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Evaluation OF SOME NATURALLY PLANT EXTRACT COMPOUNDS FOR CONTROLING ROOT-KNOT NEMATODE, *Meloidogyne javanica*, ON POTATO PLANTS

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ABSTRACT

Three plant extract compounds (fatty acids, polysaccarides and viatmins) and one nematicide (Furadan 10% G.) were evaluated for their efficacy against *Meloidogyne javanica* on potato plants under greenhouse and field conditions. All plant extract compounds tested reduced the nematode galling on the root system and inhibited nematode reproduction. Among the three plant extract compounds, vitamins had the highest effect in reducing nematode infection under greenhouse and field conditions, Nematicide Furadan 10% G. had the best control for *M. javanica* on potato plants. All the plant extract compounds had astimulatory effect on the pctato plant growth. Data either under greenhouse or field conditions were similar.

Keywords : Fatty acids, polysaccarides, vitamine, nematode, *Meloidogyne javanica* potato cv. Diamant, nematode management, Furadan 10%.

INTRODUCTION

The abhazardous use of nematicides and their bad effects on the environment stimulate the man efforts to give more attention for the non-chemical control against the pests. Naturally occurring phytochemicals and allelochemicals such as vitamins, fatty acids, and some polysaccarides as chitin, cellulose, and starch had demonstrated to be effective in reducing soilborne pathogens including nematodes. The inhibitory effect of the fatty acids on the development and reproduction of some nematode species was demonstrated by many investigators (Sayre *et al.*, 1964 and 1965; Patrik *et al.*, 1965; Banage and Visser., 1965; Sitaramaiah and Pathak., 1979 and Inskaya *et al.*, 2000). More over, the effect of vitamins on the activities of plant pathogens as well as nematodes had also demonstrated by many investigatores such as El-Zawahry and Hamada, (1994) who reported that sooking of soybean seeds in pyridoxine and thiamine at both 5 and 100 ppm concentrations had a significant reducing effect on nematode development and build up as measured by root gall index. Polysaccarides such as chitin, cellulose, hemicellulose, or pine bark had demonstrated to be effective against root-knot nematode reproduction. Culbreath *et al.*, 1985; Godoy *et al.*, 1983; Kokalis, Burelle *et al.*, 1994; and Rodriguez - Kabana *et al.*, 1983, 1987. demonstrated that the organic amendments including chitin and himicellulose have efficacy in reducing damage caused by root-knot nematodes and other nematode genera. Benhamou and Theriault, 1992 and Benhamou *et al.*, 1994 reported that chitin and chitosan enhance plant growth and induce defense mechanisms when applied at low rates. This work was carried out to investigate the possibility to apply such phytochemicals to control root-knot nematodes under greenhouse and field conditions.

MATERIALS AND METHODS

I- Greenhouse experiment:

Three naturally plant extract compounds including (fatty acids; polysaccarides and vitamins) (Table 1), as well as one nematicide, Furadan 10% G. were evaluated against the root-knot nematode *Meloidogyne javanica* parasitizing potato under greenhouse conditins during spring season 2001. One sprout of potato tuber cv. Diamant was planted in 20 cm diam. clay pots containing mixture of clay and sand soil (2:1 w/w). After two weeks, the potato seedlings were inoculated with 3000 newly hatched juveniles (J2) of *M. javanica* for each plant. Each treatment was replicated three times. All plant extracts were added weekly as soil drench, at the concentrations of 1%, 2% and 3% for fatty acids, polysaccarides, and vitamins as well as Furadan 10% G. at the rate of 0.05, 0.50 and 1 gram. All treatments were added after inoculation of nematode except the treatment of Furadan which was added at planting time. Three inoculated pots were left without treatments and served as control. Pots were keept under greenhouse conditions at 30 ± 5 °C in randomized block design. After 50 days from inoculation the plants were uprooted and the data on growth and nematode parameters were determined and recorded. The data were analyzed statistically by the method of Duncen's multiple range test (Duncan's 1955).

Table (1) Analysis of naturally plant extracts

Contents of naturally plant extract	Fatty acids* Bio booster (A.S.E)	Polysaccarides* Bio crop (Sun)	Vitamines** (Soil plus)
Active matter	Fatty acids	Polysaccarides	Ascorbic acid
Formulation	Liquid	Liquid	Liquid
Contents	Sulfobetain RIZ, Anoinical Tenside, Sulfobetain and Factacidmonoglycerid-polyglucolether	Humic acids Pectinate Seaweed species. Organic matter Pine oil	Ascorbic acids and vitamine A and B. Amino acid.
Organic matter	----------	Up to 85%	----------
PH	6.9	7.8	7.1

* Shieer Holland INT. B.V

** Holland farming B.V. the incredible Dutch.

II- Field – experiment:

A heavy infested area with *M.javanica* was selected to carry out this field experiment during spring season 2002. The same naturally plant extracts with different concentrations were added weekly as soil drench two weeks after planting for three times as well as the nematicide, furadan 10%, which was added for one time directly before planting. Three microplots were chosen for each treatment including the check without any addition. Each microplot includes 30 plants of potato in three row. Four months after planting, all plants in each microplot were harvested. All the nematode parameter were recorded for each replicate. The mean of each character was calculated for each replicate (microplot) and treatment including the check.

RESULTS

I- Greenhouse experiment:

Three plant extract compounds (fatty acids, polysaccarides, and vitamins) were evaluated for their efficacy to control *M. javanica* on potato plants. Data in table (2) revealed that all the plant extract reduced the nematode galling on the root system and inhibited the nematode reproduction as reduced the formation of egg-masses. Among the three plant extracts tested, vitamins had the highest effect in reducing the nematode galling and reproduction. The plant extracts which contain fatty acids or polysaccarides were also effective against the nematode infection but their efficacy in suppressing number of nematode galls and reproduction was less than that of the vitamins. The combination of the three plant extracts together had the equal effect of the single application of vitamins alone, and it was more effective than the other single or double combinations of fatty acids and polysaccarides. Nematicide application (Furadan 10% G.) gave the best control for root-knot nematode infection as reduced the root galling and egg-masses formation. Data in table (2) also revealed that the effectiveness of plant extracts was increased as the concentration of the active matter increased. Table (3 and 4) show plant growth reaction as a result of the plant extracts addition to the soil. The data revealed that all the plant extracts had a positive effect on the plant growth of potato. Vitamins had the highest enhanced effect among the single application treatments, however the combinations of two or three plant extracts showed more effective than any single application in increasing plant growth of potato.

II- Field experiment:

Data in table (5) show results of the field application treatments for the three plant extracts (fatty acids, polysaccarides, vitamins) to control *M.javanica* on potato plants. Data revealed that all the plant extracts had a positive effect in suppressing root gall index and egg-masses formation on the root system of potato plants. Single application of vitamins gave the highest reduction of root galling and egg-masses formation under field conditions. Other single applications and combinations were less effective than that of the vitamins. Data of the field experiment had similar trend to greenhouse data. Moreover there are no significant differences between the application of the same material tested either under greenhouse or field conditions.

Table (2): Effect of some plant extract as applications on the reproduction of the root-knot nematode *Meloidogyne javanica* infected potato cv. Diamant during spring season 2001.

Treatments	Amount added %	No. of galls/root	Nematode population				Nematode final population (pf)	Rate of nematode reproduction (pf/pi)
			Juveniles in soil/root	Nematode developmental stages/root	No. of egg masses/root	No. of eggs-egg mass		
Fatty acids Bio booster (A.S.E)	1%	67 B	800	24 BC	83 B	241 C	20827	6.94
	2%	45 C	700	10 DE	58 D	218 CD	13354	4.45
	3%	36 CD	400	10 DE	51 D	214 D	11324	3.77
Polysaccarides Bio crop (Sun)	1%	69 B	900	25 BC	73 BC	280 B	21365	7.12
	2%	42 C	800	24 B	62 CD	204 DE	13472	4.49
	3%	20 E	500	13 DE	32 E	190 E	6593	2.19
Vitamine (Soil plus)	1%	36 CD	600	13 DE	50 D	200 DE	10613	3.53
	2%	21 E	400	10 DE	20 EF	190 E	5160	1.72
	3%	14 F	100	9 E	14 F	180 E	2629	0.87
Fatty acids and polysaccaridea	1%	60 B	800	20 C	50 D	200 CD	10820	3.60
	2%	36 CD	500	18 CD	40 DE	180 E	7718	2.57
	3%	18 E	300	15 B	30 E	160 F	5115	1.705
Fatty acids, polysaccarides and vitamine	1%	44 C	500	20 C	33 E	180 E	6460	2.15
	2%	35 CD	400	16 D	25 EF	160 F	4416	1.47
	3%	15 EF	100	14 D	15 F	140 G	2214	5.73
Furadan 10%	0.25g	35 CD	300	17 D	32 E	185 E	6537	2.08
	0.50g	19 E	200	12 DE	16 F	160 F	3072	0.92
	1.00 g	12 FG	80	7 EF	9 FG	145 G	1712	0.46
Check	0	252 A	3000	48 A	158 A	369 A	61350	20.45

Values in a column followed by the same letter(s) are not significantly different (P=0.05) according to Duncan's multi-range test.

Table (3): Grawth response of potato c.v Diamant infected with *M. javanica* as influenced by some plant extracts.

Treatments	Amount added %	Growth character			
		Shoot fresh wt (g)	% increase	Root fresh wt (g)	% increase
Fatty acids Bio booster (A.S.E)	1%	40.00 A	97.00	20.00 CD	30.46
	2%	37.33 AB	84.00	18.00 DEF	17.41
	3%	35.00 AB	72.15	15.67 EF	2.21
Polysaccaridea Bio crop (Sun)	1%	28.00 CD	38.00	16.00 EF	4.37
	2%	32.33 BC	59.02	17.00 DEF	11.00
	3%	35.33 AB	74.00	19.00 CDE	24.00
Vitamine (Soil plus)	1%	33.00 BC	62.32	14.67 EF	- 4.30
	2%	36.00 AB	77.07	16.33 DEF	6.52
	3%	39.33 A	93.45	21.00 C	37.00
Fatty acids, polysaccarides	1%	33.00 BC	62.32	16.33 EF	6.52
	2%	36.67 AB	80.37	19.00 CDE	24.00
	3%	41.33 A	103.29	21.00 C	37.00
Fatty acids, polysaccarides and vitamine	1%	35.00 AB	72.15	21.00 C	37.00
	2%	40.00 A	97.00	22.00 AC	44.00
	3%	41.00 A	103.29	24.00A	57.00
Furadan 10%	0.25g	33.00 BC	62.32	16.67 DEF	9.00
	0.50g	36.00 AB	77.07	19.00 CDE	24.00
	1.00 g	41.00 A	103.29	20.00 CD	30.46
Check	0	20.33 E		15.33 F	

Values in a column followed by the same letter(s) are not significantly different (P=0.05) according to Duncan's multi-range test.

Table (4): Increment in total plant growth fresh weights of potato infected with *M.javanica* and treated with some plant extract in greenhouse.

Treatments	Amount added %	Total fresh weight in (gm.) shoot and root	Total % increase
Fatty acids Bio booster (A.S.E)	1%	60.00	68.25
	2%	55.33	55.16
	3%	50.67	42.09
Polyccaride Bio crop (Sun)	1%	44.00	23.39
	2%	49.00	37.41
	3%	54.33	52.36
Vitamine (Soil plus)	1%	47.67	33.68
	2%	52.33	46.75
	3%	60.33	69.18
Fatty acids and polyccaride	1%	49.33	38.33
	2%	55.67	56.11
	3%	62.33	74.79
Fatty acids and polyccaride and vitamine	1%	56.00	57.04
	2%	62.00	73.86
	3%	65.00	82.28
Furadan 10% G.	0.25 g	49.67	39.29
	0.50 g	55.00	54.23
	1.00 g	61.00	71.06
Check		35.66	

$$\text{Total \% increase} = \frac{(shoot + root)treated - (shoot + root)control}{(shoot + root)control} \times 100$$

Table (5): Avarge numbers of root galls, egg masses and egg-egg masses of *M. javanica* as effected by some plant extracts on potato Diamant in open field during spring season 2002.

Treatments	Amount added %	No. of galls/root	No. of egg masses/root	No. of egg/eggmass /root	% root galls reduction	% egg masses reduction	% egg/eggmasses reduction
Fatty acids Bio booster (A.S.E)	1%	31	33	240	85.58	89.90	38.46
	2%	26	23	200	87.90	92.96	48.71
	3%	19	19	180	91.16	94.18	35.84
Polysaccarides Bio crop (Sun)	1%	93	134	290	56.74	59.02	25.64
	2%	72	87	240	66.51	73.39	38.46
	3%	39	62	180	81.86	81.03	53.84
Vitamine (Soil plus)	1%	63	32	210	70.69	90.21	46.15
	2%	25	16	170	88.37	95.10	56.41
	3%	7	6	150	96.74	98.16	61.53
Fatty acids and polysaccarides	1%	63	63	260	70.69	80.73	33.33
	2%	56	57	220	73.95	82.56	43.58
	3%	24	42	166	88.83	87.15	57.43
Fatty acids, polysaccarides and vitamine	1%	55	49	210	74.41	85.01	46.15
	2%	32	39	180	85.11	88.07	53.84
	3%	16	21	110	92.55	93.57	71.97
Furadan 10%	0.25g	55	41	140	74.41	87.46	64.10
	0.50g	20	14	120	90.69	95.71	69.23
	1.00g	14	7	80	93.48	97.85	79.48
Check	0	215	327	390	0	0	0

Values in a column followed by the same letter(s) are not significantly different (P=0.05) according to Duncan's multi-range test.

DISCUSSION

From the above mentioned data in table (2) and (5), it can be concluted that the plant extract of vitamins which included ascorbic acid, pyridoxine and thiamine had the superiority in controlling *M. javanica* on potato plants. These results are in accordance with the results obtained by El-Zawahry and Hamada, 1994 who reported that soaking application of soybean seeds in Pyridoxine and Thiamine at both 50 and 100 ppm concentration had a significant reducing effect on nematode development and build up as measured by root gall index. They explained the physiological effect of vitamins in plant tissues by the accumulation of soluble carbohydrate. This increase in soluble carbohydrate may in turn play an important role in increasing the osmotic pressure of the cytoplasm. This conclusion is in accordance with the results obtained by Shaddad *et al.*, 1990 who recorded that vitamins enhanced the soluble carbohydrate production. El-Zawahry and Hamada, 1994 mentioned that vitamins generally had a stimulatory effect on the accumulation of soluble and total protein in roots, therfore it may be concluded that the accumulation of soluble components offers a great promis as one of the major physiological mechanisms of infection tolerance in test plants. Moreover they mentioned that seed soaking in ascorbic acid, pyridoxine or thiamine not only alleviated the inhibitory effect of nematode infection on fresh and dry matter weights of the different organs but also induced a significant stimulatory effect on plant growth. Moreover, the combination between two or three plant extracts showed more effectiveness than the single applications in stimulating the plant growth of potato plants. These data can be explained as a result of the additive effect of the individual treatments, when applied together in combinations. The effect of the plant extracts including fatty acids or polysaccarides to reduce nematode development was also demonstrated in this work. As the application of such materials can also be effective against nematode infection on potato plants and may be had a stimulatory effect in increasing the plant growth. These findings can be explained as a result of the direct toxicity of the fatty acids for *M. javanica* as mentoined by many investigators. (El-Miligy and Norton., 1973; Sitaramaiah and Pathak., 1979; Alsayed, *et al.*, 1988).

The inhibitory effect of the products during decomposition of the polysaccarides materials (chitin, cellulose, pectine) are directly toxic to phytonematodes. Miller, *et al.* (1968) reported that cellulose amendments were effective in suppresing, *Hetrodera tabacum*. The microbial decomposition products of the polysaccarides materials can also participate to reduce the population of root-knot nematode in the soil. Mankau and Minteer. (1962) suggested that the NH_3 produced during the decomposition of a fish amendment was probably responsible for the decline in root-knot nematodes. Walker. (1971) found that decomposition of nitrogenous substances during ammonification and nitrification were probably resposible for the decrease in nematode populations. These findings was also in accordance with the results of many investigators [Benhamou *et al.*, 1994; Benhamou and Theriault., 1992; Culbreath *et al.*, 1985; Godoy *et al.*, 1983; Gupta., 1927, 1988 and 1997; Kokalis – Burelle *et al.*, 1994; Rodriguez – Kabana *et al.*,

1983, 1987], who demonstrated that the use of some polysaccarides materials as organic amendments can decrease the nematode population.

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تقييم بعض المستخلصات النباتية الطبيعية فى مكافحة نيماتودا تعقد الجذور (ميلودوجينى جافانيكا) على نباتات البطاطس.

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**** المعمل المركزى للزراعة العضوية- مركز البحوث الزراعية**

تم اختبار كفاءة ثلاثة مستخلصات نباتية (أحماض دهنية- سكريات عديدة- فيتامينات) مقارنة بالمبيد النيماتودى (الفيورادان ١٠%) لمكافحة نيماتودا تعقد الجذور من النوع ميلودوجينى جافانيكا على نباتات البطاطس تحت ظروف الحقل والصوبة. أثبتت الدراسة أن جميع المستخلصات النباتية تحت الاختبار خفضت من تعداد العقد النيماتودية على الجذور وتكاثر النيماتودا. ومن بين الثلاثة مستخلصات النباتية كانت الفيتامينات أكثرهم تأثيرا فى خفض الإصابة النيماتودية سواء تحت ظروف الحقل أو الصوبة. كما كان لمبيد الفيورادان ١٠% أفضل النتائج فى مكافحة نيماتودا تعقد الجذور (ميلودوجينى جافانيكا) على نباتات البطاطس. جميع المعاملات النباتية كان لها تأثير منشط على نمو نباتات البطاطس. كما كانت نتائج الحقل والصوبة متشابهة لحد كبير.