Bull. Fac. Agric. Cairo Univ.,53
(2002): 265-274.

EFFECTS OF OSMOTIC PRIMING ON SEED GERMINATION AND SEEDLING GROWTH OF BERMUDAGRASS (*Cynodon dactylon* L.) UNDER SALINE CONDITIONS

(Received :3.7.2001)

By
A.I. Al-Humaid

College of Agriculture and Veterinary Medicine, King Saud University, Qassim Branch, Buriedah, Saudi Arabia

ABSTRACT

To study the effect of seed priming on germination and seedling growth of bermudagrass cv. Common Bermuda under saline conditions, seeds were immersed in a solution of 300g polyethylene glycol (PEG) 6000 dissolved in a litre of distilled water for 3 or 7 days at 15 °C. Primed seeds were either immediately placed, or surface dried and then placed in Petri dishes containing 3000, 6000, 9000, 12000 and 15000 ppm sodium chloride (NaCl) solution. Results showed that seed priming followed by immediate sowing improved the final germination percentage significantly in all growth media, whereas the corrected germination rate index (CGRI) was improved by seed priming followed by immediate sowing in almost all saline solution treatments. In general, seeds primed for 3 days and immediately placed in the growth medium exhibited the highest values of seed germination and CGRI. In comparison with unpriming, this treatment also improved plumule growth significantly. Therefore, the obtained results indicate that the osmoconditioning of bermudagrass seeds with PEG followed by immediate sowing improved seed germination and seedling growth under saline conditions.

Key words: *osmoconditioning, osmotic priming, polyethylene glycol (PEG), salinity stress, seed germination, seed priming.*

1. INTRODUCTION

The soil environment is often not conducive to rapid germination and seedling growth of plant seeds. Physical stress, extreme temperature, excess or deficit of water and salinity, can all adversely affect seed germination and seedling emergence. It is not surprising, therefore, that there have been many attempts to design presowing treatments in order to improve seed performance in such conditions. One of such pre-sowing seed treatments is osmotic conditioning or priming (Heydecker *et al*., 1973).

Priming has improved seed vigor, particularly under adverse seedbed conditions such as low temperature (Pill *et al.*, 1991; El-Gizawy, 1992 and Murray *et al.*, 1992), metric stress (Frett and Pill, 1989) and salinity (Weibe and Muhyaddin, 1987 and Pill *et al.*, 1991).

Seed treatments following priming, however, can affect subsequent germination responses. If primed seeds are transferred directly from priming solution to the germination medium, germination will be more rapid than drying them before planting (Pill, 1986 and Bujalski *et al.*, 1991).

However, the obstacle facing the commercial application of seed priming is the variability among the different plant species and varieties. Moreover, irrigation water usually has a relatively high salt levels especially in arid and semi-arid environments, which could decrease seed germination and seedling growth. Therefore, the present study was undertaken to investigate the effect of priming on germination and seedling growth of bermudagrass seeds under salinity conditions.

2. MATERIALS AND METHODS

The present study was carried out during 1999 at the College of Agriculture and Veterinary Medicine, King Saud University, Qassim

Branch, Buriedah, Saudi Arabia. Seeds of bermudagrass (*Cynodon dactylon* L.) cv. Common Bermuda, were primed in a solution of 300 g polyethylene glycol 6000 (PEG, a water soluble waxy solid, (C2H4O)nH2O) dissolved in a litre of distilled water for 3 or 7 days at 15 °C. After that, the seeds were washed thoroughly with distilled water and then either immediately sown or surface dried and kept at room temperature(25 °C) to be used later. Hundred seeds of each of these treatments were placed in a 9.5 cm Petri dish on a double layer of Whatman No. 1 filter paper moistened with 6 ml distilled water as a control or 3000, 6000, 9000, 12000 and 15000 ppm sodium chloride solution. Each treatment was replicated 4 times. To prevent water loss by evaporation, a thin layer of Vaseline was applied to the inside surface of the Petri dish cover rim and then the dishes were enclosed in a transparent polyethylene bag. Petri dishes were arranged in a randomized complete block design in an incubator controlled at 30 ± 1 °C, illuminated by cool white fluorescent light (100 μ mole m^{-2} s^{-1}).

Seeds were considered to have germinated when the radicle length was at least 0.5 mm, using a dissecting microscope fitted with a micrometer. Germinated seeds were counted everyday until no further germination occurred for five successive days.

Seed germination was determined. The corrected germination rate index (CGRI) (Evetts and Burnside, 1972; and Hsu *et al.,* 1985) was calculated as follows :

$$\text{CGRI} = \frac{\text{Summation of daily germination percentage X 100}}{\text{Total number of days of germination X final germination percentage}}$$

To study the effect of osmoconditioning of the seeds on seedling growth of bermudagrass under different salinity levels, the treatment which had the most significant priming effect of the previous experiment was utilized. Unprimed seeds, and seeds primed for 3 days and sown immediately, were put in Petri dishes lined with Whattman No 1 filter paper moistened with distilled water and kept in an incubator at 30 ± 1 °C. When those seeds just started to germinate; as the radicles started to appear (0.5 mm length), 5 seeds were transferred to each of the Petri dishes containing the saline solutions.

Plumule length was measured daily for 6 days; the mean plumule length of each Petri dish was caluculated.

The data were subjected to analysis of variance according to the procedures outlined by Snedecor and Cochran (1967). Duncan's multiple range test was used for comparison between means.

3. RESULTS AND DISCUSSION

The obtained data clearly revealed that, regardless of seed priming effect, final germination percentage of bermudagrass seeds was significantly reduced as salinity level increased (Table 1). Using distilled water as a growth medium, osmoconditioning the seeds and immediately sowing them resulted in the highest final germination percentage. No significant differences were found between the control and seed priming followed by surface drying. Results also showed that the duration of seed priming had a significant effect on the final germination percentage. When seeds were immediately sown, seeds primed for 3 days were significantly higher in germination than those primed for 7 days (Table 1).

Priming seeds for 3 days and immediately sowing them resulted in the highest final germination percentage, regardless of the salinity levels. This treatment also showed a moderate decline in the final germination percentage as salinity level increased, whereas a sharp decline was obtained with the other seed priming treatments (Table 1), resulting in a significant interaction between seed priming and salinity levels.

The corrected germination rate index (CGRI), which has been used to compare the relative rate of germination (Hsu *et al.,* 1985), was not improved by seed priming when seeds were germinated in distilled water (Table 2). However, significantly higher CGRI values were exhibited by seeds primed for 3 days and immediately sown in comparison with unprimed seeds for all salinity levels (Table 2). CGRI decreased gradually as salinity levels increased, with the aforementioned treatment having the least effect. A significant interaction was found between seed priming and salinity levels.

Comparing the effect of priming seeds for 3 days and immediately sowing them with unpriming, showed that plumule

Table (1) : Final germination percentage of primed and unprimed seeds of bermudagrass at different salinity levels .

Salinity conc. (NaCl)	Unsoaked seeds	Soaked 3 days		Soaked 7 days		Mean
		Immediate sowing	Surface dried	Immediate sowing	Surface dried	
Control	61.6 Ca	77.0 Aa	62.6 Ca	72.0 Ba	67.3 BCa	68.1a
3000 ppm	52.0 Cb	65.6 Ab	50.0 Db	58.3 Bb	52.0 Cb	55.6b
6000 ppm	38.0 Ce	55.0 Ac	37.3 Ce	45.0 Bc	45.6 Be	44.2c
9000 ppm	25.0 Cd	45.0 Ad	26.3 Cd	38.6 Bd	21.0 Dd	31.2d
12000 ppm	14.6 Ce	24.3 Ae	13.0 Ce	17.3 Be	13.6 Ce	16.6e
15000 ppm	3.6 Df	12.0 Af	7.6 Cf	9.3 Bf	6.0 Cf	7.7f
Mean	32.5 D	46.5 A	32.8 CD	40.1 B	34.3 C	--

* Percent germination data were arcsin transformed for analysis.

**Means followed by the same letter were not significantly different at the 5 % level using DMRT; capital letters for the rows and small letters for the columns.

Table (2) : The corrected germination rate index (CGRI) (day^{-1}) of primed and unprimed seeds of bermudagrass at different salinity levels .

Salinity conc. (NaCl)	Unsoaked seeds	Soaked 3 days		Soaked 7 days		Mean
		Immediate sowing	Surface dried	Immediate sowing	Surface dried	
Control	88.3Aa	88.9Aa	88.9Aa	89.2Aa	81.0Ba	87.26a
3000 ppm	78.6Bb	87.8Aa	87.4Aa	88.6Aa	72.4Bab	82.96b
6000 ppm	77.3ABb	85.6Aa	66.1Bb	73.9ABb	66.7Bb	73.92c
9000 ppm	49.7Cc	74.7Aab	48.2Cc	66.1Bbc	62.9Bb	60.32d
12000 ppm	41.6Bcd	70.1Ab	36.5Cd	50.0BCc	51.4Bbc	49.92e
15000 ppm	22.4Be	45.4Ac	29.6Be	36.6ABd	28.0Bc	32.40f
Mean	59.6C	75.4A	59.5C	67.4B	60.4C	---

*Means followed by the same letter were not significantly different at the 5 % level using DMRT; capital letters for the rows and small letters for the columns.

Table (3): Plumule length (mm) 6 days after germination of primed and unprimed seeds of bermudagrass at different salinity levels .

Seed treatments	Salinity concentrations (NaCl) ppm						Mean
	Control	3000	6000	9000	12000	15000	
Unsoaked seeds (control)	7.16 Aa	5.66Bb	4.90Cb	3.93Db	2.20.Eb	1.03Fb	4.15B
Soaked 3 days Immediate sowing	7.66Aa	7.50Aa	7.13 Aa	5.86Ba	3.76Ca	2.56Da	5.75a
Mean	7.41 A	6.58B	6.01B	4.90C	2.98D	1.80E	---

*Means followed by the same letter were not significantly different at the 5 % level using DMRT; capital letters for the rows and small letters for the columns.

length was not affected by seed priming when distilled water was used as a growth medium (Table 3). In contrast, it improved the plumule length when saline solutions were used as growth media. As expected, plumule length decreased gradually with the increase in salt concentration.

Improvement of seed germination by seed priming under saline soil or irrigation water was also reported for a variety of other plant species (Weibe and Muhyaddin, 1987 and Pill *et al.,* 1991). The adverse effect of seed drying after priming on seed emergence was observed by Davison *et al.* (1991), whereas Pill *et al.* (1991) reported that sowing seeds of high moisture content (primed seeds) was an effective strategy to improve final germination under saline conditions.

For the effect of priming period, Hardegree and Emmerich (1992) found that optimum germination generally occurred with seeds primed at high water potential for a short period. This agrees with the results of the present study since priming seeds for 3 days and immediately sowing them resulted in a significantly higher germination percentage (Table 1).

The effect of priming on improving germination could be attributed to the exposure of seeds to an external water potential low enough to bring about pre-germinative physiological and biochemical activities (Bradford, 1986). This could involve a marked increase in protein, DNA and nucleotide biosynthesis (Bray *et al.*, 1989),and/or the replacement of the damaged ribosomal RNA (Davison *et al.*, 1991).

Based on these results, it could be concluded that osmoconditioning of bermudagress seeds with PEG may improve the seed germination and seedling growth of bermudagrass under saline conditions. Therefore, it is recommended to prime bermudagrass seeds for 3 days with PEG followed by direct sowing when the irrigation water and/or the soil has a relatively high salt concentrations.

4.REFERENCES

Bradford K.J. (1986). Manipulation of seed water relations via osmotic priming to improve germination under stress conditions. Hort Science, 21 (5): 1105-1112.

Bray C.M. Davison, P.A. Ashraf, M. and Taylor R.M. (1989). Biochemical changes during osmopriming of leek seeds. Annals of Botany 63: 185-193.

Bujalski W., Nienow A.W., Peteh G.M and Gray D. (1991). Scale-up studies for osmotic priming and drying of carrot seeds. Journal of Agricultural Engineering Research, 48 (4): 287-302.

Davison P.A., Taylor R.M. and Bray C.M. (1991). Changes in ribosomal RNA integrity in leek (*Allium porrum L.*) seeds during osmopriming and drying back treatments. Seed Science Research, 1: 37-44.

El-Gizawy A.M. (1992). Effect of osmotic priming treatment on germination of some vegetable seeds with special reference to okra crop. Egyptian Journal of Applied Science, 7(1): 619-637.

Evetts L.L. and Burnside O.C. (1972). Germination and seedling development of common milkweed and other species. Weed Science, 20: 371-375.

Frett J.J. and Pill W. G. (1989). Germination characteristics of osmotically primed and stored impatiens seeds. Scientia Horticulturae, 40: 171-179.

Hardegree S.P. and Emmerich W.E. (1992). Effect of matric-priming duration and priming water potential on germination of four grasses. Journal of Experimental Botany, 43: 233-238.

Heydecker W., Higgins J. and Guillver R.L. (1973). Accelerated germination by osmotic seed treatment. Nature (London), 246: 42-44.

Hsu F.H., Nelson C.J. and Matches A.G. (1985). Temperature effects on germination of perennial warm-season forage grasses. Crop Science, 25: 215-220.

Murray G.A., Swensen J.B. and Beaver G. (1992). Emergence of spring – and summer – planted onions following osmotic priming. Hort Science, 27(5): 409-410.

Pill W.G. (1986). Parsley emergence and seedling growth from row, osmoconditioned and pregerminated seeds. Hort Science,21: 1134-1136.

Pill W.G., Frett J.J.and Morneau D.C. (1991). Germination and seedling emergence of primed tomato and asparagus seed under adverse conditions. Hort., Science, 26: 1160-1162.

Snedecor G.W. and Cochran W.G. (1976). Statistical Methods. 6th ed. Iowa State Univ. Press, Iowa, U.S.A.

Weibe H.J. and Muhyaddin T. (1987). Improvement of emergence by osmotic treatment in soil of high salinity. Acta Horticulturae, 198: 91-100.

تأثير المعاملة الأسموزية لبذور حشيشة البرمودا على الإنبات ونمو البادرات تحت الظروف الملحية بالمعمل

عبد الرحمن إبراهيم الحميد

كلية الزراعة والطب البيطري – جامعة الملك سعود – فرع القصيم – البريدة –المملكة العربية السعودية

ملخص

تم فى هذا البحث دراسة تأثير نقع بذور حشيشة البرمودا فى محلول من البولي اثيلين جليكول ٦٠٠٠ بتركيز ٣٠٠ جم/لتر لفترتى ثلاثة وسبعة أيام , عند درجة حراره ١٥ °م , ثم زراعتها بعد النقع مباشرة أو تجفيفها سطحيا ، على الانبات ونمو البادرات فى تركيزات مختلفة من الملوحه.

أظهرت النتائج أن المعاملة الأسموزية للبذور أدت بصورة عامة إلى تحسن قياسات الإنبات تحت الدراسة ، مثل نسبة الإنبات النهائية ، ومعامل الإنبات المعدل. كما بينت الدراسة كذلك أن معاملة البذور لمدة ٣ أيام ثم زراعتها مباشرة أعطت أعلى تأثير معنوي منشط لتلك القياسات ، بينما أدت المعاملة للبذور لمدة ٧ أيام مع تجفيف سطح البذور ثم زراعتها إلى أقل تأثير علي قياسات الإنبات. هذا وكان نمو الريشة للبادرات الناتجة من البذور المعاملة يشابه قياسات الإنبات.

من ثم تشير نتائج هذه الدراسة إلى أن نقع بذور البرمودا في محلول البولي اثيلين جليكول قبل الزراعة مباشرة أدى إلى زيادة معنوية في قياسات الإنبات ونمو البادرات تحت الظروف الملحية.