ACTA UNIVERSITATIS AGRICULTURAE ET SILVICULTURAE MENDELIANAE BRUNENSIS

Volume 62 98 Number 5, 2014

http://dx.doi.org/10.11118/actaun201462050953

EVALUATION OF SUITABILITY OF GRASS SPECIES FOR DRY CONDITIONS (WATER STRESS)

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Abstract

JERÓNIMO PAULO ANTÓNIO, HRABĚ FRANTIŠEK, KNOT PAVEL, KVASNOVSKÝ MICHAL. 2014. Evaluation of Suitability of Grass Species for Dry Conditions (Water Stress). *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis,* 62(5): 953–960.

Based on three-year results of a field experiment evaluating aboveground biomass production and the number of stems of above-ground shoots of grass species (*Lolium perenne, Dactylis glomerata, Festuca pratensis*) grown in a 200×200 mm layout in two water regime variants (normal and reduced – 50% of precipitation) and further in two variants of mowing intensity (meadow – 3 mowings, grazing – 5 mowings per year), the following has been ascertained. The most productive species on averages of the two moisture regimes is *Dactylis glomerata*, *Lolium perenne* and *Festuca pratensis* have fodder weight significantly lower by 20.8% and 22.6% (meadow var.) and 16.9% and 21.9% (grazing var.). Reduction of moisture significantly decreased the above ground biomass weight in case of meadow exploitation in *Dactylis glomerata* –41.2%, in *Lolium perenne* by –9.9% and in *Festuca pratensis* –33.5%. In case of grazing exploitation, the influence of "drought" on production was less pronounced. *Dactylis glomerata* provided the same output, in *Lolium perenne* there was a decrease of –15.7% and in *Festuca pratensis* –11.9%. Reduction of precipitation significantly decreased shoot formation particularly in case of meadow utilization in *Lolium perenne* –23.7%, *Dactylis glomerata* –34.7% and *Festuca pratensis* –20.5%. In case of grazing utilization, reduction in the number of pseudostems due to "drought" was lower – in the order of the above species – 27.1% – 4.6% – 9.6%. Generally, compared with meadow utilization, grazing utilization decreases fodder production in both moisture regimes and increases the number of above-ground shoots.

Keywords: grasses, drought, utilization, production, number of pseudostems

INTRODUCTION

In relation to the ongoing global warming, it is desirable to test resistance of grass species to a lack of moisture. Apart from hypotheses of differing responses of grass species to changed moisture conditions, there is a question whether it is possible to contribute to a stress relief by the system of utilization (number of mowings). The basis of the solution consists in verifying the response of the selected grass species (*Lolium perenne*, *Dactylis glomerata*, *Festuca pratensis*, or as the case may be others) under conditions of reduced moisture supply (reduction of long-term precipitation amount). The experiment was conducted in the form of small-plot field experiment. The influence of abiotic factors was evaluated on the basis of differences and changes in production and structural characteristics of biological production.

A high water demand for creation of grass production is found in Novák (2008). The range of transpiration coefficient of 600–800 l of water for production of 1 kg of dry matter of fodder points to the differences between grass species. Rychnovská (1993) gives the daily maximum of transpiration in production grasses (cock's-foot, meadow fescue, timothy-grass) at the level of 10–30 mg.g^{-1} of dry matter min.$^{-1}$, and in case of grasses of hygrophyte character up to 60 mg.g^{-1} of dry matter min.$^{-1}$. On hot days, high evaporation causes a so-called saturation water deficit in grassland amounting to ca. 20% of the water needs even if there is sufficient moisture in the soil. Temporary withering of the cover in the afternoon hours is attributed to a lower capability of the root system to transport the required amount of water into the above-ground parts. Interaction bond of the water cycle and the temperature level is according to Kudrna (1979) in each crop plant as well as variety represented by a completely specific course of changes in internal energy during the vegetation period and it can be expressed by a so-called thermodynamic curve of a given crop plant. The lack of precipitation in a given period (so-called critical thermodynamic phase) results in reduced production. The critical thermodynamic phase frequently occurs in the phase of rapid growth of plants. In fodder crops in arable land, critical thermodynamic phase is usually during May and the second one in late July and early August. To achieve the maximum yield, these periods must be preceded by precipitation maximum (hs max.) before temperature maximum (hc-max.). According to Price (2002), tolerance of plants to drought is by 70% connected with the growth of roots. Also Rychnovská *et al.* (1985) highlights the relation between drought, root formation dynamics, and consequently reduction of the leaf area, photosynthesis and production. Increased production of alfalfa root with a larger root capacity (electrical capacitance) is stated by Chloupek *et al.* (1999); Svačina *et al.* (2014) confirms this in selected material of spring barley. Increasing the electrical capacitance by + 3.9% led to a production response almost two times higher (+ 8.1%). As for grass species after selection, an increased size of the root system and subsequently also production of meadow fescue and perennial ryegrass is referred by Bonos *et al.* (2004). An important factor in respect of grass species and drought may be the factor of multiple mowing, represented in the paper by 3-fold mowing "meadow" and 5-fold mowing "grazing" utilization. According to a number of earlier findings and consequently current ones, e.g. (Holúbek *et al.*, 2007), perennial ryegrass is classified rather as a species of pasture character with excellent vegetative skills even after being trodden down, but with shorter production perseverance in case of meadow utilization. On the contrary, cock's-foot is more suitable for meadow utilization. Its application in grazing blends is limited by a rapid fodder ageing (degradation of fodder quality) due to its early ripening. Meadow fescue is considered a suitable universal species to be used in both meadow and grazing covers. The mentioned species differences must be critically assessed in relation to newly and purposefully cultivated varieties, e.g. the ones included in our experiment. As regards ecological factors in relation to production (Holúbek *et al.*, 2007), notes temperature and light. An optimum temperature for growth of grasses is 17–21 °C. At a temperature over 25 °C, slowing down occurs and at more than 30–35 °C, growth of grasses is discontinued. From the perspective of temperature, a territory with average annual temperature of 8°C and 13–14 °C for vegetation is considered as optimum. (Hrabě *et al.*, 2009) points in connection with reduction of light to considerable species differences of reduced weight and massiveness of the root system of lawn species and a limited functionality and shortened lifetime of lawns.

MATERIAL AND METHODS

Experimental studies were conducted at the experimental site of the Mendel University in Brno, in the Fodder Research Station of Vatín. From a geographical point of view it is a potato-growing region, with altitude of 535 m. Weather conditions:

- average annual temperature 6.9 °C (of which for vegetation 12.6 °C annual),
- amount of precipitation 736 mm (of which for vegetation 440 mm).

The covers were established by planting of pre-grown plants of the individual grass species in the spring of 2009 in the form of a small-plot experiment in two blocks. Block A – normal precipitation mode, Block B – reduced precipitation mode consisting in roofing of 50% of the experimental area coverage by a special film with a minimum reduction of light conditions so as to drain a half of rainfall out of the area. The mode of precipitation regulation was applied only in the second year after planting for the reason of allowing the same conditions for initial growth and development of plants. In the years 2010–2012, precipitation regulation was implemented during the summer months, i.e. from 01. 04. to 31. 10. Evaluation of the precipitation course in the individual years, seasons and harvestings is found in the part with results.

Growing Variants

The subject matter of monitoring and evaluation was a total of 3 grass species and their suitable varieties, as for meadow and grazing character (Tab. I). Each variant consisted of planting 25 pcs of individuals grown in layouts of 200 × 200 mm in triplicate (a, b, c). Planting was carried out in June 2009. In the first year, clearing the covers of weeds was done manually. Harvest of the covers (individual plants) was carried out in the year of establishment in both two ways of using 2× a year. From 2010, a system of 3-fold mowing meadow utilization was applied to Block A and Block B was subjected to a "model" 5-fold mowing simulated grazing utilization.

I: *Overview of growing variants of grass species and varieties. Vatín 2010–2012.*

Meadow utilization		Simulated grazing utilization	
Species	**Variety**	**Species**	**Variety**
Lolium perenne	Olaf	*Lolium perenne*	Algol
Dactylis glomerata	Niva	*Dactylis glomerata*	Vega
Festuca pratensis	Pronela	*Festuca pratensis*	Kolumbus

Way of Harvesting, Evaluation and Processing of Results

In the spring of each year, stocktaking of the number of live or damaged and dead plants was performed. Harvesting of individual plants was performed manually by cutting the whole plant at stubble height of 60 mm. For each harvested plant, its weight in dry state was deter-mined by weighing after drying in a drying room. In five predetermined plants in the order of 1, 6, 11, 16, 18, also the number of stalk (and leaf) pseudostems, further the plant height, taken as the maximum length of the stalk, were determined. In case of death of the selected plant, the values under study were determined in a neighbouring plant. The terms of harvests are presented in Tab. II. Evaluation of the plant weight in dry state is carried out by its average (x-arithmetic), from three repetitions for each harvest individually, as well as the sum of weights of all the harvests in a given year, and further as the total harvest for all the three experimental years. In a similar way, also evaluation of the number of pseudostems is carried out. The results have been statistically processed in the programme Statistica 10 (StatSoft, 2011). Evaluation of inter-species differences in production, differences in production among individual mowings, years and the water mode is apart from absolute and relative assessment supplemented by statistical methods, i.e. by the Tukey's test method.

RESULTS AND DISCUSSION

Evaluating the Level and Course of Rainfall

From the data on rainfall and its distribution during individual harvests (Tab. III) it follows that only in the first crop year of 2010, its total of 881.5 mm was above the long-term average, i.e. 736 mm. In 2011 and 2012, the yearly total was relatively lower by −14.0% and −7.0%. When evaluating the precipitation amount during the growing season, the situation is similar. In relation to the 30-years' average (440 mm), the precipitation amount was in 2010 relatively higher +42.0%, in 2011 +6.2% and in 2012 −16.0%. In relation to production formation, it is necessary to take into account that in 2010 and 2011, the precipitation amount for vegetation ranged between 71% and 75% of the annual total, while in 2012, it was only 54%. Another unusual feature of the years 2011 and 2012 is a very low level of precipitation in the period of the major production harvests, i.e. the 1st and 2nd mowing. Their share in the yearly total is 15% at the maximum, and in relation to the long-term average in the same season it is lower by 1/3. From the point of view of temperature, average temperature in 2010 was 6.0 °C, which is below the long-term average (6.9 °C), in the year 2011 it was 7.4 °C, i.e. above this level, and 2012 with 6.8 °C corresponded to the long-term level.

Weight of Plants in Dray State

Meadow Utilization of Cover

The highest weight of dry fodder plants for three harvest years and an average of both moisture modes were achieved in D.g. −586.4 g/1 plant. Production in L.p. −464.2 g and F.p. −453.7 g is relatively lower by −20.8% and 22.6%, which is a significant difference. The effect of reduced precipitation was manifested in decreased production (Tab. I.) at most in D.g. to the level of 58.8%, further in F.p. by a decrease of 1/3 (rel. to 66.5%) and at least in L.p. where the production dropped to the level of 90.1%. However, a significant effect of reduced precipitation on production was, except for partial differences in certain mowings, only found in F.p. and that was only in 2012. The influence of year (Tab. VI) on production was significant (conclusive)

II: *Dates of harvests of grass species in case of meadow and simulated grazing utilization. Vatín, 2010–2012.*

Mowing	Harvest Date					
	Meadow utilization			Grazing utilization		
	2010	2011	2012	2010	2011	2012
1st mowing	17. 6.	31. 5.	28. 5.	17. 6.	10. 5.	10. 5.
2nd mowing	5. 8.	20. 7.	19. 7.	5. 8.	2. 6.	7. 6.
3rd mowing	12. 10.	26. 9.	26. 9.	12. 10.	30. 6.	11. 7.
4th mowing	-	-	-	-	16. 8.	17. 8.
5th mowing	-	-	-	-	26. 9.	4. 10.

III: *Evaluation of rainfall in the individual years and harvests. Vatín 2010–2012.*

Utilization variant	Period	The total and share of rainfall in the individual years and harvests. Vatín 2010–2012					
		2010		2011		2012	
		mm	%	mm	%	mm	%
Meadow	Spring 1. 1.–31. 3.	134.6	15.3	78.8	12.4	164.4	24.0
	1st mowing	249.9	28.3	90.5	14.3	59.6	8.7
	2nd mowing	170.8	19.4	164.3	26.0	141.8	20.7
	3rd mowing	209.4	23.7	212.4	33.6	164.2	24.0
	Autumn	120.5	13.7	86.8	13.7	154.9	22.6
	Total	881.5	100	632.8	100	684.9	100
Grazing	Spring	134.6	15.3	78.8	12.4	164.4	24.0
	1st mowing	249.9	28.3	47.5	7.5	57.5	8.4
	2nd mowing	170.8	19.4	49.7	7.8	27.6	4.0
	3rd mowing	209.4	23.7	71.9	11.4	99.7	14.6
	4th mowing	-	-	190.7	30.1	81.5	11.9
	5th mowing	-	-	107.4	17.0	108.3	15.8
	Autumn	120.5	13.7	86.8	13.7	145.9	21.3
	Total	881.5	100	632.8	100	684.9	100

IV: *Weight of plants of grass species (in grams per plant) in dry state in meadow utilization (3 mowings/year), in normal (N) and regulated (R) moisture mode. Vatín, 2010–2012.*

Species	Moisture mode	Weight of plants (g/1 piece) in dry y			Σ 2010–2012
		2010	2011	2012	
Lolium perenne	N	245.9 a	116.9 a	125.7 a	488.5
	R	236.8 a	114.0 a	89.2 a	440.0
	Rel. %	96.3	97.5	70.0	90.1
Dactylis glomerata	N	163.1a	236.8a	338.8a	738.7
	R	132.9a	137.7b	163.5a	434.1
	Rel. %	81.5	58.1	48.3	58.8
Festuca pratensis	N	151.9a	198.6a	194.6a	545.1
	R	112.2a	149.7a	100.4b	362.3
	Rel. %	73.9	75.4	51.6	66.5

only in L.p., in both moisture modes. A significantly higher fodder weight was higher in 2010 as compared to 2011 and 2012.

Simulated Grazing Utilization of Cover

When applying the simulated grazing 5-fold mowing utilization, the order of species in fodder production is the same as in the case of meadow utilization. D.g. with total weight (Tab. V) of 470.5 g/1 plant in the average of both moisture modes, then L.p. with 391.2 g and F.p. with 367.5 g with a relative decrease of –16.9% and 21.9%, which means conclusive/inconclusive increase. The effect of reduced precipitation is surprisingly manifested in a relatively low decrease in weight plant, as compared to meadow utilization. In D.g., the production was even slightly higher (rel. +3.1%). In L.p., there was a decline in production due to reduced precipitation of rel. –15.3%, while a conclusively lower production applies to years 2011 and 2012. In F.p., the production was relatively reduced by –11.9%. A lower production is conclusive in 2012. Despite the overall lower fodder production, utilization of multiple mowing may be related to better adaptation to an uneven course of precipitation during the growing season. Influence of the year on differences in plant weight (Tab. VI) is generally very significant. In *Lolium perenne* differences between the year 2010 and the two following harvest years are significant, with a clear tendency to decreasing production capability and in both good moisture modes. In *Dactylis glomerata*, there was a significant difference only of decline in production in the third year 2012 in the normal moisture mode. In F.p. there is a significant drop in production in the third year 2012, too, in both moisture modes.

Number of Stems in Grass Species

The number of pseudostems of the individual grass species, as well as of the varieties, is their specific biological property, as confirmed by the data in Tabs. VII and VIII. *Lolium perenne* which is rather a pasture species produces the most shoots which are more delicate, thus a denser cover. *Dactylis glomerata* and *Festuca pratensis* belong rather to the meadow type, with fewer and thicker shoots, particularly in the first mowing. Statistical evaluation of species divergence in this case appears to be ineffective. It is more important to assess the response and formation of shoots in each species to the effect of drought. From the presented data concerning the meadow utilization of covers (Tab. VII) it follows that the largest reduction in the number of stems due to drought occurred in *Dactylis glomerata* (–34.7%), in *Lolium perenne* by –23.7% and in *Festuca pratensis* by –20.5%. However, in terms of statistical evaluation, these differences are not significant. From the perspective of the impact of the year (Tab. III) on differences in shoot formation in meadow utilization, significant differences were ascertained in the species *Festuca pratensis*, especially between the 1st and 2nd year in both the normal and reduced moisture mode. In the variant of grazing utilization (Tab. VIII), the same species differences as in the meadow exploitation are confirmed. However, as compared with the meadow variant, an increased number of mowings stimulates a higher production of shoots both in *Lolium perenne* and *Festuca pratensis*. Reduced precipitation resulted in a decrease in the number of shoots in *Lolium perenne* by –30.1 %, in *Festuca pratensis* by –13.1 % being conclusive in the 3rd year, and in *Dactylis glomerata* only by –0.7%.

DISCUSSION

The solution aims to contribute to clarification of the differences in the response of the grass species under study to a reduced water mode and to the intensity of utilization of the covers by 3-fold mowing utilization (meadow) and 5-fold mowing utilization (grazing). Partly, the effect of the year method is evaluated, too. It is necessary to allow for the variety factor. For utilization method an appropriate variety of the meadow or grazing character was chosen. As evident from the results of in connection to findings by Rychnovská *et al.* (1985), exactly the grazing type variety could be the reason of overall lower production of fodder in grazing utilization on the one hand, but on the other hand, also of a more favourable yield response to drought than in varieties of the meadow character. The results confirm the dominant production position of *Dactylis glomerata* in conditions of both normal and reduced moisture environment. The rapid growth and development of this species (Holúbek, R. *et al.*, 2007) supported by a massive root system predestines it ideally as a possible species for use in drier conditions. Explanation of the decline in production in the situation of reduced rainfall

V: *Weight of plants of grass species (in grams per plant) in dry state in simulated grazing utilization (5 mowings, rel. %), in normal (N) and regulated (R) moisture mode. Vatín, 2010–2012.*

Species	Moisture mode	Weight of plants (g/1 piece) in dry state			Σ 2010–2012
		2010	2011	2012	
Lolium perenne	N	218.6 a	113.0 b	88.6 b	420.2
	R	226.3 a	81.7 a	48.3 a	356.3
	Rel. %	103.5	72.3	48.3	84.7
Dactylis glomerata	N	177.1 a	166.2 a	114.6 a	457.9
	R	183.1 a	169.3 a	119.7 a	472.1
	Rel. %	103.4	101.9	104.4	103.1
Festuca pratensis	N	162.7 a	145.2 a	79.3 a	387.2
	R	142.2 a	134.8 a	67.9 a	344.9
	Rel. %	87.4	92.8	84.2	89.1

VI: *Statistical evaluation of the influence of the year on the fodder weight of grass species in relation to the way of utilization. Vatín, 2010–2012.*

Grass species	Moisture mode	Significance of differences					
		Meadow utilization			Grazing utilization		
		2010	2011	2012	2010	2011	2012
Lolium perenne	N	a	b	b	b	a	a
	R	a	b	b	b	a	a
Dactylis glomerata	N	a	a	a	b	b	a
	R	a	a	a	a	a	a
Festuca pratensis	N	a	a	a	b	b	a
	R	a	a	a	b	b	a

VII: *Number of pseudostems (pieces per plant) in meadow utilization of grass species in relation to normal (N) and reduced (R) moisture mode. Vatín, 2010–2012.*

Species	Moisture mode	Number of pseudostems (1 year/pieces)			Σ 2010–2012
		2010	2011	2012	
Lolium perenne	N	388.1a	330.7a	449.5a	1 168.3
	R	342.4a	225.7a	323.8a	891.9
	rel. %	88.2	68.2	72.0	76.3
Dactylis glomerata	N	145.1a	217.0a	333.0a	695.1
	R	126.6a	162.0a	165.3a	453.9
	rel. %	87.2	74.6	49.6	65.3
Festuca pratensis	N	150.5a	218.3a	287.7a	656.5
	R	140.8a	198.9a	191.7a	522.0
	rel. %	93.5	91.1	66.3	79.5

VIII: *Number of pseudostems (pieces per plant) of grass species in simulated grazing utilization. Vatín, 2010–2012.*

Species	Moisture mode	Number of pseudostems (1 year/pieces)			Σ 2010–2012
		2010	2011	2012	
Lolium perenne	N	404.8	398.8	464.6	1268.2
	R	399.5	236.6	288.8	924.9
	rel. %	98.6	59.3	62.1	72.9
Dactylis glomerata	N	150.5	164.5	162.5	477.5
	R	143.7	151.5	158.9	454.1
	rel. %	95.4	93.0	47.7	96.0
Festuca pratensis	N	184.6	308.0	274.5	767.1
	R	191.3	290.7	211.5	693.5
	rel. %	103.6	94.3	77.4	90.4

IX: *Number of pseudostems (pieces per plant) in meadow utilization of grass species in relation to normal (N) and reduced (R) moisture mode. Vatín 2010–2012.*

Species	Moisture mode	Number of pseudostems (1 year/pieces)			Σ 2010–2012
		2010	2011	2012	
Lolium perenne	N	404.9a	695.9a	685.3a	1786.13
	R	398.7a	452.2a	393.4a	1247.8
	rel. %	98.5	65.0	57.5	69.9
Dactylis glomerata	N	149.9a	289.5a	262.7a	702.1
	R	143.7a	284.1a	269.7a	697.5
	rel. %	95.4	98.1	102.7	99.3
Festuca pratensis	N	184.7a	506.1a	362.4a	1053.2
	R	191.4a	447.1a	276.9a	915.4
	rel. %	103.6	88.3	76.4	86.9

can be related to both the species differences in evapotranspiration of grasses (Rychnovská *et al.*, 1993) and also to a slowdown in growth of the root system and the associated decrease in production (Svačina *et al.*, 2014). It is further confirmed by the data on the decreased production of shoots in the meadow utilization. A lower yield depression of this species in utilization of multiple grazing may have an explanation in the theory by Kudrna (1979) about critical moisture modes of crops. Time "concord" of two critical periods for fodder corresponds to the course of production formation precisely in case of 3-fold mowing meadow utilization. It also evidenced by an analysis of the course of precipitation. At the time of the 1st and 2nd mowing in meadow utilization, X: *Statistical evaluation of the influence of the year on the fodder weight of grass species in relation to the way of utilization. Vatín, 2010–2012.*

Grass species	Moisture mode	Significance of differences					
		Meadow utilization			Grazing utilization		
		2010	2011	2012	2010	2011	2012
Lolium perenne	N	a	a	a	a	a	a
	R	a	a	a	a	a	a
Dactylis glomerata	N	b	ab	a	b	a	a
	R	a	a	a	a	a	a
Festuca pratensis	N	b	ab	a	a	c	b
	R	a	c	b	a	c	b

XI: *Comparison (relative in %) of the influence of meadow and grazing utilization on the plant weight and the number of pseudostems in grass species. Vatín, 2010–2012.*

Indicator	Species	Moisture mode	Rel. decrease/ increase in %			
			2010	2011	2012	Σ
Weight of plants	*Lolium perenne*	N	88.9	96.6	70.5	86.8
		R	95.6	71.6	54.1	81.4
	Dactylis glomerata	N	108.6	70.2	33.8	63.2
		R	137.7	122.9	73.2	109.3
	Festuca pratensis	N	107.1	73.1	40.7	71.4
		R	126.7	90.0	67.6	95.4
Number of pseudostems	*Lolium perenne*	N	104.3	210.4	152.4	152.9
		R	116.6	200.3	200.3	139.9
	Dactylis glomerata	N	103.3	133.4	78.9	101.0
		R	113.5	175.4	163.1	153.7
	Festuca pratensis	N	126.7	231.8	125.9	160.4
		R	135.9	224.8	144.4	175.4

Note: Plant weight in case of meadow utilization – 100%

the precipitation amount for the individual years was at the level of ca. 1/3 of the long-term total. In case of grazing utilization, the decrease in production was compensated in late summer in the 3rd to 5th mowing by a higher subsidies chance. The results indicate a need for further investigation of the relation between the effects of drought on root growth and formation of the above-ground phytomass in interaction with intensity of the utilization of covers. Good prospects of breeding of species and varieties with a view to obtaining a larger root system in relation to resistance to drought and a higher production is confirmed by Svačina *et al.* (2014), Bonos *et al.* (2004).

Lolium perenne with production lower by ca. 15–20% as compared with *Dactylis glomerata* distinguishes itself by a “more favourable” resistance to drought. Although in absence of precipitation, this species forms fewer new shoots (by ca. ¼), the production is reduced due to drought only by 9.9% (meadow) or 15.7% (grazing method). The production compensation stems from the ability of this species to form more stem shoots increasing the fodder production in the summer in the situation of drought; or as for grazing utilization of multiple mowing, to form short leaf shoots quickly after rain. The conclusive decline in production with ageing of the cover is in line with findings by Holúbek *et al.* (2007). This will be applied primarily in short-time 3 to 4-year intensive covers on arable land and in temporary grassland for 4 to 6 years (Hrabě and Buchgraber, 2004). *Festuca pratensis* is a species with producing lower by ca. 1/5 as compared to *Dactylis glomerata* and with a similar course of the reaction to drought. However, the rate of decreased production due to drought in meadow utilization is lower by ca. 1/3, and in grazing utilization only by 11.6%, while corresponding to the decreased formation (number) of shoots. The significant effect of the year on production, as well as on the number of stems, especially in case of grazing utilization, presents a challenge of verifying this statement (Holúbek *et al.*, 2004) on plasticity of the species as for the way or intensity of utilization. The results further confirm a lower fodder production and a higher formation of pseudostems in all species at the 5-fold mowing utilization of covers. Generally, this fact is expressed in connection with the lower weight and massiveness of the root system. The proof is in the results reported in high-mowed, i.e. less often mowed, and in short-mowed, i.e. very often mowed lawn species Knot *et al.* (2009), followed by *Lolium perenne* (Straková and Hrabě, 2001).

SUMMARY

In the three-year field experiment, the effect of reduced precipitation (–50.0% as compared with the normal course) was evaluated, along with the effect of the system of utilization of covers, i.e. meadow – three mowings/year and grazing – five mowings/year on the fodder weight and number of forage above-ground shoots in grass species grown individually in a 200/200 mm layout. The species with the highest ability to create fodder of *Dactylis glomerata* significantly decreased fodder production and formation of above-ground shoots due to reduced precipitation in meadow utilization. A similar trend was also observed in the utilization in *Festuca pratensis*. The decrease in both production and the number of shoots was conclusive due to the year. The lowest reduction in production due to drought (rel. only –9.9%) appeared in *Lolium perenne*. In this species, production decreases significantly with ageing of the cover. In case of the grazing system, production of all grass species was insignificantly lower as compared with meadow exploitation. The effect of drought on decrease in production (max. 15.7% in *Lolium perenne*) has not been proved.

Acknowledgement

The paper was prepared under the support from Grant No. IGA TP 2/14 „Effect of specifically positive aditives in animal nutrition on animal products quality and environment preservation during forage production“.

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