Weed dynamics in differently managed fields

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Abstract. Latvia is characterized by variation among farms. Analysis of the dynamics of weed diversity is based on monitoring sowings during 1997–2004 in westerly and central regions of Latvia. The aim of this research was to compare the dynamics of weed on unchanging types of grain sown, fields with elevated grain density and un-utilised agricultural land. Two hypotheses were put forward: the dynamic of several species of weeds to impact the total number of weeds in land laying waste (un-utilised agricultural land), and the increase in the numbers of several specific weeds in fields with elevated grain density using annual herbicides.

Key words: weed, biodiversity, change of crops

INTRODUCTION

Latvia is characterized by differences in field management. Agricultural land usage in large farms was related to elevated density of grain crops, but 24% of agricultural land was un-utilized in the republic in 2003 (Agriculture …). The Institute of Soil and Plant Sciences of the Latvia University of Agriculture has been studying the dynamics of weed levels in stationary, annually observed areas. The rotation of crops and field areas take place in farms of smaller land holders. The monitoring of weed infestation provides the opportunity to analyze the survival of some species of weeds and to establish the diversity of weeds. The results of analysis of long-term and annually observed weed infestation of sowings make it possible to determine the effects of the management of fields among different rotations of crops .

MATERIALS AND METHODS

The data of the analysis of weed infestation in various sowings was based on comparable data of only four (4) fields from among 75, with different intensities of management, which were grouped and arranged by management and grain crop densities during the research years (Table 1). The second field (15 ha) was a highly cultivated section of a large, intensive farm in Zemgale; the third field (5 ha) employed grasses-grain crop rotation. The fourth field (4 ha) was near Nigrande in Kurzeme. The field management level was characterized by distinctive crop structure in changes of crops years: 1st – 12.5; 2nd – 100; 3rd – 37.5 and 4th – 75%. In the 1st field the land was not utilized for 4 years and herbicide was not used. Herbicide was used annually in the

2nd field, but in the 3rd and 4th fields herbicide was not applied in barley and wheat which had an undersowing of grass. The weed infestation of sown areas was determined using the quantitative currency method developed by A. Rasinsh and M. Taurina. Supporting this method was a correlation between the currency of weed species in fields and the number of this weed species in 1 m^2 of the field area (Lapinsh et al., 2004). The Shannon index of biological diversity was used for an explanation of the dynamic of weed diversity depending upon the intensity of land use and cereal proportion in crop rotation (Magurran, 1988; Lebedeva et al., 2002.].

Table 1. Change of crops in differently managed fields (B – spring barley; G – perennial grasses; N – out of crop; WW – winter wheat; SW – spring wheat; SR – spring rape).

Field	1997	1998	1999	2000	2001	2002	2003	2004
1st	B + G	G	G	G	N	N	N	N
2nd	WW	WW	WW	WW	SW	SW	SW	SW
3rd	G	G	G	G	G	B	WW	WW
4th	SW	G	SR	B	WW	WW	B+G	WW

RESULTS AND DISCUSSION

The low total number of weed species in 8 years was established annually in fields under cereal crops (Table 2). A high number of weeds (p. m^{-2}) was identified in the field which had not been utilized for 4 years. There were fewer weed species in the field management variance in the 3rd and 4th fields compared to un-utilized agricultural land until 2002.

Table 2. Dynamic of weeds in differently managed fields.

Field	Total number of weed species	1997	1998	1999	2000	2001	2002	2003	2004
1st	48	196*	230	78	162	380	658	719	418
		15**	23	8	17	18	10	10	20
2nd	19	73*	36	47	56	16	7	19	4
		6**	6	8	7	6	2	8	4
3rd	50	623*	303	172	109	132	145	129	120
		24**	16	22	18	21	19	17	17
4th	44	99*	56	86	135	345	194	145	90
		19**	11	18	20	28	19	13	8

- number of weeds (p. m^{-2}); ** number of weed species (p.)

The data of the 1st field indicate the intensive distribution of *Artemisia* spp. at first, and of *Agropyron repens* after two years.. The prevalence of this weed impacted the sharp decrease shown on the Shannon index – i.e., the diversity of other weeds (Fig.1). Correlation between the number of some weed species or group of weeds and the number of *Agropyron repens* was significantly negative on the field with grass-grain crop rotation, and valid mathematical correlation exists between members of *Agropyron repens* and *Cirsium arvense* (r_{xy} = - 0.764).The prevalence of *Agropyron repens* impacted the abundance of weed species on the 3rd field, where the landholder mastered grain production technology, step-by-step, during three years. Then he successfully limited the currency of *Agropyron repens*.

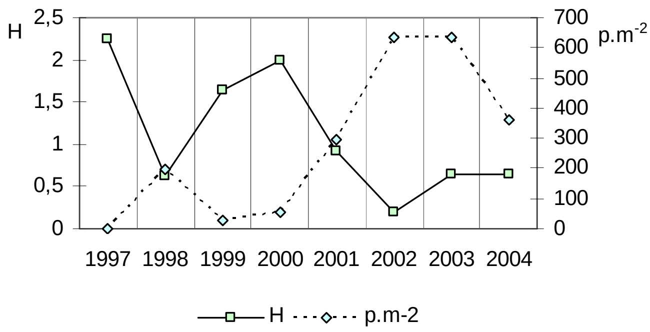

Fig. 1. The Shannon diversity index (H) and number of *Agropyron repens* on the 1st field.

Also, the negative impact of *Agropyron repens* on Shannon index was established on the 4th stationary field with changing management (Fig.2).

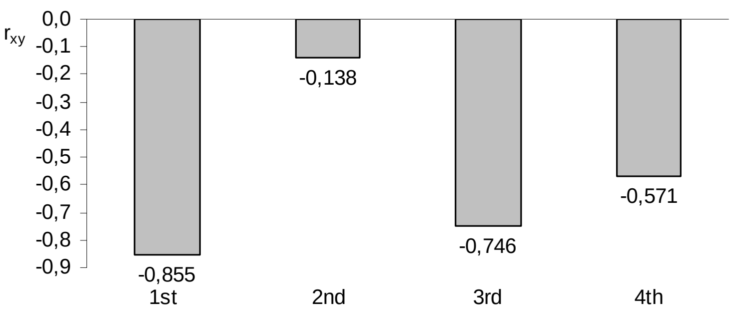

Fig. 2. Correlation (r_{xy}) between the Shannon index and the number of *Agropyron repens* on different fields.

A decrease in biological diversity in the plant community on the field with a change in grain cereal crops for 8 years and yearly herbicide use was not verified on the stationary 2nd field (Fig. 3). The increase of *Veronica arvensis*, *Viola* spp. and *Galium aparine* was not established on this field. The Shannon index and a number of annual dicotyledonous weeds on the 2nd field with intensive yearly herbicide application were determined by the effects of herbicide used.

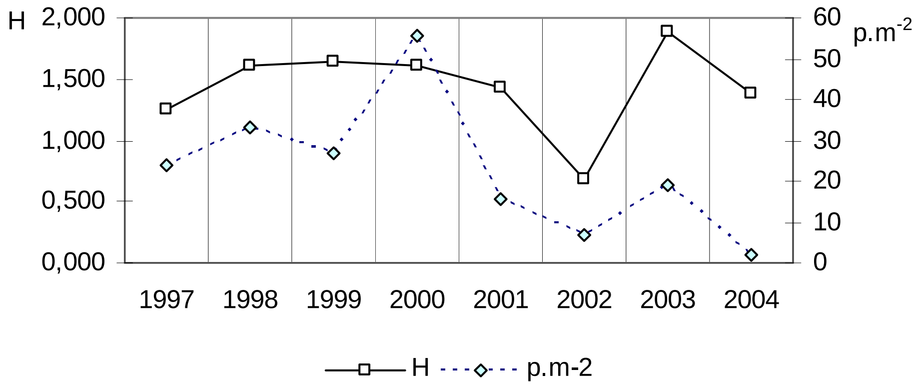

Fig. 3. The Shannon diversity index (H) and number of annual dicotyledonous on the 2nd field.

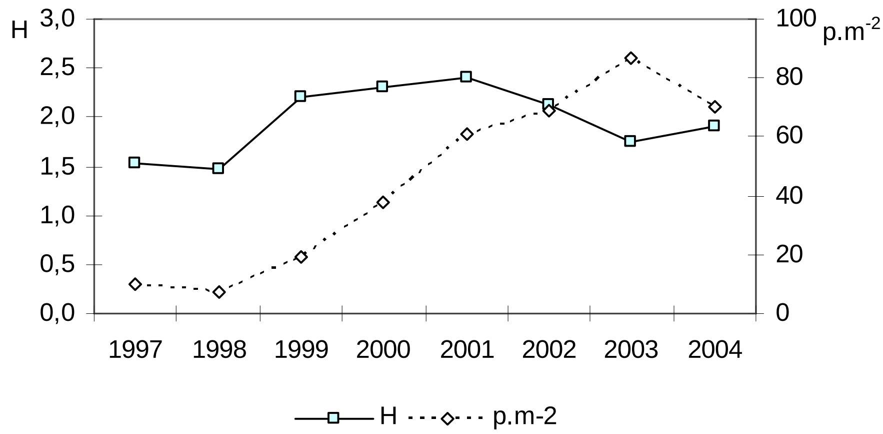

Fig. 4. The Shannon diversity index (H) and number of *Achillea millefolium* + *Taraxacum officinale* on the 3rd field.

After 4 years perennial grasses in the crop rotation on the3rd field established the negative effect of *Cirsium arvense* on weed diversity. The number of *Achillea millefolium* and *Taraxacum officinale* increased during the research and those were dominant in grain sowings on this field (Fig.4).

CONCLUSIONS

Different field management systems bring to the differential tendencies in multiplication of weeds. The low total number of weed species in 8 years was established annually in the field under cereal crops. A high number of weeds (p. m^{-2}) was identified in the field which was not utilized for 4 years.

Low-level field management on agriculturally significant sowings was the reason for the decrease in weed biological diversity and that made it possible for *Agropyron repens* and *Artemisia* spp to dominate.

A decrease of biological diversity in the plant community on the field with a variety of grain cereal crops for 8 years, and annual use of herbicide, was not verified on the stationary observation field, but did reduce the number of annual dicotyledonous weeds on the field.

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