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EFFECT OF FLOODING ON THE REGENERATION OF SIX TROPICAL GRASSES AFTER DEFOLIATION

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SUMMARY

The effect of flooding immediately and 15 days after defoliation on the survival and growth of *Panicum coloratum, Panicum maximum, Urochloa mosambicensis* **and three** *Cenchrus ciliaris* **cultivars was studied in a pot experiment at Mackay, Queensland. Flooding immediately after defoliation was more deleterious to plant survival and production than flooding 15 days later.** *Panicum coloratum* **had greater flood tolerance than the other grasses.**

I. INTRODUCTION

Once a grass is growing in an area likely to be flooded the severity of flooding injury can be influenced by many factors such as duration and depth of flooding, water velocity, presence of silt, temperature of water, etc. Reducing the intensity of any one factor may reduce plant damage but these factors are not readily subject to practical control. However, the intensity of defoliation of a pasture can be controlled. With this in mind a range of tropical grasses was treated to simulated flooding immediately after defoliation and after a period of regrowth.

Anderson (1970) has described the environment, soils, vegetation and flooding characteristics of a large area of sub-coastal central Queensland which receives periodic flooding. Knowledge of this region governed the choice of species and treatments for this experiment.

II. MATERIALS AND METHODS

Six grasses, namely (1) *Cenchrus ciliaris* cv. Biloela, (2) *C. ciliaris* cv. Molopo, (3) *C. ciliaris* cv. Tarewinnabar, (4) *Panicum coloratum* var. *makarikariense* cv. Bambatsi, (5) *P. maximum* var. *trichoglume* (green panic) cv. Petrie and (6) *Urochloa mosambicensis,* were flooded immediately and 15 days after clipping, for 0 (control), 10 and 20 days. Treatments were arranged in randomized blocks and replicated three times.

The experiment was conducted in 22 cm diam. polyester pots in an open-sided glasshouse at Mackay, Queensland. Each pot contained 5·22 kg of an alluvial grey-brown clay soil. Soil properties and the flooding technique have been described in previous flooding papers (Anderson 1972, 1974*a*).

Seed was sown on 18.xii.67 and plants were thinned to five per pot after seedlings were established. Seventy-four days after sowing all grasses were clipped with hand shears to a standard height of 5 cm above soil level. During this period the pots were re-randomized weekly within and between blocks. After flooding treatments were imposed it was no longer practicable to continue re-randomization.

Water was maintained at a height of 41 cm above soil level for the duration of the flood treatments. The water used came from the town supply and was free from any major impurities (Anderson 1974*a*). During the flooding the regrowth foliage was completely submerged.

An interval of 14 days was allowed after termination of flooding treatments before regrowth was harvested. The plant material was dried in a forced-air draught oven at 90°C for 24 hr. Results are presented as plant and tiller number survival, and dry weight production.

III. RESULTS

The interval between harvesting and flooding was extremely important in influencing the reaction to flooding. Only Bambatsi survived as little as 10 days of flooding imposed immediately after harvesting (Figure 1). With 15 days' regrowth before flooding, Tarewinnabar, green panic and *Urochloa mosambicensis* also showed some tolerance of 10 days' flooding, while a few plants of Biloela and Molopo survived. Bambatsi survival was complete with 20 days' flooding when allowed 15 days' regrowth first.

The effects of flood duration and defoliation on tiller numbers (Figure 2) closely followed the results for plant survival. This was also the case for regrowth dry-matter production (Figure 2). Although Bambatsi tended to have more tillers in the control than the other grasses, its dry-matter production was similar. The dry-matter figures are for the total material produced since clipping, both dead and live plant material being collected. Where flooding was imposed immediately after clipping, all grasses except Bambatsi failed to regrow. Where flooding commenced 15 days after clipping, all grasses made some regrowth. For most species this was between clipping and commencement of flooding. However, in the 20 days' flood duration treatment, the regrowth from the green panic and *Urochloa mosambicensis* had rotted and degenerated to such a degree that none was available for collection by harvest date.

The anomaly of lower tiller number and dry weight for Biloela at 10 days' flood duration than 20 days when flooded 15 days after clipping (Figure 2) cannot be explained.

Statistical treatment was attempted on the data after omitting the treatments with nil counts. A square root ($X + \frac{1}{2}$) transformation was used for analysis. Apart from Bambatsi, the major cultivar difference ($P = 0{\cdot}05$) was in the 15-day regrowth treatment at 10 days' flood duration, where green panic had better plant and tiller survival than Biloela buffel (Figures 1 and 2). The statistical data have been omitted as the main effects are obvious.

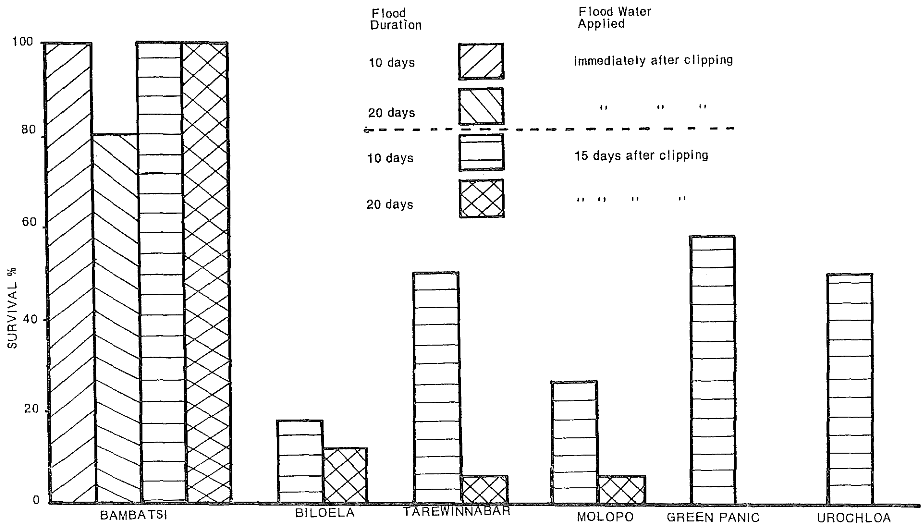

Fig. 1.—Effect of flood duration and shoot removal on survival of tropical grasses.

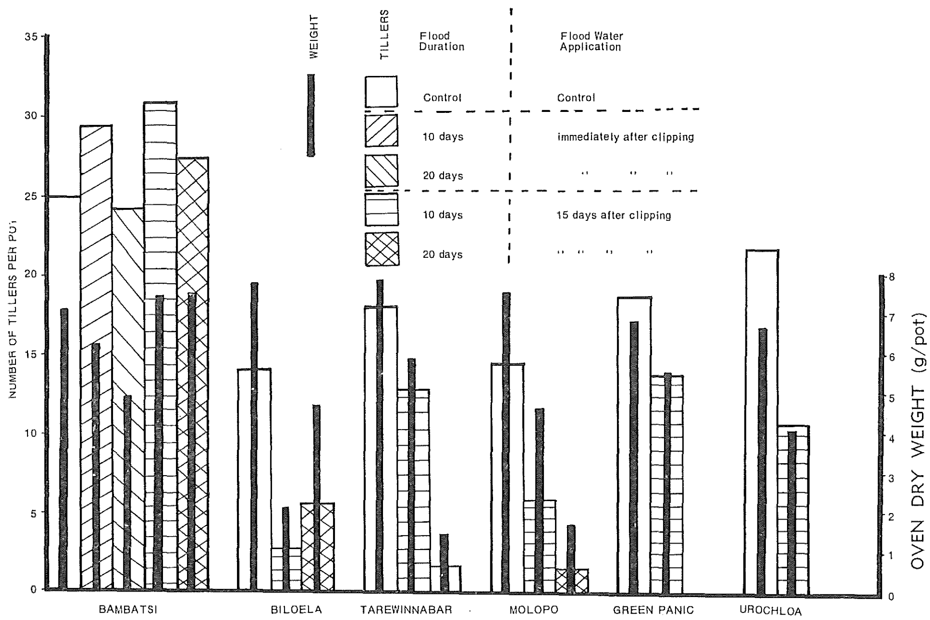

Fig. 2.—Effect of flood duration and shoot removal on the tiller number and dry weight production of tropical grasses.

IV. DISCUSSION

No previous data have been sighted for tropical grasses on the flooding/clipping effect. Erwin, Kennedy and Lehman (1959) and Rogers and Sedgley (1963) found that lucerne plants in the field were more susceptible to "flooding" injury (saturated soil) following clipping. The longer the period between clipping and flooding the greater the survival of lucerne plants. Similar results were obtained by Burt (1963) working with *Paspalum dilatatum*. Erwin, Kennedy and Lehman (1959) offered no explanation for the greater susceptibility of lucerne plants, while Burt (1963), suggested that the result could most easily be explained on the basis of "internal competition" within the plant for both minerals and carbohydrates.

Another explanation has been offered by Kenefick (1962), who established with sugar beet that the presence of leaves assisted in the elimination of ethanol produced in the roots under anaerobic conditions. He suggested that transpiration from the foliage was one means of elimination. However, under the conditions of complete submersion experienced in this experiment this is not likely to apply. Consequently Burt's "internal competition" theory is a more likely explanation and could involve a fall in the non-structural carbohydrate content of the roots and crown following severe defoliation (Sullivan and Sprague 1943; Sprague and Sullivan 1950; Reynolds and Smith 1962).

Another factor which may apply under conditions of complete submersion is that more oxygen may be trapped when the foliage is present. It is also possible that recently cut surfaces may be more susceptible to pathogenic organisms.

The results confirm previous simulated and field experiments (unpublished) in showing that Bambatsi is more tolerant of flooding than the other five grasses. However, these experiments have shown that these grasses differ in their relative flooding tolerance. The difference has not occurred in the present experiment because the shortest flooding period has been too severe on the five species for this to be exhibited. Although in retrospect a 5-day flood treatment should have been included in order to allow the different relative flooding tolerances of these grasses (other than Bambatsi) to be expressed, it was omitted because in previous experiments (on entire plants not totally submerged) this length of flooding had negligible effect on the grasses.

A practical implication of the results of this experiment is that pasture grasses in areas liable to flooding should not be in a severely defoliated condition at times of flooding. Lenient defoliation at this time could increase their prospects for survival. Such management is also compatible with ensuring seeding of the grasses to enable regeneration from seed if the sward is killed (Anderson 1972, 1974*b*).

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REFERENCES

ANDERSON, E. R. (1970).—Pastures for flooded brigalow country. *Qd agric. J.* 96:224.

ANDERSON, E. R. (1972).—Emergence of buffel grass (*Cenchrus ciliaris*) from seed after flooding. *Qd J. agric. Anim. Sci.* 29:167.

ANDERSON, E. R. (1974*a*).—The reaction of seven *Cenchrus ciliaris* L. cultivars to flooding. *Trop. Grasslds* 8 (1) (in press).

ANDERSON, E. R. (1974*b*).—Emergence of six tropical grasses from seed after flooding. *Qd J. agric. Anim. Sci.* (in press).

BURT, R. L. (1963).—Some effects of short periods of flooding on the growth and development of *Paspalum dilatatum* (Poir.). *Proc. 3rd Aust. Grassld Conf.* 14-2.

ERWIN, D. O., KENNEDY, B. W., and LEHMAN, W. F. (1959).—Xylem necrosis and root rot of alfalfa associated with excessive irrigation and high temperatures. *Phytopathology* 49:572.

KENEFICK, D. G. (1962).—Formation and elimination of ethanol in sugar beet roots. *Pl. Physiol, Lancaster* 37:434.

REYNOLDS, J. H., and SMITH, D. (1962).—Trend of carbohydrate reserves in alfalfa, smooth brome grass, and timothy grown under various cutting schedules. *Crop Sci.* 2:333.

ROGERS, V. E., and SEDGLEY, R. H. (1963).—Susceptibility of defoliated lucerne to damage by flooding at high temperatures. *Proc. 3rd Aust. Grassld Conf.* 13-4.

SPRAGUE, V. G., and SULLIVAN, J. T. (1950).—Reserve carbohydrates in orchard grass clipped periodically. *Pl. Physiol., Lancaster* 25:92.

SULLIVAN, J. T., and SPRAGUE, V. G. (1943).—Composition of the roots and stubble of perennial ryegrass following partial defoliation. *Pl. Physiol., Lancaster* 18:656.

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