Effects of Water Stress on Germination and Seedling Growth of Lovegrass Species

R E. Brevedan
Universidad Nacional del Sur

M G. Klich
Universidad Nacional del Sur

E E. Sanchez
EERA, Argentina

EFFECTS OF WATER STRESS ON GERMINATION AND SEEDLING GROWTH OF LOVEGRASS SPECIES

R.E. Brevedan[1], M.G. Klich1, E.E. Sánchez[2] and M.N. Fioretti[1]

[1] Departamento de Agronomía, Universidad Nacional del Sur and CERZOS (CONICET), 8000 Bahía Blanca, Argentina

[2] EERA, Alto Valle, INTA, 8332 General Roca. Argentina

ABSTRACT

Seeds of seven cultivars of lovegrass species Ermelo, Morpa and Tanganyika weeping lovegrass (*Eragrostis curvula var. curvula*, Don Eduardo INTA (*E. curvula var. robusta*), Cochise lovegrass (*E. lehmanniana* x *E. trichophera*), A-68 Lehmann lovegrass (*E. lehmanniana* Nees) and Catalina boer lovegrass (*E. curvula* var. *conferta*) were germinated at different water potentials. Total germination percentage differed within cultivars according to water availability, although there were no great differences between the germination of the cultivars within any given water potential. The only exception was Don Eduardo INTA which had lower germination values. A marked fall in germination was registered as from -0.6 MPa, which became practically non-existent at -1.5 MPa . Root and shoot length was measured on all cultivars of *Eragrostis curvula* var. *curvula* and shortening was observed when the water potential was reduced.

KEYWORDS

Lovegrass, weeping lovegrass, germination, water stress, seedling growth

INTRODUCTION

It is known that there is a reduction in the germination percentage with decreasing soil water potential. The capacity of seeds to germinate where there is a low availability of water depends on the species and each species of seed appears to have its own water potential threshold below which germination will not occur.

Germination and seedling emergence problems are extensive in semi-arid regions. Although soil moisture may be adequate for the growth of established plants, the surface layer of soil may often dry rapidly and prevent seed germination and seedling establishment.

Lovegrasses are warm season perennial grasses well adapted to semi-arid Argentina. At present there are more than 700,000 ha sown - mainly with cv. Tanganyika-, which is the most extensively cultivated forage perennial grass in the country.

However, in spite of the rusticity of lovegrass, its introduction has not been easy as they are species with very small seeds and a slow growth rate.

Water stress affects the ability of lovegrass seedlings to rapidly develop a root system after seed germination, which is critical for succesful seedling establishment.

The objective of this study was to determine the germination of different lovegrass cultivars and initial root growth response of several cultivars of *E. curvula* var. *curvula*, to decreasing water potential as imposed by polyethylene glycol.

MATERIALS AND METHODS

The lovegrasses used in the study were Ermelo, Morpa and Tanganyika weeping lovegrass (*Eragrostis curvula* var. *curvula* (Schrad.) Nees), Don Eduardo INTA (*E. curvula* var. *robusta* (Schrad.) Nees), Cochise lovegrass (*E. lehmanniana* Nees x *E. trichophera* Coss (Dur.), A-68 Lehmann lovegrass (*E. lehmanniana* Nees) and Catalina boer lovegrass (*E. curvula* var. *conferta* (Schrad.) Nees).

Seed germination was conducted on Whatman N°1 filter paper disks (80 mm diameter) in glass petri dishes. The filter paper, in all treatments, was supported by a plastic screen to prevent the seed and filter paper from floating.

Osmotic solutions were prepared by adding polyethylene gycol (PEG) (MW. 6000*), to distilled water as described by Michel and Kaufmann (1973). Osmotic potential was determined with a Wescor HR 33T dew point and a Wescor C-52 sample chamber psychrometer, after calibration with standard KCl solutions. The ratio PEG solution volume to filter paper weight was above 12 L kg-1 as recommended by Emmerich and Hardegree (1990). Fifty seeds of each species were placed in each petri dish. The petri dishes were wrapped with Parafilm to seal them and were incubated in a growth chamber (Karl Kolb) at 25° C and 8 h photoperiod.

All seeds were scarified. Non scarified seeds of lovegrasses exhibited very low germination at all water potentials. A seed was considered germinated when the radicle length was 2 mm or more. The root and shoot lengths of 10 randomly picked seedlings per petri dish was measured after to 7 days of incubation.

The experiment was a completely randomized design with five repetitions. Percentage germination data were analyzed, transformed by the arcsine of the square root. Treatment means were compared using Duncan's Multiple Range Test.

RESULTS AND DISCUSSION

The Catalina, Morpa y Tanganyka cultivars showed a basically similar behaviour to the highest water potential: 0 and -0.3 MPa, there being no significant differences between them, however the germination percentages fell abruptly for all the cultivars as from -0.6 MPa, and became practically non-existent in all at -1.5 MPa (Table 1). The Don Eduardo INTA cultivar showed low germination percentage for all the water potentials considered. Species adapted to semi-arid conditions have shown maximum germination at low osmotic potentials imposed by PEG, as in this experiment. In general terms, the results coincide with those obtained by other authors (Hardegree and Emmerich, 1991, 1993). Knipe and Herbel (1990) observed, on increasing the osmotic concentration of the germination medium of *E. lehmanniana* and *E. chloromelas*, a reduction in the germination rate, which fell markedly at -1.1 MPa. Germination at water potentials close to -1.5 MPa is not very common among forage species (McWilliam et al., 1970), which indicates a great tolerance by the different cultivars and especially, for this condition, by Tanganyika and Catalina. The germination capability under water stress could be an important competitive advantage against weed or annual species which hinder the establishment of lovegrasses. The fact that some species will germinate at low water potential does not signify that they will survive and reproduce under stress conditions, although this represents a competitive advantage against other colonizing species (McGinnies, 1960).

Root and shoot lengths, at different levels of water potential, change during germination of Morpa seedlings which shows that under increasing water stress the root and shoot length growth was less, indicating a slower rate of growth for seedlings under water stress conditions (Table 2). Similar results were obtained with Ermelo and Tanganyka -data not supplied-. The results obtained corroborate the evidence that the degree of sensibility to stress of germination is different to that of the elongation of the radicle and the shoot. After germination the seedling can develop and grow at lower water potentials than those which allow germination, and this is evidence that the initiation of cellular extension, rather than the lengthening itself, is the process most sensitive to water stress. (Hegarty and Ross, 1978).

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Table 1
Percent germination of seven lovegrasses as a function of water potential

Water potential	Cultivars Morpa	Tanganyka	Ermelo	Don Eduardo	A-68	Cochise	Catalina
MPa	%						
-0.0	82.7 a*	78.0 a	79.3 a	27.8 a	71.3 a	74.6 a	81.0 a
-0.3	75.0 a*	76.0 a	77.2 a	25.4 a	66.5 a	69.3 a	77.4 a
-0.6	62.2 b*	54.4 b	61.4 b	19.3 a	58.3 a	51.2 b	60.5 b
-0.9	30.6 c*	46.4 c	35.3 c	12.1 b	32.1 b	31.3 c	40.8 c
-1.2	11.3 d*	15.7 d	12.4 d	12.3 c	10.5 c	11.7 d	15.9 d
-1.5	10.0 e*	11.4 e	10.0 e	10.4 c	10.0 d	10.0 e	11.6 e

* Means in a column with the same letter are not significantly different (p=0.05).

Table 2
Root and shoot growth of cv. Morpa after 7 days, at different water potentials.

Water potential	Length Root	Shoot
MPa	mm	
- 0.0	10.5 a*	13.9 a
- 0.3	9.4 a	19.8 a
- 0.6	2.5 b	12.6 a
- 0.9	< 1.0 a*	1< 1.0 a*
- 1.2	< 1.0 a*	1< 1.0 a*
- 1.5	——	——

* Means in a column with the same letter are not significantly different (p=0.05).