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EFFECTS OF WATER STRESS ON SEED PRODUCTION IN RUZI GRASS *(Brachiaria ruziziensis Germain and Everard)*

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Abstract

Water stress at different stages of reproductive development influenced seed yield in Ruzi grass differently. Under mild water stress, the earlier in the reproductive developmental stage the stress was applied (before ear emergence) the faster the plants recovered and the less the ultimate damage to inflorescence structure and seed set compared with the situation where water stress occurred during the later stages after inflorescences had emerged. Conversely, severe water stress before ear emergence had a severe effect in damaging both inflorescence numbers and seed quality. Permanent damage to the reproductive structures resulted in deformed inflorescences. Moreover, basal vegetative tillers were stunted and were capable of only limited regrowth after re-watering.

Introduction

Ruzi grass (*Brachiaria ruziziensis*) is important for dairy pastures in Thailand, but its acceptance by farmers depends on the availability of a cheap but high quality seed supply. Skerman and Riveros (1990) noted that Ruzi grass probably had “good drought tolerance”, but needs a reasonably high rainfall (1000 mm or more) for successful plant development.

However, there is no report on the effects of water deficit stress on seed productivity in Ruzi grass. In tropical grasses some general studies have shown that timely irrigation can support the realization of potential seed yield (e.g. in *Cynodon dactylon* (Ahring et al., 1974) in *Panicum maximum* cv Likoni (Sarroca et al., 1980). In ryegrass (*Lolium perenne*) under more temperate climates, however, water deficit before stem elongation causes a decrease in seed yield by reducing seedhead numbers (Hebblethwaite, 1977), but mild water stress after this stage has little effect on floret site utilisation and seed yields over 2,000 kg/ha can be obtained (Rolston et al. 1994). Conversally, in timothy (*Phleum pratense*) Lambert (1967) reported that thousand seed weight could be reduced if water stress occurred after anthesis, probably due to reduced photosynthetic area and capacity.

The objective of this study was to investigate the effects of different levels of water stress applied at three different stages of reproductive growth on seed yield, yield components and seed quality in Ruzi grass.

Material and Methods

The experiment was part of a larger study conducted in temperature controlled glasshouses at Palmerston North, New Zealand (Lat 40^{o}C, Long 170^{o}E). Details of the experiment are reported in Wongsuwan (1999).

The treatments were three levels of water stress:

1.	No stress (W)	average Relative Water Content (RWC) 90%, and average Leaf Extension Rate (LER) 6 cm/day;
2.	Mild stress (D1)	average RWC 65%, and average LER 3 cm/day; and
3.	Severe stress (D2)	average RWC 40%, and average LER 1 cm/day.

Each water stress was applied at three different stages of reproductive development:

1. Between floret initiation (FI) and ear emergence (EE)

2. Between ear emergence (EE) and full flowering (FF)
3. Between full flowering (FF) and seed harvest (SH)

There were three block replications.

The 15 treatments are described in Table 1.

Results and Discussion

Table 2 summarizes the key results from the experiment: Mild stress caused a significant reduction in seed yield if it occurred during ear emergence to full flowering (WD1W) or during full flowering to seed harvest (WWD1); but did not reduce yield if it occurred during floret initiation to ear emergence (D1WW), as was also found by Scott (1973) in his work with perennial ryegrass. Yield was reduced because total seed number per plant (Table 2B) was reduced, but seed weight was largely unaffected (Table 2C).

When mild stress was extended over two consecutive development stages, which included the ear emergence to full flowering stage, the detrimental effect on seed yield was again evident. However, if the extended stress was broken by temporary relief during this period (EE-FF) (D1WD1) the plant was capable of showing remarkable recovery and achieved a relatively high seed yield (Table 2).

This depression in seed yield from plants deprived of adequate water during EE-FF appeared to be due to a number of adversely affected components, ie. reduced floret and seed numbers, lower percentage seed set and lower seed weight. On the other hand, the production of seed from plants subjected to severe water stress at particular developmental stages was quite different from that of plants subject to mild stress. Severe stress at an early stage (D2WW) depressed seed yield dramatically compared with the control treatment (WWW), due mainly to low floret and seed numbers per plant and in spite of a high seed set (Table 4). When applied at ear emergence (WD2W) or full flowering (WWD2) the reduction in seed yield was much less and not significantly different from that of the control (WWW). As expected during this seed filling stage, seed weight showed a small but non-significant ($P<0.05$) reduction.

When severe stress was extended over two consecutive stages (FI-EE, EE-FF) the results were dramatic and clear cut with almost total failure of the plant to produce seed. The only exception to this was, again, in the treatment given temporary relief during the period between ear emergence and full flowering (D2WD2), which enabled some inflorescences to complete their seed production cycle and produce a small quantity of seed.

Water stress appeared to have no effect on the percentage of pure germinating seed (%PGS) (Table 2 E) in those treatments that produced seed. There was no significant difference in this parameter when mild stress was applied at any single developmental stage, or even for the entire period compared with the well watered control. Similarly the application of severe stress at any single stage showed no adverse effect on %PGS.

The seed yield response of Ruzi grass to different levels of water stress was clearly shown in terms of physiological and morphological changes, particularly when the stress was continued throughout reproductive development. The stage of plant development and level of water stress were both important in affecting plant dry matter production, seed yield and seed yield components.

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Table 1 - Water stress treatments used in this study

	Reproductive stage at which stress was applied		
Treatment No.	Floret Initiation to Ear Emergence	Ear Emergence to Full Flowering	Full Flowering to Seed Harvest
1	W	W	W
2	D1	D1	D1
3	D2	D2	D2
4	D1	W	W
5	W	D1	W
6	W	W	D1
7	D2	W	W
8	W	D2	W
9	W	W	D2
10	D1	D1	W
11	W	D1	D1
12	D1	W	D1
13	D2	D2	W
14	W	D2	D2
15	D2	W	D2

Note: 1. W = no stress, D1 = mild stress, D2 = severe stress (see text)

2. Mild and severe water stress (D1 and D2) were not combined within the developmental stages. This reduced the number of treatments from 18 to 15.

Table 2 - Seed production data under different water stress regimes

Treatment	A: Seed yield		B: Seed No		C: 1000 SW		D: Seed set		E: PGS	
	g/plant	% relative to control	per plant	% relative to control	g	% relative to control	%	% relative to control	%	% relative to control
WWW	19.5	100	3713.0	100	5.3	100	52.7	100	35.0	100
D1D1D1	11.3	58	2413.0	65	4.8	90	52.0	99	37.3	107
D2D2D2	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
D1WW	19.4	99	3480.0	94	5.6	106	58.8	112	31.7	91
WD1W	10.2	52	2183.0	59	5.0	95	50.8	96	26.7	76
WWD1	13.0	67	2653.0	71	5.5	103	50.8	96	26.7	76
D2WW	7.0	36	1300.0	35	5.5	103	75.2	142	55.0	157
WD2W	15.6	80	2844.0	77	5.5	104	67.2	128	48.3	138
WWD2	14.4	74	2862.0	77	5.1	95	43.5	83	45.0	129
D1D1W	11.8	61	2517.0	68	4.7	88	58.7	111	18.3	52
WD1D1	7.7	39	1636.0	44	4.7	89	45.9	87	15.0	43
D1WD1	14.8	76	2740.0	74	5.4	102	68.4	130	30.0	86
D2D2W	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
WD2D2	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
D2WD2	4.2	22	1012.0	27	4.3	82	42.6	81	5.3	30