THE HOT WATER TREATMENT OF SUGARCANE SETTS

By N. C. KING

The hot water treatment of seeds and plants for curing certain diseases and insect pests is not new. The technique has been used overseas for some time, mainly in the bulb industry, but more recently this hot water treatment has been extended to the strawberry industry where the treatment is used to kill nematodes present in the strawberry plants.

After it was established that sugar cane was attacked by virus diseases, work was carried out on the thermal death point of the viruses causing these diseases. As a natural consequence of this work, attempts were made to control virus diseases in cane by subjecting the setts to a temperature which would kill the virus and at the same time cause no injury to the cane setts. Wilbrink[1] (1923) appears to be one of the first to try experiments of this nature and she claimed to control sereh disease of sugar cane by treating the setts in hot water at 52-55°C for 30 minutes. About the same time Brandes and Klaphaak[3] carried out experiments with hot water treatment of cane setts for the killing of mealie bug and mothborer and used the temperature of 50°C for 20-30 minutes.

Probably the most work on the hot water treatment of sugar cane cuttings has been done in conjunction with the curing of chlorotic streak. Edgerton and his co-workers have probably carried out the most intensive work in this sphere of therapeutic pathology. As a result of the work carried out on chlorotic streak, the treatment of 52°C for 20 minutes is the treatment which produces healthy cane plants.

Recently, another disease has appeared which was first identified in Queensland and is known as ratoon stunting disease. This disease, thought to be due to a virus, has also been identified in Natal. Fortunately, canes infected with this disease can be cured by treating the canes in hot water for 2 hours at a temperature of 50°C. This treatment has been recommended by Steindl and Hughes[2] who have carried out numerous time-temperature combinations which would be suitable for curing the disease. The length of time of treatment can be reduced if the temperature is raised but this is very liable to impair the germination. The temperature of 50°C is the one at which the disease is cured and has least effect on the germination. This method of treatment is not a haphazard affair but one which requires a certain amount of technical apparatus. The object of this paper is to describe some of the apparatus which have been used successfully and the effect of this treatment on the germination of some of the varieties.

Hot Water Treating Tanks

(*a*) *Laboratory Apparatus*

The apparatus used in the laboratory consists of a drum 30 inches high and 24 inches in diameter which is lagged with about 3 inches of vermiculite. The heating element conststs of 6 ordinary 1 kw. commercial heating elements each connected to its own switch. Above the heating elements is a perforated plate on which the wire baskets containing the cane setts are placed. The temperature is controlled by a Sunvic thermostat in conjunction with a hot wire vacuum switch. The tank, which is provided with an overflow and outlet, can treat about 150 lbs. of setts at a time. A lid should also be provided.

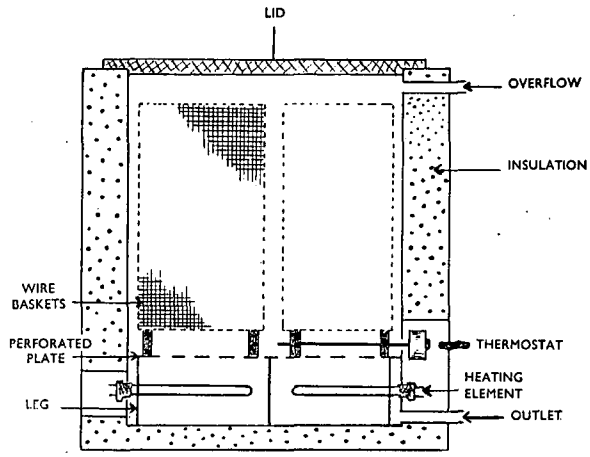


Fig. 1. Diagram of Laboratory Apparatus for hot water treating of sugarcane cutting.

(*b*) *Apparatus Suitable for Planters' Use*

The apparatus makes use of a 44 gallon oil drum. The top of the drum is removed and perforated with $\frac{3}{4}$" holes , and to this is attached three 5-inch legs, for which purpose bolts are used. This perforated disc is used as a base on which the canes rest. This prevents any over-heating which may take place if the cane was directly on the bottom. The drum is suitably lagged with a non-combustible material, and it is then placed on bricks at a suitable height to allow the flame of a 5 pint brazing lamp (which is the source of the heat) to reach the base of the tank. The flame of the lamp should be directed onto a brick which reflects the heat upwards, and when the lamp is removed the brick will continue to give off a certain amount of heat. The setts are bundled and placed in an upright position. The tank is filled to a suitable height, (i.e. so that no water will overflow when the setts are immersed), and the water is heated to 50°C, which should take

about half an hour. The setts are put in and the water is heated slowly until the temperature again reaches 50°C. The lamp is then removed. Periodically more heat will have to be applied in order to maintain the temperature. In practice it has been found necessary to apply heat only once or twice. A lid is provided to decrease the loss of heat from the surface of the water.

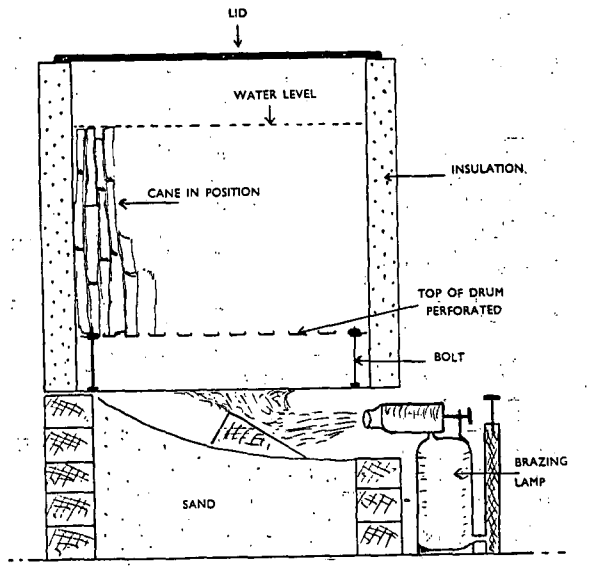


Fig. 2. Diagram of apparatus which could be used by planters for hot water treatment of sugarcane setts.

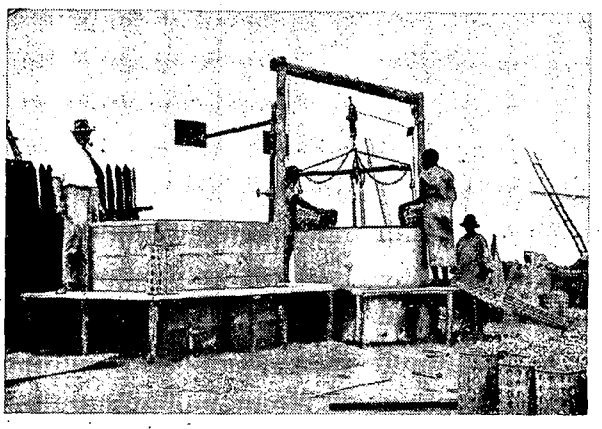
(c) *Treating Tanks Suitable for Heating By Steam*

The tanks are usually constructed out of iron but a very satisfactory tank has been made by lining, with galvanised iron (all joints must be soldered), a wooden tank made out of $1\frac{1}{4}$" thick timber and bolted together. This type of tank is easily constructed with relatively unskilled labour and any alterations can easily be carried out.

Tanks of 60-80 cu. ft. capacity are very satisfactory, and in tanks of this size it is unnecessary to have forced circulation. The convection currents are sufficient to maintain the water at an even temperature. The heating is done by passing steam through a perforated pipe arranged in the form of a fork and situated at the bottom of the tank. A couple of inches above this heating element is a perforated plate, which acts as a platform on which the baskets containing the setts, rest.

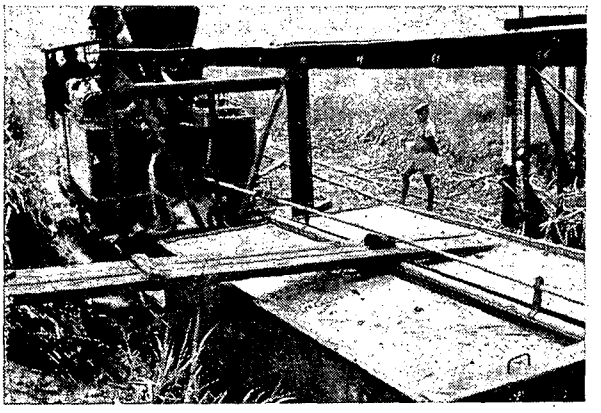
The tanks should have provision made for an overflow, and an outlet which should be of a fairly large diameter.

The temperature is controlled manually by operating a steam valve, or an automatic control can be installed. If the tanks are lagged the temperature regulation is made much easier, but this is not in any way absolutely necessary.



Hot water treating tanks at Umhlatuzi propagation farm. The tank on the left made out of wood. The one on the right out of metal.

A novel way of solving the problem of having to cart seed cane to a central place, usually the mill, for treatment, has been solved by the Illovo Sugar Estates, Ltd. who have installed a hot water treating tank on a cane truck. This is moved from place to place by a steam locomotive. The steam from the engine provides heat for the treating tank, and water for the tank is collected from the same source as that for the steam engine. The temperature is controlled by an automatic steam regulating valve.



Hot water treating tank as used by the Illovo Sugar Estates, Ltd. The treating tanks is in the foreground and the steam engine in the background.

Method of Treatment

The method of treatment is the same, whatever type of apparatus is used. The water should be heated up to 50°C and then the seed cane put in and the water heated again until the temperature returns to 50°C. After treatment, the canes are more subject to attack by pathogenic organisms and should be completely immersed in an organo mercurial fungicide. It has been found that a number of varieties, especially N:Co.310, tend to split rather badly when immersed in the hot water.

It has been suggested that the fungicide should be included in the treatment tank but until we know more about the rate of deterioration of the fungicide, it is advisable to keep the two operations separate.

(*d*) *Effect of the Hot Water Treatment on Germination*

In order to find out the effect of the hot water treatment on germination, three experiments were carried out which in fact simulated three different conditions for germination.

(*a*) Single bud setts, (divided into tops, middles and bottoms), were planted in sand in germinating flats and placed in a constant temperature room. The temperatures was maintained at 90°F and adequate moisture was always present. This would represent conditions which were ideal for germination.

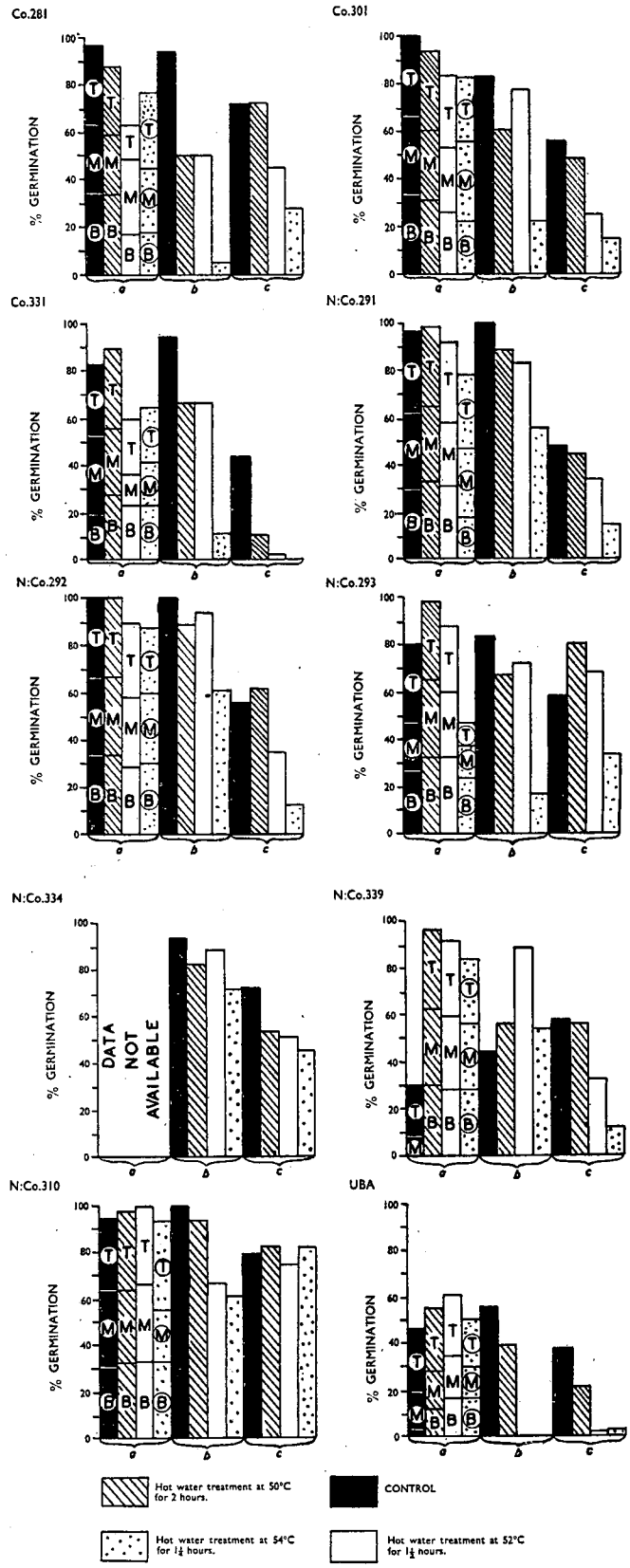
(*b*) Three single-budded setts were planted in sand in a 5-inch earthenware pot and placed in the glasshouse. Moisture was always optimum but the temperature dropped during the night. This experiment was replicated six times. This would represent conditions which were very good for germination but possibly not as good good as those obtained in (*a*).

(*c*) Three-budded setts were planted under good field conditions. The experiment was planted on the 10th December and final germination counts were made on the 25th January, 1954. Over this period, 7.1 inches of rain were recorded.

From these results it appears that if perfect conditions ((*a*) above) for germination exist, all the varieties tested at the three time-temperature combinations, would give a good stand of cane. In N:Co.339 the control is very low and the lower buds failed to germinate. The reason for this is uncertain but the variety does sometimes germinate very badly. In this variety the hot water treatment appears to have stimulated germination. Generally the top, middle and bottom buds do not show much difference in germination. The seed cane used in this experiment was typical dry land cane which had been subjected to a prolonged drought.

In the glasshouse ((*b*) above) the germination is very similar to that in (*a*), with the exception that the percentage germination is lower.

Under field conditions ((*c*) above) the germination is considerably less than that in either (*a*) or (*b*). The treatments 52°C for 1½ hours, and 54°C for 1¼ hours are too severe for most of the varieties, with the exception of N:Co.310 which will stand the heat treatment exceptionally well. The treatment of 50°C for 2 hours has given, in nearly every case, a germination which is as good as the control. The exception is Co.331, which does not withstand the



These graphs show the percentage germination recorded for a number of varieties when treated with hot water at various temperatures and times.

heat treatment well, and has resulted in some very poor stands of cane. Poor germination in this variety is not always the case, but the condition of the seed cane probably plays an important part. Uba and Co.301 have given very poor gemination, and in field plantings the strike has sometimes been disappointing.

Rooting:

The following table gives the extent of root development at the various hot water treatments.

G=Good root development
F=Fair
P=Poor
VP=Very Poor

	Control	50°C for 2 hrs.	52°C for 1½ hrs.	54°C for 1½ hrs.
Co.281 ...	F	F	P	P
Co.301 ...	G	F	P	P
Co.331 ...	F	F	P	P
N:Co.291 ...	G	F	P	VP
N:Co.292 ...	P	F	F	P
N:Co.293 ...	P	G	F	P
N:Co.310 ...	G	G	F	P
N:Co.334 ...	—	—	—	—
N:Co.339 ...	P	F	F	P
Uba	P	F	F	P

Table 1 (*a*) from experiment carried out in constant temperature room.

	Control	50°C for 2 hrs.	52°C for 1½ hrs.	54°C for 1½ hrs.
Co.281 ...	F	P	P	VP
Co.301 ...	G	F	F	P
Co.331 ...	F	F	P	VP
N:Co.291 ...	G	G	F	P
N:Co.292 ...	F	F	F	P
N:Co.293 ...	G	F	F	VP
N:Co.310 ...	G	G	F	F to P
N:Co.334 ...	G	G	G to F	F
N:Co.339 ...	F	F	F	P
Uba	F	F	P	P to VP

Table 1 (*b*) from experiment carried out in the glasshouse.

From the above observations it is easily seen that the hot water treatment tends to inhibit root development. At the higher temperatures this inhibitory effect would weaken the shoots as the only plant food available to the plant would be that which is stored in the sett. If the shoots were rather weak, as is usually the case when treated at 54°C, they would probably die before any shoot roots were formed, resulting in a poor stand.

Rate of Germination

After the hot water treatment the rate of germination appears to vary somewhat. N:Co.310 germinates more rapidly after the hot water treatment, and even at the higher treatment temperatures, the speed of germination remains fairly rapid. The other varieties tested, after hot water treatment at 50°C, germinate as rapidly as the control, but when the higher temperatures are used the rate of germination is much slower, especially at 54°C.

General Observations on the Hot Water Treatment of Setts

The cane selected for hot water treatment should be well grown, with well formed buds and showing no signs of premature germination. Buds which have begun to germinate on the standing cane are easily killed by the hot water treatment.

If seed cane is going to be heat-treated, the age of the cane does not seem to play a very important part. After the hot water treatment, very good stands of cane have been obtained by taking good seed and cutting the whole stick into setts. Some workers have recommended that old seed cane should be used, but in Natal we have not found that to be the case. In only one instance has there been a partial failure in germination due to the type of seed cane used. In this case the buds were extremely young and simply rotted in the ground, and even without hot water treatment it is probable that a number of these setts would have rotted.

In preparing setts for hot water treatments it is unnecessary to remove the trash. When the sticks are cut quite a lot of trash automatically falls off, and after the heat treatment the trash is left very soft and soon falls off with handling or quickly rots in the ground. The advantage of leaving the trash on is that it protects the buds during the frequent handling of the setts which is necessary during the hot water treatment.

Summary

(1) Hot water treatment tanks for (*a*) laboratory use (*b*) planters' use and (*c*) where steam is available, are described.

(2) The effect of the hot water treatment temperatures, of 50°C, 52°C and 54°C, on germination of some local varieties are given.

(3) Root development and rate of germination is discussed.

(4) General observations on hot water treatment are made.

REFERENCES

[1]Cook M. T., (1947) Viruses and virus diseases of Plants Page 55.

[2]Steindl, D. R. L., and Hughes, C. S., (1953) Ratoon Stunting Disease. Cane Growers Quarterly Bulletin Vol. XVI, No. 3, 79.

Yoder, P. A. (1924) Hot water treatment of Dormant and Sprouted Seed Cane. U.S. Department of Agriculture. Dept. Circular 337.

Dr. McMartin (Chairman) said that this summarised some recent experiments carried out to eliminate, if possible, the ratoon stunting disease which now appeared to be present in Natal. It was a record of what we knew up to now, but further study was necessary.

Dr. Dodds pointed out that almost all of the cane varieties mentioned were thin canes and he asked

what would be the effect on thicker cane varieties and how would they react to this hot water treatment.

Mr. King said that no POJ canes had been treated but in replanting the collection of varieties at the Experiment Station it would appear that the *Saccharum officinarum* type of cane did not respond well to hot water treatment. In some cases heat treatment in an oven at 50° for twenty-four hours was necessary.

Mr. Main asked if any cold water treatments had been tried out at the same time as the hot water treatment. In India, treatment with limed water in the cold gave very good results as far as germination was concerned.

Mr. King said that was a different experiment altogether. It was merely an attempt to improve germination and not to cure the cane of any disease. When we had tried cold water treatment, germination had improved, but there was no increase in the final yield.

Dr. McMartin supported this view and said that when soaking in cold water had been tried, they had found that no water was taken up unless cuttings with leaves left on were used, when transpiration from the leaves probably caused the uptake. Treatment with limed water had also been tried, with very conflicting results.

Mr. Main stated that at the onset of the very hot weather in India, the high ambient temperatures automatically raised the temperature of the water in which the cane setts were soaked, and the good results claimed for the so-called cold, and limed, water treatments may have anticipated the present results from hot water treatment.