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EMERGENCE OF SIX TROPICAL GRASSES FROM SEED AFTER FLOODING

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SUMMARY

Emergence of six tropical grasses from seed after flooding in pots for 0, 10, 20, 30 and 40 days was investigated. Seedling emergence did not occur until flooding ceased, and it took longer in flooded treatments than in the control. Flooding caused a considerable reduction in seedling emergence, with the effect being most marked at the shortest duration. The ability of the grasses to emerge was in the following order: *Cenchrus ciliaris* cv. Biloela > *Panicum coloratum* var. *makarikariense* cv. Bambatsi > *Chloris gayana* cv. Pioneer >> *Urochloa mosambicensis*, *P. maximum* cv. Sabi and *P. maximum* var. *trichoglume* cv. Petrie. The last three grasses emerged very poorly.

I. INTRODUCTION

In subcoastal central Queensland there are large areas of land that receive periodic inundation. Anderson (1970*a*) has described the region and its flooding hazard. Some data are now available on the flooding tolerance of grasses used in the region (Anderson 1970*b*, 1972*a*, 1974). The persistence of pasture plants after flooding ensures earlier grazing than if they have to regenerate from seed. It also imposes a greater barrier to the ingress of weeds into the sward. However, if a pasture does have the ability to regenerate entirely from seed this is still a desirable characteristic, as it can prevent the need for expensive mechanical replanting.

The study of regeneration of tropical pastures from seed has generally been neglected. Apart from *Cenchrus ciliaris* (Anderson 1972*b*) there are no data available on the ability of tropical grasses to regenerate from seed after flooding, although temperate grasses (Heinrichs and McKenzie 1947; McKenzie, Anderson and Heinrichs 1949; McKenzie 1951) have received some attention.

This paper reports the emergence of a range of grass seedlings following simulated flooding.

II. MATERIALS AND METHODS

The experiment was conducted in 15 cm polyester pots in an open-sided glasshouse at Mackay, Queensland. An alluvial grey-brown clay soil of medium to heavy texture was used. Soil properties, technique for simulating the flooding, and water quality, were similar to those in previous flooding experiments (Anderson 1972*b*, 1974).

Treatments, arranged in a randomized block design with five replicates, were 6 grasses by 5 flood durations (0, 10, 20, 30 and 40 days). Grasses planted were (1) *Cenchrus ciliaris* cv. Biloela, (2) *Chloris gayana* cv. Pioneer, (3) *Panicum coloratum* var. *makarikariense* cv. Bambatsi, (4) *P. maximum* cv. Sabi (Sabi panic*), (5) *P. maximum* var. *trichoglume* cv. Petrie (green panic) and (6) *Urochloa mosambicensis*.

* This should not be confused with Sabi grass, which is the common name for *Urochloa mosambicensis*.

Fifty viable seeds were planted in each pot. The number was calculated from germination and purity analysis of the seed prior to sowing and the seed then planted by weight (Table 1). At planting the seed was evenly spread over the soil surface, covered with 1 cm of soil, then firmed by lightly tamping.

TABLE 1

PURITY AND GERMINATION PERCENTAGES AND WEIGHT OF SEED OF SIX TROPICAL GRASSES SOWN IN EACH POT

Grass	Purity (%)	Germination (%)	No. of Seeds per g	Weight (g) of 50 Viable Seeds
Biloela	95·5	46	570	0·199 8
Bambatsi	95·2	37	1 400	0·101 5
Pioneer	94·4	18	4 206	0·069 9
Urochloa	44·5	20	659	0·852 5
Sabi panic	81·5	19	1 570	0·205 5
Green panic	92·7	28	1 185	0·162 3

All flooding treatments commenced on October 28, 1969, and water was maintained at 30 cm above the soil surface. After the removal of the surplus water each pot was maintained at approximately field capacity. Emerged seedlings were counted and removed every 3–4 days for 40 days after the cessation of each flooding treatment.

Temperatures during the experiment ranged between a mean maximum of 27°C and a mean minimum of 19°C.

III. RESULTS

Seedlings in the control pots began to emerge approximately 5 days after watering, while in the flooded treatments emergence did not commence until approximately 9 days after the removal of water (Table 2). Biloela emerged fastest in flooded treatments (7 days) and Sabi panic slowest (11 days), while the other species took 8–9 days.

TABLE 2

NUMBER OF DAYS FOR SEEDLINGS OF SIX TROPICAL GRASSES TO COMMENCE EMERGENCE AFTER FLOODING

Grass	Control	Flood
Biloela	5	7
Bambatsi	6	9
Pioneer	5	8
Urochloa	5	9
Sabi panic	6	11
Green panic	5	9
MEAN	5·3	8·8

Emergence percentages in the control pots calculated from the number of viable seeds sown (50), showed that Biloela > Pioneer and green panic > Bambatsi, Sabi panic and *Urochloa* (Table 3. The emergence of Biloela was close to the potential, while Bambatsi, Sabi panic and *Urochloa* were reduced considerably. Pioneer and green panic were intermediate.

TABLE 3

EMERGENCE IN POTS OF SIX TROPICAL GRASSES EXPRESSED AS A PERCENTAGE OF THE NUMBER OF VIABLE SEEDS (50) SOWN

Potential emergence 100%

Grass	Emergence %
Biloela	98·6
Pioneer	79·9
Green panic	76·8
Bambatsi	37·1
Urochloa	32·6
Sabi panic	28·1

Because of the variable emergence in the controls, the data have been arranged to compare the effects of flooding by expressing each treatment as a percentage of its control (Table 4). The species mean over all flooded treatments showed Biloela > Bambatsi > Pioneer > *Urochloa* > Sabi panic and green panic in decreasing order of flood tolerance. Sabi panic and green panic were severely affected by the flooding, with seedlings failing to emerge after more than 10 days' flooding and with very few emerging at 10 days' flooding. *Urochloa* emergence also was severely reduced at all flood durations. Biloela, Bambatsi and Pioneer had their emergence progressively reduced with increasing flood duration but after 40 days this emergence was still greater than 10%.

TABLE 4

EFFECT OF FLOODING ON THE EMERGENCE OF SIX TROPICAL GRASSES EXPRESSED AS A PERCENTAGE OF THEIR CONTROLS (UNFLOODED)

Grass	Days Flooded				Mean (a)
	10	20	30	40	
	Emergence % (c)				
Biloela	63·8 (0·925)*	60·2 (0·888)	56·0 (0·848)	38·2 (0·666)	54·6 (0·831)
Bambatsi	50·8 (0·793)	47·3 (0·758)	27·4 (0·851)	25·3 (0·527)	37·3 (0·657)
Pioneer	41·5 (0·700)	35·1 (0·634)	22·1 (0·489)	12·8 (0·365)	27·1 (0·547)
Urochloa	4·4 (0·211)	15·7 (0·408)	4·2 (0·207)	1·4 (0·120)	5·5 (0·236)
Sabi panic	5·6 (0·238)	0 (0)	1·2 (0·107)	0 (0)	0·7 (0·086)
Green panic	3·3 (0·182)	0 (0)	0 (0)	0 (0)	0·2 (0·046)
MEAN (b)	23·7 (0·508)	18·8 (0·448)	12·9 (0·367)	7·6 (0·280)	

* Inverse sine transformation used for analysis
L.S.D. P = 0·05: (a) (0·085); (b) (0·069); (c) (0·169)

IV. DISCUSSION

It was not possible to obtain seed with similar germination percentages (Table 1) for this experiment. Though the numbers of seeds planted were adjusted to give 50 viable seeds per pot, emergence in the pots was (except for Biloela) well below the potential (Table 3). Consequently the results were assessed as a percentage of the controls. This may tend to reduce their significance but it was noteworthy that after being flooded the ability to emerge shown by the different grasses was not consistently related to the original germination percentage *per se*. Similar results occurred with seed of a range of cultivars of *Cenchrus ciliaris* in another experiment (Anderson 1972*b*). As noted then, the the reason for the disparity between the expected and the obtained germination percentages is not known.

As shown with a range of *Cenchrus ciliaris* cultivars (Anderson 1972*b*), flooding reduced the emergence of the tropical grasses tested in this experiment. The phenomenon of delayed emergence following flooding, compared with unflooded pots, also occurred. This was most probably due to the waterlogged condition of the soil persisting after the initial removal of the flood (surplus) water. As already recorded by Anderson (1972*b*), this view was supported by the observation that, by increasing the flooding period, no increase was noted in the length of time required for emergence after drainage.

In this experiment the reduction in seedling emergence was most marked at the shortest flooding period, particularly with the susceptible plants (Anderson 1970*b*) green panic and *Urochloa*. Bambatsi seedlings regenerated well after flooding, again reflecting the tolerant characteristics of the plant. Similar tolerance to flooding of grasses by seed as well as plants has been reported by McKenzie (1951) to be possibly an inherent characteristic of temperate species. Insufficient evidence is available to generalize to this extent with tropical grasses, particularly and Sabi panic and Biloela had poor correlations for seed/plant tolerance to flooding.

An apparent anomaly occurred with the results for Biloela. In the previous experiment (Anderson 1972*b*) its emergence after flooding was poor, while the opposite has occurred in this experiment. A major difference between the two experiments is that the present experiment was conducted under cooler conditions than the *Cenchrus ciliaris* experiment (mean maximum and mean minimum temperatures for this experiment were 27°C and 19°C versus 30°C and 24°C for the previous experiment). Finn *et al.* (1961), Rhoades (1967) and Beard and Martin (1970) reported that the duration of submersion tolerance was inversely proportional to the water temperature; this may explain the higher germination of Biloela in this experiment. Nevertheless, it does indicate that any comparisons between the two experiments should be treated with caution.

The correlation between emergence in pots and in the field is unknown. As found by McKenzie (1951) with temperate grasses, it is likely to be lower in the field due to such factors as burial of seed by silt, removal of seed by water movement, puddling of the soil, formation of a hard crust after drainage, and weather conditions following drainage. It has been noted in a field experiment (not published), in which the original plants, except for Bambatsi, were killed by flooding that seedlings of grasses used in this experiment did subsequently establish. Most seedlings established in the Sabi panic and *Urochloa* plots with Biloela also establishing well. Poorest seedling regeneration was with Bambatsi. However, the unknown in the field was the actual number of seeds on the ground prior to flooding. Buffel, *Urochloa,* green panic and Sabi panic were observed to set large amounts of seed, particularly *Urochloa* and Sabi panic. As a result, even though the pot experiment has shown relatively low percentage emergence of these grasses from seed after flooding, the actual number of seeds set in the field has been sufficient to allow enough plants to germinate and regenerate the stand. On the other hand, Bambatsi is a poor seed producer, with weak seedlings which are slow to establish (Lloyd and Scateni 1968), so higher mortalities from a lower seed reservoir could have been operating against this species.

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