THE EFFECT OF SUB LETHAL QUANTITIES OF 2,4,5-T ON TOMATOES

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Summary. Tests were carried out to determine the amount of 2,4,5-T (as the iso octyl ester) needed to produce distinctive phytotoxic symptoms on tomatoes. The herbicide was topically applied to seedling tomatoes and at early flowering. An early symptom was subtending of leaves, which was outgrown within 7 to 10 days. The appearance of subcutaneous adventitious roots were distinctive. The yield of fruit was reduced only by the highest rate tested, (11 - 13 µg a.i./g fresh weight) and at some rates was increased. Decreased fruit quality, consisting mostly of increased splitting, was only obvious after application to plants at early flowering.

INTRODUCTION

The application of herbicides without the loss of herbicide from the treated area is essential, not only because such losses leads to a reduction in the effect of the herbicide on target weeds, but because it can lead to off-target damage. The phenoxyacetics have been reported to impart damage to a number of species through drift, including grapes (5), tobacco (2) and tomatoes (3). The user of a herbicide is legally responsible for ensuring that it does not move onto adjacent areas (4). Tests were carried out on tomatoes to determine the quantities of 2,4,5-T needed to impart distinctive symptoms and affect fruit production.

METHOD

Known quantities of 2,4,5-T (as the 40%w/v iso octyl ester) were applied to tomatoes (cv. Moneymaker) at two growth stages. The rates chosen represent heavy to negligible drift. Seedling tomatoes were treated at the 2 - 3 leaf growth stage when they were 4.6 ± 0.3 cm in height, 70 ± 0.16 g in fresh weight and with a leaf area of 127.68 ± 26.0 mm^2. Plants at the early flowering stage were 32.6 ± 1.9 cm. in height, 26.4 ± 4.4 g in fresh weight and with a leaf area of 35,007 ± 6066 mm^2.

At the seedling stage up to 100 droplets of 164 µm in diameter were applied to the top one to three leaves, at varying concentrations, to obtain doses between 0.0134 to 13.44 µg a.i./g F.W. (Fresh Weight) in four intervals. The four dose rates used at the early flowering stage were from 0.011 to 11.09 µg a.i./g F.W. in four intervals using up to 200 droplets of 412 µm diameter at varying concentrations and applying them to the top six leaves. After treatment they were planted into a peat mixture, "Grobags", and placed in a randomised block design in a heated glasshouse . The side shoots were regularly removed and the main terminal taken out when the second fruiting truss was established. The plants were regularly fertilised using a commercial liquid tomato fertiliser containing N 6.0% w/w, phosphonic acid solution in H_2O 5% w/w, and potash 9% w/w. Harvested ripe fruit was weighed, assessed for shape and halved to determine the number of locules, the condition of the placenta and the extent of seed production.

RESULTS

The initial reaction, within 24 hours, was for the leaves and or petioles to subtend downwards. This symptom was outgrown within 7-10 days. Subcutaneous roots were visible on the stem two to three weeks after application. The extent of subcutaneous root development increased with increasing dose. Their appearance persisted for the life of the plants. Yield and fruit number data was analysed using a one way analysis of variance. Transformation of the data was found not to be necessary.

At both growth stages only the highest dose rate significantly (P=0.05) reduced fruit numbers and weight. When applied to seedlings at 13.4 µg a.i. 2,4,5-T /g F.W. both numbers and fruit weight were reduced by approximately 63% relative to the untreated control (Table 1). Application of 11.01 µg a.i. 2,4,5-T/g F.W. to plants at the early flowering stage produced similar levels of supression reducing fruit numbers by 59% and their weight by 66%. The application of 0.11 µg a.i./g F.W. to plants at the early flowering stage increased the yield of fruit by 26% compared to the untreated control. Though significance was not detected an increase of 28.7% would have been significant. At the seedling growth stage it was the lowest rate of 0.011 µg a.i./g F.W. that increased, by 17%, the weight of fruit compared to the untreated plants. This was not detected as significant as an increase of 37.6% would have been required for this.

Application at the early flowering stage increased the proportion of split fruit. (Table 3). When the herbicide was applied at the early flowering stage the seed numbers increased while there was a reverse tendency from application at the seedling growth stage. In general overall fruit shape was improved by all rates of the herbicide.

Table I. Effect of 2,4,5 - T on the production of fruit when applied to seedling and early flowering tomatoes.

Dose µg a.i./g F.W.		Mean number of fruit		Mean weight of fruit	
A	B	A	B	A	B
13.44	11.01	b 5.88	b 6.13	b 296.18	b 234.41
1.34	1.10	a 17.50	a 14.00	a 894.16	a 552.84
0.13	0.11	a 16.75	a 17.88	a 768.47	a 869.71
0.01	0.01	a 19.25	a 16.88	a 929.64	a 732.04
Control	Control	16.38	a 15.00	a 793.38	a 689.37

Treatments followed by the same letter do not differ significantly (P=0.05)
A=seedling growth stage
B=Early flowering growth stage

Table 2. Effect of 2,4,5-T on fruit when applied to seedling tomatoes.

Parameter		2,4,5-T µg a.i./g F.W.				
		13.44	1.34	0.13	0.01	Control
Overall Shape	Round	70.2	70.0	71.6	82.5	68.3
	Triangular	29.8	30.0	28.4	17.5	31.7
End Shape	Normal	89.4	86.4	94.8	83.8	89.5
	Pointed	8.5	10.7	3.0	7.1	5.6
	Dimpled	2.1	2.1	2.2	9.1	4.9
	Beaked	0	0.8	0	0	0
Splitting	Slight	80.9	69.3	41.8	66.9	35.0
	Moderate	10.6	20.0	37.3	17.5	21.1
	Severe	8.5	10.7	20.9	15.6	43.9
Number of Locules	2	93.6	88.6	85.1	86.4	83.7
	3	6.4	11.4	14.9	13.6	16.3
Placenta	Intact	63.8	50.1	65.7	68.8	56.1
	Partial	27.7	20.0	14.2	15.6	14.6
	Complete	8.5	27.9	20.1	15.6	29.3
Seeds	Full	85.1	62.9	54.5	65.6	52.0
	Depleted	6.4	15.7	8.2	13.6	12.2
	Nil	8.5	21.4	37.3	20.8	35.8

Figures represent % fruit within each category

CONCLUSIONS

The results on fruit weight following the application of 2,4,5-T to tomato plants are in agreement with a previous study (7) in which a rate of 0.12 kg a.i./ha gave a yield reduction of 49 %, although an increase in yield with lower rates was not reported. However, 2,4,5-T has been used to improve fruit setting (8). As both fruit numbers and weight were increased by certain dose rates in these tests, the differences may reflect increased fruit set due to the herbicide. While little 2,4,5-T is still used these data can be useful when estimating the effect of similar herbicides. For example it has been shown that the LD50 for triclopyr amine and 2,4,5-T ester are the same at 1.28 kg a.i./ha and 2,4-D amine a little less active at 1.43 kg a.i./ha (7).

While no adverse effects to fruit shape were noted in the present studies they have been reported previously (1,8). This may reflect differences between varieties, the method of application or the formulation used.

Table 3. Effect of 2,4,5-T on fruit when applied to tomatoes at early flowering.

Parameter		2,4,5-T µg a.i./g F.W.				
		11.01	1.10	0.11	0.01	Control
Overall Shape	Round	69.4	67.0	78.3	71.9	75.0
	Triangular	30.6	33.0	21.7	28.1	25.0
End Shape	Normal	79.6	94.6	95.8	92.6	76.7
	Pointed	14.3	2.7	1.4	5.2	15.0
	Dimpled	4.1	2.7	2.8	2.2	8.3
	Beaked	2.0	0	0	0	0
Splitting	Slight	67.4	42.9	48.9	32.6	71.7
	Moderate	10.2	17.9	36.4	34.1	20.8
	Severe	22.4	39.2	14.7	33.3	7.5
Number of locules	2	87.8	95.5	88.1	88.9	80.8
	3	12.2	4.5	11.9	11.1	19.2
Placenta	Intact	81.6	74.1	82.5	78.5	77.5
	Partial	10.2	6.3	4.2	5.9	17.5
	Complete	8.2	19.6	13.3	15.6	5.0
Seeds	Full	67.4	53.6	61.5	52.6	75.8
	Depleted	10.2	8.0	9.1	11.1	13.3
	Nil	22.4	38.4	29.4	36.3	10.9

Figures represent % fruit within each category
F.W. = fresh weight

REFERENCES

1. Davison, J.G. 1961 in: Ph.D. Thesis, University of Nottingham, UK.
2. Fung, K.H. Belcher, R.S. and Whitfield D.M. 1973. Aust. J. Exptl. Agric. Anim. Res. 328-334.
3. Gilbey, D.J. 1984. Proc. 7th Aust. Weeds Conf. 1, 93-95.
4. Irvine, F.N. 1984. Proc. 7th Aust. Weeds Conf. 1, 89-92.
5. Kasimatis, A.N. Weaver, R.J. & Pool, R.M. 1968. J. Etiology Viticulture 19, 194-204.
6. Merritt, C.R. and Drinkwater, 1977. Pestic. Sci. 8, 457-462.
7. Smith, L.L. and Geronimo, J. 1978 in: Abstracts Meeting Weed Sci. Soc. Amer. [WSSA, Champaign, Ill. USA] p 32.
8. Tokerev, V.V. 1971. Bull Sibirkkogo Nauho Issledouated Iskogo Institute Khimiz, Sel Sko. Khozyyaistua, No. 3., pp 51-53