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SOUTH AFRICAN SUGAR INDUSTRY
AGRONOMISTS' ASSOCIATION

3300/72 EFFECT OF SMUT ON YIELD AND QUALITY

Cat: 1493

Object: To investigate the effects of smut on yield and quality of NCo 376 at different levels of infection.

This crop: Plant Age: 11,5 months (24.10.84 to 10.10.85)

Location: ZSA Experiment Station, F 1/2.

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

Design: Randomised blocks, 4 replications.

Spacing: 1,5 m between rows, 0,5 m between stools.

Variety: NCo 376.

Fertiliser:

	N	P_2O_5	K_2O
kg/ha	140	100	60

Rainfall: 663,9 mm **Irrigation:** 1056,0 mm

Treatments:

1. Plots planted with 5% inoculated stools.
2. Plots planted with 10% inoculated stools.
3. Plots planted with 20% inoculated stools.
4. Plots planted with 50% inoculated stools.
5. Plots planted with 75% inoculated stools.
6. Plots planted with 100% inoculated stools.
7. No inoculated stools.

Conduct:

a) Stools consisting of 3 single-budded setts, spaced 0,5 m apart.
b) Inoculated setts were dipped in a fresh smut spore suspension containing 2 whips per litre of deionised water for 10 minutes.
c) Uninoculated setts were dipped in Bayleton fungicide (1,0 ml Bayleton 250 EC per litre of water) for 5 minutes before planting in the field.
d) Different numbers of inoculated stools, according to each treatment, were included randomly in each plot.
e) Planted stools were covered immediately.

Records

Monthly records were taken of (a) infected stools per plot after marking them with plastic ribbons, and (b) number of whips rouged per stool and per plot.
At harvest routine quality analysis for:-
a) Samples from healthy stools.
b) Samples from stools with 1 whip , 2, 3, 4, 5, 6 and 7 whips.
c) Samples from stools with 8 and more whips.

RESULTS

Relevant smut incidence, stalk population and cane yield are shown in Table 1, while the results of quality analysis of different samples at various levels of whip production shown in Table 2.
It should be noted that whips were rouged regularly to minimise the spread of the disease and interference with treatment effects. Therefore all the results should be studied in the light of the fact that restricted smut control measures were observed during the test period.

a) Germination: The number of germinated stools at different treatments were very similar, with no real differences between the treatments. This indicated that the inoculation method used to create various infection levels did not encourage or supress the germination of stools.

b) Stool infection: As expected, there was a very highly significant difference between treatments, indicating that the desired levels of infection were achieved by delibrately assigning various numbers of inoculated stools for each treatment. The correlation between the assigned infection levels and the obtained smut levels during the plant crop, shown in Fig. 1, was very highly significant ($P = 0,001$). However, none of the plots planted with uninoculated setts remained free of smut, and on the other hand none of the plots planted with 100% inoculated setts produced 100% infection.

c) Smut whip production: The number of whips produced at different levels of infection followed the same pattern as stool infection percentages, and the relationship between these two values was linear and very highly significant. ($P = 0,001$), Fig. 2.

The lowest number of whips (1389 whips/ha) was rouged from the control plots, planted entirely with uninoculated setts. In contrast the highest number of whips (122278 whips/ha) was rouged from plots receiving 100% inoculated setts.

d) Stalk population: Differences in the number of millable stalks harvested at different smut infection levels were very higly significant. The highest number of stalks were recorded in the control plots, while plots planted with 100% inoculated setts produced the lowest stalk numbers.

Stalk population dropped marginally at lower smut levels, but a marked reduction occured when the infection level rose above 20% stool infection or 19000 whips/ha.

The relationship between the stalk population and different levels of whip production and stool infection were negatively correlated and highly significant ($P = 0,01$), Fig. 3.

e) Cane yield: The 0,5 m spacing between stools in a row resulted in a below average cane yield in this trial.

Negligible yield reductions were noted at lower smut infection levels, but cane yields were reduced markedly at levels above 20% stool infections. The yields were significantly dropped by 7 and 13% when 58 and 79% of stools were infected respectively.

Yield performance at different whip production and stool infection levels were negatively correlated and both regression coefficients, shown in Fig. 4, were highly significant ($P = 0,01$).

QUALITY TESTS

The quality tests were based on samples taken from stools with different numbers

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of whips rouged during the test period. Unfortunately it was not possible to take the equal number of samples for test. . For instance, stools producing 6 or 7 whips were rare to sample while stools with no whips were abundant. The variability among samples was high, particularly in cane yield per stool and number of stalks per stool.

Cane sampled from stools with different levels of whip production for quality analysis provided additional information such as yield per stool, stalk population per stool, stalk weight per stool and stalk diameter per stool, which are shown in table 2.

a) Cane quality: Apart from fibre%cane, none of the quality parameters such as ERC% cane, TFAS% cane and Reducing Sugars% cane were statistically significant.

When stools produced two or more whips the fibre content of healthy stalks did increase significantly. However, the number of whips rouged per stool was not significantly correlated to the fibre content of remaining healthy stalks.

b) Stalk Numbers/stool: Differences in the number of healthy stalks harvested from stools with different smut levels, i.e. number of whips rouged during the test period, were highly significant. Results indicated that as the number of whips per stool increased, the number of harvested healthy stalks decreased. This was not clearly evident at lower smut levels, but when the number of whips per stool increased to 6 or more there was a marked reduction in stalk population. However, the number of harvested stalks per stool was not strongly correlated to the number of whips rouged per stool.

c) Cane yield/stool: It was shown that as the number of whips per stool increased the cane yield per stool decreased significantly. This was very noticable with stools producing 6 or more whips during the test period. The correlation between thses two parameters was linear and significant ($P = 0,05$) and it indicated that for each whip rouged per stool nearly 550 g cane per stool was lost at harvest, Fig. 5.

d) Stalk weight: The mass of individual healthy stalks from stools with different infection levels was evaluated. The results showed that differences in stalk weight at different smut levels per stool were not significant, although lower weights per stalk were recorded at higher smut levels.

However, the correlation between stalk weights harvested from stools, and different number of whips produced by stools was very highly significant ($P = 0,01$), Fig. 6, and it was shown that for every whip produced by an individual stool there was a 14 g loss in each harvested stalk, irrespective of number of stalks lost for that stool.

e) Stalk diameter: The results indicated that the mean diameter of healthy stalks from stools with different number of whips were not statistically significant, but it was clearly evident that as the number of whips per stool increased the stalk diameter decreased pregressively.

When these two parameters were plotted, Fig. 7, it was shown that the relationship was linear and statistically significant ($P = 0,05$), and it was estimated that for each whip produced by an individual stool the diameter of remaining healthy stalks was further reduced by 0,11 mm. This in turn resulted in reduction of stalk weight and consequently cane yield.

4/CONCLUSIONS.....

CONCLUSIONS

Different levels of smut infection were simulated to evaluate the effect of smut on yield and quality of NCo 376.
Results indicated that:-

1. Cane yield was reduced when the whip numbers or stool infection percentages increased.
2. Stalk population at harvest was adversely affected by increase in whip numbers, or infected stool percentages.
3. Yield loss for individual stools was directly related to the number of whips rouged from that stool.
4. Yield loss and decrease in stalk population was negligible and hard to detect up to ± 20% stool infection or ± 19000 whips/ha, but there was a sharp decrease in yield and population when smut levels were higher.
5. For every whip rouged from individual stools, a 550 g loss per stool was estimated.
6. There was no direct quality loss in healthy stalks obtained from infected stools.

The trial will be grown for one more cycle to obtain more information.

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Table 1 : Smut incidence, stalk population and cane yield (t/ha) at different levels of infection.

Plots planted with inoculated stools	% germinated stool (1)	% smut infected stool (1)	whips/ha rouged (2)	stalks/ ha x 10⁻³ at harvest	Cane Yield	
					t/ha	% of control
0 (Control)	90,9 (72,75)	6,2 (14,15)	1389 (3,073)	142,9	117,70	100,00
5%	87,5 (69,66)	7,5 (14,93)	3567 (3,269)	137,9	117,13	99,52
10%	84,1 (66,69)	13,0 (21,12)	9222 (3,958)	130,4	115,74	98,33
20%	88,3 (70,35)	20,5 (26,82)	18861 (4,275)	134,4	117,06	99,46
50%	86,7 (69,99)	39,2 (38,74)	46722 (4,669)	125,8	112,83	95,86
75%	92,5 (74,38)	57,7 (49,45)	72778 (4,858)	122,8	109,07	92,67
100%	96,2 (79,38)	78,8 (63,07)	122278 (5,085)	111,8	102,14	86,78
Significance	N.S.	***	***	***	*	-
LSD P = 0,05		(6,56)	(0,511)	11,11	9,44	-
P = 0,01		(8,99)	(0,699)	15,22	12,93	-
Trial mean	89,5 (71,88)	31,8 (32,61)	39273 (4,169)	129,4	113,09	96,09
S.E. plot ±	(5,77)	(4,42)	(0,344)	7,48	6,35	-
S.E. Treatment ±	(2,88)	(2,21)	(0,172)	3,74	3,18	-
C.V.%	(8,03)	(13,54)	(8, 24)	5,78	5,62	-

(1) Data were transformed using arc $\sin\sqrt{x/100}$ before analysis and are shown in brackets.

(2) Data were transformed into log x before analysis and are shown in brackets.

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Table 2 : Yield and quality analysis per stool with different number of whips produced during the plant crop (means and standard errors).

No.of whips/ stool	No. of samples	No.of stalks/ stool	Yield/ stool (kg)	mean stalk mass(kg)	ERC% cane	Fibre% cane	TFAS% cane	Reducing sugars% cane	mean stalk diameter(mm)
0	29	12,3 ± 0,8	12,0 ± 0,94	0,96 ± 0,03	10,71 ± 0,24	13,6 ± 0,29	12,82 ± 0,20	0,79 ± 0,05	21,3 ± 0,3
1	25	15,1 ± 0,9	14,5 ± 1,01	0,94 ± 0,03	11,14 ± 0,25	13,1 ± 0,32	13,15 ± 0,21	0,71 ± 0,06	21,7 ± 0,3
2	18	12,4 ± 1,0	11,7 ± 1,19	0,94 ± 0,03	10,85 ± 0,30	14,9 ± 0,37	12,84 ± 0,25	0,64 ± 0,07	20,7 ± 0,4
3	15	13,0 ± 1,1	11,7 ± 1,31	0,89 ± 0,04	11,14 ± 0,33	14,2 ± 0,41	13,09 ± 0,27	0,63 ± 0,07	21,2 ± 0,4
4	16	15,1 ± 1,1	13,7 ± 1,26	0,90 ± 0,04	11,62 ± 0,32	13,9 ± 0,40	13,49 ± 0,26	0,57 ± 0,07	21,3 ± 0,4
5	10	12,9 ± 1,4	12,3 ± 1,60	0,93 ± 0,04	11,36 ± 0,40	14,7 ± 0,50	13,31 ± 0,33	0,62 ± 0,09	20,9 ± 0,5
6	5	10,6 ± 1,9	9,3 ± 2,26	0,84 ± 0,06	11,28 ± 0,57	14,3 ± 0,71	13,18 ± 0,47	0,57 ± 0,13	21,0 ± 0,7
7	8	10,1 ± 1,5	8,8 ± 1,79	0,88 ± 0,05	11,39 ± 0,45	14,3 ± 0,56	13,39 ± 0,37	0,66 ± 0,10	20,8 ± 0,5
8 or more	12	10,8 ± 1,3	9,1 ± 1,46	0,83 ± 0,04	10,71 ± 0,37	14,7 ± 0,46	12,89 ± 0,31	0,83 ± 0,08	20,2 ± 0,4
Significance		**	*	N.S.	N.S.	*	N.S.	N.S.	N.S.
Samples mean		13,0	12,1	0,91	11,07	14,02	13,08	0,69	21,1
S.E.samples ±		4,3	5,06	0,14	1,27	1,58	1,06	0,29	1,50
C.V.%		33,58	41,78	15,54	11,50	11,28	8,09	41,56	7,09

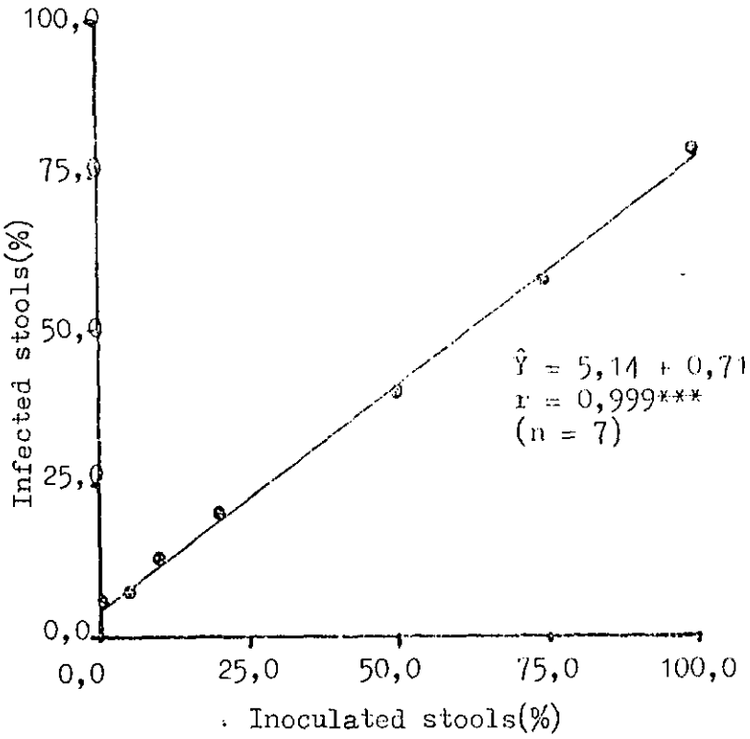


Fig. 1. The relationship between planted smut inoculated stools (%) and observed infected stools (%).

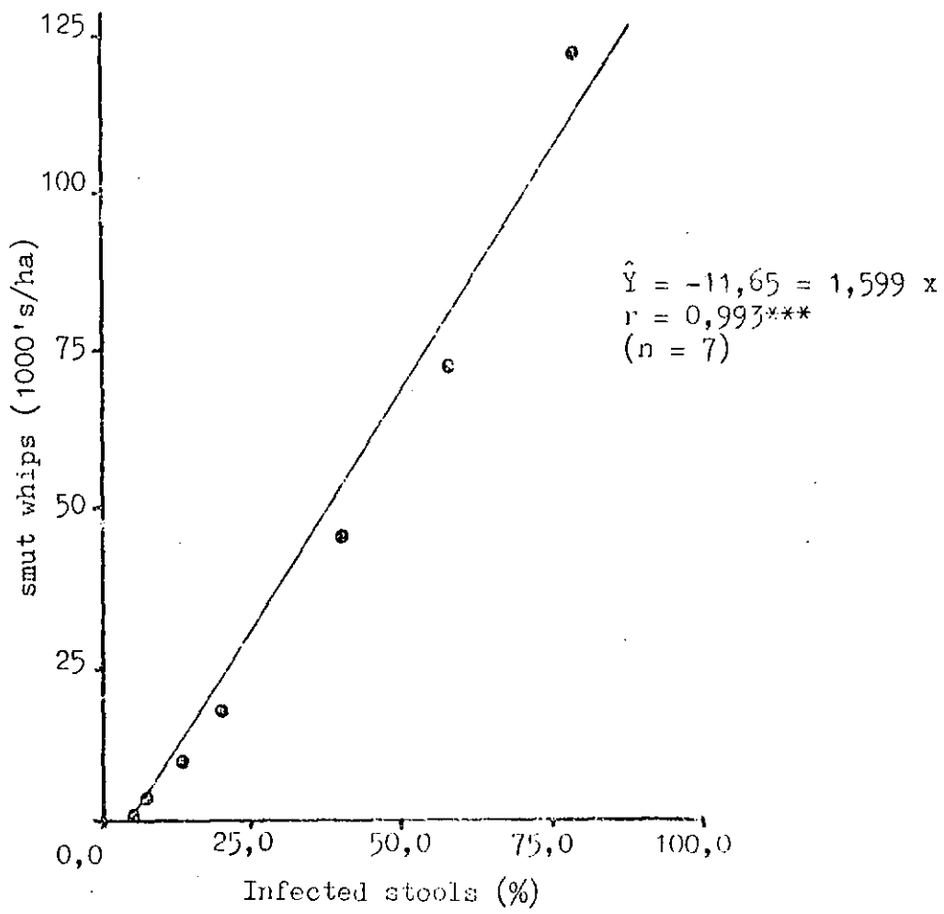
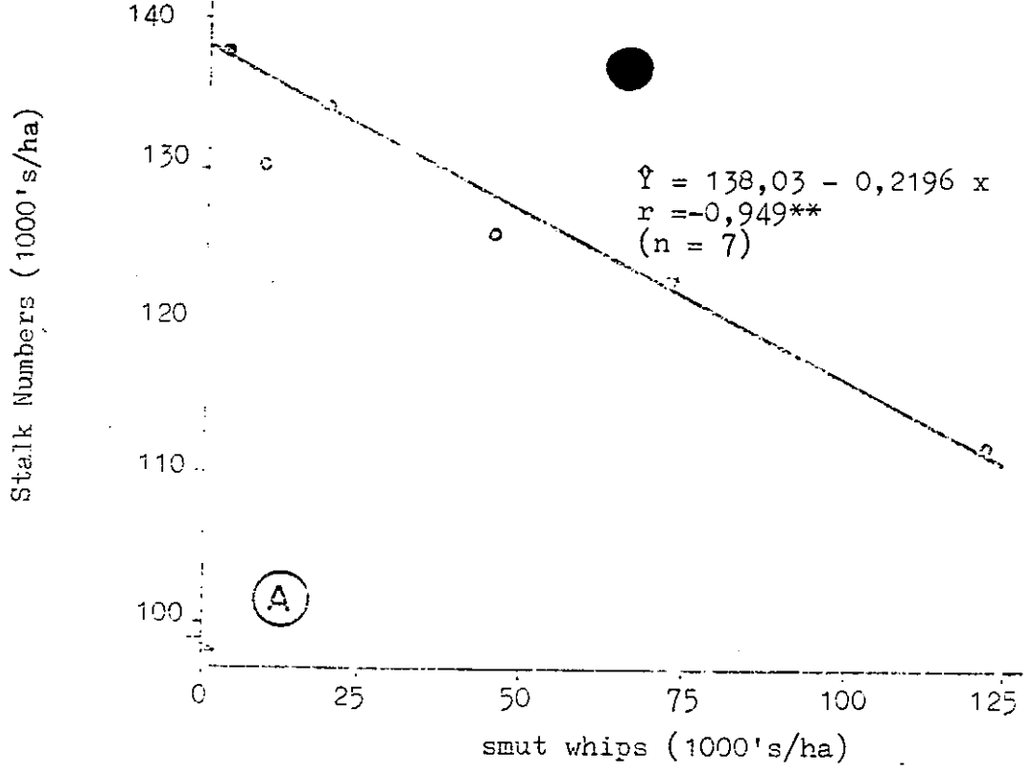


Fig. 2. The relationship between rouged smut whips (1000's/ha) and infected stools (%).



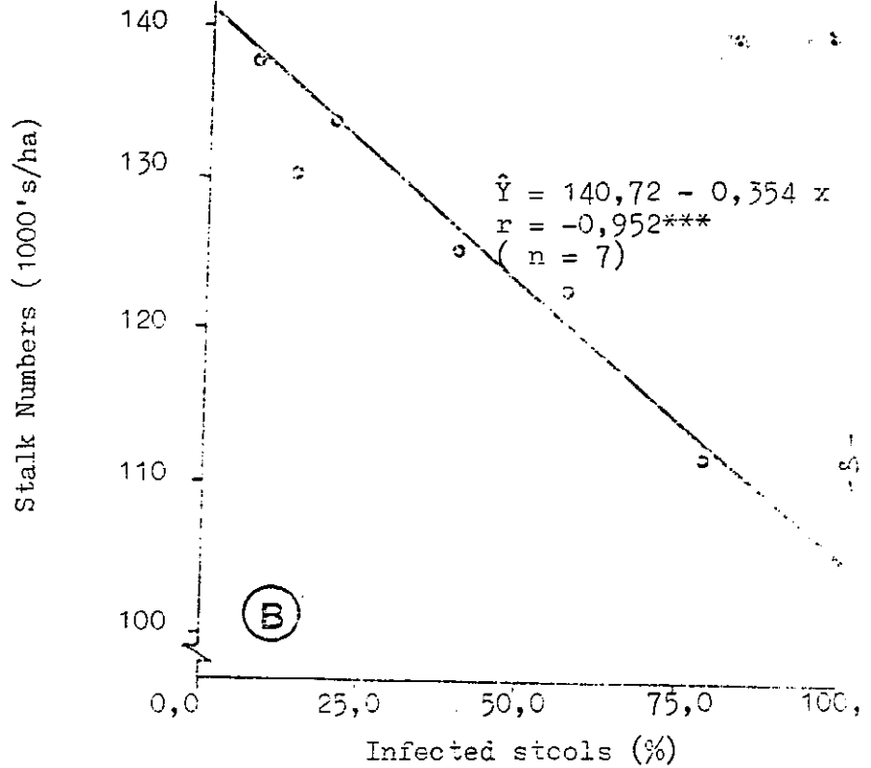
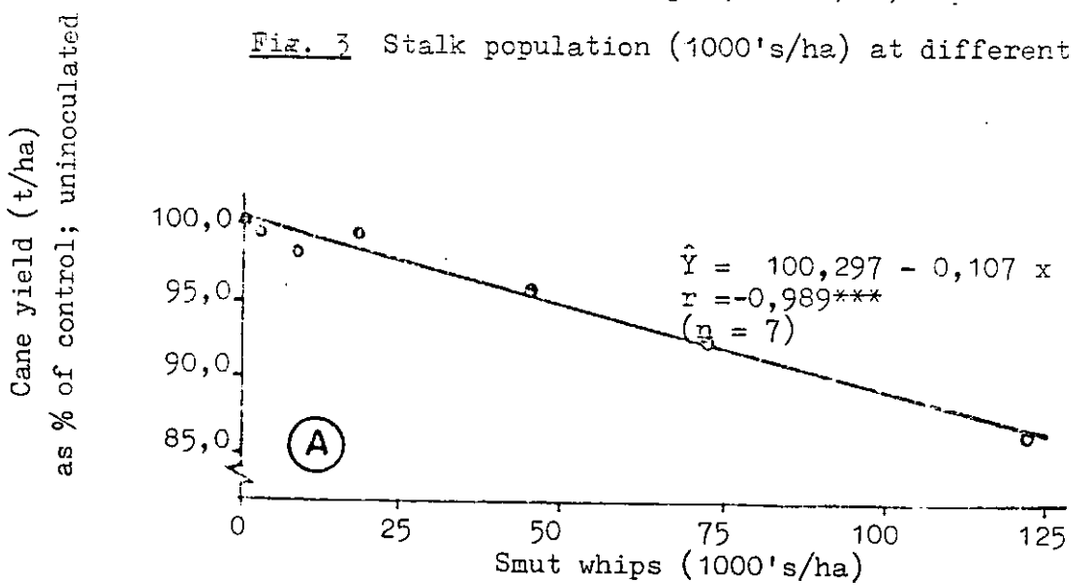


Fig. 3 Stalk population (1000's/ha) at different smut levels; A = smut whips (1000's/ha) and B = smut infected stools(%



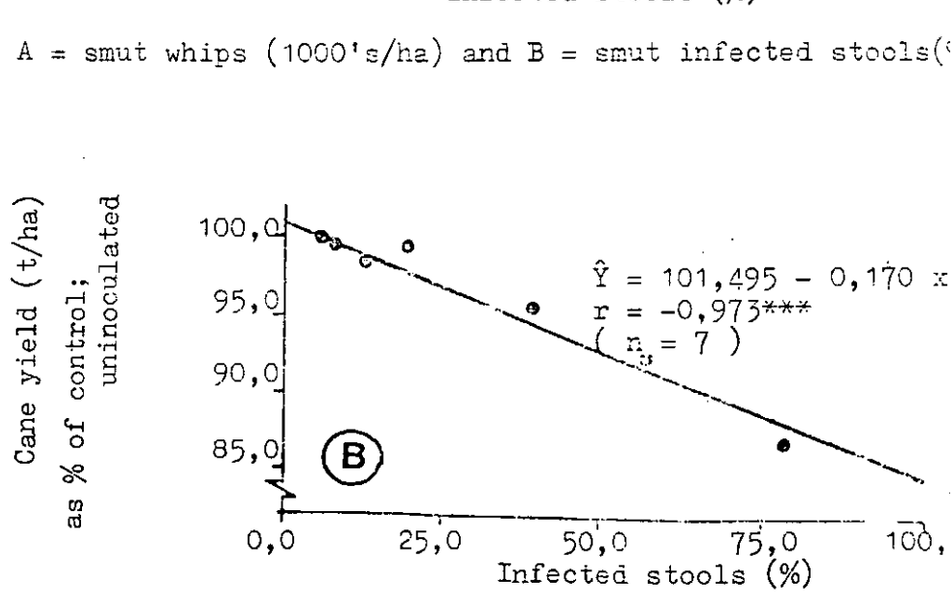


Fig. 4 The effect of smut whips (1000's/ha), A, and infected stools (%) B, on cane yield, (relative to the yield of control) in the plant crop.

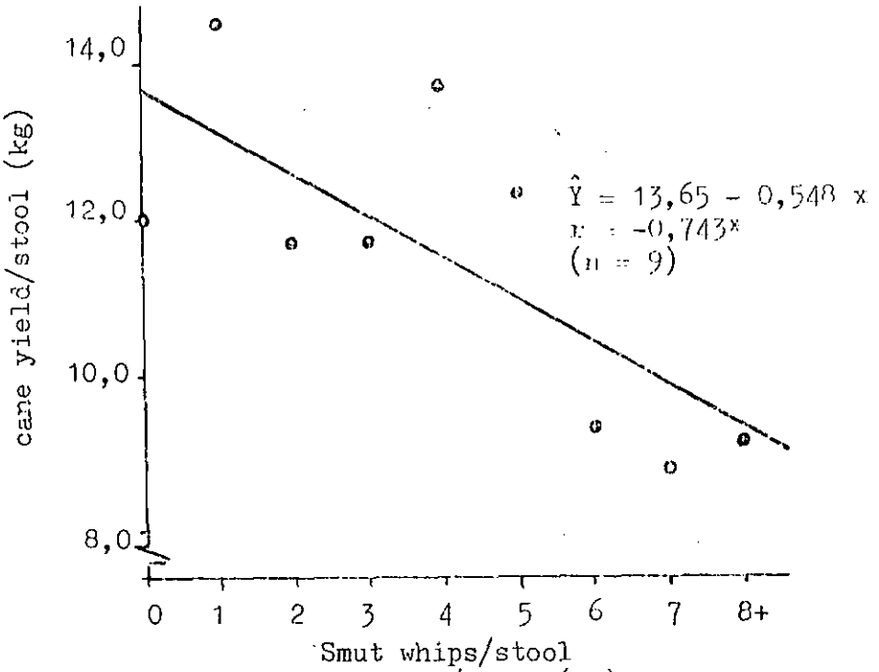


Fig. 5. Cane yield/stool (kg) in relation to the number of smut whips/stool rouged in the plant crop.

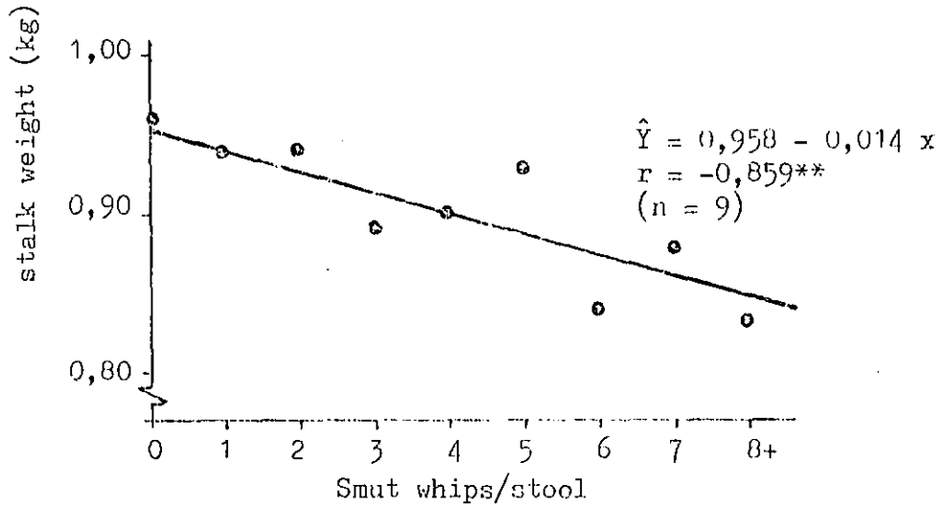


Fig. 6. Stalk weights (kg) of healthy cane in relation to the number of smut whips/stool rouged in the plant crop.

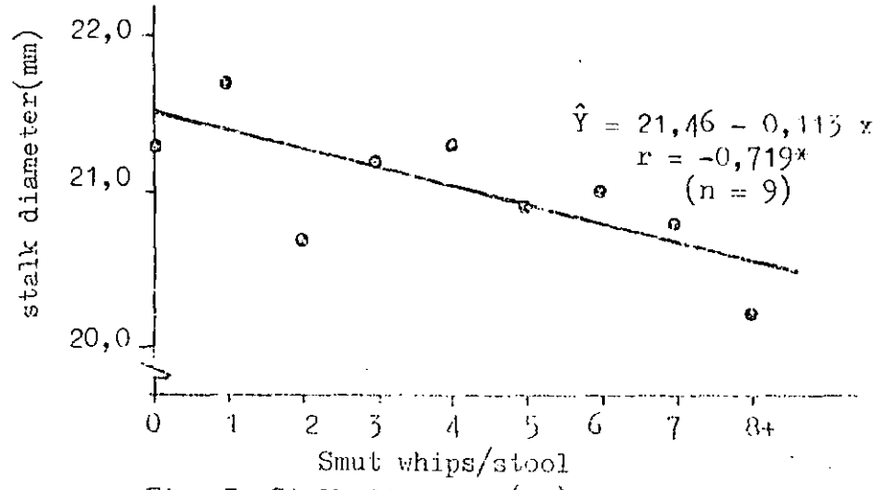


Fig. 7. Stalk diameter (mm) of healthy cane in relation to the number of smut whips/stool rouged in the plant crop.