K fertilizers favoured the legumes' development (Garcia et al), but some pests, such as *Phytonomus meles* F. and *Ph. nigrirostris* F. spread more intensively in luxuriant (denser) perennial grasses. *Apion seniculus* Kby. was less damaging to red clover in soils of neutral reaction and was more harmful when fertilized by potassium and phosphorus fertilizers (Salonen et al., 2001). A powdery mildew primarily harms red clover growing in those soils having the most Ca (of more neutral reaction). The expansion of powdery mildew is also influenced by the unbalanced fertilizing with phosphoric fertilizers; the disease expands less on red clover which has been more abundantly fertilized by the mineral fertilizers containing potassium .

The aim of this research was to investigate the incidence of diseases and pests of red clover, which grew in soils with different pH_{KCl} and amount of nutrients.

MATERIALS AND METHODS

Experiments were carried out in the Vėžaičiai Branch of the Lithuanian Institute of Agriculture in Dystric Albeluvisol (texture − morain loam) soil. The following crop rotation was applied: 1) fodder beet (*Beta vulgaris*), 2) spring barley (*Hordeum vulgare*) and perennial grasses: red clover (*Trifolium pratense*) 'Liepsna' + timothy (*Phleum pratense*) 'Gintaras II', 3) first year perennial grasses, 4) winter wheat (*Triticum aestivum*), 5) oat (*Avena sativa*). The seeding rate of perennial grasses was 160 kg ha^{-1}. The seed proportion of red clover and timothy was 80:20. Soil was limed by different amounts of $CaCO_3$ 92.6%: 1.9, 3.3, 5.8, 14.7 and 49.6 t ha^{-1}. After liming, the soil reaction was measured: pH_{KCl} increased from 3.9 to a maximum of 6.7. Every plot with different soil reactions was fertilized with increasing rates of mineral fertilizers according to the following scheme: unfertilized, one ($P_{30}K_{30}$), two ($P_{60}K_{60}$) and three ($P_{90}K_{90}$) rates of phosphorus (P) and potassium (K). During crop rotation, different amounts of manure were applied twice during the intercropping periods, creating a full range of nutrients in the soil: available P_2O_5 47−317, available K_2O 100−360 mg kg^{-1}, organic matter (OM) content 1.71−2.36 mg kg^{-1}. Agrochemical analyses were made by these methods: P_2O_5, K_2O using the method of Egner−Rimo−Domingo (A−L) and pH_{KCl} − in a potentiometric way. Experiments presented in this paper were carried out in five variants with different nutrient levels: **1**. P_2O_5 47−101 mg kg^{-1}, K_2O 100−152 mg kg^{-1}, OM 1.71−1.84 mg kg^{-1}; **2**. P_2O_5 102−156 mg kg^{-1}, K_2O 153−205 mg kg^{-1}, OM 1.85−1.97 mg kg^{-1}; **3**. P_2O_5 157−211 mg kg^{-1}, K_2O 206−258 mg kg^{-1}, OM 1.98−2.10 mg kg^{-1}; **4**. P_2O_5 212−266 mg kg^{-1}, K_2O 259−311 mg kg^{-1}, OM 2.11−2.23 mg kg^{-1}; **5**. P_2O_5 267−317 mg kg^{-1}, K_2O 312−360 mg kg^{-1}, OM 2.24−2.36 mg kg^{-1}. There were two experiments with different soil pH_{KCl}: very acid−average acid reaction (pH_{KCl} 3.9−4.9) and moderately acid−close to neutral reaction (pH_{KCl} 5.7−6.7). There were ten variants and three replications in all.

Fungi and pests of the aboveground parts of red clovers were investigated in 1998−1999 and 2005 during the blooming season. Ten (10) plants in 10 places of each variant were investigated.. Incidents of foliar diseases and pests were accounted for using the number of foliar clover damaged by diseases and pests, expressed by percentage according to literature (Šurkus et al).

Meteorological conditions. The average temperature was 12.6°C and precipitation was 44.5 mm in May 1998. In June of the same year, the mean temperature was 14.7°C, in line with the standard of several years, but there was high precipitation: 87.4 mm. The climate was cool and wet in April 1999 (temperature, 7.9°C, amount of precipitation, 68.1 mm). The beginning of May was even cooler. Rather warm weather and decreased precipitation e characterised the month of June. The average atmospheric temperature in April 2005 was 6.2°C and the sum of precipitation only 14.5 mm; in May, 11.1°C and 37.3 mm; in June, 14.4°C and 45.5 mm. The data was analyzed statistically.

RESULTS AND DISCUSSION

During the investigative period the red clover were harmed by 8 kinds of fitopathogenic microorganisms and by 5 kinds of pests in total. The more serious and frequently occurring fungal diseases were northern anthracnose (agent *Kabatiella*

caulivorum (Kirchn.) Kar.), common leaf spot (agent *Pseudopeziza trifolii* (Biv.-Bern:Fr.) Fuskel), sooty blotch (agent *Cymadothea trifolii* (Pers.) F. A. Wolf.) and powdery mildew (agent *Erysiphe polygoni* DC.). The fungal foliar diseases damaged red clover from 9.8–l 57.5% and pests, from 20.0–55.5% in soils with different nutrient levels and pH_{KCl} at the end of growing seasons (blooming) in 1998−1999 and 2005. Northern antracnose, common leaf spot and sooty blotch spread more intensively (1.2−1.4 times) in 1998 (high temperature and precipitation during vegetation period) in comparison with 1999 and 2005. Clover seed weevil was more intensively spread in 2005 and clover leaf weevil,. in 1998 and 2005 (Table 1).

Table 1. Estimation of incidence red clover diseases and pests in soils with different nutrient level and pH_{KCl} in 1998−1999 and 2005.

No of var.	Foliar diseases incidence, %								Pests incidence, %			
	Northern antracnose		Common leaf spot		Sooty blotch		Powdery mildew		Clover seed weevil		Clover leaf weevil	
	A*	N*	A	N	A	N	A	N	A	N	A	N
						In 1998						
1	55.5	55.0	34.1	20.5	22.2	20.9	12.5	11.9	20.2	20.5	40.4	42.2
2	56.2	55.2	24.4	24.1	20.2	21.1	10.6	12.0	21.5	22.3	40.5	42.5
3	52.2	52.0	28.5	18.5	24.4	22.5	12.6	12.2	20.0	20.9	40.6	40.0
4	57.5	56.5	26.4	14.5	22.5	23.8	12.9	12.5	20.9	20.0	41.2	41.2
5	55.8	55.5	30.5	16.4	25.1	22.6	12.0	12.0	20.0	20.0	40.0	40.2
$LSD_{0.05}$	0.75	0.68	1.22	1.12	0.52	0.55	0.68	0.45	1.05	0.87	1.12	1.52
						In 1999						
1	41.4	40.4	19.2	15.2	10.0	10.2	20.0	21.0	35.5	36.6	25.9	24.9
2	40.2	40.5	20.0	18.8	9.8	10.4	21.4	21.2	32.2	32.9	26.1	26.1
3	40.0	40.2	20.5	16.9	10.2	10.2	22.0	21.8	35.0	35.8	22.5	22.5
4	39.8	40.8	20.0	19.9	10.0	10.9	22.5	22.0	38.9	32.2	24.4	24.4
5	40.5	40.5	20.2	19.0	10.0	10.6	22.9	22.0	36.6	32.0	25.5	26.8
$LSD_{0.05}$	1.58	0.95	0.38	0.29	0.45	0.65	0.72	0.42	1.56	0.69	1.22	0.95
						In 2005						
1	45.9	45.0	29.9	16.3	15.5	15.9	14.2	15.2	55.5	55.9	40.2	42.2
2	45.5	45.5	26.6	14.6	16.5	16.0	15.0	15.5	53.5	55.0	41.5	41.5
3	46.3	45.9	25.9	13.5	15.7	16.5	18.2	16.2	53.2	48.5	40.5	40.2
4	45.6	45.5	26.0	18.9	16.0	16.0	16.5	16.0	55.2	40.2	40.9	40.6
5	45.5	45.5	24.5	18.0	16.0	16.6	16.9	16.9	55.0	42.0	40.2	40.2
$LSD_{0.05}$	0.42	0.24	0.65	0.86	0.23	0.42	1.22	0.26	1.56	1.22	0.35	0.85

Note: *A − soil of pH_{KCl} 3.9−4.9, N − soil of pH_{KCl} 5.7−6.7.
$LSD_{0.05}$ − least significant difference at $P \leq 0.05$.

The incidence of common leaf spot was influenced by differences in quantity of soil nutrients and soil pH_{KCl}; differences among all variants were found to be significant. In 1998 the incidence of common leaf spot was more intense, by 1.1−1.4, and in 2005, was 1.1−1.2 times more intense on the red clover which grew in the poor soil (P_2O_5 47−101 mg kg^{-1}, K_2O 100−152 mg kg^{-1}, OM 1.71−1.84 mg kg^{-1}) in comparison with plants which were grown in the soil rich in nutrients (P_2O_5 102−317 mg kg^{-1}, K_2O 153−360 mg kg^{-1}, OM 1.85−2.36mg kg^{-1}) when pH_{KCl} was 3.9−4.9 (r_{1998} = −0.752, r_{2005} = −0.625, P <0.05). In 1998 common leaf spot incidence was1.3−1.7 times more intensive on the red clover that grew in the soil with P_2O_5 102−156 mg kg^{-1}, K_2O 153−205 mg kg^{-1}, OM 1.85−1.97 mg kg^{-1} in comparison with those red clover

which grew in soil with P_2O_5 157−317 mg kg^{-1}, K_2O 206−360 mg kg^{-1}, OM 1.98−2.36 mg kg^{-1} when pH_{KCl} was 5.7−6.7 ($r = -0.752$, $P < 0.05$). But this disease incidence was different in red clover in 1999 (Table 1). Common leaf spot incidence on red clover growing in the soil of pH_{KCl} 3.9−4.9 was 1.1−2.4 times higher than red clover growing in the soil of pH_{KCl} 5.7−6.7. Correlation analyses revealed a significant relationship between common leaf spot incidence and pH_{KCl} in the soil of red clover habitat ($r = -0.854$, $P < 0.05$). Differences in quantity of soil nutrients and soil pH_{KCl} in red clover habitat had no effect on the incidence of northern antracnose and sooty blotch, but the incidence of these diseases differed significantly among some variants (different soil nutrient levels). Averaging data in 1999 and 2005 show the positive influence of increasing the quantity of nutritional materials in the soil of the host plants' habitat for the incidence of powdery mildew: $r_{1999} = 0.665$, $r_{2005} = 0.582$, $P < 0.05$ (Table 1). According to the average research data. of the investigative period, a mild positive correlation was found between foliar diseases in red clover and the amount of nutrients (P_2O_5, K_2O and OM) in which these plants grew ($r = 0.598$, $P < 0.05$). The level of nutrients in soils with pH_{KCl} 3.9−4.9 had no significant influence on clover seed weevil and clover leaf weevil attacks ($r = 0.255$ and $r = 0.325$, $P = 0.0145$), but clover seed weevil damaged plants 1.1−1.3 times more intensively in soils with the smallest amount of nutrients and organic matter in pH_{KCl} 5.7−6.7 in 1999 and 2005 ($r = -0.452$, $P < 0.05$).

CONCLUSIONS

Increasing the quantity of nutritious materials (P_2O_5 from 47 to 317 mg kg^{-1}, K_2O from 100 to 360 mg kg^{-1}, organic matter from 1.71 to 2.36 mg kg^{-1}) and changes in pH_{KCl} from 6.7 to 3.9 in the soil of red clover habitat significantly reduced the spreading of common leaf spot in some cases. However, it increased the incidence of powdery mildew in 1999 and 2005. Different quantities of soil nutrients and pH_{KCl} had no significant influence on the incidence of northern antracnose and sooty blotch in many cases. Increasing the quantity of soil nutrients reduced the incidence of clover seed weevil in soils with pH_{KCl} 5.7−6.7 in 1999 and 2005.

REFERENCES

Garcia, R., Andres, S., Alvarenga, J. & Calleja, A. 2005. Efecto de la fertilización NPK y del fraccionamiento del nitrogeno en la producción de tréboles. *Producciones agroganaderas: gestión eficiente y conservación del medio natural* **2**, pp. 549–556, Gijon, Spain.

Salonen, J., Bromand, B. & Nistrup-Jorgensen, L. 2001. Crop production conditions in the northern European region with a special reference to crop protection. *Dias report* **59**, 120−125.

Sigvald, R. 2000. Plant protection in Sweden and warning systems for pests and diseases. Forecasting and warning systems for pests and diseases. *Epidemiology, Risk Assessments, Models*, 9−14. Upsala, Sweden.

Šurkus, J. & Gaurilčikienė, I. (eds.). 2002. Agricultural plant diseases and pests and their accounting. Academia, Lithuania, 345 pp. (in Lithuanian).

Wallenhamman, A.C., Adolfsson, E., Engström, M., Henriksson, M., Lundmark, S., Roemphe, G. & Ståhl, P. 2006. Field surveys of Fusarium root rot in organic red clover leys. Sustainable Grassland Productivity. *Grassland Science in Europ* **11**, pp. 369–371. Badajoz, Spain.