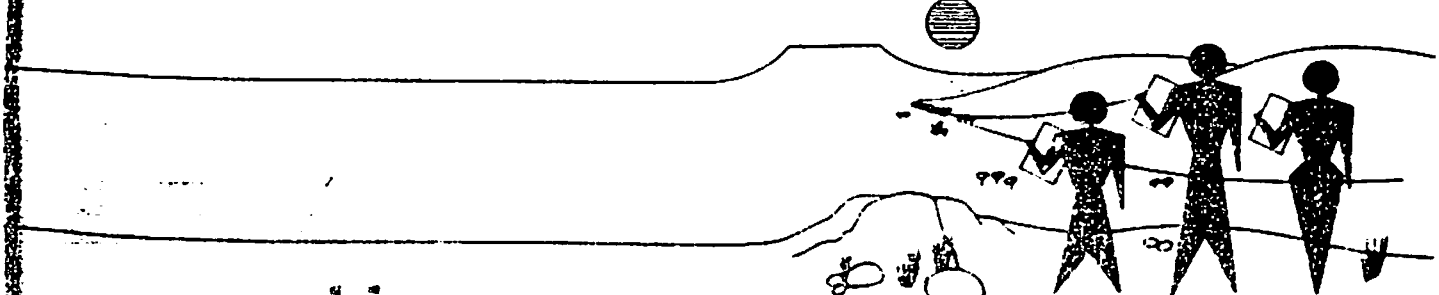
462

SECOND INTERNATIONAL RANGELAND CONGRESS

ADELAIDE, AUSTRALIA, May 1984.



working papers

These Papers were prepared by Ms Gaye Wallder with the assistance of Ms Gillian Crook, Mr Max Gentle, Mr Peter Lynch, Mr Graham Miles and Mrs Helen Warrener from C.S.I.R.O's Divisions of Wildlife & Rangelands Research, Deniliquin and Groundwater Research, Perth.

Printed by Reliance Printing — Deniliquin, N.S.W. Australia. 2710

WATER SEQUENCES AND ARID RANGELANDS REVEGETATION

G.W. Frasier
U.S. Department of Agriculture,
Agricultural Research Service,
Southwest Rangeland Watershed Research Centre,
Tucson, Arizona 85719, United States of America

Highlight

A greenhouse study showed that the initial germination and seedling emergence responses of grasses is affected by the first wet-dry water sequence. By combining this information with a probabilistic description of a location's precipitation wet-dry periods, an objective method for selecting species, accessions, and planting times for optimum survival is possible.

Soil water for seed germination and plant establishment in non-irrigated areas is depleted by evapotranspiration and replenished by precipitation. The variable characteristics of precipitation events in arid and semi-arid regions make it difficult to predict when soil moisture will be adequate for seedling establishment. Techniques for achieving successful revegetation can be enhanced if germination and seedling growth responses to periods of favourable and unfavourable soil moisture conditions within the seedbed or rooting zone can be identified and correlated to precipitation patterns.

A series of greenhouse studies was conducted to determine the emergence and seedling survival response of five warm-season grasses to selected combinations of initial wet-day and dry-day water sequences. Included in the study were two accessions of two of the species to determine the relative effects of varietal differences. Grasses investigated in this study were *Bouteloua curtipendula* (Michx.) Torr. ('Premier', sideoats grama); *Eragrostis lehmanniana* Nees ('A- 68', Lehmann lovegrass); *Eragrostis lehmanniana* Nees X *E. trichophora* Coss. and Dur. ('Cochise', Atherstone lovegrass); *E. curvula* var. *conferta* (Schrad.) Nees ('A-84' and 'Catalina', Boer lovegrass); and *Panicum antidotale* Retz ('A- 130' and 'SDT-SEA', blue panicgrass).

Materials and Methods

The studies were conducted in a greenhouse using the procedures reported by Frasier et al. (a) and (b) (in press), and Cox et al. (in press). Tapered plastic cones, 3.8 cm in diameter by 20 cm long, were filled with fine- grained silica sand (< 0.25 mm diam.). Ten seeds of the desired grass accession were placed on the surface and covered with a 2 to 3 mm layer of dry sand. Water was applied daily in predetermined wet-dry-wet sequences with an overhead reciprocating spray system. All cones were initially wetted to field capacity with 20 grams of water (approx. 10% moisture by weight). In the wet sequences, the cones were sprinkled daily with sufficient water to maintain the average moisture content of the sand media at the original 10% level.

Five water sequences investigated were: (1) 1 day wet, 5 days dry; (2) 2 days wet, 5 days dry; (3) 1 day wet, 7 days dry; (4) 2 days wet, 7 days dry; and (5) 3 days wet, 7 days dry. Following the dry period, the cones were watered daily for the remainder of the 14 day study to germinate any viable seeds which had survived the initial wet-dry water sequence. Live plants in each cone were counted daily. There were six completely randomized blocks, with five replications in each block. Block means of the daily plant count were compared by analysis of variance techniques. When F-values were significant (P 0.05), Tukey's (hsd) w-procedure was used to evaluate differences among accession means.

Results and Discussion

There were differences among species, and within accessions of the same species, in the seedling response to the five water sequences. Seedling emergence and survival characteristics of the *Eragrostis lehmanniana* 'A-68', *E. curvula* 'A-84', and *P. antidotale* 'SDT-SEA' were similar (Table 1). The initial seedling emergence of these grasses was less than 18%, and 25% or more of the seedlings died during the dry period. Final seedling survival was less than 30% of the seeds planted.

The seedling emergence and survival characteristics of *E. lehmanniana* x *E. trichophora*, *E. curvula* 'Catalina', and *Panicum antidotale* 'A-130' were typified by good initial seedling emergence (for example, 21 to 62% with 2 days or more wet) and moderate to low seedling mortality (< 46%) during the dry period. Final seedling survival varied from 34 to 58% of the planted seeds.

Table 1. Initial seedling emergence (%), seedling mortality during dry period (%), and final seedling survival (%) of seven grass accessions with five wet dry watering sequences.[1]

Species	Water sequence Wet days	Dry days	Initial seedling emergence	Seedling mortality	Final seedling survival
Eragrostis lehmanniana	1	5	0	–	14c
	2	5	0	–	14c
	1	7	0	–	14c
	2	7	0	–	8c
	3	7	5e[2]	100	6c
E. lehmanniana x *E. trichophora*	1	5	7e	14	48ab
	2	5	42c	10	52a
	1	7	25d	12	45ab
	2	7	53ab	13	51a
	3	7	53ab	9	55a
E. curvula (A-84)	1	5	0	–	24bc
	2	5	1e	0	26bc
	1	7	0	–	24bc
	2	7	2e	100	27bc
	3	7	9e	78	16c
E. curvula (Catalina)	1	5	4e	0	55a
	2	5	40c	25	46ab
	1	7	21c	14	49a
	2	7	57ab	9	58a
	3	7	62a	21	51a
Panicum antidotale (A-130)	1	5	9e	11	46ab
	2	5	48b	46	34b
	1	7	26d	42	35b
	2	7	54ab	15	51a
	3	7	62a	21	52a
P. antidotale (SDT-SEA)	1	5	1e	0	27bc
	2	5	10e	40	27bc
	1	7	7e	29	14c
	2	7	18d	17	27bc
	3	7	17d	24	14c
Bouteloua curtipendula	1	5	41c	83	29bc
	2	5	67a	70	24bc
	1	7	64a	59	42ab
	2	7	64a	22	53a
	3	7	68a	47	38b

[1] Data obtained in part from Frasier *et al.* (in press) and Cox *et al.* (in press).
[2] Numbers in a column followed by the same letter are not significantly different at the 5% level.

Bouteloua curtipendula had high initial seedling emergence (41 to 67%), but also had high seedling mortality (22 to 83%). Final seedling survival was less than 53%.

Greenhouse studies cannot duplicate field conditions, but they do demonstrate the wide range in responses of grass species and accessions within species to the length of the first wet-dry sequence after planting. These studies, in combination with a probabilistic description of natural wet-dry sequences, may provide an objective method for selecting germ plasm and planting dates which will optimize seedling ermegence and survival at a given location.

Literature Cited

Cox, J.R., G.W. Frasier, and D.A. Woolhiser. In Press. Emergence and seedling survival of native and exotic grasses as affected by the timing of precipitation. J. Range Manage.

Frasier, G.W., J.R. Cox, and D.A. Woolhiser. (a) In Press. Emergence and seedling survival of seven warm-season grasses as influenced by initial wet dry sequences. J. Range Manage.

Frasier, G.W., D.A. Woolhiser, and J.R. Cox. (b) In Press. Emergence and seedling survival of two warm-season grasses as influenced by the timing of precipitation. A greenhouse study. J. Range Manage.

Paper presented by U.S.D.A. representive.