Observation of Root Rot and Internal Breakdown of Redclover (*Trifolium pratense* L.) in the 3rd Year

H. Nakashima
Hokkaido University, Japan

H. Morishita
Hokkaido University, Japan

T. Hirata
Hokkaido University, Japan

K. Yoshida
Hokkaido University, Japan

The XIX International Grassland Congress took place in São Pedro, São Paulo, Brazil from February 11 through February 21, 2001.

Proceedings published by Fundacao de Estudos Agrarios Luiz de Queiroz

ID # 14-04

OBSERVATION OF ROOT ROT AND INTERNAL BREAKDOWN OF REDCLOVER (*Trifolium pratense* L.) IN THE 3RD YEAR

H. Nakashima, H. Morishita, T. Hirata and K.Yoshida

Faculty of Agriculture, Hokkaido University, Sapporo 060-0811 Japan,

hnaka@exfarm.agr.hokudai.ac.jp

Abstract

Two red clover (*Trifolium pratense* L.) cultivars; Hokuseki and Merviot were surveyed growth habits and deterioration at the crown and taproot in the 3rd year. Each cutting plants were marked and measured the plant height and dry matter weight. After 3rd cutting of the 3rd year, plants were digged out and scored the degree of root rot and internal break down (no symptom: 0-severe damaged: 5). The severe damaged plants at the 3rd cutting tend to have larger plant size at the 1st cutting. And other root development traits during growth were observed.

Keywords: Red clover, persistence, internal breakdown, root rot, root and crown development

Introduction

Red clover (*Trifolium pratense* L.) is widely grown in many temperate countries. Since it is a short-lived perennial, a great deal of breeding effort has been directed to increase its level of persistence. Lacking of long-term stand persistence may be associated with the deterioration of their taproots and crowns (Kilpatrick et al. 1954). Root rots and internal

breakdowns in the crowns of red clovers were thought as results of physiological processes in root and crown developments (Graham et al. 1960; Cressman 1967) and an invasion by soil-borne pathogens (Skipp and Christensen 1990; Christensen et al. 1994).

Several workers found that winter survival or sward yield in the 3rd year of red clovers were relative to some developmental or morphological traits (Smith and Bishop 1993; Christie and Martin 1999). However, there are few reports of relationship between the taproot and crown symptoms of damaged and growth habits in field condition. The objective of this investigation was to examine the association between root rot or internal breakdown and growth habits, main shoot, crown and root developments.

Material and Methods

Experimental field were situated at Experiment Farms, Faculty of Agriculture, Hokkaido University, Sapporo, Japan. The 5m x 5m plots were established in August 1997 by sowing 2 red clover cultivars, 'Hokuseki' and 'Merviot' , respectively (2g seeds/m2) and 2 subplots (1m X 1m quadrates set 10cm margins on the all sides; practically 80cm X 80cm) were put in the each plot. All plants were defoliated to leave a 5 cm stubble for 3 times per year after the 2nd year.

In 1999, 30 plants in the each plot outside the subplots were sampled before one week at each cutting time and had sward growth traits measured, crown and root above 10cm depth. All sampled plants were classified by 6 root and crown symptom types according to diagnosis of root rot and internal breakdown, respectively. The plants of type 0 had no symptom in crowns or taproots; the plants of type 1 exhibited slight symptom; plants of types 2, 3, 4 and 5 had crown or taproot necrosis tissues lower than 10%, 10 to 30%, 30 to 50%, above 50% respectively.

All plants in the subplots were surveyed for the sward characters at the 3 cutting time

in 1999. After the 3rd cutting, all survival plants were digged out and measured the whole plant characters and classified by the 6 symptom types of root rot and internal breakdown, respectively.

Results and Discussion

Dry matter weights of shoots, plant height and the number of shoot for symptom types of root rot (table 1) and internal breakdown (table 2) at each cutting time in 1999 show no clear difference between cultivars.

The plants of types 4 and 5 at the 3rd cut were larger than those of other types at the 1st and 2nd cut. At the 3rd cut, however, these plants were smaller than others. It should be estimated that more developed plants have more deteriorated crowns or taproots at the beginning of the 3rd growth year when plant size were usually big. In greenhouse experiments, Rufelt (1983) observed that plants showing larger root rot and internal breakdown symptoms were large, and not stressed, compared to small and the stressed plant. The plants of types 4 and 5 at the 3rd cut could be the plants which showed less stress than plants of the others types at the 1st cut.

In our field condition, plants that showed severe root rot symptoms could be the ones attacked by insect-feeding or infection of fungus and other physiological stress. Jin et al. (1992) illustrated that the plants with larger taproots showed more feeding stress by *Hylastinus* and the disease. The larger plant had had severe root rot in our experiments.

It was observed the interaction of shoot, crown and root developments and development of root and crown symptoms. These results may indicate the possibility to control the progress of root and crown deterioration of red clover by inhibition of growth rate, such as competition stress. Several kinds of root formation were also found.

References

Christensen, M.J., Koga H., Tsukiboshi T. and Uematsu T. (1994). Possible causes of poor persistence of red clover stands in Japan. Bull. Natl. Grassl. Res. Inst. **49**: 43-50.

Christie, B.R. and Martin R.A. (1999). Selection for persistence in red clover. Can. J. Plant Sci. **79**: 357-359.

Cressman, R.M. (1967). Internal breakdown and persistence of red clover. Crop Sci. **7:** 357-359.

Graham J.H., Rhykerd C.L. and Newton R.C. (1960). Internal breakdown in crown of red clover. Plant Dis. Reptr. **44**: 59-61.

Kilpatrick, R.A., Hanson E.W. and Graham J.H. (1954). Root and crown rots of red clover in Wisconsin and the relative prevalence of associated fungi. Phytopathology **44**: 252-259.

Jin, X., Morton J. and Butler L. (1992). Interaction between *Fusarium avenaceum* and *Hylastinus obscurus* (Coleoptera: Scolytidae) and their influence on root cecline in red clover. J. Econ. Entomol. **85**: 1340-1346.

Rufelt, S. (1983). Root rot - an unavoidable disease? a discussion of factors involved in the root rot of forage legumes. Vaxtskyddsnotiser **46**: 123-128.

Skipp, R.A. and Christensen M.J. (1990). Selection for persistence in red clover: influence of root disease and stem nematode. N. Z. J. Agric. Res. **33**: 319-333.

Smith, R.S. and Bishop D.J. (1993). Astred - a stoloniferous red clover. International Grassland Congress, Palmerston North, New Zealand **17**: 421-423.

Table 1 - Frequency of internal breakdown symptom types of survival plants of two red clover cultivars, 'Hokuseki' and 'Merviot', at the third cut of the third growth year (1999) and their sward characteristics at the three cutting times in 1999

	n	Dry matter (g/plant)			Sward height (cm)			Number of stems/plant*		
		May/99	Sep/99	Oct/99	May/99	Sep/99	Oct/99	May/99	Sep/99	Oct/99
Hokuseki										
Types 0&1	11	2,32	1,49	4,82	52,4	41,3	52,4	3,45	4,73	10,18
Types 2&3	9	7,99	5,17	9,57	55,9	53,5	49,1	6,89	9,67	13,89
Types 4&5	17	10,44	4,02	4,60	63,0	51,4	44,2	6,53	8,00	8,82
Merviot										
Types 0&1	2	3,10	1,81	4,68	67,5	51,0	36,3	4,00	5,08	13,67
Types 2&3	7	7,44	4,05	7,03	84,8	60,2	46,3	6,00	5,86	14,86
Types 4&5	14	10,59	4,26	4,05	88,1	54,4	34,1	8,43	9,29	15,29

n - number of plants

*number of stems were counted at 5cm plant height

Table 2 - Frequency of root rot symptom types of survival plants of two red clover cultivars, 'Hokuseki' and 'Merviot', at the third cut of the third growth year (1999) and their sward characteristics at the three cutting times in 1999.

	n	Dry matter (g/plant)			Sward height (cm)			Number of stems/plant*		
		May/99	Sep/99	Oct/99	May/99	Sep/99	Oct/99	May/99	Sep/99	Oct/99
Hokuseki										
Types 0&1	12	4,25	3,10	8,57	52,3	46,9	53,3	5,67	6,67	14,08
Types 2&3	14	6,89	3,66	5,71	64,9	52,9	51,4	5,21	7,79	11,36
Types 4&5	11	11,90	3,93	3,05	55,9	46,0	37,2	6,36	7,82	5,36
Merviot										
Types 0&1	9	4,06	1,83	4,65	63,6	47,6	38,7	4,11	4,78	13,00
Types 2&3	11	6,80	4,01	6,72	80,0	58,0	40,2	6,64	8,27	22,00
Types 4&5	13	9,71	3,78	3,56	91,2	56,1	34,4	7,54	7,54	9,46

n - number of plants

*number of stems were counted at 5cm plant height