FOLIA POMERANAE UNIVERSITATIS TECHNOLOGIAE STETINENSIS
Folia Pomer. Univ. Technol. Stetin., Agric., Aliment., Pisc., Zootech. 2015, 318(34)2, 15–22

Kazimierz JANKOWSKI, Jacek SOSNOWSKI, Wiesław CZELUŚCIŃSKI, Beata WIŚNIEWSKA- KADŻAJAN, Elżbieta MALINOWSKA

EFFECT OF DEPTH OF PLACEMENT OF THE HYDROGEL AND THE TYPE OF SOIL COVER ON THE INITIAL GROWTH AND DEVELOPMENT OF LAWN GRASSES

WPŁYW GŁĘBOKOŚCI UMIESZCZENIA HYDROŻELU I RODZAJU OKRYWY GLEBOWEJ NA WSCHODY TRAW GAZONOWYCH

Department of Grassland and Green Area Creation, Siedlce University of Natural Sciences and Humanities

Streszczenie. Celem pracy było zbadanie wpływu superabsorbentu Aqua–gel P4 na dynamikę wschodów traw w zakładanych trawnikach. Doświadczenie założono w 2007 roku i było ono prowadzone do 2009 roku. Badania były realizowane na podstawie dwóch doświadczeń trawnikowych. Pierwsze doświadczenie stanowił trawnik monokulturowy gdzie w siewie czystym badano cztery gatunki traw gazonowych. W drugim doświadczeniu wykorzystano cztery zaprojektowane mieszanki tych samych gatunków traw. W początkowym okresie prowadzenia doświadczenia (2007) po 15 i 30 dniach dokonano oceny wschodów traw. Rodzaj zastosowanej okrywy glebowej (gleba uprawna, torf ogrodniczy) nie powodował istotnego zróżnicowania we wschodach zarówno traw gazonowych wysianych w siewie czystym jak i w mieszankach. W miarę zwiększania głębokości umieszczenia hydrożelu (5; 10; 15 cm) w podłożu glebowym wschody traw gazonowych wysianych zarówno w siewie czystym, jak i mieszankach uległy pogorszeniu.

Key words: germination of grasses, hydrogel, lawns, soil cover.
Słowa kluczowe: hydrożel, okrywa glebowa, trawnik, wschody traw.

INTRODUCTION

In recent years, droughts, and hence water shortages are becoming more frequent and last longer. The use of modern irrigation systems is not a perfect solution. In general these pumps are too expensive. One way to better use of rainwater for lawn and turf plants to reduce water consumption for watering lawns is the use of superabsorbents also called hydrogels (Henderson and Hansley 1986; Jankowski et al. 2011a and b). Superabsorbents, as defined Górecki and Paul (1993) are chemical compounds having properties of a large amount of water retention and easy sharing to plants. As a result of the addition of the hydrogel to the surface of the soil increases its water capacity to the extent that it is possible to reduce the hydration of the substrate by up to 70% (Łuczak 1995). Due to the cyclical

Corresponding adres – Adres do korespondencji: Kazimierz Jankowski, Department of Grassland and Green Area Creation, Siedlce University of Natural Sciences and Humanities, Bolesława Prusa 14, 08-110 Siedlce, Poland, e-mail:laki@uph.edu.pl

properties of water collection and donation they are important during the periods of water stress (drought), as this weakens its effects. Henderson and Hansley (1986) add that the use of hydrogels as additives to the ground there is a delay time, in which usually starts wilting of plants due to lack of water. In the literature concerning the use of lawn, there is little data on the possibility of using hydrogels to improve the condition of the turf lawn (Jankowski et al. 2011a, 2011b; Sady and Domagała 1995). The aim of this study was to investigate the effect of the superabsorbent Aqua-Gel P4 on grass emergence in lawns.

MATERIAL AND METHODS

The experiments were established in 2007 and continued until 2009 in the experimental field of the University of Natural Sciences and Humanities in Siedlce. The research was carried out on the basis of two field experiments established in triplicate, conducted in a split-split-plot. The experimental unit was a plot with an area of 1 m^2. The first experiment was a lawn monoculture (Table 1) in which four species of lawn grasses has been studied. In a second experiment, the four mixtures of the same grass species were used. In Each mixture was applied one grass species as a dominant (40%) and the remaining three species accounted for 20%, and so:

M 1 ryegrass 40%; M 2 – fescue 40%; M 3 – 40% meadow grass;

M 4 – Agrostis vulgaris 40%.

In each experiment, the following research factors were used:

Kind of subsoil: a) without hydrogel – "0" – control; b) with hydrogel placed at a depth of 5 cm; 10 cm; 15 cm – (GUH)

Soil cover: a) cultivated soil – (P); b) horticultural peat – (T)

Table 1. Monocultures of grasses used in the experiment
Tabela 1. Monokultury traw zastosowane w doświadczeniu

Marker Oznaczenie	Grass species Gatunek trawy	Cultivar Odmiana	Seeds sowing Wysiew nasion [g · m^{-2}]
O 1	Perennial ryegrass Życica trwała	Inka	3.10
O 2	Red fescue Kostrzewa czerwona	Nil	3.90
O 3	Kontucky bluegrass Wiechlina łąkowa	Alicja	2.40
O 4	Common bent Mietlica pospolita	Tolena	1.10

After staking of plots hydrogel was used in an amount of 50 g · m^{-2} in the topsoil on a depth of 5; 10 and 15 cm. Seeds were sown at the end of April 2007. After sowing of the grass seeds, soil surface in a random way was covered with a thin layer of horticultural peat or agricultural soil.

In the initial period of the experiment (2007) after 15 and 30 days, according to the methodology developed by Domański (1996) the emergence of grass was assessed.

The results were statistically analyzed by performing analysis of variance. For significant sources of variation (factors and interactions) was done a detailed comparison of averages by Tukey's test at a significance level of $P \leq 0.5$ (Trętowski and Wójcik 1991).

Experiments were carried out on soil classified as anthropogenic soils type hortisoli formed from weakly loamy sand. The soil was characterized by pH in an alkaline, high content of magnesium (Mg · 84 mg kg^{-1}) and phosphorus (P · 39.6 mg kg^{-1}) and the low content of potassium (K · 15.8 mg kg^{-1}).

In the study the impact of meteorological factors on the course of the growing season and plant growth in 2007, on the basis of which the hydrothermal coefficient of Sielianinow (Bac et al. 1993) was determined (Table 2).

Table 2. Hydrometrical Sielianinow indexes (K) in individual months of vegetation seasons of 2007
Tabela 2. Współczynnik hydrotermiczny Sielianinowa w poszczególnych miesiącach okresu wegetacyjnego 2007

Years – Lata	IV	V	VI	VII	VIII	IX	X
2007	0.24	0.40	0.32	0.37	0.16	0.51	0.20

Do 0.5 high drougth – silna posucha, 0.51–0.69 – drougth – posucha; 0.70–0.99 poor drougth – słaba posucha; >1 no drought – brak posuchy.

In the year of experiment establish (2007) Sielianinow hydrothermal coefficient indicate a strong drought in the months from April to October. No water in the first months of the growing season adversely affected crop emergence

RESULTS AND DISCUSSION

The period of growth and development in the year of grasses sowing can be defined as "the installation of plants" in the habitat (Martyniak and Żyłka 2001). These characteristics determine its turfness, not only during the installation of plants in the year of sowing, but also in subsequent years.

In the studies varying the number of emerging grass used in the context of the hydrogel both in relation to the type of the mixture and monoculture was reported.

Analyzing the emergence of grass in single-species plantings (Table 3) it can be concluded that the value of assessed parameter was influenced mainly species of grass and the depth of the hydrogel placed in the ground. In the case of the tested substrates has been shown that the largest number of emergence on average for the tested grasses (5591 pcs · m^{-2}) was found on the object with the 5 cm depth placing of hydrogel. The obtained number of emergence of grass on this object was significantly higher than on the control object (without hydrogel) and to the objects of 10 and 15 cm depth placing of hydrogel. How say Chmiel and Stasiak (1997) the presence of hydrogels in soil positively effected on the growth and development of plants.

According to Górecki and Paul (1993) among other thanks the improvement of the air water properties of soil that affect the better development of lawn turf. In this study, also four grass species were characterized by the highest number of emergence on the object. Among the studied grass species the highest number of emergence was recorded on the object of red fescue (6400 pcs · m^{-2}), and the smallest of the meadow grass (4766 pcs · m^{-2}).

Table 3. Grasses germination (plants · m^{-2}) of mixture and monoculture turfs after 15 days from sowing, depending on the depth of hydrogel placement (GUH) and the type of cover
Tabela 3. Wschody traw (roślin · m^{-2}) muraw mieszankowych i monokulturowych po 15 dniach od wysiewu w zależności od głębokości umieszczenia hydrożelu i rodzaju okrywy

Treatment Obiekt		Monoculture – Monokultura (A)					Mixture – Mieszanka (A)				
		O1	O2	O3	O4	Mean Średnie	M1	M2	M3	M4	Mean Średnie
DHP GUH (cm) (B)	„0”	4250	3433	3683	5183	4137	9783	8250	8783	9650	9116
	5	5450	6400	4766	5750	5591	9966	10000	9950	9583	9874
	10	2933	2750	3000	5016	3424	9616	9133	9450	9466	9416
	15	2633	2533	2616	2900	2670	3633	3566	3683	3700	3645
Mean Średnie		3816	3779	3516	4712		8250	7737	7966	8100	
Cover type Rodzaj okrywy	P	3625	3816	3508	4683	3908	8275	7808	8133	7825	8010
	T	4008	3741	3525	4741	4003	8225	7666	7800	8375	8016
Mean Średnia		3816	3779	3516	4712	–	8250	7737	7966	8100	–
LSD $_{0.05}$ for – NIR $_{\leq 0,05}$ – dla:							LSD $_{0.05}$ for – NIR $_{\leq 0,05}$ – dla:				
Monoculture – Monokultura (A)				–1195			Mixture – Mieszanka (A)			– n.s. – n.i.	
DHP – GUH (B)				– 1453			DHP – GUH – (B)			– 5469	
Cover type – Rodzaj okrywy (C)				– n.s. – n.i.			Cover type – Rodzaj okrywy (C)			– n.s. – n.i.	
Interaction – Współdziałanie:							Interaction – Współdziałanie:				
(AxB)				– 2015			(AxB)			– 1715	
(CxA)				– n.s. – n.i.			(CxA)			– n.s. – n.i.	

DHP – depth of hydrogel placement; GUH – głębokość umieszczenia hydrożelu.
n.s. – not significiant; n.i. – nieistotne.

According to Prończuk (1994) important meaning to obtain the proper growth of plants in the sward have among others, biological factors, which are characterized a particular species (varieties) of grasses.

With respect to the type of soil cover varied grass emergence of tested species was obtained after 15 days from sowing, but these differences were not significant. Generally slightly better emergence was found at the object with peat cover (4003 pcs · m^{-2}) than with the cover of cultivated soil (mean 3908 pcs · m^{-2}). According to Kitczak et al. (2000) enrichment of the top layer of soil in the organic material and mixing it to a depth of 10–15 cm improves trofical conditions of substrate. According to Dąbrowski and Pawluśkiewicz (2011), an important element in establishing of turf lawn is prepareing of the ground with a particular abundance of essential nutrients. While on domestic lawns can be applied to the substrate enrichment of the organic substance (peat, compost), on turfs with a high load is not allowed. Then decreases the porosity of the layer, what reduce the capacity of the field, and worsening conditions of use.

Studies have shown that regardless of the depth of hydrogel placement in the soil and the type of soil cover, the greatest number of emergence after 15 days had common bent (4712 pcs · m^{-2}), and the smallest meadow grass (3516 pcs · m^{-2}), and only between the two species of grasses difference of emergence was significant. On the other hand, 30 days after seeding, emergence number was increased (Table 4).

Table 4. Grasses germination (plants · m^{-2})of mixture and monoculture turf after 30 days from sowing, depending on the depth of hydrogel placement (GUH) and the type of cover
Tabela 4. Wschody traw (roślin · m^{-2}) muraw mieszankowych i monokulturowych po 30 dniach od wysiewu w zależności od głębokości umieszczenia hydrożelu i rodzaju okrywy

Treatment Object		Monoculture – Monokultura (A)					Mixture – Mieszanka (A)				
		O1	O2	O3	O4	Mean Średnie	M1	M2	M3	M4	Mean Średnie
DHP GUH cm (B)	„0”	5933	3933	4316	6900	5270	10 200	8933	9600	9783	9629
	5	5966	6600	5366	6200	6033	10 800	10 883	10 350	10 583	10 654
	10	4666	3516	3600	5800	4395	9716	10 350	8616	10 316	9749
	15	3333	3100	3166	3416	3253	6066	6083	5600	5666	5853
Mean Średnie		4975	4287	4112	5579		9195	9062	8541	9087	
Cover type Rodzaj okrywy	P	5266	4241	4033	5725	4816	9341	8916	8766	9083	9026
	T	4683	4333	4191	5433	4660	9050	9208	8316	9091	8916
Mean Średnia		4975	4287	4112	5579	–	9195	9062	8541	9087	–
$LSD_{0.05}$ for – $NIR_{\leq 0,05}$ – dla:							$LSD_{0.05}$ for – $NIR_{\leq 0,05}$ – dla:				
Monoculture - Monokultura (A)				– 861			Mixture – Mieszanka (A)			– n.s. – n.i	
DHP – GUH (B)				– 874			DHP – GUH (B)			– 903	
Cover type – Rodzaj okrywy (C)				– n.s. – n.i.			Cover type - Rodzaj okrywy (C)			– n.s. – n.i.	
Interaction – Współdziałanie:							Interaction - Współdziałanie:				
(AxB)				– 1765			(AxB)			–1865	
(CxA)				– 1190			(CxA)			– n.s. – n.i.	

DHP – depth of hydrogel placement; GUH – głębokość umieszczenia hydrożelu.
n.s. – not significiant; n.i. – nieistotne.

In studies of Grabowski et al. (2001) in sowing year, the best reproduction as the state of surface coverage with stalks and leaves, has characterized also common bent. Similarly, in the study of Harkot and Czarnecki (1999), regardless of the sowing date, higher rankings of sodding also characterized a variety of common bent.

Just as after 15 days from grass sowing the highest number of emergence had grass species examined on the object with the 5 cm depth of hydrogel placing (6033 pcs · m^{-2}). This value was significantly higher than the emergence obtained on objects with 10 and 15 cm depth of hydrogel placing. In studies of Jankowski et al. (2010) was found a less diverse number of emerging plants between objects with applied hydrogel and without its use. The difference between these objects was 11% in favor of the substrate without hydrogel. The reason for the negative impact of hydrogel on the grass emergence was probably strong absorption of soil water by hydrogel at 10 cm of soil layer, what resulted in the drying and limiting of grass seed germination. Furthermore, as in the previous measurement period has been shown that with increasing of the depth of hydrogel placement, emergence of grasses were weaker. Type of soil cover, as in the earlier period had no significant effect on the number of emergence. Contrary to the assessment of emergence after 15 days from sowing, the higher number of emergence was obtained on the objects with the cover of the arable soil (4816 pcs · m^{-2}) than with peat cover (4660 pcs · m^{-2}).

Within the individual soil coverings were showed significant differences in emergence between the studied grass species. On the objects with arable soil of common bent emergence number was significantly higher than Kentucky bluegrass and red fescue, and on objects with peat cover emergence of common bent were significantly higher only to emergence of Kentucky bluegrass. Regardless of the depth of hydrogel placement or type of soil cover after 30 days from sowing of grass seed, the largest number of emergence had common bent (5579 pcs · m^{-2}), and the smallest meadow grass (4112 pcs · m^{-2}). Emergence number of common bent was significantly different from both the emergence of Kentucky bluegrass and red fescue (4287 pcs · m^{-2}).

In turn, given the type of lawn mixtures (Table 3), it can be concluded that similary as in the case of single-species crop the highest number of emergence after 15 days from sowing of grass seed characterized a mixtures from objects with 5 cm depth of hydrogel placed (9874 pcs · m^{-2}). The value of this parameter was significantly higher only to the number of emergence obtained on objects with 15 cm depth of hydrogel placement (3645 pcs · m^{-2}).

Also, all the tested mixtures of grasses the highest emergence reached on the object with 5 cm depth of hydrogel placing and from mixtures with the largest number of emergence (10 000 pcs · m^{-2}) had a mixture M2 with 40% share of red fescue, and the smallest (9583 pcs · m^{-2}) mixture M4 with 40% share of common bent. It is worth noting that compared to the control (9116 pcs · m^{-2}), a slightly higher number of emergence was obtained on the object with 10 cm depth of hydrogel placing (9416 pcs · m^{-2}).

After 15 days from sowing of grass seed, emergence of grass mixtures studied were not significantly different between the applied types of soil cover. Regardless of the depth of hydrogel placement in the substrate or type of soil cover, the greatest number of emergence was observed in M1 mixture with 40% share of ryegrass (8250 pcs · m^{-2}), and the smallest for M2 mixture with 40% share of red fescue (7737 pcs · m^{-2}). The differences in the emergence of grasses between the studied lawn mixtures were not statistically significant.

On the other hand, after 30 days from sowing of grass seed, the number of emergence of lawn mixtures both on objects with different depths of hydrogel placing and in relation to the type of soil cover has increased (Table 4).

Taking into account the depth of hydrogel placement, it was demonstrated that the largest number of emergence characterized the lawn mixture sowed on objects with 5 cm depth of hydrogel placement (10 654 pcs · m^{-2}). Similarly as after 15 days from sowing the number of emergence different significantly only from the value obtained on object with 15 cm depth of hydrogel placement (5853 pcs · m^{-2}). Also, all the tested lawn mixtures the highest value of emergence had on the object with 5 cm depth of hydrogel placement, and the highest values of this characteristic obtained M2 mixture with 40% share of red fescue (10.883 pcs · m^{-2}) and M1 mixture with 40% share of ryegrass (10 800 pcs · m^{-2}). With respect to the type of soil cover, there were no significant differences in the emergence of lawn mixtures, while better emergence of these mixtures were on the object with cover of arable soil (9026 pcs · m^{-2}) than with peat soil (8916 pcs · m^{-2}).

Regardless of the type of substrate or soil cover from the mixtures, the highest value of emergence reached M1 mixture with 40% share of perennial ryegrass (9195 pcs · m^{-2}), and the lowest M3 mixture with 40% share of Kentucky bluegrass (8541 pcs · m^{-2}). Differences in emergence between the studied lawn mixtures were not statistically significant.

According to Martyniak and Żyłka (2001) quick and uniform emergence of grasses provide better system, not only because of the faster sodding of surface, but also in the smaller infestation.

CONCLUSIONS

1. The emergence of grass swards both monoculture and mixtures, regardless of the date of assessment, the most favorable impact had 5 cm deep of hydrogel placement in the soil. With increase of the depth of hydrogel placement in soil, emergence of lawn grasses sown both in pure and in mixtures, have deteriorated.
2. The type of soil cover (arable soil, horticultural peat) did not cause significant differences in the emergence of lawn grasses sown both in pure and in mixtures.
3. Regardless of the applied research factors better emergence, after 15 and 30 days from sowing was observed in mixtures than in grass monocultures.

REFERENCES

Bac S., Koźmiński C., Rojek M. 1993. Agrometeorologia. PWN, Warszawa. [in Polish]

Chmiel H., Stasiak S. 1997. Wykorzystanie hydrożeli jako dodatku do podłoży w uprawie pięciu gatunków paproci [The use of hydrogels as a supplement to the substrates in the cultivation of five species of ferns]. Zesz. Probl. Postęp. Nauk Rol. 449, 31–42. [in Polish]

Dąbrowski P., Pawluśkiewicz B. 2011. Wpływ warstwy wierzchniej podłoża o różnej zawartości piasku na rozwój wybranych gazonowych odmian *Lolium perenne* L. [The influence of the surface layer of substrate with different content of sand on the development of selected varietes of *Lolium perenne* L.]. Prz. Nauk. 51, 27–35. [in Polish]

Domański P. 1996. System badań i oceny traw gazonowych w Polsce [System of testing and evaluation of lawn grasses in Poland]. Biul. IHAR 183, 251–263. [in Polish]

Górecki R., Paul M. 1993. Superabsorbenty w ogrodnictwie [Superabsorbents in horticulture]. Ogrodnictwo 4, 12–13. [in Polish]

Grabowski K., Grzegorczyk S., Kwietniewski H. 2001. Początkowy wzrost i rozwój wybranych gatunków i odmian traw gazonowych na trawnikach ozdobnych [The initial growth and development of selected species and varieties of lawn grasses on lawns]. Pam. Puł. 125, 295–300. [in Polish]

Harkot W., Czarnecki Z., 1999. Przydatność polskich odmian traw gazonowych do zadarniania powierzchni w trudnych warunkach glebowych [Usefulness of Polish varieties of lawn grasses to sodding of surface in difficult soil conditions]. Folia Univ. Agric. Stetin 197, Agriculture 75, 117–120. [in Polish]

Henderson J.C., Hansley D.L. 1986. Efficacy of hydrophilic gel as a transport aid. Hort. Sci. 21(4), 991–992.

Jankowski K., Czeluściński W., Jankowska J., Ciepiela G.A. 2010. Wpływ hydrożelu na początkowy rozwój muraw trawnikowych oraz estetykę ich w latach użytkowania [Effect of aquagel on the initial development of turfgrasses and their aesthetical value]. J. Res. Apll. Agric. Eng. 55(2), 36–41. [in Polish]

Jankowski K., Sosnowski J., Szczykutowicz A. 2011a. Zadarnienie muraw trawnikowych założonych na bazie kostrzewy czerwonej przy zastosowaniu hydrożeli w podłożu [Turf lawn sodding established on the basis of red fescue with using of hydrogels in the substrate]. Wiad. Mel. Łąk. 2, 89–92. [in Polish]

Jankowski K., Sosnowski J., Jankowska J. 2011b**.** Effect of hydrogel and different types of fertilizers on the number of turf shoots in lawns created by monocultures of red fescue (*Festuca rubra* L.) Cultivars and its mixtures. Acta Agrobot. 64(3), 109–118.

Kitczak T., Gos A., Czyż H., Trzaskoś M. 2000. Wzrost i rozwój gatunków traw i motylkowatych na masie popioło-żużlowej z dodatkiem biohumusu i nawozów azotowych [Growth and development of grasses and legumes on the ash and slag mass with addition of biohumus and nitrogen fertilizers]. Łąk. Pol. 3, 71–79. [in Polish]

Łuczak M. 1995. Zastosowanie superabsorbentów w rolnictwie [The use of superabsorbents in agriculture]. Poradnik gospodarski 3, 38. [in Polish]

Martyniak J., Żyłka D. 2001. Zależność obsady i instalacji roślin życicy trwałej od ilości wysiewu w uprawie na nasiona [Dependence of density and installation of perennial ryegrass plants on saw quantity in the crop for seeds]. Zesz. Probl. Postęp. Nauk Rol. 474, 282–297. [in Polish]

Prończuk S. 1994. Stan hodowli i nasiennictwa traw gazonowych w Polsce [State of breeding and seed lawn grasses in Poland]. Genet. Pol. 35A, 329–339. [in Polish]

Sady W., Domagała I. 1995. Ekożel MI może być przydatny do zakładania trawników [Ecogel MI may be useful for the establishment of lawns]. Ogrodnictwo I, 26–27. [in Polish]

Trętowski J., Wójcik A.R. 1991. Metodyka doświadczeń rolniczych [Methodology of agricultural experiments]. Wydaw. WSR-P Siedlce. [in Polish]

Abstract. The aim of this work to determine the effect of superabsorbent Aqua–Gel P4 on the dynamics of lawns emergence. The experiment was established in 2007. The studies were carried out on the base of two lawn experiments. The first experience was a monoculture lawn where in pure sown four species of lawn grasses were studied. In the second experiment four designed mixtures of the same grass species were used. At the beginning of the study (2007) after 15 and 30 days, evaluating of the grasses emergence was done. The type of used soil cover (cultivated soil or garden peat) did not cause significant variation in the emergence of both lawn grasses sown in pure stand and in mixtures. With the increasing of the depth of hydrogel placement (5, 10, 15 cm) in soil, the emergence value of the lawn grasses sown in both as pure stand and in mixtures has worsen.