EFFECT OF TOBACCO SEEDBED TREATMENTS FOR NEMATODE CONTROL ON PLANT GROWTH IN THE FIELD

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SUMMARY

Trials at Millaroo in North Queensland showed that tobacco seedbeds treated with heat or by methyl bromide fumigation provided seedlings free from infestation by the root-knot nematode *Meloidogyne javanica* (Treub).

Early seedling growth was better in the burned beds than in methyl bromide fumigated beds, but an added application of nitrogen fertilizer eliminated this difference by the time of transplanting.

The methyl bromide treatment produced seedlings with markedly higher bromine content than seedlings from fired beds, but this difference was not shown in the cured leaf.

Plants from all the seedbed treatments were similar in field growth and in yield and value of cured leaf.

I. INTRODUCTION

The root-knot nematode *Meloidogyne javanica* (Treub) is a serious pest of tobacco in Queensland. The use of infested seedlings as transplants was proved by Smith (1957) to cause a serious depression in yield of cured leaf even when the seedlings were planted into fumigated fields. Effective seedbed sterilization against nematodes was for a long time achieved by heat produced from burning "antbed" or wood. As both of these materials became scarce in some areas, tobacco growers turned to chemical means of fumigating seedbeds and methyl bromide treatment has become general practice. Investigation by Colbran and Saunders (1957) showed that sterilization by burning produced the larger seedlings. It was necessary therefore to determine whether the kind of seedbed sterilization or the size of transplants influenced yield or quality of cured leaf. Two trials with this object were carried out, one in 1958 and the other in 1960.

II. MATERIALS AND METHODS

General.—Both trials were on a fine sandy loam at Millaroo Research Station on the Burdekin River in North Queensland. In each, the variety Hicks was used and also in each the same three seedbed treatments were made. All

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beds received an overall application of 4:12:8 fertilizer at the rate of 1 lb per 40 sq. ft. at the time of sowing. In both the seedbeds and the field, insect pests and diseases were controlled by standard methods (Smith 1957; Pont 1956).

Seedbed Treatments.—The following treatments were applied in each trial:

A. Methyl bromide under gas-tight covers at the rate of 2·5 lb per 100 sq. ft.

B. Methyl bromide as in A, with application of sodium nitrate at 10 oz per 100 sq. ft. 3 weeks after sowing.

C. Antbed burning, using a 6-in. layer of the central mound structure of *Coptotermes acinaciformis* (Frogg.).

Trial 1.—Each method was applied to a seedbed 40 sq. ft. in area. (See Figure 1.) Sowing was made on July 14, 1958, and the plants lifted for transplanting on September 13. At this time 100 plants taken at random from each bed were assessed for nematode infestation. Seedlings were transplanted into subplots of a 3x3x3 field fertilizer trial, so the seedbed treatments were replicated 27 times. Plots were in a single row and each subplot contained 52 plants. The land had been fumigated on August 15 with EDB, 27·5 per cent. w/v, as a double-row treatment, using 10 gal per ac. The fertilizer treatments, applied on August 28, were (per ac) as follows:

N1, 10 lb N	P0, 0 lb P_2O_5	K0, 0 lb K_2O
N2, 20 lb N	P1, 50 lb P_2O_5	K1, 50 lb K_2O
N3, 30 lb N	P2, 100 lb P_2O_5	K2, 100 lb K_2O

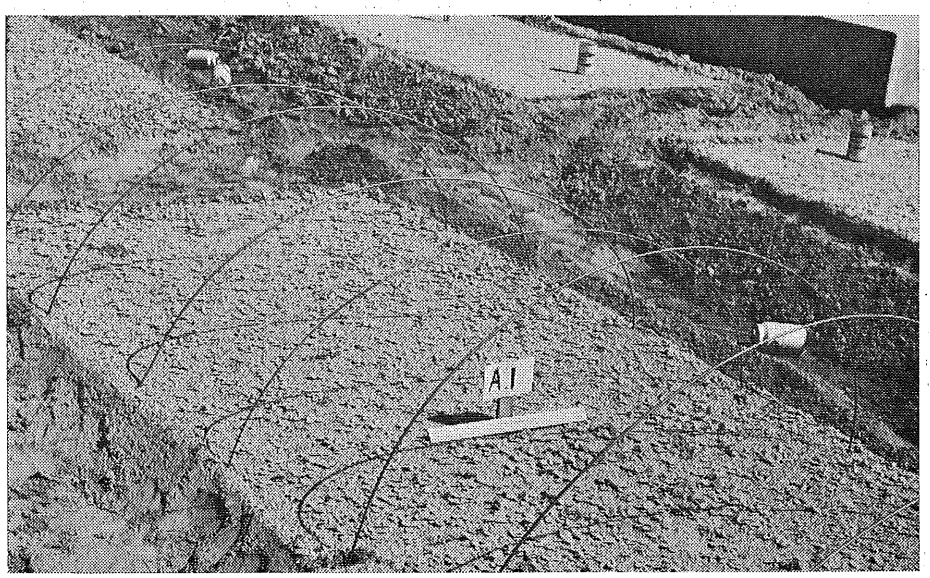

Fig. 1.—One of the seedbeds used in the experiments. Planted June 30, photographed August 10.

The leaf was harvested, cured and graded in the usual way and relative values were assigned to each grade according to leaf quality. After the harvest, plants from each plot were examined for nematode infestation.

Trial 2.—Seedbed sowings were made on June 30, July 4, 7 and 11, 1960, to provide plants of different sizes from each of the three differently sterilized beds. Seedbed plot size for each sowing was 6 ft x 3 ft, with a datum area of 5 ft x 2 ft.

At the time of lifting for transplanting on September 6, the numbers and green weights of washed seedlings were determined from six random 8-in. square quadrats in each bed. After being counted as plantable and unplantable and the green weights of seedlings in both categories determined, the combined plants from each quadrat were dried in a well-ventilated tobacco barn at 65–70°C. Analyses for bromine and chlorine were carried out, using methods given by Colbran and Green (1961). A further 100 plants taken at random from each bed were assessed for nematode infestation.

In the field, each of the seedbed treatment/planting time combinations was replicated 4 times in randomized blocks. Plot size was 4 rows each 35 ft long containing a total of 80 plants. The field had been fumigated on August 18 with EDB, 27·5 per cent. w/v, as an overall treatment, using 20 gal per ac. Harvested leaf was cured and graded as in Trial 1. Yields of cured leaf were determined and samples analysed for bromine and chlorine content. After harvesting, every second plant was assessed for nematode infestation.

III. RESULTS

Trial 1.—Both antbed burning and methyl bromide fumigation effectively controlled root-knot nematode. No infested seedlings were found in any beds at the time of transplanting.

Seedlings in the fired bed made faster growth than those in the methyl bromide treated beds. By the time of transplanting, however, the seedling size was equalized by the additional application of nitrogen fertilizer in one of the methyl bromide treated beds.

Conditions after planting caused some loss of transplants. Death of plants from the fired bed at 9·2 per cent. was higher than that of plants from the methyl bromide treated beds either with or without the additional fertilizer, such deaths being 5·2 and 2·6 per cent. respectively.

Some significant differences were shown between yields and relative values of cured leaf produced by plants from each of the three seedbed treatments (Tables 1 and 2). These differences, however, were in complex relation to the field fertilizer treatments.

TABLE 1

TRIAL 1. YIELDS OF CURED LEAF
(lb/ac)

Fertilizer Treatment	Seedbed Treatment			Mean
	A Methyl Bromide	B Methyl Bromide with Additional Fertilizer	C Burned with Antbed	
N1	1421	1370	1321	1371
N2	1418	1337	1322	1359
N3	1442	1398	1490	1444
P0	1508	1431	1281	1407
P1	1438	1321	1416	1392
P2	1335	1354	1436	1375
K0	1408	1362	1528	1433
K1	1453	1409	1332	1398
K2	1419	1335	1273	1342
Mean ..	1427	1369	1378	1391

At P0 A>>C, B at 1% level

At K0 C>B at 5% level

At K2 A>C at 5% level

No significant differences at other fertilizer rates

TABLE 2

TRIAL 1. RELATIVE VALUES OF CURED LEAF

Fertilizer Treatment	Seedbed Treatment			Mean
	A Methyl Bromide	B Methyl Bromide with Additional Fertilizer	C Burned with Antbed	
N1	90·2	87·2	85·3	87·6
N2	92·6	85·1	87·0	88·2
N3	90·2	87·7	92·7	90·2
P0	96·8	91·2	80·9	89·6
P1	92·9	83·8	92·5	89·7
P2	83·3	85·0	91·6	86·6
K0	89·9	84·8	97·8	90·9
K1	92·0	90·4	85·4	89·3
K2	91·1	84·8	81·7	85·9
Mean ..	91·0	86·7	88·3	88·7

At P0 A>C at 5% level

No significant differences at other fertilizer rates

Only slight nematode infestation occurred on the mature plants after harvesting and this was scattered, without relation to the seedbed treatments.

Trial 2.—Growing conditions in the seedbed were good and differences in seedling size due to differences in sowing time soon disappeared. The various sowing times were not true replicates and these results were not analysed.

Numbers and green weights of seedlings showed only slight variations between the seedbed treatments (Table 3). Mean dry weight of seedlings and percentage of plantable seedlings, however, were greatest in the methyl bromide treated bed to which an additional nitrogen fertilizer application had been made (Table 3).

TABLE 3

TRIAL 2. RESULTS FROM SEEDBEDS

Seedbed Treatment	Type of Seedlings	Mean per Quadrat 8 in. Square				Mean Green Weight per Plant (g)	Mean Bromine Content (p.p.m. Br)	Mean Chlorine Content (% Cl)
		Number	Green Weight (g)	Percentage of Total	Dry Weight (g)			
Methyl bromide ..	Plantable	22	72	36	11·5	3·2	4,488	1·7
	Unplantable	40	46	64		1·2		
Methyl bromide with additional fertilizer	Plantable	36	109	50	14·2	3·1	3,025	1·5
	Unplantable	36	43	50		1·2		
Fired with antbed ..	Plantable	28	86	42	11·1	3·0	110	1·8
	Unplantable	43	50	58		1·2		

The use of methyl bromide greatly increased the bromine content of seedlings (Table 3). The chlorine determinations showed only slight differences.

As in Trial 1, nematodes were effectively controlled in all beds, with only a minor trace of infestation in a few seedlings.

There were no significant differences in yields and relative value of cured leaf from plants coming from the various seedbed treatments. The bromine content of cured leaf was even between treatments and the chlorine content remained uniform (Table 4).

TABLE 4

TRIAL 2. RESULTS FROM CURED LEAF

Seedbed Treatment	Mean Yield (lb/ac)	Relative Leaf Value	Bromine (p.p.m. Br)	Chlorine (% Cl)
Methyl bromide ..	1364	54·5	2803	2·55
Methyl bromide with additional fertilizer	1382	55·8	2689	2·48
Fired with antbed ..	1353	53·8	2727	2·51
	No significant differences		Not analysed	

Nematode infestation in the mature plants was light and scattered.

IV. DISCUSSION AND CONCLUSIONS

These trials again demonstrated that effective seedbed sterilization for root-knot nematode control is achieved either by antbed burning or by methyl bromide fumigation.

Partly by improving water penetration into the beds and partly by the addition of plant nutrients from the ash, firing the beds improved the growth of seedlings in beds so treated compared with those from methyl bromide fumigated seedbeds. By the time of transplanting the response to an additional application of nitrogen fertilizer to one of the methyl bromide treated beds had eliminated the difference in size of transplants.

Under severe conditions after planting out, softer transplants from fired beds, and from methyl bromide fumigated beds, with extra fertilizer, showed higher mortality than those from methyl bromide fumigated beds without additional fertilizer.

Although the methyl bromide treatment greatly increased the amount of bromine in seedlings, this difference in bromine content did not carry through to the cured leaf. Field growth of plants from all seedbeds was normal and the bromine content of cured leaf was comparable with that reported by Colbran and Green (1961) from plants grown on land treated with EDB at 20 gal per ac.

Plants from methyl bromide treated beds did not differ in yield or value of cured leaf produced from those from fired seedbeds.

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