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The effect of different ways of watering pots after the application of aldicarb on control of the potato cyst-nematode

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Abstract

The multiplication of *Heterodera rostochiensis* on potatoes in pots was reduced more strongly by aldicarb mixed with the soil than by aldicarb applied to the top of the soil. Excessive amounts of water strongly reduced the effectiveness of the first method of application; moderate amounts of water did not improve the second method sufficiently.

Introduction

Mixing 2.5 mg aldicarb per kg into the soil (equal to 5 g Temik 10 g per m^2 and 20 cm depth) reduced the maximum rate of multiplication of the potato cyst-nematode, *Heterodera rostochiensis*, by 98.2% of that in untreated pots (Kaai and Den Ouden, 1967). In another pot trial in the greenhouse superficial application of the same amount of aldicarb reduced it by 97.4% while in a third experiment with containers dug into sandy soil outdoors a reduction of 90% was obtained, also by spreading the aldicarb on top of the soil (Den Ouden, 1968).

However, in field trials on sandy loam superficial application of aldicarb resulted in poorer control of the potato cyst-nematode than in pots probably because the chemical was insufficiently distributed through the soil (Den Ouden, 1969). Therefore a pot trial with a loam soil was done in which aldicarb was mixed with the soil with and without excessive quantities of water added before planting. Application of the chemical as a drench was also investigated.

Materials and methods

Plastic cylinders 10 cm wide and 20 cm high were filled with 2 kg of loam (28% < 2 μm) into which 1000 and 3000 eggs of *H. rostochiensis* had been introduced. Aldicarb was extracted from granules of Temik 10 G in water and made into a 0.1% solution of the active ingredient. Five ml of this solution – the amount for one pot – was mixed into 75 g of soil and increasing amounts of soil were then added and mixed to complete the pot content.

The seven treatments are listed in Table 1. Each treatment and each nematode density was replicated 5 times. In each pot a suberized, cylindrical piece of a potato tuber with one sprout was planted (cultivar Libertas). The moisture content of the

Table 1. Rates of multiplication and their reduction obtained by applying aldicarb in different ways with different quantities of water given shortly after the application. Values followed by the same letter do not differ significantly at $P = 0.05$.

Treatment	Multiplication		Reduction (%)	
	without aldicarb	with aldicarb		
1) Mixing 10 ml aldicarb solution (5 mg a.i.) into 2 kg soil and adjusting to field capacity (23%)	11,6	2,5	78	A
2) As 1) plus an additional 23% of water applied during the following day	8.8	6.4	27	B
3) As 1) plus an additional 3 times 23% of water applied during the following day	8.6	7.9	8	E
4) As 3 but spread out over 3 consecutieve days	7.8	7.6	3	E
5) Drenching of the soil with diluted aldicarb solution up to field capacity	10.0	5.8	42	D
6) Adjusting soil to field capacity. Applying 75 g of soil containing aldicarb on top	12.6	7.9	37	C
7) Applying 75 g of soil containing aldicarb on top. Adjusting to field capacity afterwards	13.7	9.5	31	D

Tabel 1. Graden van vermenigvuldiging en vermindering hiervan verkregen na verschillende wijzen van toediening van aldicarb met verschillende hoeveelheden water gegeven kort na het toedienen. Percentages gevolgd door dezelfde letter verschillen niet significant bij P = 0,05.

soil at the start of the experiment was 14%. The percentage retained against a suction of about 0.9 atm was 23%. During the development of the potatoes the moisture content of the soil in the cylinders was maintained at about 23%. Fourteen weeks after the beginning of the experiment the nematode density was determined.

Results and discussion

As the multiplication of the nematodes appeared to be the same in the pots with the two initial numbers of eggs, the average rate of multiplication of ten pots per treatment is given in Table 1. The results show ($P = 0.05$) that:

1) Very wet soil at planting reduced the multiplication of *H. rostochiensis* (Table 1, column 2 – 2, 3, 4, vs 1, 5, 6, 7) where 1, 5, 6, 7, should be considered as equal.

2) Application of aldicarb by methods other than mixing with the soil reduced the multiplication of the nematode much less (Table 1, column 4 – 1 vs 5, 6, 7).

3) An excessive quantity of water applied to soil where aldicarb had been intro-

duced by mixing reduced the effect of the nematicide considerably if not completely (Table 1, column 4 – 2, 3, 4, vs 1).

It is clear that excess water reduced the negative effect of an initially good dispersion of aldicarb in the soil on the multiplication of *H. rostochiensis*. Poor nematode control caused by an insufficient dispersion of aldicarb in the soil cannot be improved sufficiently by manipulation of the water supply.

Andrawes et al. (1971) have shown that on sandy loam rainfall of 3 cm or more at various times after application of aldicarb was associated with a considerable reduction in the total of labelled toxic residues of ^{14}C aldicarb in the soil. The main constituents of this total were sulfoxide and sulfone for at least two months. Aldicarbsulfoxide is the toxic oxidation product of aldicarb. It is slowly oxidized into toxic aldicarbsulfone and, depending on the conditions, partly hydrolyzed into oximsulfoxide.

Bromilov (1973) mentioned a relatively high mobility of the substances aldicarbsulfoxide and aldicarbsulfone. Their ratio concentration per g soil organic matter/ concentration per ml soil water is low. In soils such as most clays in which the organic matter content is low, a high mobility of water soluble compounds can therefore be expected after heavy rainfall.

Other factors, however, such as structure and texture of the soil and the evaporation of soil water also contribute to upward and downward movement. Bromilov stated that with moderate rainfall the major loss of the chemical in the upper 10 cm of his sandy loam soil was caused by degradation but Bull et al. (1970) suggested that residues of these highly water soluble substances dissipate because of leaching or because volatilization of aldicarb equivalents increases with greater moisture.

Coppedge et al., (1970) found more movement in coarse sand than in clay or loam while in muck samples the aldicarb equivalents were distributed equally in all five layers examined. The development of nematodes will be reduced or slowed down to a certain extent depending on when their various stages in the roots come in contact with aldicarb (Den Ouden, 1971). In addition nematodes present as larvae in the soil may sometimes encounter sufficiently large concentrations of the compound resulting in a temporary inactivation or even death (Nelmes, 1970; Bunt, 1975). The experimental results described, together with the data from literature, show that the final effect of a treatment in the field, will depend on weather and soil conditions. Insufficient mixing of the chemical with the soil cannot be made good by watering the soil as a distributing agent.

Samenvatting

De invloed van verschillende wijzen van watergeven na de toediening van aldicarb ter bestrijding van het aardappelcystenaaltje in een potproef

Verschillen in resultaten met aldicarb tegen *Heterodera rostochiensis* bij potproeven in de kas (aldicarb in grond gemengd en oppervlakkig toegediend), bij een potproef buiten (oppervlakkige toediening) en bij veldproeven gaven aanleiding tot een onderzoek over de invloed van de wijze van toediening van dit nematicide. Grote hoeveelheden water bleken een nadelige invloed te hebben op de zeer goede werking die aldicarb heeft wanneer dit middel door de grond is gemengd. Boven op de grond

toegediend werkte aldicarb minder goed en de toegepaste variaties in deze wijze van toediening hadden nauwelijks effect. Met verschillende manieren van water geven kan de werking van het middel niet voldoende worden verbeterd.

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