EFFECT OF NEMATOCIDES ON THE HALIDE CONTENT AND BURNING TIME OF FLUE-CURED TOBACCO LEAF IN SOUTH QUEENSLAND

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SUMMARY

Five nematocides were studied under field conditions to determine efficacy in controlling the root-knot nematode *Meloidogyne javanica* (Treub) and influence on the halide content and burning time of flue-cured leaf of the variety Hicks.

DD and EDB gave a high level of nematode control and were consistently superior to "Vapam" and EN18133 (0,0 diethyl 0-2 pyrazinyl phosphorothioate). EN28450 (2-allylthio-2-thiazoline) was ineffective.

Soil treatment with EDB resulted in a marked increase in the bromine content of the cured leaf.

The chloride content of the leaf was increased following soil treatment with non-halogenated as well as halogenated chemicals. The levels were higher in leaf from plots treated with DD and EDB, and in two trials were sufficient to reduce the burning time.

I. INTRODUCTION

In Queensland the high chloride content of tobacco leaf, particularly from the Burdekin and Inglewood districts, has been the cause of much concern. Although the chloride contents of soils and irrigation waters are the most important considerations, several overseas workers (Neas 1959; McCants, Skogley, and Woltz 1959) have reported that the use of soil fumigants aggravates the problem. The increase in halide uptake appears to be due in part to the addition of halide ions to the soil solution and in part to the suppression of nitrification.

During the 1960-61 season three field trials were carried out on farms in the Beerwah-Glasshouse Mountains district to screen DD, EDB, and three non-halogenated compounds against the root-knot nematode *Meloidogyne javanica* (Treub), and compare their relative effects on the halide content and burning time of the cured leaf. The variety Hicks was used. Trials 1 and 3 were on land treated with EDB for the 1959-60 season and Trial 2 on land not previously fumigated.

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II. MATERIALS AND METHODS

The chemicals used were—

EDB.—Ethylene dibromide in power kerosine. EDB (sp.gr. 25/25 2·17) content 12·5 per cent. v/v.

DD.—A mixture of 1,3 dichloropropene and 1,2 dichloropropane containing 50-59 per cent. of total chlorine; inert compounds not exceeding 1 per cent. by weight.

EN18133.—0,0-diethyl 0-2-pyrazinyl phosphorothioate as a 5 per cent. granular formulation.

EN28450.—2-allylthio-2-thiazoline as a 20 per cent. granular formulation in Trials 1 and 2, and as an 80 per cent. emulsifiable concentrate in Trial 3.

"Vapam".—A water solution containing 5 lb sodium N-methyl dithiocarbamate per gal.

A 10 x 4 randomized block layout was used with the following treatments:

1. "Vapam"—25 gal/ac
2. EDB—20 gal/ac
3. DD—20 gal/ac
4. EN28450—15 lb a.i./ac
5. EN28450—25 lb a.i./ac
6. EN28450—35 lb a.i./ac
7. EN18133—5 lb a.i./ac
8. EN18133—10 lb a.i./ac
9. Untreated
10. Untreated

The soil was irrigated prior to treatment. "Vapam", EDB, DD and EN28450 (liquid) were applied by hand injector at a depth of 6 in. in holes 1 ft apart. EN18133 and EN28450 (granular) were applied by hand in a band 9 in. wide 3 in. beneath the intended plant line.

Tobacco plants were grown 18 in. apart with a 4 ft row interspace. There were 30 datum plants per plot.

Heights of 14 plants per plot were measured. One ripe leaf from each of 12 plants per plot was picked and flue-cured prior to halide analyses. When harvesting had been completed, 12 plants in each plot were dug and rated for root-knot nematode infestation. Root-knot indices (0-100) were calculated from the ratings (after Smith and Taylor 1947). Dates of field operations are given in Table 1.

For halide analyses the flue-cured leaves were dried to constant weight in a forced-draft oven at 40°C.

TABLE 1

DATES OF FIELD OPERATIONS

Operation	Trial 1	Trial 2	Trial 3
DD and EDB application	Sept. 12	Sept. 15	Sept. 16
" Vapam " application	Sept. 12	Sept. 15	Sept. 15
EN18133 application	Sept. 22	Sept. 28	Sept. 29
EN28450 application	Sept. 22	Sept. 28	Oct. 11
Planting	Oct. 4	Oct. 6	Oct. 11
Height measuring	Jan. 10	Jan. 10	Jan. 10
Leaf sampling	Jan. 25	Jan. 18	Jan. 18
Root-knot rating	Feb. 15	Feb. 15	Feb. 15

Chloride* was determined on a suspension of 1g oven-dried and powdered leaf sample in approximately 200 ml distilled water by titration with standard silver nitrate solution, using the method of Best (1929).

Bromine was determined by ashing the oven-dried and powdered leaf sample under alkaline conditions (Dudley 1939) at constant furnace temperature (450°C); the ash was extracted with hot distilled water and the extract treated with chromic acid solution of controlled strength. Under these conditions, bromine compounds were oxidised to bromine, which, on being passed through potassium iodide solution, liberated iodine quantitatively. The iodine was estimated by titration with N/100 sodium thiosulphate.

Burning time was taken as the time the flue-cured leaf, dried to a constant weight in a forced-draught oven at 100°C, continued to glow after being started with an electrically heated nichrome wire. The determination was made near the centre of the leaf, half-way between the midrib and the leaf margin. Figures given in Table 4 are the average of 12 determinations, one on each leaf of the sample.

III. RESULTS

The results are presented in Tables 2-6.

"Vapam" at 20 gal/ac gave a low level of root-knot nematode control. Plant growth was improved. Changes in leaf halides were not significant. Burning time was reduced in Trial 2.

EDB (12½% v/v) at 20 gal/ac gave a high level of root-knot nematode control. Plant growth was good. The bromine content of leaf from untreated plots was higher in Trials 1 and 3, which had been fumigated with EDB in the previous season. The chloride content was increased in each trial. Burning time was reduced by EDB in Trial 2.

* A proportion of the bromine in cured leaf is present as inorganic bromides. As silver nitrate tends to precipitate bromide ions before chloride ions, chloride analyses for the EDB-treated plots would be slightly high, less than 10 per cent. of the reported figure being bromine. For the other plots, the amount of bromine present would be insufficient to affect the figure for chloride content.

DD at 20 gal/ac gave the highest level of nematode control in the three trials. Plant growth was good. The bromine content of the cured leaf was not increased but there was a marked increase in the chloride content. In Trials 1 and 2, fumigation with DD reduced the burning time.

EN28450 was ineffective as a nematocide. Plant growth was very poor.

EN18133 (10 lb/ac) controlled root-knot nematodes but was inferior to DD and EDB. Changes in leaf halide and burning time were not significant.

TABLE 2

ROOT-KNOT INDICES

Chemical	Rate per Acre	Root-knot Index		
		Trial 1	Trial 2	Trial 3
"Vapam"	25 gal	68·4	92·2	40·8
EDB	20 gal	9·8	67·2	29·5
DD	20 gal	8·4	35·8	16·1
EN28450	15 lb	62·5	95·2	98·2
EN28450	25 lb	65·8	96·4	98·8
EN28450	35 lb	53·9	90·5	97·0
EN18133	5 lb	50·9	83·3	52·4
EN18133	10 lb	23·5	61·9	36·0
Untreated	..	82·0	97·9	97·9
Necessary differences for significance 5%	..	17·8	15·5	12·0
Necessary differences for significance 1%	..	24·0	20·9	16·1

TABLE 3

HEIGHTS OF TOBACCO PLANTS

Chemical	Rate per Acre	Average Height (cm)		
		Trial 1	Trial 2	Trial 3
"Vapam"	25 gal	84·3	136·5	100·6
EDB	20 gal	95·9	151·5	102·9
DD	20 gal	89·5	164·2	85·1
EN28450	15 lb	54·2	113·0	53·7
EN28450	25 lb	58·7	132·0	51·0
EN28450	35 lb	55·4	117·8	41·2
EN18133	5 lb	75·9	111·8	87·5
EN18133	10 lb	81·6	134·2	105·4
Untreated	..	66·8	109·0	50·4
Necessary differences for significance 5%	..	16·7	28·5	22·4
Necessary differences for significance 1%	..	22·5	38·5	30·2

TABLE 4

BURNING TIME OF CURED LEAF

Chemical	Rate per Acre	Burning Time (sec)		
		Trial 1	Trial 2	Trial 3
"Vapam"	25 gal	4·6	2·5	5·3
EDB	20 gal	3·4	1·9	3·4
DD	20 gal	2·1	1·1	4·7
EN18133	5 lb	3·3	3·0	6·2
EN18133	10 lb	3·7	4·0	5·8
Untreated	..	4·7	5·8	3·8
Necessary differences for significance 5%	..	1·7	1·7	2·4
Necessary differences for significance 1%	..	2·3	2·4	3·4

TABLE 5

BROMINE CONTENT OF CURED LEAF

Chemical	Rate per Acre	Bromine Content (p.p.m. Br)		
		Trial 1	Trial 2	Trial 3
"Vapam"	25 gal	282	90	68
EDB	20 gal	2,825	3,642	1,315
DD	20 gal	382	92	108
EN18133	5 lb	300	12	57
EN18133	10 lb	275	112	292
Untreated	..	182	18	98

TABLE 6

CHLORIDE CONTENT OF CURED LEAF

Chemical	Rate per Acre	Chloride Content (% Cl)		
		Trial 1	Trial 2	Trial 3
"Vapam"	25 gal	0·76	1·22	0·42
EDB	20 gal	1·40	1·79	0·76
DD	20 gal	1·33	2·54	0·77
EN18133	5 lb	1·10	1·04	0·35
EN18133	10 lb	0·88	1·30	0·63
Untreated	..	0·84	1·00	0·24
Necessary differences for significance 5%	..	0·30	0·59	0·34
Necessary differences for significance 1%	..	0·41	0·82	0·47

IV. DISCUSSION

It is unlikely that fumigation with EDB or DD to control nematodes in Queensland tobacco fields will be superseded in the near future. Cultural practices for nematode control such as the early ploughing out of infested roots, summer fallow and crop rotation can only be regarded as supplements to fumigation and not as substitutes, especially on areas where tobacco is grown every year.

The bromine content of leaf from plots not treated with EDB was higher in Trials 1 and 3 than in Trial 2. The sites of Trials 1 and 3 had been fumigated with EDB in the 1959-60 season, whereas the site of Trial 2 had not been treated. This suggests that the continued use of EDB may result in increasing levels of leaf bromine.

The marked increase in leaf chloride in plots treated with EDB and lower increases in plots treated with non-halogenated nematocides indicate that the main effect is probably exercised through the action on nitrification.

The effect of fumigation on nitrification is of a temporary nature (Tam 1945) and the need for studies to determine the effect of time of fumigation on halide uptake is indicated.

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