THE ROLE OF SEEDS RATE IN HIGHER PERSISTENCE ON NEWLY ESTABLISHED MEADOWS

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ABSTRACT

The paper presents results of a 7-year experiment concerning four mixtures applied for the renewal of meadows using the method of conventional tillage. The increase of the seed rate guarantees that the final composition of the obtained sward resembles the composition of species used in the sowing mixture and, what is equally important, this composition remains unchanged for a long period of utilization of meadows subjected to this method of renovation. Denser sowing restricts the appearance in the sward of species not used in the sowing mixture. Furthermore, it allows the development of a much more compact sward with a favourable, for plant growth and development, combination of soil thermal and moisture conditions. In other words, it creates optimal conditions for the improvement of meadow persistence and, hence, ensures durable plant cover. It can, therefore, be said that denser sowing is a positive factor in the protection of natural environment.

KEYWORDS

Seed rate, renovation, meadow persistence, establishment of grasslands

INTRODUCTION

The accelerated degradation of permanent grasslands constitutes an important problem for modern meadow management practices not only in Poland. It is, therefore, necessary to renew meadows periodically. The method of conventional tillage is applied whenever it is impossible to employ other ways of meadow renovation. Conventional tillage ensures fast reestablishment of full economic value to degraded grasslands (Rieder, 1991). Successful renovation is further enhanced by the appropriate application of cultivation procedures, proper selection of mixture components as well as sowing of adequate seed rate (Falkowski, 1991). Application of simplified grass mixtures and lower seed rate sown on newly established grasslands which has recently become popular also in Poland (Grzyb, 1975) has not been very welcome by farmers. Both meadows and pastures established with the use this method quickly alter floristic composition of their swards and show diminished persistence. That is why current recommendations for meadow establishment are questioned more and more often. Kui-Jia Xiang *et al*. (1989) observed the best floristic composition of pastures established using increased seed rate. Similar investigations are carried out also in our center. The aim of this study is to determine the role of seed rate in the improvement of persistence of newly established meadows.

MATERIALS AND METHODS

Experiments were carried out in production conditions. New meadows were established using the method of conventional tillage in 1988. When planning seed rate to be sown, current recommendations were applied. Four different mixtures were used: A in the amount of 30 kg ha^{-1} (*Ag* 5 kg, *Fp* 15 kg, *Pp* 4 kg, *Php* 3 kg, *Th* 3 kg), B - 43 kg ha^{-1} (*Ae* 10 kg, *Bc* 5 kg, *Bi* 10 kg, *Dg* 3 kg, *Fp* 10 kg, *Pp* 2,5 kg, *Tp* 2,5 kg), C - 36 kg ha^{-1} (*Ae* 4 kg, *Dg* 2,5 kg, *Fp* 10 kg, *Fr* 3 kg, *Lm* 2 kg, *Lp* 3,5 kg, *Php* 2,5 kg, *Pp* 2,5 kg, *Th* 4 kg, *Tp* 2 kg) and D - 35 kg ha^{-1} (*Fp* 17,5 kg, *Dg* 3,5 kg, *Lp* 3,5 kg, *Php* 3,5 kg, *Pp* 3,5 kg, *Tr* 3,5 kg). Simultaneously, on half of the experimental areas, norms of sown seeds were increased by 100% and, in this way, two experimental treatments were obtained: "standard norms" sowing (S) and "higher norms" sowing (H). Soil coverage by individual sward components was ascertained using the point method (Levy, 1933). Characterization of the meadow microclimate was conducted. Light intensity in the sward, soil temperature at the depth of 5 cm and soil moisture content at the depth of 10 cm were determined. Details of the conducted experiments are discussed in another paper (Golinski, 1993).

RESULTS AND DISCUSSION

In meadow swards established according to increased seed rate, species sown in mixtures show higher degree of surface cover (Table 1). The most significant differences between experimental combinations reaching 125% in favour of denser sowing were observed for mixtures A and B. In the remaining mixtures, i.e. C and D, the share predominance of species sown in the meadow surface cover, in comparison to meadows established according "standard norms" sowing, was slightly lower. This was most probably caused by the multi-species of mixture C and better site conditions of the meadow on which mixture D was sown. A detailed analysis of changes in the cover of the meadow surface was carried out for mixture D. The presented specification shows these changes with reference to species sown in mixtures in successive years of utilization:

		1989	1990	1991	1992	1993	1994	1995
species sown	S	78,3	70,6	70,4	58,5	59,7	56,5	52,3
in mixture	H	89,3	85,6	78,5	74,3	63,7	61,7	61,7

Denser sowing increased the share, in the sward cover, of species introduced in the mixture already in the first year of utilization. A similar level was maintained during the subsequent years.

In conditions of "standard norms" sowing, a significant area of the meadow, especially in the first years of utilization, remained without plants. Empty, free of turf areas were readily taken over by *Poa annua* and especially by *Stelaria media* as well as other annual weeds. The inventory given below illustrates the process quite well:

		1989	1990	1991	1992	1993	1994	1995
meadow area	S	21,7	22,6	19,8	17,1	8,3	8,0	9,8
free of turf	H	9,6	9,7	7,6	11,6	6,0	6,0	6,4

The increased presence of empty places, in comparison to the combination with "higher norms" sowing, in conditions of "standard norms" sowing led to a rapid expansion of dicotyledonous, perennial weeds, mainly *Cirsium* sp., *Rumex* sp. as well as *Elytrigia repens*. These unfavourable changes in the floristic composition of the sward in the consecutive years of utilization are presented below:

		1989	1990	1991	1992	1993	1994	1995
perennial weeds	S	0,0	4,3	8,4	13,2	14,2	19,5	21,4
	H	0,3	0,8	4,8	8,8	13,7	15,8	16,2
Elytrigia repens	S	0,0	0,0	5,4	10,1	19,0	16,5	19,0
	H	0,8	1,5	4,8	2,2	14,5	11,8	13,2

The process of grasslands degradation as well as the time of their next renovation and, consequently, their persistence depend very much on the share of these unwelcome species in the sward floristic composition.

The increase of the seed rate appears to be an important factor which has a beneficially modifying effect on the microclimate of newly

established meadows. Higher quantities of sown seeds applied at sowing improved sward density which, in turn, restricted the amount of light reaching the soil leading to the reduction of soil temperature and increase of water content in the near-surface layer of soil. This is well illustrated by results of investigations carried out on mixture D (Table 2). The maintenance of the optimal element combination of the meadow microclimate - light, humidity and temperature of the upper layer of soil - has a decisive effect on the proper growth, development and persistence of the desirable sward constituents (Kessler and Nösberger, 1994). The increase of the seed rate guarantees that the final composition of the obtained sward resembles the composition of species used in the sowing mixture and, what is equally important, this composition remains unchanged for a long period of utilization of meadows subjected to this method of renovation. Denser sowing restricts the appearance in the sward of species not used in the sowing mixture. Furthermore, it allows the development of a much more compact sward with a favourable, for plant growth and development, combination of soil thermal and moisture conditions. In other words, it creates optimal conditions for the improvement of meadow persistence and, hence, ensures durable plant cover. It can, therefore, be said that denser sowing is a positive factor in the protection of natural environment.

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Table 1

Participation changes of sown species in cover of the meadow surface in conditions of “higher norms” sowing (relative numbers, “standard norms” sowing = 100)

Symbol of mixture	Successive years of utilization						
	1989	1990	1991	1992	1993	1994	1995
A	160	140	145	160	225	188	163
B	154	147	123	130	137	175	148
C	118	111	119	112	101	112	139
D	114	121	112	127	107	109	118

Table 2

Changes of microclimate conditions on meadow caused by higher norm of seed rate in mixture D

Years of utilization	Light intensity in sward (%)			Temperature of soil (°C)			Water content in soil (%)		
	S	H	$lsd_{.05}$	S	H	$lsd_{.05}$	S	H	$lsd_{.05}$
1989	7,7	4,2	2,216	16,8	16,2	0,187	24,6	26,1	1,932
1990	9,2	4,6	2,264	14,5	14,6	ns	25,5	28,2	2,459
1991	13,3	4,9	2,987	15,0	15,1	ns	25,5	27,2	1,013
1992	16,2	13,4	2,473	18,3	18,8	0,176	17,5	18,1	0,393
1993	13,1	8,1	3,528	19,9	17,9	0,449	23,1	25,1	1,672
1994	12,1	10,3	1,438	16,1	15,9	0,087	22,5	23,8	0,971
1995	13,2	9,8	1,231	17,3	17,0	0,053	21,8	22,9	0,342
Mean	12,1	7,9	-	16,9	16,5	-	22,9	24,5	-