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THE INFLUENCE OF THE SLUDGE SEDIMENT AND HYDROGEL ON THE GERMINATION OF SOME VARIETIES OF LAWN GRASSES

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Summary. The determination of the effect of sewage sludge and hydrogel on grain germination lawn grass varieties commonly used to set up turf in urban areas was the aim of this study. In the Petri dishes with a diameter of 10 cm, filled with 1 cm layer of substrate: loose sand mixed with the sediment sludge in amount 3.56 g/dish and 7.12 g/dich, loose sand mixed with hydrogel in an amount 0.4 g/dish and lined with filter paper – were the control variant. In order to determine the effect on germination the values of seeds germination energy and germination capacity were measured. Object of researches were: *Lolium perenne* variety Niga, *Poa pretensis* variety Amason, *Festuca rubra rubra* variety Adio and *Festuca rubra commutata* variety Nimba. It was found that the use of sludge at a dose of 3.56 g significantly reduced the value of energy and capacity of germination all of grass species, excluding *Poa pratensis.* The germination on a loose sand mixed with hydrogel depended on varieties.

Key words: germination energy, germination capacity, lawn grasses

INTRODUCTION

The presence of lawn in urban an industrial areas is being seen as something positive and desirable. The green of grass amends a revival in a monotonous landscape of asphalt street and buildings. The grassland is also a biological filter which improves peoples' living conditions in the city [Rutkowska and Dębska-Kalinowska 2000, Wysocki and Stawicka 2005]. One of the basic features of the lawn varieties created from the grass is rapid and uniform sodding of the area [Rutkowska and Stypiński 2003, Domański 2004, Szczepanek and Skinder 2006]. The progressive degradation of the soil in urban areas significantly limits the ability to install turf with the desired characteristic [Adams 1999, Siuta and Wasiak 2001, Pawluśkiewicz 2009]. Currently, the sludge and

hydrogels are being used to improve habitat conditions [Siuta 2001, Breś 2006, Hadam *et al*. 2006, Jankowski *et al*. 2010, Dmochowski *et al*. 2011].

The determination of the effect of sediment sludge and the hydrogel on the process of seeds germination turf grass varieties commonly used to establish turf in urban areas, such as: perennial ryegrass (*Lolium perenne*), red fescue (*Festuca rubra),* and meadow grass (*Poa pretensis)* was the aim of this study.

MATERIAL AND METHODS

The study was conducted in the Spring 2011 in the laboratory with air temperature at of the range 24–26°C. The experiment was established in Petri dishes with a diameter of 10 cm, filled with 1cm layer of the substrate. The following substrates were tested: loose sand mixed with sludge in an amount 3.56 g/dish – substrate O1, loose sand mixed with sludge in an amount 7.12 g/dish – substrate O2, loose sand mixed with hydrogel in an amount 0.4 g/dish – substrate H. The dishes lined with filter paper – substrate 0 were the control variant. Chemical composition of sewage sludge is shown in table 1. 100 varieties of grass seeds in three replicates for each variant were seeded on the dish. The tested grasses were: *Lolium perenne* L. variety Niga (PL), *Poa pretense* L. variety Amason (SE), *Festuca* spp. *rubra* variety Adio (PL), *Festuca* spp. *commutate* variety Nimba (PL).

Table. 1. Chemical composition of sludge sediment

Dry weight, %	Organic matter, % dry matter	pH	Macroelements, % dry matter		Heavy metals, mg · kg^{-1} dry matter	
19.3	58.4	6.7	Ca_{total}	5.51	Cd	< 0.5
			$N_{amonium}$	0.14	Cr	58.0
			Mg_{total}	0.66	Cu	194.0
			N_{total}	3.99	Pb	23.5
			P_{total}	2.73	Ni	22.0
					Zn	1459.0

In order to determine the effect of substrate on germination of seed the method commonly accepted by the Seed Testing Station was used. It consisted in determining the values of: (1) seed germination energy and (2) germination capacity. The value the energy of germination of *Lolium perenne* was determined after 5, *Festuca rubra* after 7, and *Poa pratensis* after 10 days, and the value of germination capacity after 12, 21 and 28 days from the sowing [Dorywalski *et al*. 1964]. Statistically significant differences between the average for

the studies factor were calculated by use of the LSD test at the significance level of 0.05. For the purpose of statistical calculations of the energy and germination capacity the values were expressed as the number of germinated seeds.

RESULTS

The germination rate of lawn grass varieties seeds sown on the sand mixed with sewage sludge depended mainly on the sediment doses (Tab. 2). The dose of 3.56 g per dish (O1) decreased seed germination energy value depending on the species by 30–50%, excluding *Poa pratensis.* While the effect of adding into the sand deposits in 7.12 g dose (O2) resulted that there was none germinated seed at time required to estimate the value of energy. Influence of sewage sludge on the viability of seeds was less distinct than on germination energy value, especially at the sludge lower dose (O1). The value of seed germination on this base was depending to the species from 78% to 95%, and did not differ significantly from seed germination under control conditions. On a base of higher sludge dose (O2) viability seeds was much lower. The value of germination was depending on the species and was only from 3% to 18%. Adding sand hydrogel (H) have an effect on seed germination energy value. The contents of the reaction depend on the species of the hydrogel.

Table 2. The energy and the capacity of germination (% = pcs)

Parameter	The energy of germination					The capacity of germination				
Base	0	O1	O2	H	$LSD_{0,05}$	0	O1	O2	H	$LSD_{0,05}$
Lolium perenne	94	56	0	89	4	96	92	6	97	3
Poa pratensis	44	49	0	69	19	88	95	18	97	14
Festuca rubra spp. rubra	82	32	0	79	17	95	78	3	97	11
Festuca rubra spp. commutata	77	47	0	57	13	95	87	9	96	5

Lolium perenne. The grains in control conditions (0) germinated very well. Five days after sowing 94% of seeds were germinated. The addition of sludge sediment at a dose of 3.56 g per dish (O1) resulted in a substantial, statistically significant reduction in energy values of seeds germination. The germination on this substrate was much slower, the value of germination energy was only 56% and was 38% lower than in control. In next days the number of germinated seeds increased. In result, the capacity of germination was 92% and was reduced only by 4%. Adding sludge sediment to the sand in a larger dose (7.12 g/dish) resulted in no seeds germination in the provided time. The addition of hydrogel to sand (H) resulted, in relation to control condition, with statistically significant reducing the value of energy of germination. The number of germinated seeds

was quite high – amounted 89% and was less 5 than under control conditions. In next days the number of germinated seeds increased rapidly. In result, after 12 days the capacity of germination was similar to control conditions.

Poa pratensis. Seeds sown on filter paper for up to ten days after sowing germinated very poor (0). Ten days after sowing were 44 and twenty eight days after sowing were 88 germinated seeds. The addition of sewage sludge to the sand at a dose of 3.56 g/dish (O1) did not cause significant differences in number of germinated seeds. The use of 7.12 g dose of sediment in the substrate (O2) resulted that within the period provided for determining the values of energy were not germinated seeds, and in the period provided for determining the value of capacity sprouted only 18 seeds. Significantly higher energy valuethan on control conditionswas shown by this species on the substrate with a hydrogel (H). The number of germinated seeds was equal to 69. From 11 to 28 days after sowing the number of germinated seeds on the test substrates visibly increased. In effect, 28 days after sowing there were 97 germinated seeds – 9 higher than in control conditions.

Festuca rubra rubra. The value of energy germination of creeping form of *Festuca rubra* in control conditions was 82%. It was significantly worse in the case of the seeds sown on sand with additives the sewage sludge. A dose of 3.56 g/dish (O1) resulted in 50% reduction of seed germination energy values and in 17% of germination capacity comparision to control conditions. On the ground with twice the dose of sludge (O2) there were no germinated seeds after 7 days and the capacity was only 3%. The value of energy and capacity of *Festuca rubra rubra* sown on the ground with the hydrogel was not significantly different from values obtained in control conditions.

Festuca rubra comuttata. In control conditions the energy of germination seeds of clumps forms of *Festuca rubra* was 77%. The addition of sewage sludge at a dose of 3.56 g/dish (O1) resulted in germination of 47% grains during this period, and was less than 30% in control condition. The number of germinated seed was increased in next days. The value of capacity was significant worse (8%) than in control condition. On a base of a higher dose of sludge (O2) until 7 days after sowing no seeds were germinated. In the period from 8 to 21 days after sowing the number of germinated grains was only 9. The addition of hydrogel (H) reduced seed germination energy by 20%. In period from 8 to 21 days after sowing, the number of germinated seed increased rapidly. The capacity on this ground was 96%.

DISCUSSION

The study confirms results of Jankowski *et al*. [1999] that sewage sludge has a significant influence mainly on grass germination energy, and increasing the dose increases the negative effect. Reaction to the content of the sludge in the soil of lawn grass varieties depend on the characteristics of species, like varieties of

forage in the study of Jankowski *et al*. [1999]. The study may also support the observations of better rising of lawn varieties of *Poa pratensis* in the comparison with *Lolium perenne* and *Festuca rubra* form *commutate* on the substrate with larger dose of sewage sludge [Kitczak *et al*. 2000].

Undertaken studies also indicate that *Festuca rubra commutata* better than *Festuca rubra rubra* tolerates difficult soil conditions. Literature data defining the response of grasses in the initial stage of their development are few and concern mainly the effects of the appearance of grasslands [Jankowski *et al*. 2010, Jankowski *et al*. 2011]. Nevertheless, as in the studies undertaken, it may be seen the influence of mixed species composition of grasslands implied on the substrate enriched hydrogel.

CONCLUSIONS

1. The process of seed germination of lawn grass varieties sown on the sand mixed with sewage sludge depended on the dose of sludge in the Petri dish. The dose of 3.56 g caused a reduction of energy values of 30–50% and the germination of 4–17%. Doubling the dose of sludge in the soil caused only by 3-18% germinated seeds.

2. The species differ in response to the contents of the sediment in the substrate. The worst germinated seeds were *Festuca rubra* spp *rubra* Adio ones and the best- the varieties of *Poa pratensis* L. Amason ones.

3. The content of the hydrogel in the substrate had no significant effect on seed germination of tested grass species, influencing only the rate of germination. *Festuca rubra* spp. *commutata* Nimba was the slowest germinating species on the hydrogel substrate.

REFERENCES

Adams R., 1999. Germination of Callitris seeds in relation to temperature, water stress, priming, and hydration-dehydration cycles. J. Arid Environ., 43, 437–448.

Breś W., 2006. Wpływ hydrożelu Ascosorb AS 400 na stan odżywienia traw gazonowych. Acta Agrophysica, 7(4), 859–866.

Domański P., 2004. Trawy darniowe. Synteza wyników doświadczeń odmianowych. COBORU Słupia Wielka, ss. 1199.

Dorywalski J., Wojciechowicz M., Bartz J., 1964. Metodyka oceny nasion. Państwowe Wydawnictwo Rolnicze i Leśne. Warsawa, 290 pp.

Hadam A., Wrochna A., Karaczun Z., 2011. Effect of hydrożel on the turf Grass species growing under salt stress. Ann. Warsaw Univ. of Life Sci., SGGW, Land Reklam. 43 (1).

Jankowski K., Czeluściński W., Jankowska J., Ciepiela G.A., 2010. Wpływ hydrożelu na początkowy rozwój muraw trawnikowych oraz ich estetykę w latach użytkowania. J. Res. App. Agricul. Eng., 55(2), 36–40.

Jankowski K., Jodełka., Kolczarek R., 1999. Działanie osadu ściekowego na kiełkowanie nasion traw. Zesz. Nauk. Wyższej Szkoły Rolniczo-Pedagogicznej w Siedlcach, Rolnictwo, 56, 59–65.

Jankowski K., Sosnowski J., Szczykutowicz A., 2011. Zadarnienie muraw trawnikowych założonych na bazie kostrzewy czerwonej przy zastosowaniu hydrożeli w podłożu. Wiad. Melior. Łąk., 54, 2, 89–92.

Kitczak T., Gos H., Czyż M., Trzaskoś M., 2000. Wzrost i rozwój gatunków traw i motylkowatych na masie popiołu żużlowego z dodatkiem biohumusu i nawozów azotowych. Łąkarstwo w Polsce 3, 71–78.

Pawluśkiewicz B., 2009. Analiza możliwości wykorzystania gazonowych odmian traw do poprawy powierzchni trawiastych na obszarach zurbanizowanych. Wydawnictwo SGGW, Warszawa, 131 pp.

Rutkowska B., Dębska-Kalinowska Z., 2000. Przydatność gatunków i odmian traw na trawniki. Wieś jutra, 4(21), 19–22.

Rutkowska B., Stypiński P., 2003. Właściwości determinujące wykorzystanie *Lolium perenne* jako trawy trawnikowej. Łąkarstwo w Polsce 6, 145–153.

Siuta J., Wasiak G., 2001. Zasady wykorzystania osadów ściekowych na cele nieprzemysłowe (przyrodnicze). Inż. Ekol. nr 3, 13–32.

Szczepanek M., Skinder Z., 2006. Wpływ czynników agrotechnicznych na jakość plonu nasion życicy trwałej (*Lolium perenne* L.) w trzyletnim okresie użytkowania. Acta Sci. Pol., Agricultura 5(1), 63–70.

Wang X., Chen T., Ge Y., Yongfeng Jia Y., 2008. Studies on land application of sewage sludge and its limiting factors. J. Hazardous Materials 160, 554–558.

Wysocki Cz., Stawicka J., 2005. Trawy na terenach zurbanizowanych. Łąkarstwo w Polsce, 8, 227–236.

WPŁYW OSADU ŚCIEKOWEGO ORAZ HYDROŻELU NA KIEŁKOWANIE NIEKTÓRYCH GAZONOWYCH ODMIAN TRAW

Streszczenie: Celem pracy było określenie wpływu osadu ściekowego oraz hydrożelu na proces kiełkowania ziarniaków gazonowych odmian traw, powszechnie wykorzystywanych do zakładania muraw na terenach zurbanizowanych. Badania przeprowadzono w szalkach Petriego o średnicy 10 cm wypełnionych 1 cm warstwą piasku luźnego wymieszanego z komunalnym osadem ściekowym w dawce 3,56 g i 7,12 g oraz piasku luźnego wymieszanego z hydrożelem. Wariant kontrolny stanowiły szalki wyłożone bibułą filtracyjną. Oceniano przebieg kiełkowania *Lolium perenne* L. odm. 'Niga', *Poa pratensis* L. odm. 'Amason' oraz *Festuca rubra rubra* odm. 'Adio' i *Festuca rubra commutata* Gaud. odm. 'Nimba'. Stwierdzono, że osad w dawce 3,56 g istotnie zmniejszył energię oraz zdolność kiełkowania badanych traw z wyjątkiem *Poa pratensis*. Stwierdzono także, że wpływ hydrożelu zależny jest od odmiany.

Słowa kluczowe: energia kiełkowania, zdolność kiełkowania, gazonowe odmiany traw