Beiträge zur Tabakforschung · Band 6 · Heft 3 · März 1972

DOI: 10.2478/cttr-2013-0283

Pesticide Residues in Rhodesian Tobacco Attributable to Recommended Pest Control Practices*

by M. J. P. Shaw

Tobacco Research Board of Rhodesia, Salisbury, Rhodesia

The Tobacco Research Board of Rhodesia has for many years controlled the use of pesticides on tobacco in Rhodesia by a Pesticide Approval Scheme. The scheme imposes a series of tests and standards to be met by any new pesticide intended for use in Rhodesian tobacco culture. Tests are concerned with the biological efficiency of a pesticide, the resultant residues and smoking or manufacturing characteristics of the leaf and the effects of treatment on toxicity and tumourgenicity of smoke condensates. Thus, they take into account metabolites and degradation products of new pesticides likely to be recommended for use (3).

Table 1 lists pesticides currently used in Rhodesian tobacco culture giving rates of application, targets of treatment and anticipated residues attributable to recommended pest control practices.

Pesticides Applied in the Seedbeds

Residues attributable to seedbed treatments have not been studied in detail. Generally, it has been assumed that because all seedbed leaves are lost in the field after transplanting, residues from seedbed treatments are unlikely to be detectable. Seedbeds are, however, used in a two-year rotation and large reserves of the more persistent pesticides like DDT do accumulate in the soil.

Seedbeds are routinely treated with a number of pesticides. Before making up the beds, the entire site is fumigated with methyl bromide or DD/MITC against nematodes, weeds, anthracnose *(Colletotrichum tabacum)* and other soil borne diseases.

Two weeks after seedlings have germinated, a drench of 0.23 % DDT is applied at the rate of 1 litre/m^2 as a precautionary measure against cutworms *(Agrotis ypsilon, A. segetum)*. The treatment results in about 12 ppm in the 15 cm soil zone, 10 or 11 ppm of which is still present at the next application in a two-year rotation, assuming 5—10 % decomposition per year (6). In spite of this rate of accumulation, residue analyses have shown that the tobacco plant takes up negligible amounts. Ecologically, the treatment is undesirable and an alternative is being sought.

Routine, twice weekly sprays of thiram (0.2 %), manco-zeb (0.12 %) or zineb (0.1—0.2 %) are recommended for the control of anthracnose *(Colletotrichum tabacum)* and copper oxychloride or oxysulphate (0.25 % Cu) sprays at intervals of 5—10 days are recommended for the control of wildfire *(Pseudomonas tabaci)*, angular leaf spot *(P. angulata)* and frogeye *(Cercospora nicotineae)*.

Pesticides Applied to the Soil in the Field

Three weeks before tobacco is transplanted, each planting station is fumigated with a nematicide. Recommended amounts of EDB, DD or telone/EDB are usually injected with a fumigation gun. Significant increases in total halides of 1—3 % of dry weight (10,000—30,000 ppm) following fumigation have been recorded (4), but the amount of increased halide attributable to bromine where EDB or telone/EDB is used is not known and is now being studied.

Aldrin and dieldrin are no longer used in association with tobacco culture in Rhodesia, but for many years it was routine practice to apply 0.56 kg active aldrin or dieldrin per hectare to planting holes as a precaution against attack by false wireworm and white grubs. Growers favoured dieldrin to aldrin and over a period of time this preference has led to an accumulation of dieldrin in some of our rotated tobacco soils.

Tincknell (5) has studied soil residue data for these two materials from various parts of America and Europe and has derived two simple expressions for the rates of decay of both materials in the soil (aldrin $= \frac{d}{4}(1-p)^{n-1}$, dieldrin $= d\,(1-p)^n$). These give estimated residues at the end of the n^{th} year of a single application of d kilograms active pesticide per hectare, where p, the proportion of decay per annum, is a constant of estimated value 0.16—0.29 [*Tincknell* (5)] or 0.28 [*Edwards* (2)] for temperate regions. Applications of dieldrin were made to tobacco fields in 3- or 4-year rotation at Kutsaga from 1955 to 1968. Soils were sampled for dieldrin residues for the first time in 1969 (Table 2) and further samples will be taken each year to trace trends in decay. Analysis of the 1969 samples showed a much less rapid decay than expected from work done in temperate regions and estimates of the constant p indicate a value of about 0.13 (13 %) in Table 2, theoretical rates of accumulation and decay

* Presented at the 5th International Tobacco Scientific Congress, Hamburg, September 1970.
Research Paper No. 133.

Table 1. Rates, targets of treatment and anticipated residues of pesticides recommended for use in Rhodesian tobacco culture.

	Pesticide	Rate	Applications	Target	Anticipated residues in cured leaf
Seedbed pesticides	**Nematicides**				
	98 % methylbromide	49 g/m²	1	nematodes, weeds and soil borne diseases	nil
	DD/MITC	32 ml/m²	1		
	Insecticides				
	DDT	1 litre 0.23 %/m² drench	1–2	cutworms	
	Fungicides				
	thiram	0.2 % spray	UP	wildfire, angular leaf spot and frog-eye	
	mancozeb	0.12 % spray			
	zineb	0.1–0.2 % spray	TO		
	copper oxysulphate / copper oxychloride	0.25 % Cu spray	20		
Soil pesticides	**Nematicides**				
	EDB (41 %)	4 ml/stn.	1	*M. javanica* and other nematodes	1 % increase* in halides
	DD	8 ml/stn.	1		3 %
	telone/EDB	4 ml/stn.	1		2 %
	Insecticides				
	DDT	25 ml 0.23 %/plant	1	cutworms	nil
	disulfoton	3 g 5 %/gran./stn.	1	aphids	nil
	menazon	6 g 5 %/gran./stn.	1		< 1.0 ppm
Leaf pesticides	**Fungicides**				
	dinocap (A)	0.25 % spray 5–10 kg 2 %/dust/ha	5	powdery mildew	< 1.0 ppm**
	Insecticides				
	monocrotophos (C)	0.075 % spray	3	leafminers, budworms, stinkbugs and aphids	< 0.5 ppm
	demeton-s-methyl (C)	0.15 % spray	3	aphids	< 1.0 ppm
	dimethoate (A)	0.15 % spray	3		< 0.5 ppm
	menazon (A)	0.21 % spray	1		< 5.0 ppm

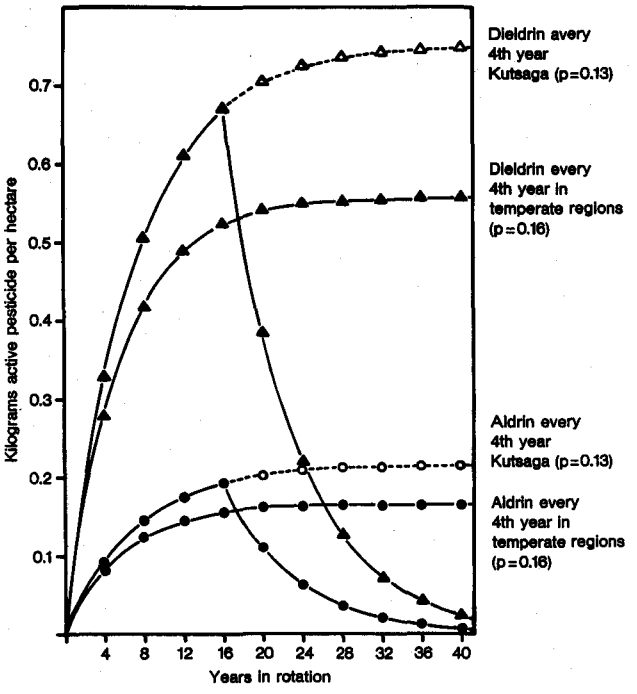
* Tillet, 1966.
** Cole, 1963.

(A) Approved pesticides that have completed full series of pesticide approval scheme tests.
(C) Pesticides still under test but with no evidence for disapproval.

Table 2. 1969 dieldrin residues in soil zones to 30 cm in tobacco fields at Kutsaga, treated at intervals with 0.56 kg active dieldrin per ha, showing estimates of the constant (p) for rates of decay.

Field No.	Years treated	X soil zone	Y – 1969 dieldrin content	Mean content to 30 cm	Expected values for p			Value of X when Y = 0	Extrapolated mean content
					0.13	0.16	0.29		
		cm	ppm	ppm	ppm	ppm	ppm	cm	ppm
1	1955, 1958	0–10	0.35						
	1962, 1966	10–20	0.19	0.213	0.200	0.167	0.085	49.46	0.300
		20–30	0.10						
2	1956, 1960	0–10	0.46						
	1964, 1968	10–20	0.26	0.277	0.261	0.235	0.167	45.53	0.404
		20–30	0.11						
3	1957, 1961	0–10	0.14						
	1965	10–20	0.25	0.150	0.157	0.130	0.059	45.31	0.219
		20–30	0.06						
4	1959, 1963	0–10	0.33						
	1967	10–20	0.14	0.187	0.207	0.183	0.117	41.69	0.285
		20–30	0.09						

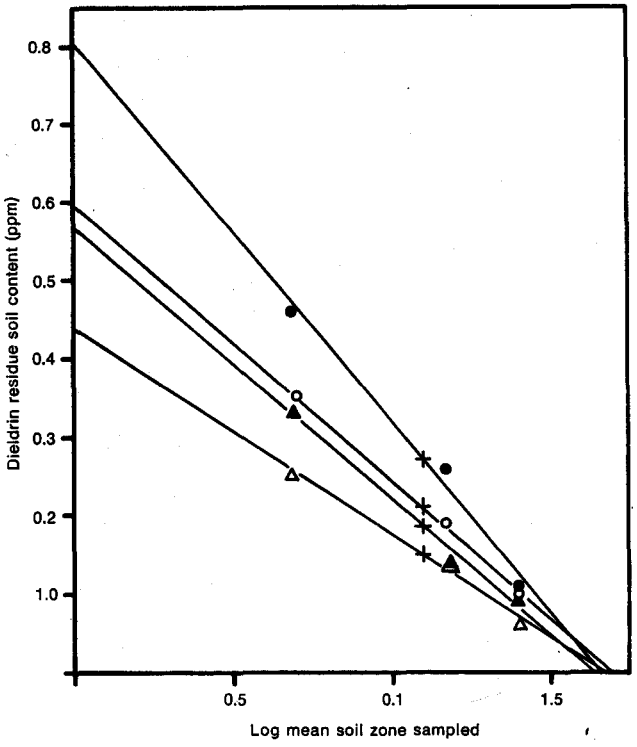
Figure 1. Theoretical rates of accumulation and decay of dieldrin (—▲—) and aldrin plus dieldrin (—●—) residues in soils treated every 4th year with 0.56 kg active dieldrin or aldrin per hectare.



being illustrated in Figure 1. If dieldrin content is plotted against log mean soil zone for samples from each field and regression lines fitted (Figure 2), it is evident that some dieldrin was probably in the soil below the sampled zone, possibly as far down as 50 cm

Figure 2. Regressions of mean dieldrin residue content (ppm) on log mean soil zone sampled in tobacco fields at Kutsaga in August 1969.

	a	b
Field No. 1 ○	0.5997	−0.3542
Field No. 2 ●	0.8089	−0.4878
Field No. 3 △	0.4394	−0.2653
Field No. 4 ▲	0.5707	−0.3521



(Table 2). If the additional content is estimated from the regression lines and an extrapolated mean content to the estimated depth of permeation is calculated, it is apparent that the estimated value of $p = 0.13$ may be extremely optimistic (Table 2). Future samples, which will be taken to a depth of 90 cm, will improve the reliability of new estimates. The rate of transfer of dieldrin soil residues to tobacco plants under our conditions is currently under study. Preliminary results have shown that 0.2 to 0.3 ppm dieldrin may be found in the first reapings of tobacco grown in rotated land treated every 4th year from 1957 with 0.56 active dieldrin per hectare but untreated in the current season (Table 2, field No. 3).

Aphids (*Myzus persicae*) and aphid borne virus diseases are not a serious problem in Rhodesia at the moment. Tobacco is now planted earlier in the season and most of it has probably completed the growth stage most favourable for aphid colonisation before the overwintering aphid population can take advantage of it. If aphids become a problem again, routine pre-planting applications of the granular aphicides disulfoton and menazon that resulted in negligible residues in cured leaf after recommended planting hole applications of 45 kg and 90 kg of 5% granules/ha respectively, may again become necessary.

After transplanting, as a precaution against cutworms in the field, about 25 ml of a 0.23% DDT suspension is poured over the centre of each seedling so that the liquid trickles down and wets the surrounding soil. As a result of this treatment (1.05 kg/ha), DDT accumulates in the soil and 0.56 kg/ha of one application is present before the next is applied in a 4 yr. rotation. None of this appears to be transferred to the tobacco plant, nevertheless, a less persistent treatment is urgently being sought.

Pesticides Applied to the Leaves in the Field

Dinocap fungicide is the only pesticide that is, in some instances, applied to leaf in the field as routine. Treatment is directed against powdery mildew, caused by *Erysiphe cichoracearum* and is applied as a 2% dust (10.1 kg/ha) or as a 0.025% spray, starting about 6–8 weeks after planting. In recent years disease resistant varieties have been bred and this has led to a rapid decline in the use of this pesticide. Anticipated residues from treatment are less than 1 ppm (1).

Monocrotophos is the insecticide most frequently applied to the leaf. Sprays of 0.075% a. i. (0.2–0.4 kg a. i./ha) are directed mainly against tobacco leaf miner (*Pthorimeae operculella*) but also give effective control of aphids, stinkbugs (*Nazara* spp.) and budworms (*Heliothis armigera*) if treatment is applied early enough. Residues are below measurable quantities. Three other recommended systemic aphicides are seldom used now. Residues are below limits of detection after applying 0.15% sprays of demeton-s-methyl or dimethoate (0.2–0.4 kg a.i./ha). Menazon sprays (0.21%) (0.2–0.6 kg a.i./ha) have produced residues of up to 5 ppm per application but the material has met all standards

required by the Pesticide Approval Scheme and is fully approved.
Until recently the Tobacco Research Board of Rhodesia's Pesticide Approval Scheme has been voluntary and although most growers undoubtedly adhered to it very closely, for they were well aware of the dangers to the industry of not doing so, legislation has now been introduced that will render tobacco treated with pesticides other than in accordance with Tobacco Research Board recommendations unsaleable, and liable to destruction without compensation. Pesticide residues in the crop offered for sale will be monitored to ensure that the legislation is functional.

SUMMARY

The use of pesticides on tobacco in Rhodesia is controlled by legislation that prevents the sale of tobacco treated with unscheduled pesticides. Residues attributable to seedbed treatments have not been studied in detail; the scheduled pesticides that can be applied to the soil and the leaf in the field have been considered more fully. Although no longer permitted for use, aldrin and dieldrin soil residues from previous treatments are more persistent in tropical sandy soils than in soils of the temperate regions and small amounts of background dieldrin are taken up by tobacco grown in these soils. Uptake of DDT is negligible and very little disulfoton or menazon applied to the soil is found in cured leaf. The pesticides that are permitted for application to the leaf result in residues of less than 1 ppm except menazon which results in a residue of up to 5 ppm.

ZUSAMMENFASSUNG

In Rhodesien wird die Verwendung von Pestiziden bei Tabak durch Gesetze geregelt, die den Verkauf von Tabak verbieten, wenn dieser mit amtlich nicht zugelassenen Pestiziden behandelt worden ist. Rückstände, die auf Behandlung im Saatbeet zurückzuführen sind, wurden bisher im einzelnen kaum untersucht; hingegen liegen mehr Ergebnisse über Reste von amtlich zugelassenen Pestiziden vor, die zur Behandlung der Böden und der Pflanzen im Tabakfeld verwendet werden können. Aldrin und Dieldrin werden zwar nicht mehr angewendet, die Rückstände dieser Mittel aus früheren Behandlungen bleiben in tropischen sandigen Böden aber nachhaltiger persistent als in den Böden der gemäßigten Zonen und werden von den Tabakpflanzen entsprechend aus den Böden aufgenommen. Die Aufnahme von DDT ist zu vernachlässigen. Im getrockneten Blatt finden sich nur sehr geringe Reste an Disulfoton und Menazon, wenn diese Mittel dem Boden zugesetzt werden. Pestizide, die auf Blattabak angewendet werden dürfen, führen nur zu Rückständen von weniger als 1 ppm. Nur bei Menazon fanden sich Rückstände bis zu 5 ppm.

RESUME

En Rhodésie l'usage de pesticides pour le tabac est contrôlé par une loi qui interdit la vente du tabac traité avec des pesticides non prévus. On n'a pas étudié en détail les résidus imputables aux traitements des graines; on a étudié d'avantage les pesticides autorisés pour le traitement du sol et du feuillage.
Quoique l'aldrin et le dieldrin ne sont plus autorisés, on décèle des résidus dans le sol dûs à des traitements antérieurs, qui semblent plus persistants dans les sols tropicaux sablonneux que dans les sols des régions tempérées, aussi on découvre des quantités minimes de dieldrin résiduel absorbé par le tabac qui pousse sur ces sols. La quantité de DDT absorbée est négligeable et on ne trouve que très peu du disulfoton ou du menazon, appliqués au sol, dans les feuilles séchées. Les pesticides autorisés à être appliqués sur les feuilles ne se retrouvent qu'en quantités résiduelles inférieures à 1 ppm excepté le ménazon qui donne un résidu jusqu'à 5 ppm.

REFERENCES

1. Cole, J. S.: Control of tobacco powdery mildew caused by *Erysiphe cichoracearum* DC by foliar sprays; Rhod. J. Agric. Res. 1 (1963) 65–70.
2. Edwards, C. A.: Insecticide residues in soils; Residue Reviews 13 (1966) 83–132.
3. Shaw, M. J. P.: Rhodesian moves anticipated tobacco pesticide residue problem; Tobacco N. Y. 170 (1970) 15.
4. Tillet, E. R.: The effect of fumigation and sources of nitrogen on the yield, quality and composition of flue-cured tobacco in Rhodesia; Proc. 4th Int. Tobacco Scientific Congress, Athens, 1966, 127–134.
5. Tincknell, R. C.: Residues in agricultural soils derived from aldrin and dieldrin applications; I.U.P.A.C. Symposium on the Chemical Control of the Human Environment, Johannesburg, S. Africa, 1969, 25 p.
6. Yu, S. Kagan, Fudel-Ossipova, S. I., Knaikina, B. J., Kugminskaya, U. A., and Konton, S. D.: On the problem of the harmful effect of DDT and its mechanism of action; Residue Reviews 27 (1969) 43–79.

The author's address:

Tobacco Research Board of Rhodesia,
P.O. Box 1909, Salisbury, Rhodesia.