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Influence of field applications of some carbamate insecticides on chlorophyll content of sweet potato leaves and certain microbiological processes in soil

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Abstract - Methomyl(Lannate), Carbofuran(Furadan), Oxamyl(Vydate) and Thiodicarb(Larvin) applied at the recommended rates of application did not affect the amount of total chlorophyll formed in sweet potato leaves after the 1st spray, the only exception is the reduction (13.62%) in the amount of total chlorophyll formed after Furadan application . Generally, the 2nd spray reduced significantly total chlorophyll content. Reduction in total chlorophyll after the 2nd spray could be arranged in descending order ; Vydate (45.91%), Furadan (34.03%), Lannate (32.48%), and Larvin (7.46%). On the other hand, larvin caused a stimulating effect on both respiration (11.82%) and nitrification (35.73%) processes. Lannate increased soil respiration only by 24.45%, while Furadan and Vydate did not affect the two processes.

INTRODUCTION

Sweet potato (Ipomoea batatas Lam.) is one of the vegetable crops grown successfully in Egypt. During the growing season, sweet potato plants are subjected to attack by different species of insect pests especially the cotton leafworm Spodoptera littoralis Boisd which necessitates the use of insecticides. In many cases, the pesticidal treatments influence the crop beyond its pesticidal action by changing the growth rate and causing discoloration[7]. On the other hand, pesticides are applied by different ways and finally reach the soil. Once in the soil, pesticides may influence the population, growth and activity of the microorganisms and therefore, affect the major soil microbiological processes (i.e. nitrification and respiration) and ultimately influence soil fertility and plant growth[19]. Few reports are available about the effect of insecticides on chlorophyll content of vegetable plants. The spray residues may affect the chlorophyll content by changing the illumination and nutritive conditions of the sprayed plant parts[4]. The interaction of insecticides with the non-target soil microoganisms and their activities under laboratory conditions have been studied by many investigators[11,17,18]. While[8,13] studied this interaction under field conditions. The effects of certain systemic carbamate insecticidal treatments on the green color of sweet potato leaves and the interaction of these insecticides with the soil microbial activities under field

conditions are discussed in the present study during the growing season of sweet potato plants.

MATERIALS AND METHODS

Field plots:

A field trial was carried out at Abis area (Alexandria Province) during the summer season of 1989 to study the effect of some the commonly used carbamate insecticides on the growth of sweet potato plants expressed as total chlorophyll content of the leaves and on the nitrification and respiration processes in soil. the sweet potato plants: Ipomoea batatas (Lam.) local variety Abis was used in the present experiment. The soil was well prepared and the top stem cuttings from the studied cultivar were planted on May 5, and harvested on August 12, 1989. Six treatments were distributed in complete randomized block design. Each treatment consists of three plots, the area of each plot was 120 m. The plots were sprayed twice with the insecticides Methomyl, Carbofuran, Oxamyl, and Thiodicarb. Dates of spraying were June 16 and July 7, 1989 by knapsack sprayer (CP-3) at the recommended rates of application. Plants on control plots were sprayed with an equal amount of water. All management were made as usually practiced in commerical production of sweet potato.

Sampling techniques:

A- Leaf samples and chlorophyll determination :

Representative portions from field samples of sweet potato leaves were collected weekly after the 1 st and 2 nd sprays for total chlorophyll determination[13].

B-Soil samples and microbiological determinations:

1- Soil samples: Soil samples were taken from the treated and untreated plots at weekly intervals after the 2 nd spray using a core of 10 cm in depth and 5 cm i.d. Six random samples were collected from each experiment plot (Gross sample), dried, sieved, and composited into one sample per plot. The physical and chemical properties of the soil are shown in Table 1.

Table 1- Physical and chemical properties of the soil used.

Mechanical analysis			Texture class	O.M	PH	E.C
Sand	Silt	Clay		(%)	1:2.5	ds.m^{-1}
%						
67.11	5.26	27.63	Sandy clay loam	1.15	8.12	2.3

Soluble ions meq/L

Cations				Anions			
Ca^{++}	Mg^{++}	Na^{+}	K^{+}	$CO_3^{=}$	HCO_3^{-}	Cl^{-}	$SO_4^{=}$
9.5	5.4	8.0	0.6	nil	3.2	15.6	4.3

ii- Microbiological determination: Soil respiration and nitrification were tested for microbial activities in soil field plots. Soil respiration was estimated according to and adopted by[14], while the nitrification rate was measured for nitrite-nitrogen[3] and also for nitrate-nitrogen[3].

The data obtained after chlorophyll determination were statistically analyzed using a factorial design, whille soil data were analyzed using a split-plot design[16]

RESULTS AND DISCUSSION

1- Effect on chlorophyll:

The change in chlorophyll content is the reflection of an alteration in the metabolism of a plant. In fact, the margin between insecticidal action on the insects and phytotoxicity to the crop is often narrow[4].

Results in Table 2 and figure 1 reveal that after the first spray Furadan, and Vydate caused a remarkable reduction in total chlorophyll at the 1st week and the most powerful one was Furadan. After the second spray a general trend was noticed for Lannate and Vydate in which the total chlorophyll contents started to increase after the 5th week till the end of the experiment harvest time while Furadan and Larvin showed a decreasing effect. Reduction of chlorophyll content in plant leaves may be caused by a reduced synthesis or an enhanced breakdown of the chlorophyll pigment[5].

In another work carried out in greenhouses by Furadan, Nemacur, and Vydate increased the total chlorophyll contents of carrot leaves when they were applied as soil granules. Also, a considerable increase in total chlorophyll content of five tomato cultivars was indicated by[6] as a result of Temik application.

In general, the means of the three intervals calculated after the first spray indicated that, all the insecticides tested did not affect the total chlorophyll content of sweet potato leaves. The only exception is the reduction in the amount of total chlorophyll formed after Furadan application. On the contrary, the second spray with the same chemical significantly reduced the total chlorophyll.

It could be concluded that, after the first application no alterations in growth rate were observed resulting from the application of the insecticides. There were no signs of phytotoxicity during the first three weeks until the second application of Furadan. Leaf burning was evident in all Furadan treated plots. The first indication of phytotoxicity was noticed at the 1st week after the second application of Furadan in which the treated plants lost 55.80% of its total chlorophyll due to Furadan application at the rate of 420 gm a.i/fedan. At the 2nd week after second application the plants began to recover themselves and only about 14.08% of its total chlorophyll was lost. At the end of the experiment 35.02% of the total chlorophyll was lost.

2-Effect of the tested insecticides on soil respiration:

Soil respiration, as indicated by oxygen consumption or CO_2-evolution, is a good index for the activity of microflora involved in organic matter decomposition[17,18]. The rate of CO_2-evolution from treated and untreated field plots was determined and presented in Table 3.

The results illustrated in Table 3 indicate that the mean amounts of CO_2-evolved from the soil throughout the experiment were significantly higher in plots treated with Lannate and Larvin than in the untreated plots. Furadan and Vydate are similar to the untreated plots.[16] Indicated that Furadan at the recommended field rate had no significant effect upon the respiratory activity of the soil. Vydate also had no significant influence on the rate of CO_2-evolved from soil under field conditions[13].

3-Effect of examined insecticides on nitrification process:

The nitrification is the biological process whereby ammonium ions are oxidized to nitrate ions through two steps. The importance of nitrifying microorganisms is due to nitrate production which is the preferable nitrogen source for higher plants[12,13,18]

Figure 2 shows that the average values of Furadan, Lannate and Larvin had no effect on NO2-N formation. While, Vydate appeared to have an increasing effect on NO2-N production. The average effect on NO3-N production for each insecticide throughout the experiment shows that, there is no significant differences among the tested insecticides except Larvin which caused 35.73% increase on this process. The nitrification process (NO2 + NO3)-N production presented in Figure 2 show that, Larvin is the only insecticide seems to have a stimulating effect.[17] Found that Vydate had no significant effect on the nitrification process in a Loamy sand soil. Also NO3-N level in soil was unaffected by the application of Furadan, Temik and Vydate [9].

Our findings as previously discussed indicate that, the increase in CO2-evolution or nitrification process may be attributed to rapid degradation of these chemicals and their use as nutrients by microorganisms [2,17].

From the the present study, it could be concluded that, application of both Vydate and Furadan on sweet potato foliage did not affect respiration or nitrification processes in the soil, but they reduce the total chlorophyll content of the leaves by 45.91% and 34.03%, respectively. lannate increase soil respiration only and have no effect on the nitrification process, but reduce the total chlorophyll content of sweet potato leaves by 32.48% .

Therefore, since the insecticide Larvin had a stimulating effect on the soil microorganisms responsible for respiration and nitrification processes and at the same time, Larvin caused the least reduction of the green pigment of sweet potato leaves. Accordingly, Larvin could be recommended in sweet potato plants to prevent the serious damage caused by the Egyptian cotton leafworm without any fear on the soil fertility and plant growth.

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Table 3- Effect of certain systemic carbamate insecticides on soil respiration (mg CO2/100 gm soil).

Weeks after application	Treatments					Mean
	Control	Lannate	Furadan	Vydate	Larvin	
1	23.82±2.7	47.64±2.7	30.97±4.1	33.34±5.5	16.67±1.4	30.49 b
2	22.00±2.1	31.16±3.2	25.66±2.1	21.99±2.1	25.66±0.0	25.29 c
3	46.43±4.4	48.87±3.2	41.54±6.5	36.66±2.1	71.47±7.4	48.99 a
4	17.71±3.2	9.16±3.7	10.39±2.4	11.00±1.1	9.16±0.0	11.48 d
Mean	27.49 cd	34.21 a	27.14 d	25.75 d	30.74 b	

Values presented in the table are averages of three replicates ± S.E Means indicated by the same letter are not statistically different at 0.05 level of probability.

L.S.D = 4.33 (for two period means, factor A)
= 3.05 (for two treatment means, factor B)
= 6.20 (for two treatment means at the same level of time B at A)

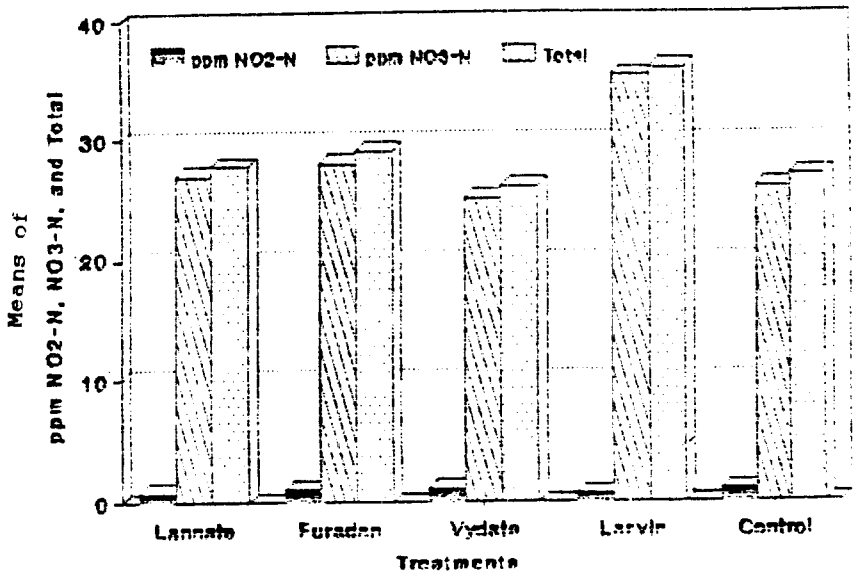

Fig.(2): Effect of certain systemic carbamate insecticides on the nitrification process in soil after four weeks.

Table 2- Changes in total chlorophyll content of sweet potato leaves after two sprays with certain systemic carbamate insecticide

Treatments	Rate of application (gm a.i./ feddan)	Total chlorophyll concentration (mg/L)								Grand mean
		First spray				Second spray				
		1st week	2nd week	3rd week	Mean	4th week	5th week	6th week	Mean	
Control		80.31±1.2	121.19±8.3	158.05±2.8	119.85	296.49±0.12	341.98±17.1	370.69±9.26	336.39	228.12
Lannate 90%	720	75.93±4.4	128.56±3.5	155.73±1.5	120.07	150.67±15.8	249.90±10.9	280.86±7.14	227.14	173.61
Furadan 75%	420	81.90±5.9	118.64±5.2	109.83±6.5	103.52	131.94±14.9	293.84±5.71	240.89±16.9	221.92	162.74
Vydate 24%	720	81.06±3.8	119.14±1.4	144.2±10.8	114.80	105.02±11.9	172.21±2.10	268.58±7.34	181.94	148.37
Larvin 80%	400	77.45±6.8	131.76±8.2	168.52±6.1	125.91	285.14±20.5	360.88±6.21	287.88±8.99	311.30	218.6
Mean		79.33	123.90	147.27	116.83	193.67	283.76	289.76	255.74	186.28

Values reported are averages of three plots ± S.E
L.S.D 0.05 A(sprays) = 10.36, B(periods) = 9.30, C(treatments) = 14.24, AB =14.24, BC = 23.19

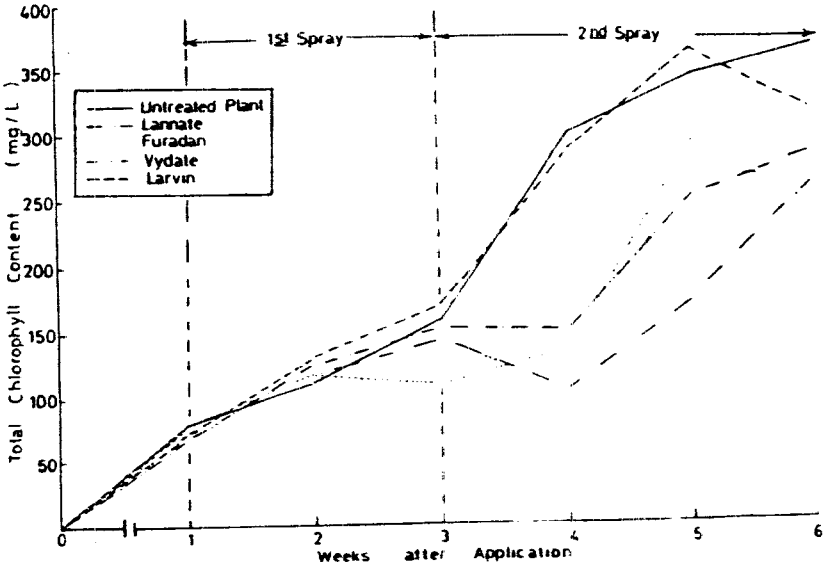

Fig (1) Effect of Certain Systemic Carbamate Insecticides on Total Chlorophyll Content of Sweet Potato Leaves

الملخـــص

تم دراسة تاثير كل من مبيد اللانيت ، الفيوردان ، الفايديت ، اللارفين على محتوى اوراق نبات البطاطا من الكلوروفيل الكلى وكذلك بعض العمليات البيولوجية فى التربة بعد رش النبات بهذه المبيدات مرتين بالمعدل الموصى به حقليا • واوضحت النتائج انه لايوجد تاثير علـــى محتوى الاوراق من الكلوروفيل الكلى بعد الرشه الاولى عدا المعاملة بمبيد الفيوردان فقـــــــد احدث انخفاض قدره (٢٢ر١٣٪) •

وبصفة عامة فقد ادت المبيدات المستخدمة الى انخفاض معنوى فى محتوى الكلوروفيـــل الكلى بعد الرشه الثانية ويمكن ترتيب الانخفاض تنازليا كالاتى :-

الفايديت (٩١ر٤٥٪) ، الفيوردان (٠٣ر٣٤٪) ، اللانيت (٤٨ر٣٢٪) ، اللارفين (٤٦ر٧٪)

ومن ناحية اخرى فان مبيد اللارفين قد ادى تاثيرا تحفيزيا لكل من عمليتى التنفـــس والنيتره بمقدار (٨٢ر١١٪) ، (٧٣ر٣٥٪) على التوالى – وان مبيد اللانيت قد ادى الـــى زيادة فى معدل تنفس التربه فقط بمقدار (٤٥ر٢٤٪) بينما الفيوردان والفايديت لايوثر علـــى هاتين العمليتين •