THE EVALUATION OF DROUGHT RESISTANCE OF SOME VARIETIES OF COOL SEASON PERENNIAL GRASSES USED FOR TURF

Constantin Iulian POPOVICI[1], Vasile VÎNTU [1], Costel SAMUIL[1], Ciprian CIOBANU[1]
E-mail: iulian_vici@yahoo.com

Abstract

In Romania are sold turfgrass varieties that are imported from foreign countries. Turf seed farms from countries like France, Germany, Netherlands and Great Britain are involved in the breeding process of a large variety of species and varieties used for turf. They have a major objective of testing the performance of the new turf varieties in diverse climatic areas from countries where they intend to sell. These tests or trials are meant to evaluate the performances of a large number of varieties and doing so, to indicate which one is best adapted to a specific climatic area. One of the most important indicators of turf quality is represented by the drought resistance of turf, because of the latest trend in turfgrass management towards a low input management, specifically a reduced irrigation and fertilization, or even no irrigation at all. For this specific reason, creating new and improved cultivars that can resist to moisture stress has become a key factor in turfgrass breeding. In this research we have evaluated eighteen imported varieties and one romanian variety which represented the control factor. The evaluation of turf drought tolerance was done using a visual rating system, with ratings from 1-9, where 9 represents the best drought resistance. The data was collected in the years 2005 and 2007. The results indicated that the species with the best drought resistance was *Festuca arundinacea*, where two varietes, Montserrat and Starlett were rated 9 in the year 2005. The english ryegrass varieties had a good drought tolerance only in the year 2005, but later, in 2007 they failed to resist at extended drought. Three of five imported varieties were rated lower than control variety and only Capri and Keystone were rated 3.7 the same as the romanian variety Mara.

Key words: turf varieties, drought resistance, visual ratings

Most turfgrass varieties marketed in Romania come from companies from Europe which generally breed and grow those varieties in areas with cooler and wetter climate compared with the climate in our country, often characterized by extremely hot and dry summers. Drought is becoming more common in recent years in our country due to global climate change, while seeking new varieties more resistant to heat and drought has taken on increased importance (Singh D.K., et. al. 2003). Among the cool season grasses, there are two species with remarcable drought resistance: *Festuca arundinacea* and *Poa pratensis* (Veronesi F. et al. 1997). The second one, is the subject of study in this research, by seven varieties breeded in the USA, which we evaluated for several years. Another grass species studied here, namely *Lolium perenne*, represents the most commonly used cool season grass in Romania, but also in many european countries, which unlike the drought resistant bluegrass, has big demands for constant water supply during the growing season. Establishment is an important indicator of turf quality and the two species could not be more different regarding this aspect. Perennial ryegrass has a major advantage over bluegrass with a fast germination and a very good establishment. For this reason using ryegrass for lawns establishment offers better results even if seedbed preparation has not been performed at the best parameters or there is a danger of weed infestation. The bluegrass, on the other hand, has poor establishment or better said a slow establishment. The cause of this deficiency could be poor seed germination or a high latency of seeds. Bluegrass has an advantage over ryegrass by the presence of strong underground rhizomes that helps to regain the loss of ground cover resulted from injury or climatic stress factors and also offers resistance to heavy traffic and soil compaction. This morphological feature of bluegrass reduces the slow establishment drawback of the species thus including it in mixtures with turf type turfgrasses (perennial ryegrass, tall fescue) or even using it in pure culture on sports fields leads to increased ground cover and persistency. Although the two species are quite different in many things, they are often put together.

[1] University of Agricultural Sciences and Veterinary Medicine of Iaşi

MATERIAL AND METHOD

The biological material used in this experiment consists in 19 varieties of perennial grasses of which 18 are imported and only one is romanian. Foreign varieties were used in pure culture, mostly as a requirement of the companies that have donated it and who wanted individual assessment of each variety in the climatic conditions of our country. To achieve the purpose of this study, was setup a monofactorial experience, with 19 plots arranged in three randomized blocks, the control plot was sown with the variety Mara (*Lolium perenne*). Evaluation of drought resistance was made using a visual rating scale with marks from 1-9, where 9 is the best resistance to drought. This visual assessment scale is recommended by the American organization NTEP.

N.T.E.P. Organization is appreciated and recognized worldwide as an authority in terms of evaluating the new turfgrass varieties. Turf industry in the USA, but also in other countries, rely heavily on data gathered in the NTEP trials. NTEP visual rating system is currently used in over 30 countries.

Turf breeders, researchers and other specialists use NTEP scale to determine the adaptability and ornamental value of grass species and varieties. Seed producers use the data provided by NTEP to promote their turgrass varieties and the landscape companies or dealers or even public institutions are using these informatio for purchasing seeds or transplanted material (rolls of turf).

The scientific value of scale N.T.E.P. is very important. However the assessment of species and varieties is difficult and complex. Also, turf assessment is generally a process based on visual estimation of characteristics such as specific color (genetic), density, leaf texture (foliage smoothness), uniformity and quality. These features can not be measured like we do in other crops. The Quality of a lawn is not a measure of production or nutritional value but is a measure of aesthetics (density, uniformity, fineness, color, habitus) and functionality (Morris K.N., 1995).

The most commonly way used to assess the quality of turf is a visual assessment scale that relies on the experience of the evaluator. It is accepted that properly trained evaluators can observe minimum differences between species using this visual assessment scale. The following indicators are taken into account:

- Resistance to drought (summer behavior). Drought tolerance is either for wilting, leaf rolling, latency or recovery. With 1 we rate the stand that is completely withered, total latency, and no signs of recovery, and with 9 a green lawn without wilted plants and a very good recovery.

For overall quality of the turf, spring greenup, drought resistance, disease resistance the rating is as follows:

9 - corresponds to a 100% green lawn without dry or damaged plants or visible water stress;

8 - idem, with values between 87.5% - 100%

7 - idem, with values ranging between 75% - 87.5%;

6 - idem, with values between 62.5% - 75%

5 - idem, with values ranging between 50% - 62.5%;

4 - idem, with values between 37.5% - 50%;

3 - idem, with values ranging between 25% - 37.5%;

2 - idem, with values between 12.5% - 25%;

1 - idem, with values between 0% - 12.5%.

Interpretation of results. Data were statistically interpreted by calculating the variance and limit differences.

RESULTS AND DISCUSSIONS

Varieties coming from Denmark seem to adapt harder to the climatic conditions of NE Moldova. Of the five varieties of perennial ryegrass subjected to evaluation in 2005 only two are above Romanian variety Mara in terms of resistance to drought, namely Margarita and Keystone varieties that were noted by 7.3 and 8 while the control received the rating 7. Esquire variety matched the control, and Capri and Ponderosa varieties were weaker as they were rated 6.3 (*tab. 1*). The differences from control plot were not significant.

The species *Festuca rubra* shows a great variability, the drought resistance of the seven varieties ranging in large limits from one variety to another. The subspecies *tricophylla* proved to be more resistant, represented by varieties Rosita and Smirna but also the variety Celianna (*Festuca rubra var. rubra*) that were rated 8. The subspecies *commutata* is weaker, the varieties Calliope and Legend receiving the lowest values, respectively 3.3 and 4.3. *Festuca rubra* can tolerate short periods of drought in conditions of cooler temperatures due to low water consumption (Goatley M., 2004).

The species *Poa pratensis* shows little ability to withstand the lack of water in the first year of vegetation, the variety Panduro was rated 5 and Connie with 4. Richardson M.D. (2008) tested 50 varieties of smooth-stalked meadowgrass using digital images and noticed that there was a large variability in the species *Poa pratensis* in terms of resistance to drought. breeding turf varieties resistant to drought is particularly important in recent years with the restriction of the use of large-scale irrigation. *Poa pratensis* is one of the most used cool season grass species in America in both intensive and extensive management.

The least drought resistant species is *Agrostis stolonifera* represented by variety Penn G6. This variety was rated 3.3 in the first year and 3 in the driest year in 2007, receiving an average rating of 3.2. This species is used to create green areas in golf courses where trimming has a very low height of only 3-5 mm. Under these conditions the use of this species under nonirrigated conditions is impossible. Drought, along with high temperatures leads to rapid drying of plants. The influence of soil temperature using minirhizotron technique was studied by Huang and Xiaozhong Bingru Liu (2003), studying the development and mortality of root system. The total length of roots and their number was highest in August and then decreased in September. From July to September the number of roots decreased in while the number of dead roots increased. The results showed that the roots of *Agrostis stolonifera* decline during the summer due to high soil temperatures, which affect the performance during the summer.

The species with the highest resistance to drought is *Festuca arundinacea*, where varieties Starlett and Montserrat were rated 9.

Of the 18 varieties from Denmark, half saw positive statistically difference compared to the control in 2007. Of these, seven had very significant positive differences. The highest values of this indicator were observed at Montserrat and Starlett varieties, which were rated with 8 and variety Dumas has been rated with 6.3. A relatively good resistance to drought the was found at varieties Rosita and Smirna which were rated 5.7.

Table 1

Drought resistance (1 – very poor; 9 – very good)

Variants of experimentation		2005			2007			Media		
		Note	Diference from control	Significance	Note	Diference from control	Significance	Note	Diference from control	Significance
Control	*L. p.*100%	7.0	0.0	Mt	3.7	0.0	Mt	5.3	0.0	Mt
V1	Margarita (*L.p.*)	7.3	0.3	-	3.0	-0.7	-	5.2	-0.1	-
V2	Capri (*L.p.)*	6.3	-0.7	-	3.7	0.0	-	5.0	-0.3	-
V3	Ponderosa (*L.p.*)	6.3	-0.7	-	3.3	-0.4	-	5.3	0.0	-
V4	Esquire (*L.p.)*	7.0	0.0	-	3.3	-0.4	-	5.2	-0.1	-
V5	Keystone (*L.p.)*	8.0	1.0	-	3.7	0.0	-	5.9	0.6	*
V6	Rosita (*F.r.t.)*	8.0	1.0	-	5.7	2.0	***	6.9	1.6	***
V7	Smirna (*F.r.t.)*	8.0	1.0	-	5.7	2.0	***	6.9	1.6	***
V8	Calliope (*F.r.c.*)	3.3	-3.7	000	3.3	-0.4	-	3.3	-2.0	000
V9	Celianna (*F.r.r.*)	8.0	1.0	-	5.0	1.3	**	6.5	1.2	***
V10	Legende (*F.r.c.*)	4.3	-2.7	000	3.3	-0.4	-	3.8	-1.5	000
V11	Capriccio (*F.r.c.*)	5.0	-2.0	000	3.7	0.0	-	4.4	-1.1	000
V12	Maxima 1 (*F.r.r.*)	7.0	0.0	-	5.3	1.6	***	6.2	0.9	***
V13	Dumas 1 (*F.o.d.*)	6.3	-0.7	-	6.3	2.6	***	6.3	1.0	***
V14	Montserrat (*F.a.)*	9.0	2.0	***	8.0	4.3	***	8.5	3.2	***
V15	Starlett (*F.a.)*	9.0	2.0	***	8.0	4.3	***	8.5	3.2	***
V16	Panduro (*P.p.)*	5.0	-2.0	000	5.3	1.6	***	5.2	-0.1	-
V17	Conni (*P.p.)*	4.0	-3.0	000	4.7	1.0	*	4.4	-1.1	000
V18	Penn G6 (*A.s.)*	3.3	-3.7	000	3.0	-0.7	-	3.2	-2.1	000
		LSD 5% = 1.1 LSD 1% = 1.5 LSD 0.1% = 1.9			LSD 5% = 0.8 LSD 1% = 1.1 LSD 0.1% = 1.5			LSD 5% = 0.5 LSD 1% = 0.6 LSD 0.1% = 0.8		

L.p. – Lolium perenne; F.r.t. – Festuca rubra ssp. *tricophylla; F.r.r. – Festuca rubra var. rubra; F.r.c. – Festuca rubra* ssp. *commutata; F.a – Festuca arundinacea; P.p. – Poa pratensis; A.s.s - Agrostis stolonifera*

The varieties of perennial ryegrass are not resistant to hydric stress caused by insufficient water regime that characterized a long period, which began in October 2006 and ended in August 2007. The values recorded at all five varieties were lower to the romanian variety and ranged between 3 - 3.7.

Graphic layout on the mean values recorded during the two years helps us to see major interspecific and intraspecific differences (*fig. 1*). Thus, it appears that the species *Festuca arundinacea* is the most resistant to water shortages represented by varieties Starlett Montserrat which obtained mean values equal to 8.5. The five varieties of perennial ryegrass have good resistance to drought only in the first year but in the coming years and especially in 2007 the possibilities of these varieties to cope with the prolonged lack of water has decreased considerably. Four of the five had average ratings lower than the Romanian variety, whilst only the variety Keystone witness obtaining a higher average rating (5.9). Species *Festuca rubra* shows a large variability thru great differences among varieties in terms of drought resistance. Thus, Rosita and Smyrna varieties have good resistance to drought obtaining average ratrings of 6.9 while Calliope and Legend varieties are strongly affected by drought obtaining average values of 3.2 respectively 3.8.

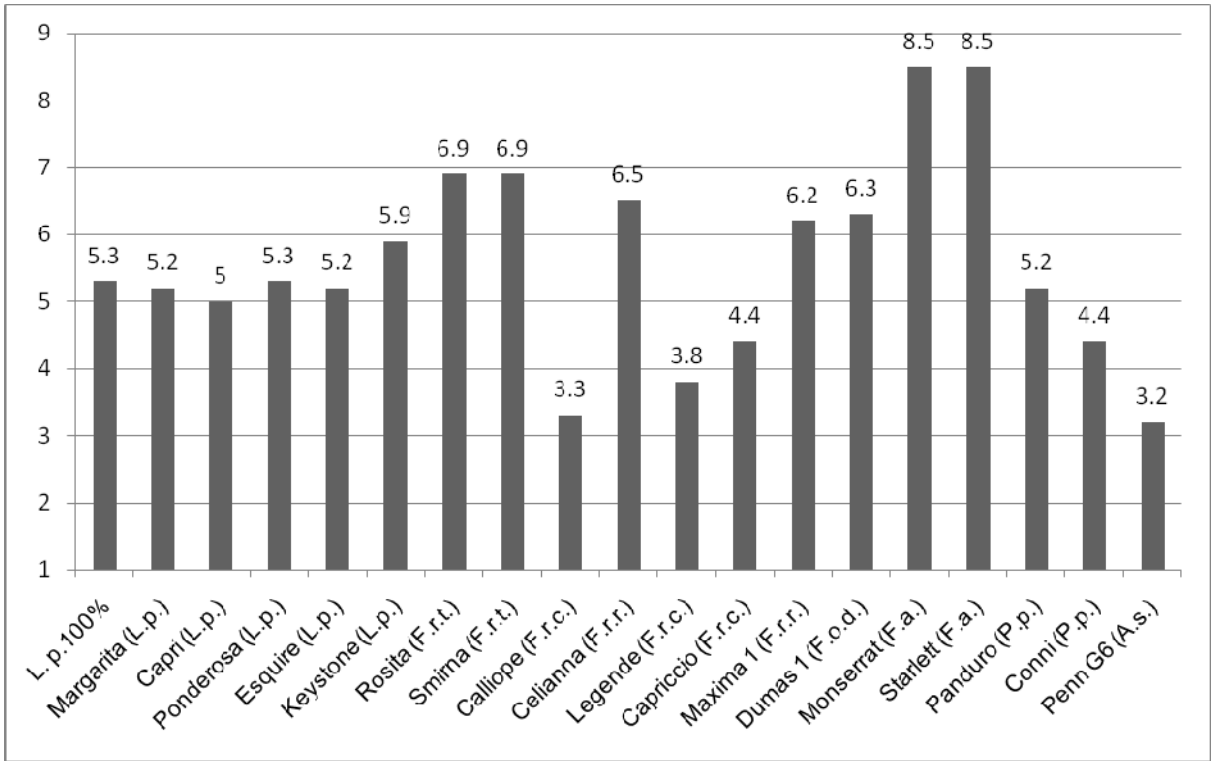

Figure 1 **Mean values of drought resistance**

CONCLUSIONS

The species *Festuca arundinacea* is the cool season grass with the best resistance to drought which was noted on average with 8.5 over two years and is indicated to be used in nonirrigated conditions in full sun.

Of the three subspecies of *Festuca rubra*, ssp *tricophylla* proved the best drought resistant and weakest one was ssp *rubra*.

The species *Agrostis stolonifera* is the most sensitive to prolonged lack of water being rated with 3.2.

The five varieties of perennial ryegrass had a lower or equal performance to that of Romanian variety Mara, suggesting the possibility of substituting imported varieties of perennial ryegrass with romanian varieties better suited to local environmental conditions from our country. Only the variety Keystone had a good performance being rated 5.9 for drought resistance.

The two varieties of smooth-stalked meadowgrass did not have shown a greater resistance to drought than the control (*Lolium perenne*) and were rated with 5.2 and 4.4.

BIBLIOGRAPHY

Bingru, Huang, Xiaozhong, Liu, 2003 - *Summer Root Decline Production and Mortality for Four Cultivars of Creeping Bentgrass*. Crop Science 43:258-265.

Goatley, Mike, 2004 - *Summer Lawn Management: Watering the Lawn*. Virginia cooperative extension Publication Number 430-010, Revised June 2004.

Morris, K. N., 1995 - *The past, present and future of turfgrass improvement*. Michigan State University, T.G.I.F. Art. Ord. Nr: Km 12/95.

Richardson, M. D., Douglas, E. Karcher, Kenneth Hignight, Debra, Rush, 2008 - Drought Tolerance and Rooting Capacity of Kentucky Bluegrass Cultivars, Crop Sci. 48:2429–2436.

Singh, D. K., Bird, P. R., Saul, G. R., 2003 - *Maximising the use of soil water by herbaceous species in the high rainfall zone of southern Australia: a review.* Australian Journal of Agricultural Research 54(7) 677-691**.**

Veronesi, F., Falcinelli, M., Lucaroni, B.; Russi, L., 1997 - *Within species variation in cool season grasses grown for turf in Central Italy [Lolium perenne - Poa pratensis - Festuca rubra - Festuca arundinacea - Umbria]*. Rivista di Agronomia - ISSN 0035-6034, p. 127-134.