The impacts of various cultivation methods and permanent grassland use on the changes in *Taraxacum officinale* Web. cover rate

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ABSTRACT

Between 1999 and 2002, the area at the foot of the Šumava Mountain Range was used to study the possibilities of harmonizing the productive and non-productive performance offered by permanent grassland. This paper presents the possibilities of *Taraxacum officinale* control within the permanent grassland covers (of the *Lolio-Cynosuretum* association). In an effort to reduce the cover rate of this species, it seems appropriate to reduce its use frequency. In the vegetation covers mowed three times a year the *Taraxacum officinale* reduction may be facilitated with the 100 N + PK dose application.

Keywords: *Taraxacum officinale* Web.; permanent grass stands; fertilization; mowing; grazing; mulching; combined use; use frequency; unharvested stands

When used in limited quantity, *Taraxacum officinale* belongs among valuable components of grassland, considered beneficial primarily for its good taste and high contents of proteins and Na (Turek and Klimeš 1984). Still the plant features some adverse properties, e.g. its fragile leaves are prone to crumbling; it tends to mould when treated for preservation; and its close-to-ground leaf rosette is inclined to create non-productive spots, thus deteriorating the grassland production utility, as is particularly true of the more xeric sites (Regal and Krajčovič 1963). *Taraxacum officinale* also reaches high values in the Index of negative phenols action of Míka et al. (1998).

In consideration of the ambivalence of *Taraxacum officinale* properties, it seems a good idea to keep the plant proportion in the grassland limited, using suitable pratotechnical procedures. As regards pastureland, *Taraxacum officinale* can be considered dietetically beneficial provided its cover rate stays between 1 and 2 percent. To prevent this species from excessive spread, Klečka et al. (1938) recommend to keep the grassland cover dense and closed. Klimeš (1984, 1987) observed the reduction of *Taraxacum officinale* in permanent grassland (*Trifolio-Festucetum alopecuretosum* Neuhäusel 1986) in response to the application of varied doses of N (also in the absence of N), provided the P:K ratio was 1:4. With the P dose doubled (40 kg/ha), or the P dose omitted at all and the K dose kept constant at 80 kg/ha, *Taraxacum officinale* exhibited marked development (within 3 to 4 years it proliferated from less then 1%*D* to 10–12%*D*). When grassland recovery was attempted in comparable environmental conditions, *Taraxacum officinale* (but also *Rumex crispus* and *Elytrigia repens*) was observed to be reduced through the effect of *Arrhenatherum elatius*, provided *Arrhenatherum elatius* had been used as the dominating component of the relevant mixture. Conversely, in vegetation covers dominated by *Festuca pratensis* (30–40%), *Taraxacum officinale* showed some development recovery.

In the current situation typical of the excessive growth of *Taraxacum officinale* in a number of vegetation cover types, it is obviously useful to study the possibilities of keeping the proportion of this species under control through adequate methods of cultivation and to put these plant communities to good use.

MATERIAL AND METHODS

Between 1999 and 2002, the area at the foot of the Šumava Mountain Range was used to study the possibilities of harmonizing the productive and non-productive performance offered by permanent grassland (mesophytic sites, *Lolio-Cynosuretum* association) when cultivated and utilized in a variety of suitable methods. For the agroecological features of the test site see Table 1.

The monitoring was commenced with a benchmark (or blind) test (1999) intended to define the basic scope of testing (variants clustered per different manners of use; the test plot area was 30 m^2, 4 repetitions). In the starting year all the test plots were cultivated in the same way (the vegetation cover was left unfertilized and it was used to graze beef cattle in two grazing cycles) and the plots were subjected to soil and phytocenologic analyses. For all tested variants, lysimeters were planted (in three repeti-

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Table 1. Agrobotanical features of the test site

Municipality/community cadastral area				Kaplice-Rejty	
Altitude above sea level (m)				670	
Average air temperature (°C)	50-year averages	V*	A*	12.82	6.70
	1999	V	A	13.96	7.30
	2000	V	A	13.45	8.04
	2001	V	A	12.46	6.82
Sum of precipitation (mm)	50-year values	V	A	502.0	715.0
	1999	V	A	382.0	583.7
	2000	V	A	377.2	645.7
	2001	V	A	616.7	841.2
Soil type				cambisol of medium-heavy texture	
pH_{KCl}				6.58	
Content of available nutrients in soil (mg/kg) (*)		P/K		64/144	
		Mg/Ca		55/1222.0	

* V – in the vegetation, A – in the year, (*) Mehlich extract

tions) so that their retention surfaces were buried 50 cm below ground.

Since 2000 the mentioned phytocenoses have been subject to controlled tests aimed to verify the suitability of various methods of cultivation and manners of use. The vegetable covers tested as pastureland were used to graze beef cattle, namely the Hereford breed. The individual harvests were preceded with phytocenologic analyses of the tested plant associations conducted in reliance on the Regal and Veselá (1975) method of reduced projective dominance. In this paper we have focused on the analysis of *Taraxacum officinale* cover rate in dependence on different methods of the tested associations cultivation and use.

To evaluate the changes in *Taraxacum officinale* cover rate (in %*D*), we have calculated the year-on-year cover rate changes (Δ*D*%), the average cover rate coefficients of change and the individual indices used to

Table 2. The development of *Taraxacum officinale* cover rate in the tested vegetation covers (in %*D*)

Manner and frequency of the vegetation cover use (*n*×)	Fertilization	Year				ΔD_{To}	k_{To}
		1999*	2000	2001	2002		
L	–	9	13	9	2	–2.333	0.606
K 1×	–	9	10	8	4	–1.667	0.763
K 2×	–	9	14	13	10	+0.333	1.036
K 3×	–	9	10	16	11	+0.667	1.069
K 2×	100N + PK	9	9	13	9	0.000	1.000
K 3×	100N + PK	9	10	14	8	–0.333	0.961
P 2×	–	9	12	15	12	+1.000	1.101
P 3×	–	9	11	13	13	+1.333	1.130
P 4×	–	9	10	11	13	+1.333	1.130
P 2×	100N + PK	9	11	17	13	+1.333	1.130
P 3×	100N + PK	9	12	12	13	+1.333	1.130
P 4×	100 N + PK	9	10	11	14	+1.667	1.159
K 1× + P 1×	–	9	13	15	12	+1.000	1.101
K 1× + P 1×	100 N + PK	9	14	17	12	+1.000	1.101
M 1×	–	9	12	9	5	–1.333	0.822
M 1× + K 1×	–	9	17	14	11	+0.667	1.069
M 1× + P 1×	–	9	22	15	17	+2.667	1.236

ΔD_{To} = average year-on-year change in the cover rate in %*D*, k_{To} = average coefficient of cover rate changes, *n*× = frequency of harvests, K = mowing, P = cattle grazing, L = unharvested vegetation covers, M = mulching

Table 3. Year-on-year changes in the cover rates of the tested *Taraxacum officinale* vegetation covers (ΔD_{To} in % of absolute values)

Manner and frequency of the vegetation cover use	Fertilization	Year			
		2000–1999	2001–2000	2002–2001	2002–1999
L	–	+4	–4	–7	–7
K 1×	–	+1	–2	–4	–5
K 2×	–	+5	–1	–3	+1
K 3×	–	+1	+6	–5	+2
K 2×	100 N + PK	0	+4	–4	0
K 3×	100 N + PK	+1	+4	–6	–1
P 2×	–	+3	+3	–3	+3
P 3×	–	+2	+2	0	+4
P 4×	–	+1	+1	+2	+4
P 2×	100 N + PK	+2	+6	–4	+4
P 3×	100 N + PK	+3	0	+1	+4
P 4×	100 N + PK	+1	+1	+3	+5
K 1× + P 1×	–	+4	+2	–3	+3
K 1× + P 1×	100 N + PK	+5	+3	–5	+3
M 1×	–	+3	–3	–4	–4
M 1× + K 1×	–	+8	–3	–3	+2
M 1× + P 1×	–	+13	–7	+2	+8

For the explanatory notes, see Table 2

follow changes in the basic and chain *Taraxacum officinale* cover rates. The relations between the use frequencies and the changes in *Taraxacum officinale* cover rates have been studied with the methods of correlation and regression analyses.

RESULTS AND DISCUSSION

The varied methods of cultivation and use of the tested plant association employed throughout the monitoring period resulted in a marked differentiation of its

Table 4. The individual indices of basic ($i_{t/to}$) and chain ($i_{t/t-1}$) *Taraxacum officinale* cover rates (in %) of the tested vegetation covers

Manner and frequency of the vegetation cover use	Fertilization	$i_{t/to}$			$i_{t/t-1}$	
		2000/1999	2001/1999	2002/1999	2001/2000	2002/2001
L	–	144.44	100.00	22.22	69.23	22.22
K 1×	–	111.11	88.89	44.44	80.00	50.00
K 2×	–	155.56	144.44	111.11	92.86	76.92
K 3×	–	111.11	177.78	122.22	160.00	68.75
K 2×	100 N + PK	100.00	144.44	100.00	144.44	69.23
K 3×	100 N + PK	111.11	155.56	88.88	140.00	57.14
P 2×	–	133.33	166.67	133.33	125.00	80.00
P 3×	–	122.22	144.44	144.44	118.18	100.00
P 4×	–	111.11	122.22	144.44	110.00	118.18
P 2×	100 N + PK	122.22	188.89	144.44	154.55	76.47
P 3×	100 N + PK	133.33	133.33	144.44	100.00	108.33
P 4×	100 N + PK	111.11	122.22	155.56	110.00	127.27
K 1× + P 1×	–	144.44	166.67	133.33	115.38	80.00
K 1× + P 1×	100 N + PK	155.56	188.89	133.33	121.43	70.59
M 1×	–	133.33	100.00	55.56	75.00	55.55
M 1× + K 1×	–	188.89	155.56	122.22	82.35	78.57
M 1× + P 1×	–	244.44	166.67	188.89	68.18	113.33

For the explanatory notes, see Table 2

Table 5. Development of cover composition (cover rates of the individual species and agrobotanical groups in %*D*) observed in covers mowed once a year (K 1×) and covers mowed once a year plus grazed once a year (K 1× + P 1×)

Species (agrobotanical group)	K 1×				K 1× + P 1×			
	1999	2000	2001	2002	1999	2000	2001	2002
Lolium perenne	5	4	1	1	5	3	5	4
Phleum pratense	6	9	12	8	6	8	3	8
Dactylis glomerata	4	22	12	7	4	18	19	16
Trisetum flavescens	32	13	16	12	32	4	4	1
Agrostis capillaris	7	6	6	7	7	6	3	4
Festuca pratensis	18	13	14	13	18	17	7	17
Elytrigia repens	.	.	.	.	+	1	.	.
Festuca rubra	2	2	4	4	2	5	6	7
Cynosurus cristatus	+	+	+	1	+	+	+	2
Agrostis alba	+	+	+	2	+	2	+	+
Holcus lanatus	+	1	+	2	+	+	+	.
Poa pratensis	5	+	3	8	5	5	13	13
Alopecurus pratensis	.	.	.	.	.	.	.	+
Grass species total	**79**	**74**	**68**	**66**	**79**	**69**	**60**	**72**
Lathyrus pratensis	+	+	2	2	+	+	2	+
Vicia cracca	.	1	5	1	+	.	.	+
Trifolium pratense	+	1	1	2	+	1	1	1
Trifolium hybridum	+	+	.	.	+	.	.	.
Trifolium repens	+	9	8	12	+	7	8	7
Trifolium dubium	.	.	.	+	.	.	.	+
Legumes species total	**+**	**11**	**16**	**17**	**+**	**8**	**11**	**8**
Taraxacum officinale	9	10	8	4	9	13	15	12
Arctium tomentosum	+	+	.	.	+	.	.	.
Rumex obtusifolius	+	+	.	.	.	.	+	+
Cerastium vulgare	+	+	+	+	+	+	+	+
Urtica dioica	.	.	.	.	.	.	.	.
Achillea millefolium	6	4	7	2	6	5	4	3
Ranunculus repens	1	+	+	5	1	1	2	1
Hypericum perforatum	1	+	+	+	1	.	+	+
Rumex crispus	+	+	+	+	+	.	.	+
Sanguisorba officinalis	+	+	.	.	.	.	.	.
Tripleurospermum maritimum	.	.	+	.	.	+	+	.
Daucus carota	+	+	.	.	.	.	.	.
Plantago lanceolata	+	1	2	5	+	2	3	3
Centaurea jacea	1	+	.	.	1	+	+	.
Prunella vulgaris	.	.	.	.	+	+	+	.
Alchemilla xanthochlora	1	+	+	1	1	1	+	1
Plantago major	.	.	.	+	.	.	.	+
Ranunculus acer	.	.	.	+	.	.	.	+
Crepis biennis	+	+	+	+	+	+	.	+
Cirsium arvense	.	.	+	+	.	.	+	.
Potentilla anserina	.	.	.	.	.	.	.	.
Anthriscus sylvestris	.	.	.	+	.	.	.	.
Galium vernum	.	.	.	.	.	.	+	.
Galium mollugo	.	.	.	.	.	.	.	+
Bellis perennis	.	.	.	.	.	.	+	+
Veronica chamaedrys	.	.	.	.	.	.	1	+
Other herbs total	**19**	**15**	**17**	**17**	**19**	**22**	**25**	**20**
Empty places	**2**	**.**	**.**	**.**	**2**	**1**	**4**	**.**
Number of species – total	**29**	**30**	**27**	**29**	**29**	**25**	**29**	**31**

%*D* = different coverage rate; coverage rate to 1%*D* = (+); without whatever coverage rate = (.)

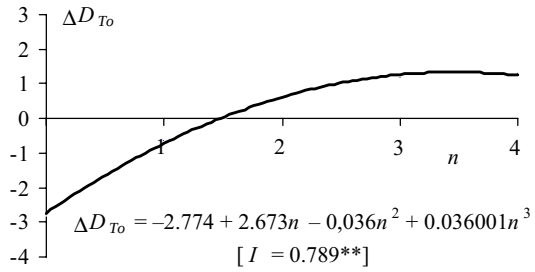

Figure 1. Year-on-year *Taraxacum officinale* cover rate changes (ΔD_{To} in %*D*) versus the number of harvests in one year (*n*)

vegetation cover composition. The differentiation of the *Taraxacum officinale* cover rate encountered within the tested vegetation covers represents an integral part of such changes. Particularly the lower use frequencies are associated with the drop in *Taraxacum officinale* cover rate within the tested vegetation covers, while the covers used twice or more times a year tend to develop a rise in the plant cover rate (Tables 2–5). The Table 2 and Figures 1 and 2 present the changes in *Taraxacum officinale* cover rates caused by the changes in harvesting frequencies as theoretical results generated from empirical data by the regression models. Obviously, the watershed use frequency (*n*) making the difference between *Taraxacum officinale* progress and regress is approximately 1.5. In other words, with just a single harvest or a single mulching a year the *Taraxacum officinale* cover rate wanes, as is also true of the unharvested vegetation covers, while in the covers harvested (mowed or grazed or both) twice or more times a year the cover rate increases. Based on a theoretical approach we could reason that with regular switching between one and two harvests a year the *Taraxacum officinale* cover rate would experience rate increase. The charts depicting the *Taraxacum officinale* cover rate changes versus the cover use intensity changes lead us to believe that unlike the mowed covers the grazed covers are not liable to the reduction of *Taraxacum officinale* cover rate, even when the use frequency is lower.

Vegetation covers mowed 3 times a year demonstrated the capability of developing much denser covers in response to a 100 N + PK dose; consequently, the *Taraxacum officinale* cover rate diminished (Klečka et al. 1938). Nevertheless, it became apparent that the diminishing of *Taraxacum officinale* cover rate is partly caused by the screening effect of higher species. It is most obvious in the mowed covers; in contrast, the grass associations encountered in grazed covers exhibit the reduction of higher species, thus developing beneficial conditions for the spread of heliophilous species in the lower layer, *Taraxacum officinale* included. The same relations are also conspicuous in the development tendencies met in the composition of covers mowed once a year (K 1×) and covers used in the combined manner (Table 2). Whereas the covers mowed once a year (delayed mowing) showed a dynamic regress of *Taraxacum officinale* as soon as the 2nd year of such treatment, the covers used in the combined way (1× mowing, 1× grazing) were inclined to proliferate not only *Taraxacum officinale*, but also some lower species (*Poa pratensis*, *Festuca rubra*) (Table 5). While the covers used in the combined manner diversified their species mixture more markedly, the clover, conversely, was better stabilized in the single-mowed covers. Nevertheless the single-mowing manner of cover cultivation, possibly included in the sphere of the *Lolio-Cynosuretum* association, results in a relatively speedy regress of *Lolium perenne*.

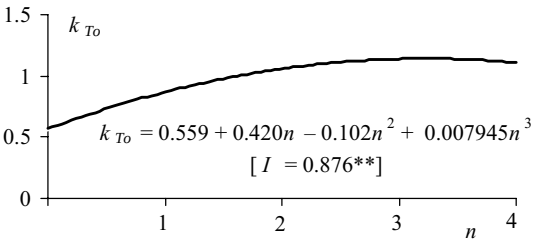

Figure 2. Year-on-year *Taraxacum officinale* cover rate changes (k_{To} in %*D*) versus the number of harvests in one year (*n*)

As follows from the assessment of the set of vegetation covers tested within the verification base (at the observation locality of the pastureland site accommodating also the test site), the covers used later and more extensively tended to exhibit the *Taraxacum officinale* cover rate reduction. These vegetation covers, beneficial for biodiversity development but not so much for the feed quality, demonstrated impacts on the *Taraxacum officinale* cover rate development similar to that of more intensively used and fertilized recovered grass covers featuring *Arrhenatherum elatius* as their predominant species. The competitive properties of *Arrhenatherum elatius* in relation to *Taraxacum officinale* make *Arrhenatherum elatius* form (also in summer) higher closed covers able to ear until the second or possibly third harvests and capable of developing sterile stems in summer (Klimeš 1987).

As follows from the overall review of influences exerted by the various methods of grassland cultivation and use on the species composition, the pratotechnical procedures can be utilized to limit the development of weed species in these plant associations (in reliance on conservative processes), without any necessity to rely on radical methods (the application of herbicides or the grassland recovery methods). Nonetheless, it is always inevitable to monitor the development of cover composition and to apply the pratotechnical procedures before the cover and biotope degradation may become more lasting (Klimeš 1984, 1987).

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ABSTRAKT

Vliv různých způsobů obhospodařování a využití trvalých travních porostů na změny pokryvnosti *Taraxacum officinale* Web.

V letech 1999 až 2002 byly v podhůří Šumavy experimentálně studovány možnosti harmonizace produkčních a mimoprodukčních funkcí trvalých travních porostů. V této práci jsou prezentovány možnosti regulace zastoupení *Taraxacum officinale* v trvalých travních porostech (asociace *Lolio-Cynosuretum*). Pro redukci pokryvnosti tohoto druhu se ukazuje jako účelné omezit frekvenci využití. U třikrát kosených porostů napomáhá k redukci *Taraxacum officinale* aplikace dávky 100 N + PK.

Klíčová slova: *Taraxacum officinale* Web.; trvalé travní porosty; hnojení; kosení; pastva; mulčování; kombinované využití; frekvence využití; nesklízené porosty

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