ACTA Acta Sci. Pol., Agricultura 10(2) 2011, 105-115

EFFECT OF RATE AND TIME OF NITROGEN FERTILIZATION ON THE YIELD AND CHEMICAL COMPOSITION OF AUTUMN REGROWTH OF RED FESCUE CULTIVATED FOR SEEDS

Zbigniew Skinder, Małgorzata Szczepanek, Edward Wilczewski
University of Technology and Life Sciences in Bydgoszcz

Abstract. The aim of the research conducted in the years 2005-2006 in Chrząstowo near Nakło (53°09' N; 17°35' E) was the evaluation of the productivity and yield quality of the autumn regrowth of red fescue cultivated for seeds in conditions of diversified rates and time of nitrogen fertilization. In autumn, after collecting the seeds 20, 40 or 60 kg N·ha^{-1} was applied. In spring, 40, 60, 80 kg N·ha^{-1} were applied once at the time of the start of growing, but also in a divided rate 40 + 40 kg (40 kg at the basic time of early spring and 40 kg at the beginning of the stage of shooting). The level of spring nitrogen fertilization did not affect green and dry matter yield of the autumn regrowth in the first and second production year. The increase of nitrogen rate in autumn from 20 to 40 kg·ha^{-1} caused the increase of green matter yield by 9-10%. Additional application of 20 kg N·ha^{-1} resulted in the increase of 5.6% in the first and 13.6% in the second production year. The level of autumn nitrogen fertilization did not affect the content of crude fiber, but the increase of the rate from 40 to 60 kg·ha^{-1} resulted in the increase of the total protein content by 11% in the first production year. Regardless of the time and level of nitrogen fertilization, nutritional value of the regrowth was limited by the deficiency of magnesium, calcium and phosphorus.

Key words: crude fiber, feed value, grass, macroelements, total protein

INTRODUCTION

Red fescue is one of the most important grasses in reproduction. Profitability of the seed cultivation of this species may be improved using autumn green crop as a source of feed in autumn [Goliński 1996]. Red fescue regrowth is a valuable feed [Goliński 2004]. Rogalski and Łyduch [1983] state that the nutritional value of forage from regrowth of grasses often does not differ from the one of the pasture forage. Grasses contain all the essential vitamins and provitamins [Krzywiecki 1985]. Their chemical

Corresponding author – Adres do korespondencji: dr inż. Małgorzata Szczepanek, Department of Plant Cultivation of University of Technology and Life Sciences in Bydgoszcz, Ks. A. Kordeckiego 20, 85-225 Bydgoszcz, e-mail: szczepan@utp.edu.pl

composition depends on the soil fertility, fertilization, species and cultivar, as well as on the stage of development at the time of harvest [Krzywiecki 1985, Kozłowski and Goliński 1997]. Nitrogen fertilization has a particularly strong effect on the quantity and quality of the grass yield [Krzywiecki 1985]. In red fescue studies, the increase of nitrogen rate caused the increase of protein content, and also of the nitrate nitrogen [Kozłowski and Goliński 1997]. This form of nitrogen after reduction to nitrites, causes oxidation of hemoglobin into methemoglobin, which may cause death of animals as a result of anoxia [Krzywiecki 1985]. Grasses usually have too high potassium content [Radkowski et al. 2005]. Supplementation of Ca and Mg deficiencies should not be forgotten when feeding animals with forages from autumn regrowths of seed grasses [Rogalski and Łyduch, 1981, Szczepanek and Skinder 2006].

According to the hypothesis, it was assumed that quantity and quality of the biomass of autumn regrowth of red fescue obtained after collecting the seeds depends on the condition of nitrogen nutrition, which is directly affected by the amount of mineral nitrogen applied in the whole production period. The aim of the research was the evaluation of the productivity and quality of the yield of autumn regrowth in conditions of diversified rates of spring and autumn nitrogen fertilization.

MATERIAL AND METHODS

The research basis was a strict field experiment, at the Experimental Station of Cultivar Testing in Chrząstowo near Nakło, Kuyavian-Pomeranian Voivodeship (53^{o}09’ N; 17^{o}35’ E), in which possibility of obtaining feed from autumn regrowth of red fescue after seed collection was evaluated. Field experiment was conducted in two series, including the seeding year (2004 and 2005) as well as two production years (2005-2006 series I, 2006 – 2007 series II). The experiment was conducted on the podzolic soil, very good rye complex, class IV a, of the granulometric composition of the silty heavy loamy sand. The soil was characterized by neutral reaction (pH in KCl 6.62), high phosphorus content and mean content of potassium and magnesium (69.4 mg·kg^{-1} P, 110 mg K, 54 mg Mg). Before setting up the experiment, the content of available nitrogen was: 10.2 mg N-NO_3^- and 3.57 mg·kg^{-1} N-NH_4^+. Split-block design was used, in four replications. The area of plots for harvest was 15 m^2. Lawn cultivar of red fescue, Nimba (*Festuca rubra* ssp. *commutata*), was sown in spring together with spring barley cultivated for grain. After harvesting the nurse crop in the seeding year or after collecting seeds in the production years, mineral nitrogen rates were: 20, 40 or 60 kg·ha^{-1} (autumn fertilization – the second factor), while P 26 kg and K 66 kg·ha^{-1}. In spring 40, 60, 80 kg N·ha^{-1} were applied once at the start of growing, and also in the divided rate 40 + 40 kg, (40 kg at the basic spring time and 40 kg at the beginning of the stage of shooting (spring fertilization – the first factor). Nitrogen fertilizer at both times was ammonium salpeter.

Seed harvest was conducted in the last days of June or in the first in the first week of July, and the autumn regrowth in the end of September. The content of dry matter was determined with the use of oven-drying method. Chemical analysis of the plant material (collective tests in four replications of each plot) included determination of: N total with Kjeldahl method, crude fiber with a modified Henneberg and Stohmann method, P with vanadium-molybdenum method, K and Ca with flame photometric method, Mg colorimetrically with titan yellow. Green and dry matter yield was subjected to statistical analysis.

Analysis of variance of repeated experiments in subsequent years was conducted as well as the synthesis according to connected inaccuracies design, and the significance of differences between means were verified with Tukey test on the significance level P = 0.05.

In the region of research, in the period from seed collection to cutting of autumn regrowth, highest rainfall was observed in July and the lowest in September (Table 1). In the years of the field experiment, the highest rainfall total from July to September was characteristic for 2006 and the lowest for 2005. Compared to the long-term period, July 2006 was particularly warm whereas September 2007 was cool.

Tabela 1. Suma opadów i średnia temperatura powietrza
Table 1. Total precipitation and mean air temperature

Month Miesiąc	Days Dni	Precipitation – Opady mm				Air temperature Temperatura powietrza °C			
		year – rok							
		2005	2006	2007	1980-2007	2005	2006	2007	1980-2007
June Czerwiec	1-10	26.8	5.1	25.8	–	12.7	12.4	19.0	–
	11-20	7.8	3.4	45.0	–	15.5	19.1	19.3	–
	21-30	3.1	6.1	40.9	–	17.9	20.0	16.2	–
Total/mean – Suma/średnia		37.7	14.6	111.7	69.3	15.4	17.2	18.2	16.8
July Lipiec	1-10	4.6	7.4	53.8	–	19.8	22.5	15.8	–
	11-20	5.2	5.9	3.0	–	20.5	21.9	20.9	–
	21-31	29.5	15.2	32.1	–	19.2	23.4	17.4	–
Total/mean – Suma/średnia		39.3	28.5	88.9	70.9	19.8	22.6	18.0	19.1
August Sierpień	1-10	31.0	115.3	4.6	–	15.8	18.4	18.7	–
	11-20	7.8	31.2	5.4	–	16.7	18.2	19.1	–
	21-31	4.4	17.4	19.4	–	18.1	15.7	16.6	–
Total/mean – Suma/średnia		43.2	163.9	29.4	58.4	16.8	17.4	18.1	18.6
September Wrzesień	1-10	0.4	43.2	14.8	–	18.8	15.9	12.7	–
	11-20	12.2	0.3	3.6	–	14.2	16.4	11.6	–
	21-30	11.2	12.1	21.1	–	13.6	15.5	13.7	–
Total/mean – Suma/średnia		23.8	55.6	39.5	45.8	15.5	15.9	12.7	13.3

RESULTS AND DISCUSSION

In 2005, at the time of the fescue regrowth after seed harvest, increasing signs of water deficiency were observed. Leaf growth was slow, some of the leaves were dry, and the relatively scarce sward before harvest reached a height of 18-20 cm. June 2006 was very dry. Water deficiency occurred also in July. In these conditions, red fescue after seed collection in the first production year (series II) reduced formation of new leaves, but leaf wilting was not observed. Intensive rainfall in the first ten days of August stimulated the regrowth. The very dense sward before harvest was 22-24 cm tall, and the forage yield was the highest in the whole research period (Table 2). Older plants in the second production year (series I) showed stronger signs of rainfall deficiency. In July almost complete wilting of the aboveground part was observed. Improvement of moisture conditions in August enabled slow regeneration, but the scarce sward before harvest reached a height of only 15-18 cm.

Table 2. Green matter yield of autumn regrowth, $t \cdot ha^{-1}$
Tabela 2. Plon świeżej masy odrostu jesiennego, $t \cdot ha^{-1}$

N rate in autumn (J) Dawka N na jesień (J) $kg \cdot ha^{-1}$	N rate in spring (W) – Dawka N na wiosnę (W), $kg \cdot ha^{-1}$														
	40	60	80	40 + 40	mean średnia	40	60	80	40 + 40	mean średnia	40	60	80	40 + 40	mean średnia
	1st production year – I rok użytkowania														
	2005					2006					2005-2006				
20	6.06	5.08	6.00	5.75	5.72	13.0	12.3	12.7	12.1	12.5	9.54	8.71	9.33	8.93	9.13
40	6.00	5.22	4.83	6.31	5.59	15.1	14.6	13.5	14.2	14.4	10.55	9.90	9.18	10.25	9.97
60	6.61	7.17	6.86	6.50	6.78	15.9	14.7	12.9	13.6	14.3	11.23	10.92	9.90	10.05	10.53
Mean – Średnia	6.22	5.82	5.90	6.19	6.03	14.7	13.9	13.0	13.3	13.7	10.44	9.85	9.47	9.74	9.88
LSD – NIR	W ns – ni J 0.608 J/W 1.185 W/J 1.270					W ns – ni J 1.143 J × W ns – ni					W ns – ni J ns – ni J × W ns – ni				
	2nd production year – II rok użytkowania														
	2006					2007					2006-2007				
20	3.47	2.71	2.74	3.77	3.17	4.85	4.70	4.83	6.42	5.20	4.16	3.70	3.79	5.09	4.19
40	4.10	3.62	4.30	4.37	4.10	4.56	4.54	5.31	6.13	5.14	4.33	4.08	4.81	5.25	4.62
60	5.09	5.06	5.65	4.40	5.05	4.94	5.97	5.42	5.45	5.45	5.02	5.52	5.54	4.92	5.25
Mean – Średnia	4.22	3.80	4.23	4.18	4.11	4.78	5.07	5.19	6.00	5.26	4.50	4.43	4.71	5.09	4.68
LSD – NIR	W ns – ni J 0.925 J × W ns – ni					W ns – ni J ns – ni J/W 0.949 W/J 1.820					W ns – ni J ns – ni J × W ns – ni				

ns – ni – non-significant differences – różnice nieistotne

In 2007, after quite rich rainfall in July, intensive formation of new leaves was observed. In conditions of moderate rainfall in August, the plants stopped growing. The sward at the time of harvest was dense but not very tall (15-16 cm).

On average, in the whole research period, the total yield of dry matter of regrowth from the two-year production period was 4.05 t·ha^{-1}, whereas in the second year it was by 35% lower compared to the first year (Table 3). Goliński et al. [2004], in tests of 16 red fescue cultivars in the region of Wielkopolska Province, in an analogical production period obtained only 2.54 t·ha^{-1} dry matter of regrowth.

Spring nitrogen fertilization did not have a significant influence on the yield of green and dry matter of regrowth, but favorable effect of increasing the rates in autumn was observed (Tables 2, 3). Scarcely occurring interactions of spring and autumn fertilization during the formation of green and dry matter yield of regrowth were rather random and did not have a directional character.

In the first production year green matter yield was significantly higher after application of 60 kg N in autumn compared to the rate 40 and 20 kg ha^{-1} in 2005 or only with reference to 20 kg·ha^{-1} in 2006 (Table 2). Reaction of red fescue to autumn nitrogen rates expressed in the yield of dry matter of regrowth was similar (Table 3). Mean yield for the two series of tests in the first production year was significantly greater after application of 60 kg N compared to 20 kg·ha^{-1}.

In the second production year, the effect of autumn fertilization rates on the quantity of the biomass of autumn regrowth was proved statistically only in 2006. Highest yields of green and dry matter were obtained after application of 60 kg N·ha^{-1} (Tables 2, 3). Increasing the rate from 20 to 40 kg stimulated the yield but the differences were significant only in the dry matter yield of regrowth.

In the first production year, mean yield of green matter of regrowth from both series of tests after application of the highest nitrogen rate 60 kg·ha^{-1} in autumn was greater by 15.3% compared to the lowest rate 20 kg·ha^{-1}; in the second year the yield increase was 25.3%. In similar tests but on perennial ryegrass in conditions of increasing nitrogen rate after seed collection from 30 to 60 kg·ha^{-1}, the result was different: the yield of dry matter of autumn regrowth was greater by 23% in the first and 12.6% in the second production year [Goliński 2003].

On average in the whole research period autumn regrowth was characterized by the mean for the species content of total protein, while it was slightly greater in the first compared to the second production year (Table 4). In the research of Goliński et al. [2004], among several red fescue cultivars the best one in this respect was Carina, which contained 147 g·kg^{-1} DM protein in the first and 134 in the second production year. According to Kozłowski and Goliński [1997], ecotypes with a very low content of protein may accumulate only 77 g protein in 1 kg DM. In own research, increased nitrogen fertilization after collecting fescue seeds from 40 to 60 kg·ha^{-1} resulted in the increase of protein content in regrowth mainly in the first production year. Increasing protein content under the effect of increasing rate of nitrogen fertilization is also presented in research on red fescue cultivated for forage [Kozłowski and Goliński 1997] or in the perennial ryegrass regrowth in seed cultivation [Goliński 2003].

Table 3. Dry matter yield of autumn regrowth, $t \cdot ha^{-1}$
Tabela 3. Plon suchej masy odrostu jesiennego, $t \cdot ha^{-1}$

N rate in autumn (J) Dawka N na jesień (J) $kg \cdot ha^{-1}$	N rate in spring (W) – Dawka N na wiosnę (W), $kg \cdot ha^{-1}$														
	40	60	80	40 + 40	mean średnia	40	60	80	40 + 40	mean średnia	40	60	80	40 + 40	mean średnia
	1st production year – I rok użytkowania														
	2005					2006					2005-2006				
20	1.86	1.53	1.96	1.73	1.77	2.85	2.76	2.85	2.69	2.79	2.36	2.14	2.41	2.21	2.28
40	1.89	1.69	1.52	1.88	1.75	3.34	3.20	2.90	3.14	3.14	2.61	2.44	2.21	2.51	2.44
60	2.12	2.20	2.19	1.96	2.12	3.38	3.33	2.97	3.02	3.17	2.75	2.76	2.58	2.49	2.65
Mean – Średnia	1.96	1.81	1.89	1.86	1.88	3.19	3.09	2.91	2.95	3.03	2.57	2.45	2.40	2.40	2.46
LSD – NIR	W ns – ni J 0.304 J × W ns – ni					W ns – ni J 0.300 J × W ns – ni					W ns – ni J 0.202 J/W 0.329 W/J 0.705				
	2nd production year – II rok użytkowania														
	2006					2007					2006-2007				
20	1.04	0.79	0.75	1.06	0.91	1.82	1.77	1.89	2.39	1.97	1.43	1.28	1.32	1.73	1.44
40	1.20	1.06	1.28	1.28	1.21	1.70	1.68	2.05	2.33	1.94	1.45	1.37	1.67	1.80	1.57
60	1.47	1.40	1.67	1.35	1.47	1.97	2.22	2.05	2.00	2.06	1.72	1.81	1.86	1.67	1.77
Mean – Średnia	1.24	1.08	1.23	1.23	1.20	1.83	1.89	2.00	2.24	1.99	1.53	1.49	1.62	1.73	1.59
LSD – NIR	W ns – ni J 0.257 J × W ns – ni					W ns – ni J ns – ni J/W 0.393 W/J 0.709					W ns – ni J ns – ni J × W ns – ni				

ns – ni – non-significant differences – różnice nieistotne

Table 4. Content of total protein and crude fiber, $g \cdot kg^{-1}$ DM
Tabela 4. Zawartość białka ogółem i włókna surowego, $g \cdot kg^{-1}$ s.m.

N rate – Dawka N $kg \cdot ha^{-1}$	Total protein – Białko ogółem						Crude fiber – Włókno surowe					
	production year – rok użytkowania											
	first – pierwszy			second – drugi			first – pierwszy			second – drugi		
In spring – Na wiosnę	2005	2006	mean średnia	2006	2007	mean średnia	2005	2006	mean średnia	2006	2007	mean średnia
40	124	102	113	124	76.6	100	269	267	268	261	258	260
60	122	104	113	126	76.6	101	279	286	283	246	276	261
80	115	113	114	135	78.4	107	267	257	262	253	280	266
40 + 40	115	104	109	130	82.1	106	280	292	286	237	249	243
In autumn – Na jesień												
20	115	103	109	131	78.0	105	271	273	272	249	269	259
40	112	104	108	122	77.9	100	277	274	276	253	261	257
60	130	111	120	133	79.3	106	274	280	277	247	266	256
Mean – Średnia	119	106	112	129	78.4	104	274	276	275	249	266	258

The content of crude fiber in red fescue regrowth, being on average for the first and second production year 266 $g \cdot kg^{-1}$ DM (Table 4), was comparable to the concentration in the perennial ryegrass regrowth (277 $g \cdot kg^{-1}$ DM) [Szczepanek and Skinder 2006]. According to Krzywiecki [1985], digestibility of polysaccharides, being part of supporting tissues of grasses, in the initial growing period is very high as the lignification of tissues is low. In the first production year there was slightly more crude fiber in the regrowth than in the second one. The least fiber was found after application of divided spring rate, but only in the second production year.

Krzywiecki [1985] states that from the point of view of dairy cow nutrition, the content of 0.4-0.5% P, 0.6-0.9% Ca and 0.2-0.3% Mg in the feed is optimum. Phosphorus content in the harvested autumn regrowth, according to these criteria, was too low in both production years (Table 5). Moreover, it was not diversified by the level of nitrogen fertilization in spring and autumn. Calcium content was low, especially in the first year. Low concentration was also found in the case of magnesium. As is stated by Goliński et al. [2004], magnesium content in red fescue forage significantly differs from the optimum one. Rogalski and Łyduch [1981] in their research on nutritional value of autumn regrowth of red fescue and other grass species considered the content of magnesium and calcium as insufficient. In own research, potassium content was relatively high in the first year. In the second year it decreased, probably because of the limited availability of this component due to a major intake in straw yield in subsequent two production years. Decrease of potassium content in regrowth from the second production year was also proved in tests of red fescue in the region of Wielkopolska Province [Goliński et al. 2004].

An important criterion of the feed quality evaluation are the proportions of elements included in it. In a good feed the proportion of Ca : P should be 2 : 1, while the tolerated one is 1 : 2 [Ruszczyc 1983]. In autumn regrowth of red fescue the weight ratio of these elements was 1.3 : 1 in the first and 1.7 : 1 in the second production year. These values did not exceed standards given above. According to Bobrecka-Jamro and Szpunar-Krok [2002], the ratio of K : (Ca + Mg) should not exceed 2.2 considering the threat of grass tetany. In the analyzed biomass of autumn regrowth, the equivalence ratio of these components (1.9 in the first and 1.3 in the second production year) may be regarded as safe in animal nutrition.

Table 5. Content of macroelements, g·kg^{-1} DM
Tabela 5. Zawartość makroskładników, g·kg^{-1} s.m.

N rate – Dawka N kg·ha^{-1}	P		Ca		Mg		K	
	production year – rok użytkowania							
	first pierwszy	second drugi	first pierwszy	second drugi	first pierwszy	second drugi	first pierwszy	second drugi
In spring – Na wiosnę								
40	2.98	2.93	3.79	4.64	1.60	1.51	24.2	18.6
60	3.06	2.93	4.00	4.95	1.55	1.52	23.6	18.7
80	2.82	3.05	3.67	5.21	1.53	1.55	21.2	18.9
40 + 40	2.80	3.08	4.13	5.45	1.57	1.49	25.4	19.1
In autumn – Na jesień								
20	2.85	3.00	4.04	4.92	1.56	1.51	23.3	18.5
40	2.82	2.91	3.81	5.02	1.55	1.50	22.9	18.3
60	3.07	3.07	3.84	5.25	1.58	1.55	24.6	19.6
Mean – Średnia	2.91	3.00	3.90	5.06	1.56	1.52	23.6	18.8

CONCLUSIONS

1. The level of spring nitrogen fertilization of red fescue in seed cultivation in the range from 40 to 80 $kg \cdot ha^{-1}$ did not significantly affect the green and dry matter yield of autumn regrowth in the first and second production year.

2. Increase of the nitrogen rate in autumn from 20 to 40 $kg \cdot ha^{-1}$ resulted in the increase of green matter yield of autumn regrowth by 9-10%. Additional application of 20 $kg \cdot ha^{-1}$ resulted in the yield increase by 5.6% in the first and 13.6% in the second production year.

3. The level of autumn nitrogen fertilization in the range from 20 to 60 $kg \cdot ha^{-1}$ did not affect the content of crude fiber. Only in the first production year the increase of the rate from 40 to 60 $kg \cdot ha^{-1}$ resulted in the increase of the total protein content by 11%.

4. Regardless of the time and level of nitrogen fertilization, nutritional value of the regrowth was reduced by the deficiency of magnesium, calcium and phosphorus.

REFERENCES

Bobrecka-Jamro D., Szpunar-Krok E., 2002. Stosunki ilościowe miedzy składnikami mineralnymi w runi traw i ich mieszanek z rutwicą wschodnią (*Galega orientalis* Lam.) [Quantitative ratios of mineral components in the grass sward and of grass mixtures with eastern galega (*Galega orientalis* Lam.)]. Fragm. Agron. 2(74), 52-58 [in Polish].

Goliński P., 1996. Analiza kosztów i opłacalności produkcji nasion traw w wybranych gospodarstwach Wielkopolski [Analysis of costs and profitability of grass seed production on chosen farms of Wielkopolska Province]. Biul. IHAR 199, 49-69 [in Polish].

Goliński P., 2003. Effect of post-harvest mineral nitrogen residues in the soil of *Lolium perenne* L. seed plantation on dry matter yield and herbage quality of autumn regrowth. Grass. Sci. Eur. 8, 182-185.

Goliński P., Domaniecki W., Walerowska M., 2004. Wartość użytkowa jesiennego odrostu runi na plantacjach nasiennych kostrzewy czerwonej [Usefulness of autumn regrowth of the sward on seed plantations of red fescue]. Wyd. Poznańskiego Towarzystwa Przyjaciół Nauk, Prace z Zakresu Nauk Rolniczych 97, 153-160 [in Polish].

Kozłowski S., Goliński P., 1997. Kostrzewa czerwona trawą pastewną? [Red fescue as a pasture grass?]. Zesz. Prob. Post. Nauk Rol. 451, 103-110 [in Polish].

Krzywiecki S., 1985. Wartość pokarmowa traw z uprawy polowej [Nutritional value of grasses from field cultivation]. Zesz. Prob. Post. Nauk Rol. 293, 41-55 [in Polish].

Radkowski A., Grygierzec B., Sołek-Podwika K., 2005. Zawartość składników mineralnych w wybranych gatunkach i odmianach traw [The content of mineral components in chosen species and cultivars of grasses]. J. Elementol. 10, 1, 121-128 [in Polish].

Rogalski M., Łyduch L., 1981. Wykorzystanie plantacji traw nasiennych do celów paszowych [The use of seed grass plantations for feed purposes]. Hod. Rośl. Nasienn. 1, 42-43 [in Polish].

Rogalski M., Łyduch L., 1983. Wykorzystanie plantacji traw nasiennych do celów paszowych [The use of seed grass plantations for feed purposes]. Zesz. Prob. Post. Nauk Rol. 282, 241-248 [in Polish].

Ruszczyc Z., 1983. Żywienie zwierząt i paszoznawstwo [Animal nutrition and feed management]. PWRiL Warszawa [in Polish].

Szczepanek M., Skinder Z. 2006. Wpływ sposobu, terminu siewu oraz rozstawy rzędów na plon i wartość pastewną odrostu jesiennego oraz słomy życicy trwałej (*Lolium perenne* L.) na plantacji nasiennej [The effect of the way, time of sowing and row spacing on the yield and pasture value of autumn regrowth and perennial ryegrass (*Lolium perenne* L.) on the seed plantation]. Fragm. Agron. 3(91), 257-268 [in Polish].

WPŁYW DAWKI I TERMINU NAWOŻENIA AZOTEM NA WIELKOŚĆ PLONU I SKŁAD CHEMICZNY ODROSTU JESIENNEGO KOSTRZEWY CZERWONEJ W UPRAWIE NA NASIONA

Streszczenie. Celem badań wykonanych w latach 2005-2006 w Chrząstowie k. Nakła (53°09' N; 17°35' E) była ocena wydajności i jakości plonu odrostu jesiennego kostrzewy czerwonej uprawianej na nasiona w warunkach zróżnicowanych dawek i terminów nawożenia azotem. Jesienią, po zbiorze nasion stosowano 20, 40 lub 60 kg $N \cdot ha^{-1}$. Wiosną aplikowano 40, 60, 80 kg $N \cdot ha^{-1}$ jednorazowo w czasie ruszenia wegetacji, a także w dawce dzielonej 40 + 40 kg (40 kg w podstawowym terminie wczesno-wiosennym i 40 kg na początku fazy strzelania w źdźbło). Poziom wiosennego nawożenia azotem nie wpłynął na plon świeżej i suchej masy odrostu jesiennego w pierwszym i drugim roku pełnego użytkowania. Zwiększenie dawki azotu w okresie jesiennym z 20 do 40 $kg \cdot ha^{-1}$ spowodowało przyrost plonu świeżej masy o 9-10 %. Dodatkowa aplikacja 20 kg $N \cdot ha^{-1}$ dawała zwyżkę 5,6% w pierwszym i 13,6% w drugim roku użytkowania. Poziom jesiennego nawożenia azotem nie wpłynął na zawartość włókna surowego, ale zwiększenie dawki z 40 do 60 $kg \cdot ha^{-1}$ spowodowało wzrost zawartości białka ogółem o 11% w pierwszym roku użytkowania. Niezależnie od terminu i poziomu nawożenia azotem wartość pokarmową odrostu ograniczał niedobór magnezu, wapnia i fosforu.

Słowa kluczowe: białko ogółem, makroskładniki, trawa, wartość paszowa, włókno surowe

Accepted for print – Zaakceptowano do druku: 12.04.2011