PHOSPHATE FERTILIZER COATS FOR BUFFEL GRASS SOWN IN INFERTILE SOILS

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Abstract

The use of a seed coating to supply buffel grass (Cenchrus ciliaris) seedlings with adequate phosphate for rapid growth on infertile, acid red earth appears practical. The concept may also apply to other phosphorus-demanding grasses such as Anthephora pubescens. Extensive field testing is now required to see if enhanced early seedling growth rate improves establishment reliability on infertile soils under natural conditions.

The potential advantages are:- (i) greater reliability of establishment (ii) more reliable seed placement (iii) easier handling and distribution (iv) less blowing of seed by wind (v) reduced ant predation (vi) introduction of buffel grass into a further 4M ha of Queensland and N.W. New South Wales.

The cost of coating may be \$1.20/kg of pure seed. At current seed prices (\$9/kg), the coating process would add 13% to the cost of seed. As compensation, the improved seed placement and reliability of establishment may allow sowing rates to be reduced by 25-50%.

Introduction

Buffel grass (Cenchrus ciliaris) is a successful introduction over a wide area of tropical and sub-tropical Australia. Greatest success has been achieved on the fertile gidyea and brigalow clay soils of central Queensland. Introduction has been less successful on sandier soils, particularly acid, infertile earths such as mulga soils.

The major non-climatic limitation to establishing buffel grass and Anthephora pubescens on sandy mulga soils is phosphate deficiency in the seedling stage (Silcock et al. 1976). Once established buffel particularly persists and yields well at Charleville. The amount of extra phosphorus needed could theoretically be as little as 0.5 mg/seed. Early studies into the P nutrition of grass seedlings on mulga soils involved either deep incorporation of the fertilizer into the soil (Christie 1975) or broadcasting. We set about to determine more critically the amount required per plant and the most efficient means of supplying the fertilizer. In the early trials, Anthephora pubescens was used as the test species because its growth habit is more suited to pot trials. Buffel grass was grown in later studies because of its greater foreseeable pasture potential.

(i) Timing of P application

A water soluble fertilizer $NaH_2PO_4.2H_2O$ was applied, at rates equivalent to 25 kg P/ha, on 1 of 6 occasions, either 3 weeks or 1 week before sowing, at sowing or at the time of emergence of the coleoptile, or leaf 2 or leaf 3 of *A. pubescens*. Subsequent seedling growth was measured for nearly 3 weeks. Within the time scale used, application at any time up until the emergence of leaf 2 was equally satisfactory for stimulating early seedling growth.

(ii) Amount and placement of phosphate

In this experiment the same fertilizer was either applied at the same rate (25 kg P/ha) to different proportions of the soil surface (centred on the seed buried 1 cm beneath) or placed in solid form above the seed (at either 0.6, 2.4 or 9.6 mg P). The pots were then watered to field capacity with a spray. Subsequent seedling growth showed that most treatments were effective, provided the P was placed close to the seed (Table 1). Placing 75 mg of P in a ring more than 5 cm from the seed had no effect on seedling growth.

Table 1. Effect of different phosphate fertilizer rates and positioning on the growth of *Anthephora pubescens* seedlings on mulga soil.

Treatment	Days to leaf 5 appearance	Tiller number after 30 days	Shoot DM yield (mg)after 30 d
no fertilizer	23.2c*	0a	72a
45 mg P, 5 cm from seed	23.8c	0a	84a
0.6 mg P, spot application	17.3ab	0.8ab	264b
2.4 mg P, spot application	16.5ab	2.5bc	435c
15 mg P, 10 cm dia. circle	17.2ab	3.5c	588c
9.6 mg P, spot application	15.3a	5.0d	943d

* Values followed by the same letter are not significantly different ($P < 0.05$).

Thus the P fertilizer requirement per seed is small provided it is supplied close to the seedling and prior to the emergence of leaf three.

Are all forms of phosphorus equally available to buffel grass seedlings? Christie (1975) used insoluble Aerophos (Monocalcium phosphate). Silcock *et al.* (1976) used soluble mono-sodium phosphate while double superphosphate (19.2%P) has been successfully used in field trials at Charleville.

(iii) Sources of phosphorus

A pot trial was conducted with 20 mg of each of eleven phosphorus sources placed 0.5 cm below each buffel seed. Only pyrophosphates were deleterious to germination. All phosphorus sources stimulated seedling growth - soluble phosphates of Ca, K, NH_4 and Na, insoluble phosphates of Ca, soluble metaphosphate ('Calgon'), commercial superphosphates and pyrophosphate.

(iv) Method of coating the seed

The application of a coherent coating to a buffel grass fascicle is difficult to achieve. However without the protection of the fascicle and its seed valves, all soluble fertilizers are very toxic to germinating seeds. If the fascicle is left intact, large quantities of fertilizer can be applied, 20-30 mg if necessary. To date we do not have a proven method applying a consistent amount of soluble phosphate to buffel facicles, but we have been able to produce enough experimentally to continue our studies.

(v) Pot trials with coated seeds

Several pot trials showing the benefits of certain coatings under well-watered conditions have been conducted (Table 2). What is the optimum amount of coating needed?

Table 2. Effect of various phosphate fertilizer coatings on the emergence and growth of buffel grass seedlings in pots of mulga soil.

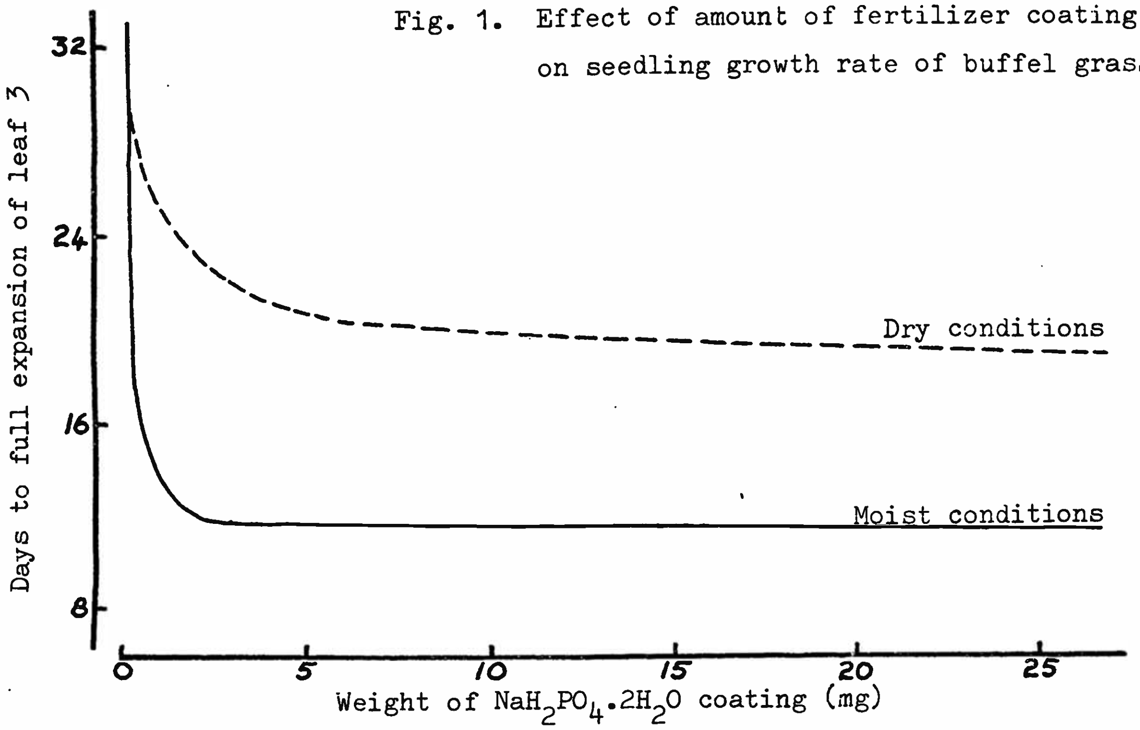
Coating	% emergence after 65 hr	Days to full expansion (F.E.) of leaf 3	Seedlings with 5 F.E. leaves after 41 days (%)
Nil	47b*	30.2d	0a
$CaHPO_4$ (insol.)	56b	21.3c	9a
$CaH_4(PO_4)_2$(sol.)	25ab	15.1ab	100b
'Citraphos'	53b	32.4d	0a
Superphosphate	14ab	16.7ab	87b
Double super	6ab	16.3ab	100b
M.A.P.	25ab	13.2a	100b
$Na_6(PO_3)_3$(sol.)	0a	17.2b	96b
$NH_4H_2PO_4$ (sol.)	33b	13.7a	100b
KH_2PO_4 (sol.)	28ab	16.0ab	100b
$NaH_2PO_4.2H_2O$ (sol.)	39b	14.6ab	97b

* Values followed by the same letter are not significantly different ($P < 0.05$).

(vi) Rate of coating trials

Mono-sodium phosphate was used as a coating material because its very high solubility in water allowed a wide range of coat weights to be produced. Seeds and coatings were individually weighed after drying in a desiccator. Two trials were conducted in pots, the second experiencing a much drier moisture regime. Seedling growth was monitored until the fourth or fifth leaf expanded. The response curves produced are shown in Figure 1.

Fig. 1. Effect of amount of fertilizer coating on seedling growth rate of buffel grass



Under moist conditions very little P was needed to give maximum stimulation to seedling growth. Where soil surface conditions were dry the optimum coating rate lay between 1 and 2 mg of P per seed.

(vii) Field trials

Two field trials were conducted in the late summer of 1980/81 to test the efficiency of phosphate seed coatings on buffel seedling growth and survival. Because of the drought, artificial watering was needed to germinate the seed in both cases. In the first trial, coatings produced by Coated Seed Ltd., New Zealand were compared against a 30 mg coating of 'Monofos' (monosodium phosphate) applied by ourselves and an uncoated control (CON). The commercial coatings CS_0, CS_1, CS_2 and CS_3 weighed between 30 and 50 mg and contained an added 0, 1, 2 or 3 mg of mono ammonium phosphate (M.A.P.) respectively.

Figure 2 summarizes the results over the first month. Emergence was slightly reduced by coating the seed. No coating was effective in reducing the rate of seedling death during the ensuing 10 days. Continuing dry weather made more watering necessary to salvage the trial. After the 2 leaf stage, seedling growth was much better from pelleted seeds and best from 'Monofos' (MON). Survival of seedlings to mid-May (98 days) was 18-38% for seedlings receiving

M.A.P. or 'Monofos' compared to 8-12% for the others.

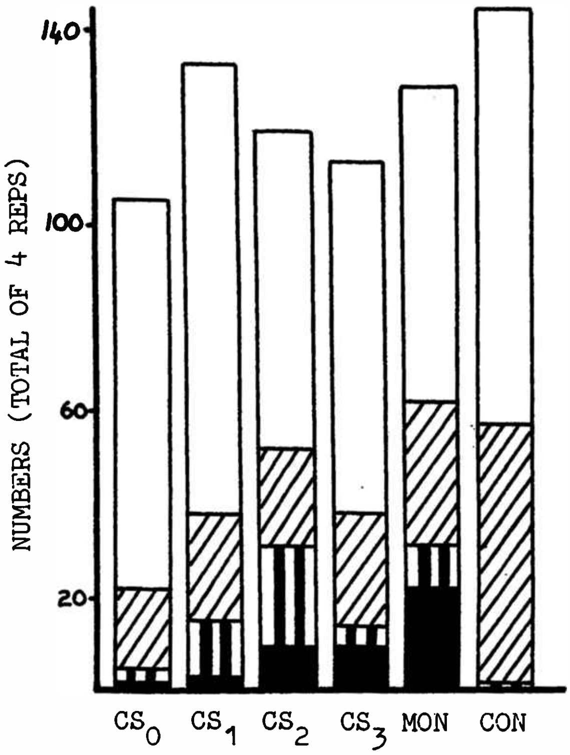


Fig. 2. Emergence, survival and early growth rate of buffel grass seedlings from seed coated with a range of fertilizers.

Table 3. Effect of 3 seed coatings on buffel seedling emergence, growth and survival on mulga soil in the field.

Treatment	Coat Wt. (mg)	% Emergence 4 days	% Emergence Total	Percentage of emergent seedlings with 3 leaves after 15 days	with 5 leaves after 35 days	surviving after 70days
CON	Nil	59	85	2	4	72
CS_2	40.0	9	87	43	53	83
MON	8.2	46	81	68	52	86
M.A.P.	14.2	39	89	52	67	79

The second field trial tested 3 coatings, M.A.P., 'Monofos' and CS_2. The results were similar to the first field trial (Table 3). All three coatings were effective but the weight of coating was much less for 'Monofos' and M.A.P. The commercial coatings are, however, very robust and durable while ours are brittle and easily removed.

References

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