

THE EFFECTS OF HOT AIR TREATMENT AND HOT WATER TREATMENT ON THE GERMINATION OF 12 COMMERCIAL SUGARCANE VARIETIES IN NATAL

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Introduction

Heat therapy of sugarcane has been used in the past as a cure for the virus disease chlorotic streak. With the discovery some years ago of ratoon stunting disease workers once more turned to heat treatment as a means of controlling this new and more serious virus disease. A new combination of temperature and time was found to be necessary and finally a 2 hour soaking in water at a temperature of 50°C was recommended.

This hot water treatment was adopted in most sugarcane growing countries with the exception of Louisiana and Malagasy where for various reasons the alternative hot air system of treatment was recommended.

Although there is apparently no difference between the two methods with respect to efficiency in disease control it has been considered more practicable to employ the hot water method in South Africa. There may, however, be some districts where electricity supply is unreliable or where the farm is a considerable distance from the nearest hot water treatment plant sited at a mill. It is in these situations that the hot air method might be considered. The plant could perhaps be operated with a gas heater or by electricity derived from a portable generator.

Object

Although hot air treatment has not yet been introduced commercially in South Africa, it was felt that certain situations might call for its use in preference to the hot water method. For this reason a complete hot air system was imported by the Experiment Station from Louisiana and the present experiment carried out to determine the effects, if any, of the two methods of treatment for ratoon stunting disease on the germination of a number of our more important varieties.

Methods

(1) *The Hot Air Oven and the Hot Water Tank*

The equipment used for the experiment consisted of a hot air treatment oven supplied by the Barola Electric Company of Baton Rouge, Louisiana imported and installed by the Experiment Station and having a capacity of approximately 1 ton of seedcane. The hot water treatment was carried out in the tanks operated by the Mount Edgecombe mill of Hulett's Sugar Corporation.

(2) *Varieties*

A selection of 12 commercial varieties was made for the experiment ranging from N:Co.293 to the most recent releases, N.55/805 and the two C.B. varieties. The full list was as follows:

N:Co.293
N:Co.310
N:Co.334
N:Co.376
N:Co.382
N.50/211
N.51/168
N.51/539
N.53/216
N.55/805
C.B. 36/14
C.B. 38/22

(3) *Seedcane and Treatments*

The seedcane for the experiment was obtained from variety collections at the Experiment Station and was in the majority of cases 12 months old plant cane.

There were three main treatments namely — Hot air treatment (H.A.), Hot water treatment (H.W.) and untreated (NIL). Within each of these there were sub-treatments of "whole stalks" and "setts" and in the heat treatment of "whole stalks treated and then cut into setts before planting". The full numbered list of treatments is as follows:

- (1) HA : Whole Stalks
- (2) HA : Whole Stalks cut into setts
- (3) HA : Setts
- (4) HW : Whole Stalks
- (5) HW : Whole Stalks cut into setts
- (6) HW : Setts
- (7) NIL : Whole Stalks
- (8) NIL : Setts

Whole stalks were cut to carry 10 buds each and setts were prepared with 5 buds each. Plots were single lines of 6 feet planted with 30 buds each i.e. 3 whole stalks or 6 setts.

For the hot air treatment the temperature of the air entering the treatment chamber averaged 57.5°C. Treatment at this temperature was for 8 hours. In the hot water treatment, the seedcane was soaked for 2 hours in water at 50°C.

All seedcane was treated with fungicide before planting.

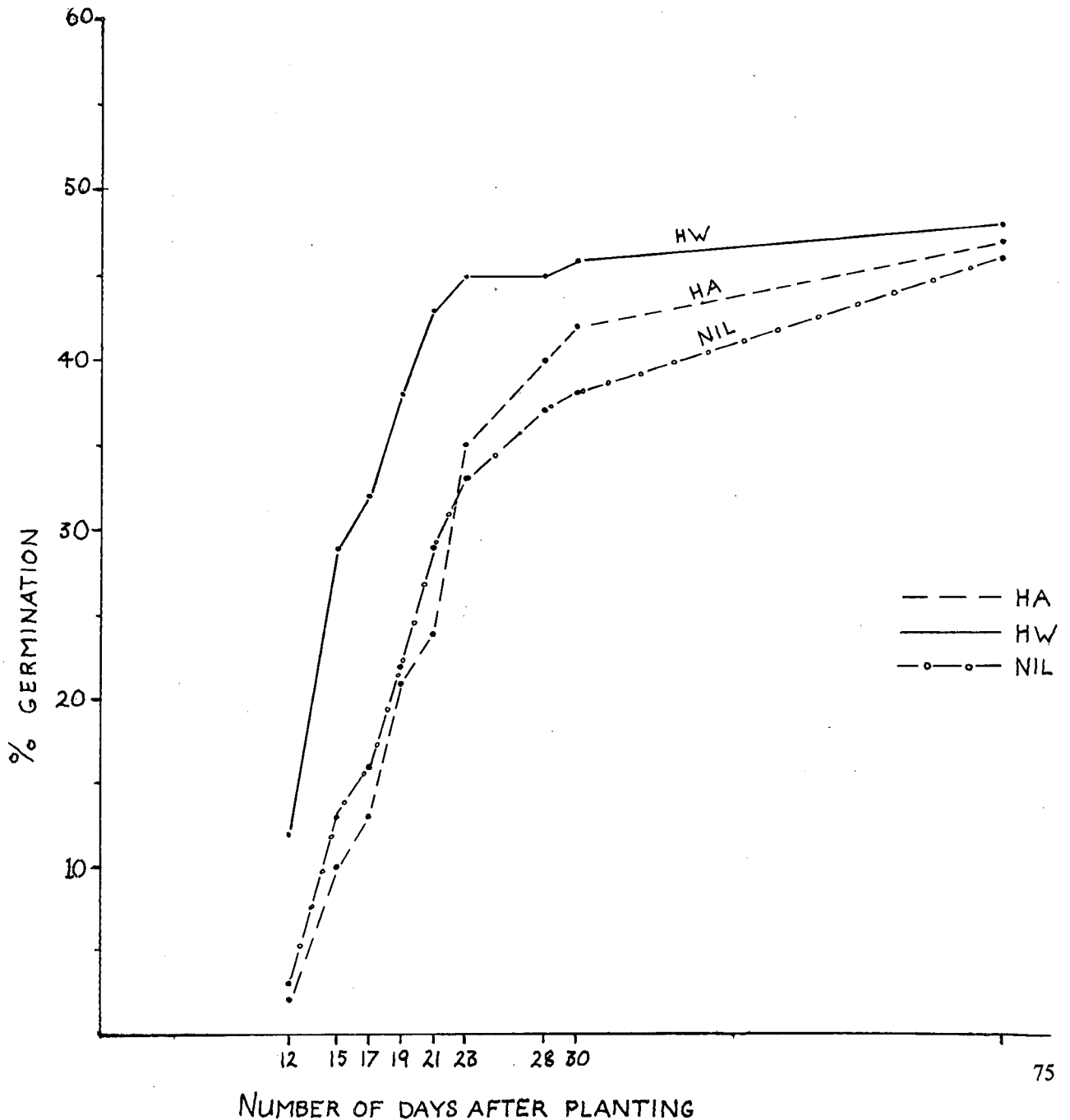
The heat treatments were carried out on 29th November 1966 and the experiment planted on the following day.

Results

Germination counting commenced on 12th December 1966 and the early indications were that hot water treated cane germinated first in most varieties. Hot air treated cane and untreated whole stalks came away very slowly by comparison (see Fig. 1).

Within approximately 30 days it was apparent that in some plots secondary shoots were beginning to appear, so that in those cases, germination as such was complete. However, to enable any slower growing varieties and treatments to complete their germination the experiment was left until 26th January 1967 when all the cane was unearthed and the actual germination counted for each stalk and sett. Only buds which had actually produced a living above-ground shoot were recorded as having germinated.

FIGURE 1: Mean rate of germination in three main treatments and varieties



A considerable number of cases was found in which the bud had germinated, produced a shoot but then had died for some reason or other. In other cases buds appeared to be still alive but unlikely to produce normal shoots.

The effect of heat treatment on the germination of buds on whole stalks is apparent from the graph in Figure 2. The whole stalks in the experiment carried 10 buds each and in the untreated stalks germination of buds lower than third from the top of the stalk fell off very markedly. By comparison more buds germinated in similar stalks treated either with hot air or hot water.

The main effects of the various treatments on the 12 varieties can be seen in Table I and are illustrated

ment was better than either hot air treated or untreated cane. Treating setts with hot air is considerably better than treating whole stalks.

N:Co.334

Germination of untreated material was distinctly inferior to that in either of the heat treatments. This poor germination in N:Co.334 has been noted before. Thus this variety appears to be stimulated by heat treatment. The best results derived from whole stalks treated with hot air.

N:Co.376

Apart from an apparent stimulation in hot air treatment the germination in this variety was dis-

TABLE I
Percent Germination in 12 Varieties following hot air treatment and hot water treatment

Variety	N:Co. 293	N:Co. 310	N:Co. 334	N:Co. 376	N:Co. 382	N. 50/211	N. 51/168	N. 51/539	N. 53/216	N. 55/805	C.B. 36/14	C.B. 38/22
HA Stalks	41.7	50.8	61.7	57.5	40.8	40.8	50.8	34.1	41.7	56.7	35.0	32.5
HA Stalks > Setts	37.5	52.5	50.9	43.3	40.0	50.0	39.1	45.0	50.0	64.2	33.3	45.8
HA Setts	33.3	60.0	50.0	45.0	48.3	40.8	53.3	51.7	51.7	60.0	32.5	50.0
Mean HA	37.5	54.4	54.2	48.6	43.0	43.9	47.7	43.6	47.8	60.3	33.6	42.8
HW Stalks	46.7	58.3	54.2	41.7	28.3	47.5	40.8	60.0	52.5	58.3	36.7	26.7
HW Stalks > Setts	41.0	61.7	50.0	48.7	34.1	41.7	56.7	46.7	63.3	60.8	40.0	45.8
HW Setts	40.8	61.9	47.5	43.5	46.1	47.5	53.3	60.8	60.0	57.5	34.1	45.8
Mean HW	42.8	60.6	50.6	44.6	36.2	45.6	50.3	55.8	58.6	58.9	36.9	39.4
NIL Stalks	39.1	59.2	34.1	35.0	34.1	50.0	44.2	40.0	36.7	48.3	32.5	37.5
NIL Setts	40.8	53.8	42.5	46.7	50.8	56.7	47.5	53.3	45.8	55.8	47.5	38.3
Mean NIL	39.9	56.5	38.3	40.8	42.4	53.2	45.8	46.6	41.2	52.0	40.0	37.9

in Figure 3. Generally speaking it shows that certain varieties are apparently stimulated by heat treatment while in others the reverse is the case. It is considered that the germination of untreated cane was rather poor particularly when it is realised that the general average germination for the whole experiment was only 47 per cent.

The following are short notes on the reaction of the 12 varieties to the treatments in the experiment.

N:Co.293

The overall germination of this variety was disappointing; in no treatment did the percentage germination exceed the general average. Hot water treated whole stalks were better than hot air treated stalks. The same was true of setts. There was little difference in germination between untreated stalks and setts. There appears to be no advantage to be gained by cutting stalks into setts after heat treatment.

N:Co.310

One of the two varieties in the experiment which gave better than average germination in all treatments (the other variety was N.55/805). Hot water treat-

ment was better than either hot air treated or untreated cane. Treating setts with hot air is considerably better than treating whole stalks.

N:Co.382

Hot water treatment inferior to hot air treatment but in general no marked stimulation by heat treatment. In both types of heat treatment and in untreated cane setts germination definitely superior to that of whole stalks.

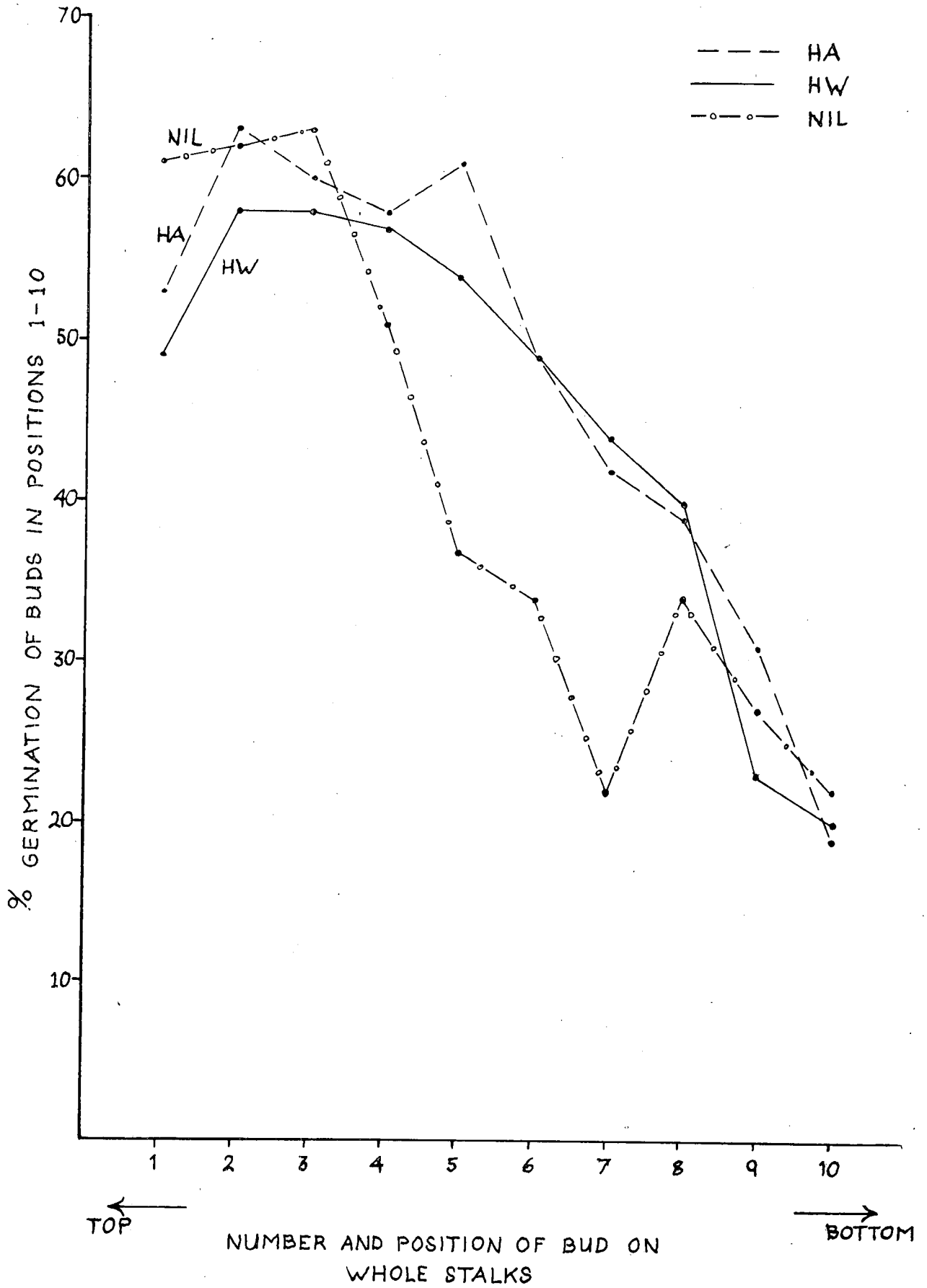
N.50/211

Germination of untreated seedcane superior to that of heat treated cane. Hot air treated cane inferior to hot water treated. Untreated setts better than whole stalks.

N.51/168

Rather poor germination in untreated cane with setts slightly better than whole stalks. Hot water treatment slightly better than hot air treatment on average but in both, particularly in hot water setts better than whole stalks.

FIGURE 2: Germination of buds in various positions on whole stalks after hot air and hot water treatments



N.51/539

There appears to be some stimulation after hot water treatment. Hot air treatment definitely inferior to hot water treatment. Apparently little difference between whole stalks and setts in hot water treatment but in hot air, setts far superior to whole stalks. The latter comparison also holds true for untreated cane.

N.53/216

Germination of untreated cane rather disappointing. Considerable stimulation in hot water treatment by comparison. On the average hot air treatment gave a better germination than untreated. Germination of setts superior to that of whole stalks after hot air, hot water and no treatment.

N.55/805

Considerable germination stimulation after heat treatment of both types. This phenomenon has been observed following hot water treatment in an earlier experiment. In untreated cane, setts better than whole stalks. On an average hot air treatment better than hot water treatment.

C.B.36/14

Only untreated setts exceeded the rather low general average otherwise the germination of this variety was very disappointing. In heat treated cane both methods gave poor results but hot water treated seedcane germinated slightly better than hot air treated. Poor germination after hot water treatment has been observed before in this variety.

C.B.38/22

Only hot air treated setts exceeded the general average germination. Untreated seedcane germinated very poorly as did heat treated whole stalks. In both types of heat treatment setts were markedly superior to whole stalks.

Summary

Considerable variation is apparent in varietal reaction to the two types of heat treatment carried out in the experiment.

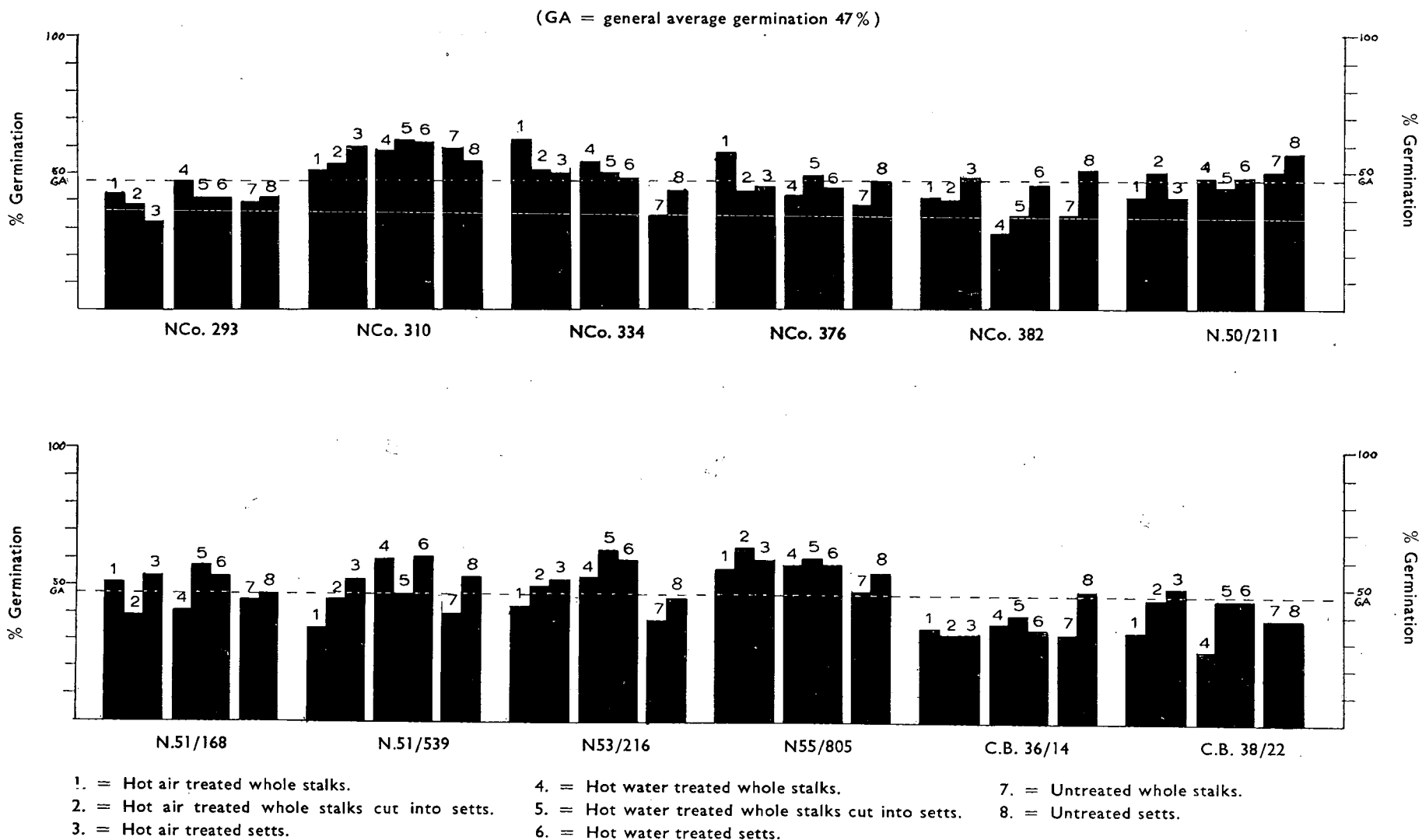
Although the general average germination over the whole experiment was considered to be low at 47%, germination stimulation was clearly observed after heat treatment in the two varieties N:Co.310 and N.55/805.

Overall germination was disappointing in N:Co.293, N:Co.376, N:Co.382, N.50/211, C.B.36/14 and C.B.38/22. The particularly adverse effects on C.B.36/14 have been observed on other occasions.

In most varieties treating whole stalks instead of setts with hot water brings no serious problems in germination. Exceptions to this are apparent in N:Co.382, N.51/168 and C.B.38/22. The picture is somewhat different in hot air treatment where in only N:Co.293, N:Co.334 and N:Co.376 was the whole stalk germination markedly better than that from setts.

As is to be expected, germination of untreated setts is superior to that of untreated whole stalks in most varieties.

FIGURE 3: Germination of hot air treated, hot water treated and untreated Seedcane of 12 Commercial varieties



Discussion

Dr. Dick (in the chair): With hot air treatment why does the treatment take so much longer than with hot water, and what prevents desiccation of the setts?

Mr. Thomson: The sett itself reaches a temperature of 50°C in about five hours in hot air, but takes a much shorter time in hot water.

No attempt has been made to control humidity, moisture derived from the seed cane being considered sufficient to prevent too much desiccation.

Mr. Gilfillan: We also found considerable stimulation of germination of N.55/805 with hot water treatment, especially if the whole stick and not the sett was treated.

What temperature tolerance is allowable in a hot water tank and what is the effect of allowing hot water treated cane to dry out for some days before planting?

Mr. Thomson: We recommend a working temperature of 50.5°C and prefer a tolerance of only 0.5°C either way.

It is usually considered advisable to plant cane immediately after hot water treatment.

Mr. King: I think Mr. Thomson should be quite satisfied with his percentage germination figures.

Regarding time of treatment, which was in November, cane is normally then in active growth and I suggest the experiments should also be carried out in August.

Hot air treatment may be useful in Louisiana, a nine month crop, because buds are young and soft but I think here we should stick to hot water treatment.

Mr. Thomson: The experiment is to be repeated in August.

Dr. Brett: Cutting stalks into setts has two main effects: the beneficial one of reducing polarity and thereby enabling more buds to germinate, and the harmful one of exposing more buds to attack by micro-organisms. Heat treatment itself can have similar effects. By destroying auxin, it reduces polarity, and by its damaging effect it may render buds more susceptible to rotting. If heat treatment completely eliminates polarity, the only effect of cutting whole stalks into sets is the harmful one of exposing more buds to attack, but if polarity is not completely eliminated, some benefit may accrue from cutting. This is evident in Table I, which shows that when heat-treated whole stalks gave better germination than untreated setts, germination usually deteriorated if these whole stalks were cut into setts. Conversely, an improvement usually resulted from cutting if the heat-treated whole stalks gave inferior germination to untreated setts.

Mr. de Robillard: Last year whole stalks were hot water treated. There was a big labour saving by treating in this way and germination was good.

Mr. Thomson: Treating of whole stalks does save a lot of time and labour and it also cuts down the amount of handling of the seed cane before and after treatment.

Mr. Gilfillan: Tongaat is treating whole stalks on a trial basis at the moment. One problem is to get an even temperature throughout the bundle of stalks during the treatment.

Mr. Thomson: Limitation of size of bundle should be considered.