

*Istituto di Nematologia Agraria, C.N.R., 70126 Bari, Italy*

## **CHEMICAL TREATMENTS AND SOIL SOLARIZATION FOR THE CONTROL OF THE STEM NEMATODE, *DITYLENCHUS DIPSACI*, ON ONIONS**

by

F. LAMBERTI, N. SASANELLI, T. D'ADDABBO, V. D'ALOISIO and P. DE COSMIS

**Summary.** Trials on the control of *Ditylenchus dipsaci* were carried out in 1997-1998 on onion in sandy soil in southern Italy. Plots were solarized from mid July to the beginning of September 1997. Nematicides were applied in early January, the fumigants, and the day of planting, on 21 January 1998, and one month later the non volatiles. There were combinations which included integration of soil solarization with chemicals and different chemicals at various times of application. All treatments statistically increased the marketable yield of onion bulbs with respect to the control, but no dramatic differences occurred among treatments. In particular, it appeared that integration of soil solarization with chemical treatments did not always improve the results obtained by each single treatment. Metam sodium, metam potassium, fenamiphos either granular or microcapsulated or the experimental Bayer granular nematicide were equally effective as single preplant applications. Their performance was not improved when after soil fumigation further application of non-volatile nematicides followed at planting and at one month after planting. Marketable bulbs represented in all treated plots between 90 and 100% of the total yield. Soil populations of *D. dipsaci* at the end of the experiment were erratic and not much different from the untreated control.

Chemical treatments do not always give good results in the control of the stem nematode, *Ditylenchus dipsaci* (Sasanelli *et al.*, 1995; Lamberti *et al.*, 2000b). Soil solarization gave more consistent results (Sasanelli *et al.*, 1998; Lamberti *et al.*, 2000b), but no differences were apparent between treatments of four and eight weeks. The integration of the two control strategies did not improve the performance of either one (Lamberti *et al.*, 2000b).

Control trials were therefore undertaken to evaluate the effectiveness of fumigants versus non-volatile nematicides, combinations of the two, single applications versus split doses of non-volatile nematicides, soil solarization and integration of soil solarization with chemical treatments.

### **Material and methods**

The trial was conducted from July 1997 to May 1998 on the sands of Zapponeta in the Province of Foggia in southern Italy.

The field was ploughed, rotary cultivated and divided in 174 plots each measuring 1.5x1.5 m, distributed at random in six blocks. There was an interspace of 0.5 m between plots. The field had previously hosted an onion crop severely damaged by the stem nematode. Soil samples collected on 15 June 1997 at various sites in the field revealed an average infestation of 18-20/50 ml of soil *Ditylenchus dipsaci* (Kuehn) Filipjev, mainly fourth stage juveniles. Soil solarization was undertaken from 15 July to 5 September 1997, during which soil tempera-

tures were constantly 40-43 °C at 10 cm of depth in the solarized plots. Solarized plots were lightly irrigated and then covered with polyethylene 0.03 mm thick plastic films. Potatoes were grown in the field during September-December.

The fumigants used were metam sodium (33% a.i.) and metam potassium (50% a.i.). They were applied on 29 December 1997 as a drench diluted in 10 l/m<sup>2</sup> of water by means of a manual irrigator. The granular nematicides, fenamiphos GR (5% a.i.) and Bayer experimental GR, were broadcast on 21 January 1998 on the soil surface and then incorporated to a depth of 10-12 cm. On the same date the microcapsulat-

ed fenamiphos 240 CS (24% a.i.) was applied as a soil drench, diluted in 10 l/m<sup>2</sup> of water. Times and doses of application of the chemicals are indicated in Table I. Six untreated plots served as control.

Onion (*Allium cepa* L.) seedlings cv. Bianca di Giugno, free of nematodes, were transplanted at a density of 80/m<sup>2</sup> on 21 January. Soil samples were collected from each plot before planting to assess initial nematode populations.

Normal local agricultural practices were undertaken in the field during the progress of the experiment.

Onion bulbs were harvested on 18 May; on the same date, soil and plant tissue samples

TABLE I - Effect of treatments on onion yield and populations of *Ditylenchus dipsaci*.

		Treatments				Yield/m <sup>2</sup>										Nematode population/100 ml of soil			
		Pre-plant		Post-plant															
		29/12/1997		21/01/1998		21/02/1998													
Chemical	Dose (c.p.)	Chemical	Dose (c.p.)	Chemical	Dose (c.p.)	N° plants surviving at harvest		Marketable yield (kg)			% of marketable bulbs								
<b>Non solarized</b>																			
-	-	Fenamiphos GR	150 kg	-	-	40	abcd	AB	1.7	abcde	ABC	100	a	A	0	a	A		
-	-	Fenamiphos GR	100 kg	Fenamiphos CS	10.5 l	32	abcd	AB	1.0	cde	BC	93	ab	A	56	bc	AB		
-	-	Fenamiphos CS	31 l	-	-	30	abcd	AB	1.4	bcde	ABC	89	b	A	44	abc	AB		
-	-	Fenamiphos CS	20 l	Fenamiphos CS	10.5 l	36	abcd	AB	1.8	abcd	ABC	100	a	A	0	a	A		
-	-	Bayer Exper GR	65 kg	-	-	31	abcd	AB	1.8	abcd	ABC	100	a	A	11	ab	AB		
-	-	Bayer Exper GR	33 kg	Fenamiphos CS	10.5 l	31	abcd	AB	1.8	abcd	ABC	100	a	A	33	abc	AB		
Metam sodium	1000 l	-	-	-	-	41	abc	AB	1.7	abcde	ABC	93	ab	A	0	a	A		
Metam sodium	1000 l	Fenamiphos GR	150 kg	-	-	35	abcd	AB	1.4	bcde	ABC	100	a	A	22	abc	AB		
Metam sodium	1000 l	Fenamiphos GR	100 kg	Fenamiphos CS	10.5 l	40	abcd	AB	1.1	cde	BC	100	a	A	11	ab	AB		
Metam sodium	1000 l	Fenamiphos CS	31 l	-	-	45	abc	AB	1.9	abcd	ABC	98	a	A	11	ab	AB		
Metam sodium	1000 l	Fenamiphos CS	20 l	Fenamiphos CS	10.5 l	43	abc	AB	1.5	bcde	ABC	100	a	A	0	a	A		
Metam sodium	1000 l	Bayer Exper GR	65 kg	-	-	45	abc	AB	1.8	abcde	ABC	100	a	A	22	abc	AB		
Metam sodium	1000 l	Bayer Exper GR	33 kg	Fenamiphos CS	10.5 l	35	abcd	AB	1.2	cde	BC	97	ab	A	0	a	A		
Metam potassium	1000 l	-	-	-	-	35	abcd	AB	1.6	abcde	ABC	100	a	A	22	abc	AB		
Metam potassium	1000 l	Fenamiphos GR	150 kg	-	-	23	bcd	AB	0.9	de	BC	100	a	A	45	abc	AB		
Metam potassium	1000 l	Fenamiphos GR	100 kg	Fenamiphos CS	10.5 l	58	a	A	2.4	abc	AB	100	a	A	0	a	A		
Metam potassium	1000 l	Fenamiphos CS	31 l	-	-	33	abcd	AB	1.0	cde	BC	100	a	A	22	anc	AB		
Metam potassium	1000 l	Fenamiphos CS	20 l	Fenamiphos CS	10.5 l	41	abc	AB	1.5	bcde	ABC	100	a	A	11	ab	AB		
Metam potassium	1000 l	Bayer Exper GR	65 kg	-	-	22	cd	AB	1.0	cde	BC	96	ab	A	0	a	A		
Metam potassium	1000 l	Bayer Exper GR	33 kg	Fenamiphos CS	10.5 l	27	abcd	AB	1.0	cde	BC	100	a	A	22	abc	AB		
<b>Solarized</b>																			
Solarization only																			
-	-	-	-	-	-	30	abcd	AB	1.2	cde	ABC	100	a	A	24	abc	AB		
-	-	Fenamiphos GR	150 kg	-	-	51	ab	A	2.7	ab	AB	100	a	A	11	ab	AB		
-	-	Fenamiphos GR	100 kg	Fenamiphos CS	10.5 l	35	abcd	AB	1.7	abcde	ABC	100	a	A	0	a	A		
-	-	Fenamiphos CS	31 l	-	-	33	abcd	AB	1.2	cde	ABC	100	a	A	22	abc	AB		
-	-	Fenamiphos CS	20 l	Fenamiphos CS	10.5 l	45	abcd	AB	2.1	abcd	ABC	100	a	A	11	ab	A		
-	-	Bayer Exper GR	65 kg	-	-	44	abc	AB	2.1	abcd	ABC	96	ab	A	0	a	A		
-	-	Bayer Exper GR	33 kg	Fenamiphos CS	10.5 l	45	abc	AB	3.0	a	A	100	a	A	7	ab	AB		
Fenamiphos GR	300 kg	-	-	-	-	53	a	A	1.9	abcd	ABC	100	a	A	0	a	A		
Control	-	-	-	-	-	11	d	B	0.4	e	C	45	c	B	67	c	B		

Data followed by the same letters on any column are not significantly different (small letters for P = 0.05; capital letters for P = 0.01) according to Duncan's Multiple Range Test.

were collected to determine final populations of *D. dipsaci*. Nematodes were extracted by the Coolen method (1979).

Data were processed statistically by Duncan's Multiple Range Test.

## Results and discussion

Data concerning preplant soil nematode populations were inconsistent and with almost no statistical meaning.

From 22 to 58 plants/m<sup>2</sup> survived to maturity in the treated plots, compared to 11/m<sup>2</sup> that survived in the control plots (Table I), a difference statistically significant between all the treated and the control plots. Plant survival was statistically the same, between 27 and 58/m<sup>2</sup>, in all the treated plots, except in those treated with metam potassium and fenamiphos GR and metam potassium and the Bayer experimental GR chemical. Such statistical uniformity is mainly due to the variability of the data on plant survival, probably affected by micro-environments present in the field. Unexplicable is the poor performance of the two treatments with metam potassium, since other similar combinations in the same experiment gave acceptable results. However, the highest and most uniform plant survival was observed in the plots treated preplant with metam potassium and fenamiphos GR and post-plant with fenamiphos CS (58), or pre-plant with fenamiphos GR at the rate of 300 Kg/ha (53).

All treatments statistically increased onion yields, compared to the control and marketable yield was over 90% with respect to total yield in all the treated plots, except in those which received a single preplant application of fenamiphos CS at the rate of 31 l/ha (Table I).

The yield was negligible in the control plots with only 45% of the bulbs considered to be marketable.

Data concerning the effect of treatments on populations of *D. dipsaci* do not present any

logical trend. Those on nematodes in the plant tissues are inconsistent, being associated with dry weather when the experiment was discontinued. Soil population densities varied to a great extent, from 0 to 56/100 g of soil in the treated plots, to 67 in the controls (Table I). In any case they were low and probably result of contaminations, when very low, from infested to non infested plots, because of the small size of the field and of the neighbouring infested fields.

In conclusion, it is appropriate to make a few remarks on the effect of the treatments on yield:

a. fenamiphos GR was used at the rate of 300 Kg/ha as a positive control; at this dosage it has always given good results, as it did in the present experiment;

b. half doses of the same chemical (150 kg/ha) gave equally good results; therefore there is no need to increase this dosage;

c. fenamiphos CS is equally effective as fenamiphos GR (Lamberti *et al.*, 2000c); probably its efficacy could be improved by a more efficient method of application (e.g. water volumes, time before planting and may be slight dose increases);

d. split doses of granular fenamiphos at planting and liquid CS 30 days later did not increase yields;

e. split doses of fenamiphos CS (at planting and 30 days later) might increase the yield;

f. metam sodium, as a preplant single treatment is equally effective as fenamiphos GR; additional treatments with fenamiphos GR or CS, either at planting or at planting and 30 days later, do not improve their effect;

g. seven weeks of soil solarization are less effective than chemical treatments, but integration of soil solarization with fenamiphos application does not give significantly better results than fenamiphos alone; possibly the two can be alternated in consecutive onion cropping to reduce environmental impact;

h. metam potassium is as effective as metam sodium and the dosage could possibly be re-

duced by one third with respect to metam sodium, producing the same results (Lamberti *et al.*, 2000a); however, it is not available on the Italian pesticide market;

i. the Bayer GR experimental nematicide seems to be as effective as fenamiphos GR; eventually it depend on the manufacturers to develop it further.

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