SOUTH AFRICAN SUGAR INDUSTRY

AGRONOMISTS' ASSOCIATION

3330/15 RSD and HWT TRIAL

CAT. No.: 1752

Object: To investigate the effect of Hot Water Treatment (HWT) and Ratoon Stunting Disease (RSD) on four varieties of sugarcane.

This crop: Plant **Age:** 12,2 months (20.9.89 to 22.9.90)

Location: ZSA Experiment Station B 13-24.

Soil type: PE.1 sandy clay loam derived from gneiss.

Design: Split-plot design, three replications.

Spacing: 1,5m between rows.

Fertiliser (kg/ha):

	N	P_2O_5	K_2O
P	140	100	60

Rainfall: 503,4 (mm) **Irrigation:** 1 221,0 (mm).

Treatments:

a) Varieties: Main plots (first digit)

1. ZN79-2343
2. ZN79-3266
3. N14
4. NCo376

b) Seedcane treatments: Sub-plots: 4 treatments consisted of combinations of two seedcane sources (RSD-infected and RSD-free), with or without Hot Water Treatment (HWT), as below:

1. RSD infected seedcane, HWT.
2. RSD infected seedcane, no HWT.
3. RSD-free seedcane, HWT.
4. RSD-free seedcane, no HWT.

Conduct: Varietal seedcane was supplied either from RSD-infected or RSD-free nurseries and cut into 75 - 80cm seed-pieces. Half of the seedcane was hot-watered treated at 50 C for 2 hours and the other half was not treated. Treated seedcane was planted normally and covered immediately. Monthly records were taken of a) Number of rogued whips per plot, and b) tiller population per plot. RSD diagnostic tests were performed when the crop was at +-9 months of age and prior to harvest. The diagnosis of RSD was based on microscopic examination of extracts of xylem sap from stalks.

Samples of 6 stalks were collected randomly from guard rows of each sub-plot and processed immediately. An internode from the basal part of each stalk was cut and the xylem sap was blown through the section using low pressure compressed air. A drop of xylem sap was transferred onto a microscopic slide and examined by phase contrast microscopy at a magnification of X1000. The characteristic bacteria of RSD, Clavibacter xyli subsp. xyli, was diagnosed. In the absence of characteristic bacteria up to 5 microscopic fields were examined. Regular disinfecting of implements was a routine exercise during the weeding, sampling and harvesting periods.

RESULTS

Relevant disease records from the plant crop together with yield and quality data are shown in the attached table.

a) RSD incidence: Cane samples from each sub-plot were taken at approximately 9 and 12 months of age and after the RSD diagnosis test, data from two sampling dates were pooled together and analysed. The results indicated that seedcane taken from the RSD-free nursery contracted very little RSD in the plant crop, and negligible RSD bacteria were detected in samples from plots receiving HWT seedcane. Although samples from N14 and NCo376 showed more RSD than the two local selections, differences were not statistically significant. However, very highly significant interactions between HWT x varieties and source of seedcane x HWT (interaction tables A and B) indicated that samples from non hot-water treated seedcane showed significantly less RSD incidence in ZN79-2343 than in other varieties

Microscopic diagnosis of RSD is quite reliable when fresh samples are processed. However, the main source of inaccuracy in diagnosis lies in the detection of RSD bacteria in samples with low disease incidence. In preparations from this trial it was noted that RSD bacteria were most readily seen in samples taken from plots receiving RSD-infected seed without hot water treatment. However, in three other treatments, whenever a positive diagnosis occurred, sparse bacteria were seen.

b) Germination: The number of primary shoots produced at 4 weeks after planting was used to compare the effects of treatments. As was expected, the germination pattern in the 4 varieties was very highly significant. The highest number of primary shoots was produced by a local selection, ZN79-2343, while the other local variety had the lowest germination counts. RSD-free seedcane produced more shoots than RSD-infected seedcane. On the other hand, plots planted with HWT material had substantially lower germination counts than controls (not HWT). This effect was very pronounced in ZN79-3266, when HWT caused nearly 75% loss on germination counts, while the rest of the varieties suffered by only 5 - 11%, (interaction table C).

c) Tiller counts at +-18 weeks: One of the local selections, ZN79-2343, with the highest germination counts at 4 weeks, produced the lowest tiller counts/ha at 18 weeks, while the highest tillers were recorded with NCo376, However, the differences were not statistically significant. The effect of treating seedcane with hot water prior to planting, which showed adverse effect on the initial germination count, was still prevalent when tiller population was measured at +-18 weeks.

d) Cane yield: The differences in yield between HWT and not HWT seedcane was very highly significant. The pronounced yield reduction in hot water treated cane was a consequence of reduction in stalk population by HWT that caused nearly 15% yield loss accross all varieties. Although RSD-infected material produced lower yields, no significant differences between plots supplied with healthy and diseased material could be detected.

e) Stalk population: Stalk population at harvest followed the same pattern as tiller population at +-18 weeks. Among the test varieties, NCo376, significantly surpassed the number of millable stalks in other varieties by producing over 115 000 stalks/ha, while the lowest stalk number of 71 000 was produced by one of the local selections, ZN79-3266. The RSD-free seedcane produced nearly 10% more stalks than RSD-infected cane, and HWT depressed the number of millable stalks significantly by as much as 9% in the plant crop. A very highly significant interaction between HWT and RSD treatments (interaction Table E) shows that stalk population decline in plots receiving HWT seedcane is greatest in the RSD-infected material, and also HWT significantly reduced stalk population in ZN79-3266 (Interaction Table D).

f) ERC% cane: The two local selections, ZN79-3266 and ZN79-2343, produced marginally superior cane quality than N14 and NCo376, the differences were not statistically significant. Neither HWT nor RSD had any significant effect on ERC% cane.

g) ERC yield: The highest sucrose yield was obtained from NCo376, followed closely by one of the local varieties, ZN79-2343. However, the differences in ERC Yield between varieties was not significant. Exposure of seedcane to HWT was the only parameter which significantly affected ERC yield in the plant crop, when control (not hot-water treated) plots produced as much as 15% higher ERC yield than HWT seedcane.

h) Smut incidence: The level of smut in the plant crop was very low. As was expected, NCo376 was the most susceptible variety with approximately 3 900 whips/ha. One of the local varieties, ZN79-2343, remained completely free of smut, and the other local variety, ZN79-3266 showed very high resistance during the plant crop. Although plots receiving RSD-infected seedcane and plots planted with HWT material produced substantially more smut whips, the differences were not statistically significant. The significant interaction effect of HWT x RSD treatments (Interaction Table F) showed that RSD-infected material produced significantly greater number of whips when exposed to HWT.

CONCLUSIONS

Earlier trials have demonstrated that HWT increased smut incidence in NCo376. The object of this experiment was to determine whether or not the exposure of planting material to HWT would promote the production of smut whips in very highly resistant varieties. Plant crop results indicated that using RSD-free planting material increased stalk population at harvest, which in turn had a beneficial effect on cane yield and ERC yield. On the other hand, the exposure of seedcane to HWT at 50 C for 2 hours had an adverse effect on early germination, which eventually depressed cane and ERC yields at harvest. Among the test varieties, ZN79-3266 was more sensitive to HWT than the others.

PS/Nov'90

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DISEASES AND HARVEST DATA:: Plant crop

	R S D %	Germination counts x1000/ha	Tiller counts x1000/ha at ±18 weeks	Cane yield t/ha	Stalks x1000/ha at harvest	E R C % cane	E R C yield t/ha	Smut whips/ha (1)
Varieties (Main plots) V								
1. ZN79-2343	22,22	26,24	126,78	105,26	92,13	14,04	14,75	0 (1,00)
2. ZN79-3266	29,17	15,39	135,77	87,70	71,28	14,07	12,45	9 (1,80)
3. N14	36,11	24,10	146,60	93,02	92,24	13,67	12,71	250 (11,22)
4. NCo376	34,03	19,00	151,82	108,52	115,81	13,81	14,95	3 889 (60,34)
L.S.D. P = 0,05	N.S.	3,78	N.S.	N.S.	19,74	N.S.	N.S.	- (10,96)
P = 0,01	N.S.	5,73	N.S.	N.S.	29,90	N.S.	N.S.	- (16,60)
S.E. main plots ±	13,59	3,78	62,57	32,67	19,76	0,57	4,67	- (10,97)
S.E. variety mean ±	3,92	1,09	18,06	9,43	5,70	0,16	1,35	- (3,17)
C.V.%	44,73	17,86	44,62	33,13	21,27	4,08	34,06	- (59,00)
Seedcane source (S)								
1. RSD infected	49,31	23,02	135,25	94,21	88,28	13,94	13,18	1 208 (20,03)
2. RSD-free	11,46	19,34	145,24	103,04	97,45	13,86	14,25	866 (17,15)
Significance	**	**	N.S.	N.S.	**	N.S.	N.S.	- N.S.
Seedcane treatment (T)								
1. HWT	4,51	18,17	127,67	90,83	88,53	13,82	12,56	1 218 (19,38)
2. Not HWT	56,25	24,20	152,82	106,41	97,20	13,97	14,86	856 (17,80)
Significance	**	**	**	**	**	N.S.	**	- N.S.
S.E. Sub plots ±	12,36	3,92	23,49	17,76	9,09	0,55	2,43	- (8,36)
S.E. Treatment mean ±	2,52	0,80	4,79	3,63	1,86	0,11	0,50	- (1,71)
C.V.%	40,70	18,52	16,75	18,01	9,79	3,99	17,70	- (44,96)
Interactions	VxT,SxT	VxT	N.S.	N.S.	SxT,VT	N.S.	N.S.	- SxT
Trial mean	30,38	21,18	140,24	98,62	92,86	13,90	13,71	1 307 (18,59)

(1) Whips/ha from each plot was transformed using square root of (x+1) before analysis and are shown in brackets.

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INTERACTION TABLES: Plant Crop

A: RSD% incidence: Varieties x HWT

Varieties	Seedcane treatment: HWT	Not HWT	Mean
ZN79-2343	6,94	37,50	22,22
ZN79-3266	1,39	56,94	29,17
N14	1,39	70,83	36,11
NCo376	8,33	59,72	34,02
Mean	4,51	56,25	

B: RSD% incidence: RSD x HWT

	Seedcane treatment: HWT	Not HWT	Mean
RSD infected	6,25	92,36	49,31
RSD-free	2,78	20,14	11,46
Mean	4,51	56,25	

C: Germination counts x 1 000/ha: Varieties x HWT

Varieties	Seedcane treatment: HWT	Not HWT	Mean
ZN79-2343	25,57	26,91	26,24
ZN79-3266	6,15	24,63	15,39
N14	22,61	25,29	24,10
NCo376	18,33	19,67	19,00
Mean	18,17	24,20	

D: Stalks x 1 000/ha at harvest: Var x HWT

Varieties	Seedcane treatment: HWT	Not HWT	Mean
ZN79-2343	92,15	92,10	92,13
ZN79-3266	59,32	83,25	71,28
N14	87,05	97,43	92,24
NCo376	115,60	116,02	115,81
Mean	88,53	97,20	

E: Stalks x 1 000/ha at harvest: RSD x HWT

	Seedcane treatment: HWT	Not HWT	Mean
RSD infected	78,58	97,97	88,28
RSD-free	98,48	96,43	97,45
Mean	88,53	97,20	

F: Smut whips/ha: RSD x HWT

	Seedcane treatment: HWT	Not HWT	Mean
RSD infected	1 676	741	1 208
RSD-free	759	972	866
Mean	1 218	856	