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Effect of heat treatment on impermeability and longevity of fine stem stylo seed

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Summary

Immersion of fine stem stylo (*Stylosanthes guianensis* var. *intermedia*) seed in hot water (55°C) for 20 min reduced hard seed content from 75% to less than 10%. Exposure of seed to hot air (57°C, 56% R.H.) reduced hard seed content from 75% to 60 to 68%.

Viability was unchanged for 3 years after the seed had been exposed to such treatments.

1. Introduction

Fine stem stylo, *Stylosanthes guianensis* var. *intermedia,* is a perennial legume showing promise for introduction into native pastures of the southern spear grass region of Queensland (Bisset 1968; Stonard and Bisset 1970). Individual commercial 'seeds' are actually pods, each enclosing a single seed of which a high proportion is 'hard' that is, with impermeable seed coats at harvest (Stonard 1968).

While hard-seededness can act as a type of insurance against adverse establishment conditions (Gilbert and Shaw 1979), it can be a disadvantage in those situations where rapid germination is a necessity (Mott, McKeon and Moore 1976).

Hard-seededness can be reduced by mechanical or acid scarification or by heat treatment (Stonard 1968). Dry heat has been successful on other *Stylosanthes* species (Gilbert and Shaw 1979; Holm 1973). Immersion of *S. guianensis* seed in hot water (55°C for 20 min) has been used in seed testing to reduce the level of hard-seededness (R. L. Harty, personal communication).

Since the longevity of hard seed is greater than that of permeable seed (Quinlivan 1971), scarification has the potential to reduce the longevity of any seed lot. This aspect has been neglected in literature.

This paper reports the effectiveness of heat treatments on hard-seededness and on the longevity of fine stem stylo seed.

2. Methods

Four 200 g samples were drawn from 20 kg of commercial seed harvested near Bundaberg in May 1968. One sample (treatment 1) was immersed in water at 55°C for 20 min and air dried at room temperature on 11 November 1968. The second sample (treatment 2) was exposed to hot air (57°C, 56% R.H.) for 20 min on 13 November 1968. The other two samples (treatments 3 and 4) remained untreated.

Each treatment sample was subdivided into five 40 g replicates and stored in paper envelopes held in a linen bag at room temperature at 'Brian Pastures', Gayndah. Subsamples of 3 g were removed for germination tests on 20 December 1968; 10 January, 17 March, 6 May, 27 June, 25 August and 16 October 1969; 10 February, 18 June and 23 November 1970; 10 May and 24 December 1971; and 1 April 1972. Immediately before each germination test, the subsamples from treatment 3 were immersed in water at 55°C for 20 min. Treatment 4 remained an untreated control.

Seed was germinated in the pod at a constant 32°C in a cabinet germinator at the Seed Testing Laboratory, Indooroopilly. Two filter papers (Greens LR52), moistened as required, were used in each tray which contained 100 seeds. Three such trays for each storage replicate were randomized within the germinator. Germinated seed was removed every 2 to 3 days over a 21-day period, after which residual seed was classified as 'fresh ungerminated' (imbibed and firm, that is, dormant), 'hard', or 'decayed' (pathogenic attack evident).

3. Results and discussion

The mean monthly atmospheric screen temperatures at 'Brian Pastures' (table 1) approximate the temperature of storage. The warmest day was 11 February 1969 with a maximum of 41°C, and 27 June 1971 was the coldest day with a minimum of 2.7°C. Room temperatures would have approached these extremes. Daily relative humidity at 9.00 a.m. varied from 27 to 100%.

Results of germination tests are shown in tables 2 and 3. Percentages shown are the means from the 15 trays of each treatment at each date. Treatment effects are clearly evident, and standard errors were small. Typical values for the standard errors are shown for three testing occasions.

Table 1. Mean monthly atmospheric temperature (°C) at 'Brian Pastures'

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1969 ..	27.5	26.3	24.8	21.5	18.8	14.9	15.9	17.3	17.1	21.1	23.2	26.1
1970 ..	26.5	24.7	23.7	22.1	16.9	14.6	13.2	15.4	18.3	21.4	22.7	24.8
1971 ..	25.4	24.2	22.9	20.5	16.5	13.6	13.3	16.4	18.1	22.7	24.4	24.8

Table 2. Effect of heat treatments on percent hard seed of fine stem stylo

Date	Hot water 11 Nov 68	Hot air 13 Nov 68	Hot water before test	Control
Dec 1968	8.0 (±1.9)	63.6 (±1.9)	4.3 (±0.7)	70.3 (±1.4)*
Jan 1969	8.5	66.1	2.5	75.2
Mar 1969	6.5	63.3	1.4	76.5
May 1969	7.5	62.7	1.1	67.4
Jun 1969	8.2	63.5	1.0	77.8
Aug 1969	8.0	65.2	0.1	72.2
Oct 1969	8.4	60.3	1.5	75.5
Feb 1970	7.7 (±0.9)	66.1 (±0.9)	11.4 (±0.9)	74.3 (±1.7)
Jun 1970	8.0	63.7	5.5	70.1
Nov 1970	7.1	66.7	2.1	71.7
May 1971	7.9	66.9	3.5	74.4
Dec 1971	7.0 (±0.8)	65.1 (±1.9)	29.7 (±1.2)	73.3 (±1.4)
Apr 1972	6.4	70.4	7.0	80.2

* Standard error

Table 3. Effect of heat treatments on percent viability of fine stem stylo

Date	Hot water 11 Nov 68	Hot air 13 Nov 68	Hot water before test	Control
Dec 1968	81.5	71.7	76.6	73.7
Jan 1969	80.3	74.8	73.2	79.3
Mar 1969	78.5	72.1	73.8	79.5
May 1969	79.1	72.2	71.7	70.4
Jun 1969	80.1	74.3	80.1	82.0
Aug 1969	78.8	74.9	78.4	75.3
Oct 1969	82.8	70.8	77.4	79.0
Feb 1970	79.9	75.5	76.4	76.9
Jun 1970	82.3	73.3	76.8	72.5
Nov 1970	78.7	76.3	75.7	73.7
May 1971	81.7	77.5	80.8	76.4
Dec 1971	77.6	74.5	74.9	75.1
Apr 1972	71.6	80.6	78.9	83.6

Hot water treatment in November 1968 (6 months after harvest) or immediately before each germination test over the 3-year period of storage was effective in reducing the hard seed content from 75% in the control samples to less than 10% (table 2). The hot air treatment reduced the hard seed content to 60 to 68%.

Except for seed immersed in hot water before testing in February 1970 and December 1971, the hard seed content for each treatment remained constant throughout the experiment. These two exceptions could have arisen from undetected variations in the temperature and/or duration of the hot water treatment.

Viability was unaffected by both heat treatments and remained constant for 3 years (table 3). Thus, hot water treatment is not only an effective method for reducing hardseededness in fine stem stylo, but also does not affect seed viability for at least 3 years under moderate storage conditions. However, storage under adverse conditions particularly higher temperatures (Gladstones 1958; Barrett-Lennard and Gladstones 1964) could have deleterious effects on such seed.

Since hot water treatments have been used successfully in the laboratory to reduce hard-seededness in both cv. Schofield and cv. Endeavour (R. L. Harty, personal communication), it is expected that these cultivars could be similarly treated in commercial practice.

The incidence of hard-seededness in *Stylosanthes guianensis* warrants the use of scarification at least in some circumstances, and particularly to induce maximum germination in the minimum time when rapid establishment is of paramount importance.

Hot water treatment (55°C for 20 min) is a cheap and effective method for treating large quantities of seed. It can be employed without fear of destroying viability if seed is to be retained for more than one season.

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