Acta Agrophysica, 2001, 52, 39-47

INFLUENCE OF THE STATE OF PEAT MASS SECONDARY TRANSFORMATION AND DATE OF SOWING ON DARNEL (*LOLIUM PERENNE* L.) EMERGENCIES

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A b s t r a c t. Influence of the sowing date and state of secondary transformations of moorsh formations on the *Lolium perenne* seed germination in the condtions of pot xperiments was studied. Peaty moorshes (Z_1) and proper moorshes (Z_2) with granular structure taken from the peat-moorsh soils at various stages of the moorshing process were used in the present experiment. Two levels of soil moisture were applied. It was found out that the influence of the sowing date on the differentiation of darnel emergencies on the moorsh soils was not big. However, a clear tendency for better germination of the seeds sown in summer than those sown in spring was observed. It was especially visible on the granular moorsh formations (Z_3) that were not able to create as favourable water conditions for darnel seed germination and development of seedlings as peat moorshes (Z_1) because of poor abilities for water conductivity. The present experiment showed that in order to ensure darnel emergencies on the soils formed of granular moorshes it is necessary to keep their moisture level close to 80% of their full water capacity. Seed germination was influenced more by the kind of moorsh and its moisture level than by the status of secondary transformation of the moorsh mass and sowing date.

K e y w o r d s: peat and moorsh formations, secondary transformation, *Lolium perenne* germination.

INTRODUCTION

One of the methods to improve farming efficiency on the degraded peat meadows is the full cultivation including ploughing and re-sowing. However, this method does not always bring expected results as periodical drying of the surface layers of peat-moorsh soils after sowing hinders seed germination or damages the seedlings. This phenomenon that usually brings about serious losses, is often related to the advanced state of secondary transformation of peat soils and sowing dates [7-9,11]. Hence, the aim of the present study was to establish how much sowing date and condition of peat mass secondary transformation determined on the basis of the water-holding capacity index (W_1) for moorshes, influence emergencies of darnel.

MATERIALS AND METHODS

Peaty moorshes Z_1 (2 soils) and proper, i.e. granular moorshes, Z_3 (5 soils) originating from weakly (MtI), medium (MtII), and strongly moorshified (MtIII) peat-moorsh soils of the Polesie Lubelskie (samples Nos 2-4 and 11-14) and Kotlina Biebrzańska (samples Nos 1 and 5-10) were examined. All the samples were taken from the depth of 5-10 cm (MtI soils) and 5-25 cm (soils MtII and MtIII). All the above soils were utilised as meadows.

The index of secondary transformations W_I was determined using the method by Gawlik [3], and the remaining basic physical characteristics by the IMUZ methods [12,14]. N-NO_3 was determined by the method of Frąckowiak with phenoldisulfone acid, and N-NH_4 by the Bremner's calorimetric method [2]. The content of phosphorus, potassium and magnesium was determined in the 0.5 M HCl extraction.

The present studies were carried out in the vegetation hall in the pots with the capacity of 11.8 l, diameter of 24 cm, and the height of 30 cm. Two levels of soil moisture were applied: I - corresponding to 80% of full water capacity, and II - close to the lower threshold of water easily accessible for grass, equal to the moisture level at pF 2.7 increased by 5% in the summer-autumn cycle, and by 10% in the spring-summer cycle. Pouring water to the bottom of the pots till the initial weight was reached compensated water losses in the soils. On hot days it was done twice a day. The tested variety was darnel (*Lolium perenne* L.), grass that is often used for the improvement of meadow sodding on peat soils. In the phase of seedling the above grass is characterised by the longest and the most extended root system among fodder grasses. It also quickly and strongly reacts to soil moisture level and temperature [1,6]. Darnel seeds (50 seeds per pot) were sown on two different dates: in summer 16^{th} of August 1994 and in spring 29^{th} of May 1995. Evaluation of emergencies was carried out after 14 days. A detailed description of the way the soil material was prepared before sowing was given elsewhere [5].

The studied soil samples represented a full range of conditions of secondary peat transformation; i.e. from the moorshes showing an initial stage of secondary transformations (W_1<40) to degraded formations (W_1>0.80). These formations were characterised by low ash content that did not exceed 25%, and their bulk density ranged from 0.20 to 0.38 g/cm^3 (Table 1). These were acidic soils (pH 1 N

KCl 4.5-5.5) with low (soils Nos 2 and 4) and very low (soils Nos 1, 3, 5, and 6) P_2O_5 content. Only the soil No. 7 showed high content of phosphorus that exceeded 80 - mg/100 g of soil. Magnesium content was also low (soils Nos 2-4, and 6) or very low (soils Nos 1, 5, and 7). As far as potassium content is concerned, all the soils were classed in the last, 5^{th} class (30 mg/100g of soil). They were very reach in mineral nitrogen (N-NO_3) [12,13].

RESULTS

The number of seed emergencies on peat moorshes (Z_1) in the first soil moisture variant that corresponded to 80% of full water capacity and was high irrespective of the sowing date. It ranged from 96.0 to 61.0% in the first study year (1994) and from 85.5 to 40.5% in the second study year. Emergencies of *Lolium perenne* on these soil formations in the conditions of the second humidity level should also be considered good. As can be seen from Table 2, the second soil humidity level did not change water conditions in most of the soils (columns IIa and IIb). This level was very similar, and in the soils Nos 1, 2, and 5 even markedly higher than the moisture level corresponding to 80% of their full water capacity. Similarity in the moisture content of the soils in both variants resulted from different determination methods. The first one was established on the basis of maximum water capacity, and the second - according to the level of soil suction force. An experiment carried out in 1994 (summer-autumn cycle) showed that the moisture level assumed for the second variant corresponding to pF 2.0 + 5% was too low as no emergencies were noted on any of the soils formed from granular moorshes [5]. Hence, when the soil moisture level was established for the second variant of the experiment in the spring-summer cycle, soil water moisture level corresponding to the lower threshold of water easily accessible for plants (pF 2.7) was increased by 10%. It appeared necessary especially that the experiment of 1995 was carried out in the conditions of intense insolation and high air temperatures.

Emergencies on grained moorshes were quite different. First of all they were very poor, especially in the spring-summer cycle. The amount of sprouted plant in the first moisture variant ranged from 1.5 to 53%, whereas in the summer-autumn cycle (1994) from 14.4 to 86%. In the conditions of the second moisture level, emergencies were observed only in the case of soil No. 5 (35%) in the spring-summer cycle. The moisture of this soil, for the reasons given above, was established at the level exceeding somewhat of 80% of their maximum water capacity (54.1%

Table 1. Physical and chemical properties of the investigated soils

No. of soil	Kind of moorsh	W_1	Ash content % dm	Bulk density	Total porosity	pH		P_2O_5	K_2O	Mg	N_{total}	NH_4	NO_3	B	Cr	Zn
			% a.s.m.	g/cm^3	vol %	H_2O	1 N KCl	mg/100 g of soi			%	mg/dm^3 of soil		mg/100 g of soil		
1	Z_1	0.38	22.7	0.20	88.8	5.4	4.6	16.0	16.4	16.4	3.18	10.3	52.0	3.5	3.2	63.5
2	Z_1	0.48	17.9	0.23	85.8	5.6	5.0	42.5	22.1	35.2	3.69	5.0	59.9	6.1	3.5	39.3
3	Z_3	0.67	17.8	0.34	79.0	5.1	4.2	15.5	16.3	28.1	3.23	4.6	65.8	6.0	3.2	15.1
4	Z_3	0.66	21.2	0.30	83.3	5.7	4.9	48.7	15.1	35.0	3.29	5.0	64.6	9.1	3.0	62.7
5	Z_3	0.71	16.6	0.31	80.5	5.7	5.1	31.7	23.8	18.7	3.62	7.1	102.1	6.5	3.3	17.8
6	Z_3	0.80	24.3	0.38	78.9	5.7	4.8	25.0	13.0	23.8	3.15	3.0	54.6	5.2	2.8	19.3
7	Z_3	0.76	22.3	0.30	83.3	6.2	5.5	102.0	14.1	19.1	3.62	6.7	61.1	8.1	3.0	20.2

T a b l e 2. Emergencies of Lolium Perenne in relation to the date of sowing and secondary transformation of peat soils in the conditions of pot experiment on the background of numerical characteristics of soil moisture level

Year	Number of soil	Kind of moorsh	W_1	Soil layer in pot. (cm)	Moisture level, vol. %					Water capacity at pF 2.7 of soil in pot		Germination capacity	
					I		II			vol. (%)		(%)	
					Ia	Ib	IIa	IIb	IIc				
0	1	2	3	4	5	6	7	8	9	10	11	12	13
				2-7		73.1			59.5				
1994	1	Z_1	0.33	10-15	74.8	73.1	58.3	61.2	62.1	70.1	54.4	96.0	23.5
				20-25		73.1			68.1				
				2-7		63.1			74.5				
1995	1	Z_1	0.44	10-15	66.7	75.0	68.6	75.4	75.9	60.2	60.2	65.5	63.0
				20-25		76.6			78.3				
				2-7		73,1			65.2				
1994	2	Z_1	0.41	10-15	73.7	74.2	65.2	68.4	67.4	66.4	66.4	61.0	95.0
				20-25		76.6			75.4				
				2-7		59.1			74.1				
1995	2	Z_1	0.55	10-15	65.4	76.2	68.4	75.2	76.6	63.0	63.0	40.5	56.0
				20-25		77.2			78.5				
				2-7		58.6			45.4				
1994	3	Z_3	0.62	10-15	62.0	71.9	48.1	50.5	60.4	51.0	46.6	14.4	0.0
				20-25		72.4			72.7				
				2-7		57.9			41.8				
1995	3	Z_3	0.72	10-15	59.0	64.1	52.0	57.2	63.9	53.6	55.9	1.5	0.0
				20-25		69.3			69.4				

Table 2. Continuation

0	1	2	3	4	5	6	7	8	9	10	11	12	13
1994	4	Z_3	0.68	2-7 10-15 20-25	63.8	56.8 71.0 72.4	48.9	51.2	44.9 57.7 61.9	48.3	48.9	30.0	0.0
1995	4	Z_3	0.65	2-7 10-15 20-25	59.0	45.9 63.2 71.5	46.1	50.7	46.5 60.8 69.9	42.5	53.6	20.0	0.0
1994	5	Z_3	0.72	2-7 10-15 20-25	64.5	53.1 63.0 66.0	53.9	56.6	52.8 59.8 63.1	48.5	46.6	18.4	0.0
1995	5	Z_3	0.71	2-7 10-15 20-25	57.2	55.2 62.8 64.7	54.8	60.3	54.1 58.5 64.2	57.5	56.5	53.0	0.0

Table 2. Continuation

0	1	2	3	4	5	6	7	8	9	10	11	12	13
1994	6	Z_3	0.78	2-7 10-15 20-25	61.1	56.4 64.2 64.2	45.7	48.2	38.6 51.9 55.1	47.5	41.4	86.0	0.0
1995	6	Z_3	0.82	2-7 10-15 20-25	56.6	52.5 60.5 66.4	46.7	51.4	48.4 58.2 66.2	61.2	50.4	13.2	0.0
1994	7	Z_3	0.81	2-7 10-15 20-25	63.3	57.9 64.1 69.3	52.0	54.6	41.8 63.9 69.4	53.6	53.4	61.0	0.0
1995	7	Z_3	0.71	2-7 10-15 20-25	63.2	56.4 64.2 64.2	50.2	50.2	38.6 51.9 55.1	47.5	52.5	48.0	0.0

Ia - soil-moisture level experimentally determined as corresponding to 80% of full soil saturation; Ib - real soil moisture determined after completion of pot experiment; IIa - soil-moisture corresponding to pF 2.7 determined in field samples; IIb - soil-moisture level experimentally determined as corresponding to pF 2.7 enlarged by 5 %; IIc - real moisture determined in soil in pot after completion of pot experiment; IId - soil-moisture corresponding to pF 2.7 determined in samples taken from pre-experimental pot; IIe - soil-moisture corresponding to pF 2.7 determined in samples taken from experimental pot after completion of pot experiment.

volume). There were no emergencies on any other soils that were characterised by lower moisture content than in the first variant.

In the light of the data collected and observations carried out it can be stated that the main factor that differentiates emergencies of *Lolium perenne* on the peat soils was soil mass structure that directly influences soil conductive abilities. Seed germination and development of seedlings depends on the moisture level of the very surface soil layer in which grass seeds are placed at sowing. If there is no watering from the above, no rainfalls, moorsh in the surface soil layers dries quickly. Drying process is favoured by strong soil warming-up intensified by the black colour of moorsh surface that absorbs sunrays. Hence, in the case of granular moorshes with limited water conductivity and water capacity far lower than that of peaty moorshes, a quick drying process additionally stimulated by low air moisture content, inhibits seed germination process and leads to dying out of seedlings.

Low efficiency of capillary rise in proper moorshes, especially visible in the conditions of the second moisture variant, is reflected by big differences, markedly higher than in peaty moorshes, between the moisture level of the surface soil layer as established at the initial stage of the experiment, and its final phase, i.e. immediately after grass cutting (Table 2, columns IIb, IIc). Moreover, moisture level in this case was generally lower (Table 2, columns 9 and 10) than the moisture level corresponding to the lower threshold of water easily accessible for plants (pF 2.7) at the initial stage of the experiment. There were only few exceptions (soil No. 4 - 1995, and soil No. 5 - 1994).

Analysis of the data obtained shows that the state of secondary transformation of the moorsh formations determined by the numerical values of the W_1 index is only loosely related to darnel emergencies. No doubt, it results from the fact that W_1 index reflects only water retention capacity of the soil [3], i.e. its water binding ability, and not water conductivity.

CONCLUSIONS

1. The present studies showed that in the first variant of moisture level, influence of darnel sowing date on emergencies on moorsh-peat soils was not big. However, a clear tendency for better germination of the seeds sown in summer than in spring was noted, especially on proper moorshes (Z_3) with characteristic granular structure.

2. In order to secure darnel emergencies on granular moorshes it is necessary to maintain their moisture level at 80% of their full water capacity.

3. It was found out that darnel emergencies depended more on the kind of moorsh and its moisture level than on the condition of moorsh mass secondary transformation determined as the value of W_1 index and sowing date.

REFERENCES

1. **Dorywalski J., Wojciechowicz M., Bartz J.**: Metodyka oceny nasion. Warszawa, PWRiL, 1964.
2. **Frąckowiak H.**: Dynamika i wielkość mineralizacji związków azotowych w dawno odwodnionych glebach torfowo-murszowych na tle warunków siedliskowych i nawożenia, IMUZ, Rozpr. habil., Falenty, 1980.
3. **Gawlik J.**: Przydatność wskaźnika chłonności wodnej do oceny stanu wtórnego przeobrażenia gleb torfowych. Wiad. IMUZ, XVIII, 4, 197-216, 1996.
4. **Gawlik J., Harkot W., Lipińska H., Lipiński W.**: Wpływ stanu wtórnego przeobrażenia masy torfowej na kiełkowanie życicy trwałej (*Lolium perenne* L.). Zesz. Probl. Post. Nauk Roln., 418, 611-616, 1995.
5. **Gawlik J., Harkot W.**: Wzrost i rozwój *Lolium perenne* w okresie letnio-jesiennym na utworach murszowych różnie przeobrażonych w warunkach doświadczenia wazonowego. Wiad. IMUZ, XIX, 3, 41-59, 1998.
6. **Harkot W., Jargiełło J.**: Seedlings growth dynamics of some grass species on the muck-peat soil. Proc. 14th General Meeting EGF, Lahti, Finland, 420-421, 1992.
7. **Harkot W. Jargiello J.**: Badania wazonowe nad wrażliwością niektórych gatunków traw na termin siewu. Annales UMCS, E, XLVIII, 8, 49-57, 1993.
8. **Kowalczyk Z., Okruszko H.**: Wpływ stanu murszowej masy glebowej na warunki kiełkowania i rozwoju roślin. Zesz. Probl. Post. Nauk Roln., 146, 77-99, 1973.
9. **Kowalczyk J., Kamiński J., Szuniewicz J.**: Zasady kształtowania i utrzymywania wysokoprodukcyjnej runi łąkowej na glebach torfowo-murszowych. Bibl. Wiad. IMUZ, 77, 23-41, 1991.
10. **Okruszko H.**: Zasady rozpoznawania i podziału gleb hydrogenicznych z punktu widzenia potrzeb melioracji. Bibl. Wiad. IMUZ, 52, 7-53, 1976.
11. **Okruszko H.**: Gospodarka na intensywnie odwodnionych torfowiskach niskich w Badeni-Wirtenbergii. Wiad. Melior., 7, 178-181, 1986.
12. **Sapek A., Sapek B.**: Metody analizy chemicznej gleb organicznych. IMUZ, Falenty, 1997.
13. Zalecenia nawozowe, część I - liczby graniczne do wyceny zawartości w glebach makro- i mikroelementów, IUNG, Puławy, 1985.
14. **Zawadzki S.**: Laboratoryjne oznaczanie zdolności retencyjnych utworów glebowych. Wiad. IMUZ, 11, 2, 11-31, 1973.