THE RESIDUAL DISTRIBUTION OF ORGANO-PHOSPHORUS INSECTICIDES IN DATES, POTATO, AND CUCUMBER CROPS

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Abstract

Khan, P., A. Barakat, A.M. Alabdulkarim and A.A. Wahdan. 1985. The residual distribution of Organo-Phosphorus insecticides in dates, potato, and cucumber crops. Arab J. of Pl. Prot. 3:33–37.

The residual distribution of methidation, phosphamidon and Rogodial [R] insecticides were studied in dates, potatoes and cucumber crops. Methidathion (40% EC) was applied via injections (80 ml) into the trunk of date palm trees. Samples of leaf-stalk, leaflet and fruits were collected at intervals after application for residue analysis. Potatoes in the field and cucumbers under greenhouse conditions were foliarly treated with methidathion (40% EC), phosphamidon (50% EC), and Rogodial [R] (dimethoate 110 g + phenthoate 410 g/kg) each at 0.2% concentration. Potato tubers and cucumber fruits were collected at predetermined intervals for residue distribution. The samples were extracted and analysed by gas-chromatographic methods. The amount of methidathion in date palm varied among the plant materials with time. However, no traces of residue down to ppb level, were found in the harvested fruit. The residues of methidathion, dimethoate, and phenthoate in potato tubers were well below the accepted tolerance levels throughout the 16 days period of study. However, the acceptable residue limit of phosphamidon (0.05 ppm) was obtained at 16 day post treatment. In cucumbers, the residues of methidathion, dimethoate, and phenthoate reached well below the permissible residue limits in 10 days and that of phosphamidon at 15 days after application.

Introduction

The rapid development of agriculture in the Kingdom of Saudi Arabia in recent years has been accompanied by a marked increase in the use of pesticides. In addition to the chemical nature of each pesticide, the method and the rate of applications with each crop actually determine the residual level under each set of the harvesting, storage, and the environmental conditions. Pesticide residues in farm produce, if exceed the permissible limits, can create health hazard for the consumers (11). It is, therefore, necessary to examine the residue level in the farm produce before marketing for consumption.

Organo phosphorus insecticides, in general, have been used extensively in the Kingdom because of their promising results in the control of a variety of insect pests.Methidathion has shown promising results in the effective control of stem borer of date palm (9). Several studies have been conducted on the persistence of methidathion, phosphamidon, dimethoate and phentoate insecticides in different crops (1, 2, 5, 7, 8, 10). Studies along this line were not conducted in the Kingdom with regard to dates, potato and cucumber where these insecticides are frequently used.

The present study was undertaken to investigate the residual distribution of three organo phosphorus insecticides namely, methidathion, phosphamidon and Rogodial [R] (dimethoate phenthoate, 110g + 410g/Kg) in date palm trees, potato and cucumber crops. It is anticipated that these studies would help in the identification of safe periods for harvesting date fruits, potatoes, and cucumber fruits after treatment with the above mentioned insecticides.

Materials and Methods

— Used

1. Phosphamidon (Dimecron[R], 50% EC): 0- (2 - chloro -2- diethylcarbamoyl - 1 -methyl - vinyl) 0,0- dimethylphosphate
2. Methidation (Supracide[R] 40% EC): 0,0 - dimethyl - S - 2 - methyloxy - 1, 3,4, - thiodiazol - 5 (4-H) - onyl - (4) - methyl dithiophosphate (4)
3. Rogodial[R] (dimethoate 110g + phenthoate 410g/kg)
   i. Dimethoate: 0,0 - dimethyl S - (N- methylcarbamoylmethyl) phosphorodithiate.
   ii. Phenthoate (Cidial): ethylmeraptophenyl acetate (0,0-dimethyl) phosphorodithiate.

— Treatment and Sampling

Field and greenhouse experiments were conducted on the residual distribution of methidathion, phosphamidon and rogodial in date palm trees, potato and cucumber crops. Five date palm trees were injected with 80 ml of methidathion mixed with an equal volume of water (1:1), recommended by CIBA-Giegy Co. (personal communication) and Wahdan (9), at the experimental farms of Al-Hassa Irrigation and Drainage Authority (HIDA), Hofuf, during December, 1982 and March, 1983. One complete leaf from each treated tree was collected and took from it five Kg of the leaf stalk and one Kg of leaflet as composite sample. The trees

treated in December, 1982 were sampled for residue analysis in leaves at 2, 14, 28, and 35 days. Those treated in March, 1983 were sampled at 1, 2, 3, 7, 12, 28, 35, 42, 49, and 56 days after application. Fruit samples for residue determination from both treatments were collected in August, 1983 at their physiological maturity stage.

Potato crop at Al-Kharj Research Station was foliarly treated with Methidathion, Phosphamidon and Rogodial each at 0.2% concentration. Potato tubers were collected at 0, 2, 4, 7, 9, 11, 14, and 16 days after treatment for residue analysis.

Cucumber crop in greenhouse at the experimental lot of Regional Agriculture and Water Research Center (RAWRC) was sprayed with methidathion, phosphamidon and Rogodial each at 0.2% concentration. A manual blast sprayer was used and efforts to ensure a complete spray coverage of test plants were made. In the above three experiments, some plants were left untreated to serve as control.

— Preparation of Sample

Randomly selected foliage and/or fruit sample was taken from each treatment. The sample was mixed well, chopped, and then taken from it a portion of 100 g in triplicate, blended/macerated the sample with 250 ml aqueous acetone (1:1) for 2 min. The sample was then filtered through glass wool using Buchner funnel and transferred to separatory funnel and extracted with chloroform three times, 30 ml each. The combined extracts were concentrated under reduced pressure at 50°C, using rotary evaporator for GLC analysis.

— Analysis

Quantitative analysis of pesticide residues were performed by a gas liquid chromatograph (Hewlett-Packard 5830 A) equipped with alkalo-flame ionization detector (AFID) using a glass column (1.8 m X 4mm i.d) packed with 3% OV-101 on 100-120 mesh WHP. The operating parameters were: column temperature 210°C; injection temperature 250°C; detector temperature 300°C, Helium carrier gas flow rate, 36 ml/min, and hydrogen and air flow to the detector were 3 and 50 ml/min., respectively. Under these conditions, the retention time was as follows: methidathion, 6.53; Isomers of phosphamidon, 4.0/ and 5.61; dimethoate 2.65 and phenthoate, 4.8 min. The detection limit for all insecticides was 2 ng. The reliability of the analytical method was tested by fortifying untreated samples with known amounts (3 ug, 5 ug) of Methidathion, Phosphamidon, and Phenthoate, followed by extraction and analysis. The recovery for Methidathion in dates ranged from 79-82%; that of methidation, phosphamidon, phenthoate in potato were 87, 83, 86 and 81% respectively, while that of the same pesticides in cucumbers were 81, 85, 78 and 80 respectively. The results were calculated for the individual insecticide from the area displayed by an integrator attached to the instrument and the data was adjusted by recovery percentage.

Results and Discussion

The amount of methidathion residue in leaf stalk and leaflets of date palm trees is presented in Table 1. The initial quantity of methidation in leaf stalk was higher (37.6 ppb) than that of leaflet (17.9 ppb) for winter treated trees. However, the residue level in leaflet exceeded that of leaf stalk with the passage of time. The highest concentration of residue (79.2 ppb) in leaflet was obtained at 28 day post treatment. The quantity of residue in leaf stalk was depleted with time while that of the leaflet had accumulated the residue inflow up to 28 days. Unlike winter treated palm trees, the leaf stalk as well as leaflets collected from spring treated lot, both indicated low residue levels at initial stages. The quantity of methidathion residue increased substantially from 1.9 to 16.0 ppb, and from non-detectable level to 665 ppb in leaf stalk and leaflets, respectively, in 35 days after application. There was a constant and gradual decrease of residue after 35 days in both the leaf stalk and leaflets. No detectable residue (< 2 ng) was found in fruit samples collected from both the winter and spring treated trees at the maturity stage. Analysis of control taken at each sampling date revealed no detectable methidathion.

In general, the concentration of residue up to 28 days after application was higher in the leaflets in winter than that of spring treated trees. However, high residue values were obtained for spring treatment after 28 days of application. The high residue accumulation in leaflets from spring treatment may be due to the active growth period of plant which helped in the process of translocation of trunk injected insecticide to the upper parts of the plant. Increase in the uptake of pesticides and hence their translocation during the growth period of the crop has been demonstrated by Chawla *et al* (10).

The residues of methidathion, phosphamidon and rogodial in foliarly treated is shown in Table 2. The results are indicative of higher quantities of phosphamidon residue than that methidathion and rogodial in potato tubers throughout the period of study. The residue of methidathion increased from 1.1 ppb to 4.4 ppb in seven days post treatment, and decreased later on with time. The rate of increase of phosphamidon residue was about 74% per day during the two days following application. However, the rate of increase slowed down to 25% per day in the next two days. The highest residue level of 375 ppb was obtained at seven days post treatment and consequently started decreasing with time. Phosphamidon residue, 20 ppb, after 16 days was less than the permissible maximum residue limit of 50 ppb (4). Unlike methidathion and phosphamidon, the maximum residue level of rogodial was obtained at 4-day post treatment, and thereafter decreased with time.

All the tested insecticides except phosphamidon resulted in residues well below the accepted toletance levels in potato tubers throughout the period of study. Phosphamidon, a systemic insecticide, yielded residue well above the maximum residue limit (50 ppb) for 11 days after application. However, the residue subsided to the accepted tolerance level at 16-day post treatment. Systemic insecticides have been used widely for the control of plant feeding insects. The degree of penetration of a systemic compound into a plant and its subsequent translocation into other plant parts are both functions of the particular plant, water solubility, polarity, and/or its stability within the living cells (1). Foliar application of methidathion and rogodial to potato crops was probably safe from the viewpoint of residues if recommended

Table 1. Amount of Methidathion residue (ppb) detected in treated palm trees at different intervals.

I. Winter treatment (December)

Plant part	time (days) 2	14	28	35
Leaf stalk	37.6	19.5	7.9	3.5
Leaflet	17.9	57.1	79.2	17.7
Fruit	not detectable residue in fruits collected in August			

II. Spring treatment (March)

Plant part	1	2	3	7	12	28	35	42	49	56
Leaf stalk	1.9	2.0	2.5	3.2	3.6	11.0	16.0	14.3	12.0	11.7
Leaflet	ND	ND	ND	4.2	8.0	17.0	665	317	470	299
Fruit	not detectable residue in fruits collected in August									

treatment doses and application practices are followed.

Data showing the residues of methidathion, phosphamidon and rogodial at different intervals in foliarly treated cucumber are shown in Table 3. Maximum residue values for methidathion, 5.51 ppm; phosphamidon, 13.92 ppm, rogodial (dimethoate, 1.4 ppm and phenthoate, 2.64 ppm) were obtained at 0 hr. post treatment. The residues of methidathion, dimethoate and phenthoate reached well below the permissible maximum residue limit 0.2, 2.0 and 0.02 ppm respectively in 10 days after application. However, phosphamidon took 15 days to reach the acceptable residue level of 0.1 ppm (4). The half-life for all the insecticides studied was less than 3 days. All residues in cucumber dissipated rapidly during the first 10 days after spray and at a slower rate, the following 5 days. This rapid decrease in the initial stages may be due to the degradation of the insecticides studied by the metabolic action within the plants. Metabolism plays an important role in relation to selectivity of action of pesticides, and thus plays a part in determining the safety of these compounds to man and his farm animals. The level of metabolism is a factor determining the persistence of pesticides in soil, plants and animal bodies and thereafter contributes significantly to the reduction of environmental pollution. This trend of dissipation is comparable with that of Westake **et al** (10) who found the degrading phosphamidon half lives as 3 to 5 days and the persisting residue half lives from 10 to 12 days in citrus fruits and cattle feed. These results are also in agreement with these reported by Llisto *et al* (7), Ferreira and Tainha (5), Chopade *et al* (3) and Iwata *et al* (6) for dimethoate, phenthoate and methidathion in cotton, olives, tomatoes and citrus crops.

Table 2. Residues of Methidathion, Phosphamidon and Rogodial in treated potato at different intervals.

Days after treatment	Residue* (ppb)			
			Rogodial	
	Methida-thion	Phospha-midon	Dimethoate	Phenthoate
0	1.1	197	1.1	2.5
2	2.3	240	2.2	5.3
4	4.2	361	5.8	9.6
7	4.5	375	3.1	5.8
9	3.4	210	1.5	2.3
11	1.9	130	----	----
14	1.9	----	0.4	----
16	0.6	120	----	----

* Each value is the average of three replicates

Table 3. Pesticide residues detected in treated cucumber at different intervals.

Days after treatment	Residue* (ppm)			
	Methida-thion	Phospha-midon	Rogodial	
			dimethoate	Phenthoate
0	5.5	13.9	1.4	2.6
1	3.3	7.6	0.9	1.6
3	1.1	3.8	0.7	0.9
6	0.1	0.7	0.2	0.1
8	0.1	0.6	0.2	0.1
10	0.0	0.4	0.0	TRACES
13	0.0	0.4	0.0	TRACES
15	0.0	0.1	0.0	TRACES

* Each value is the average of three replicates.

Acknowledgement

The authors are grateful to Dr. Salah Abu Shakra and to Dr. Wajih N. Sawaya for their valuable suggestions and constructive criticism in the preparation of this manuscript.

الملخص

خان ، بردول ، احمد عبد السلام بركات ، عبد المحسن محمد العبد الكريم ، وأحمد علي وهدان . ١٩٨٥ . توزيع متبقيات المبيدات الفوسفورية في النخيل والبطاطس والخيار . مجلة وقاية النبات العربية ٣ : ٣٨ - ٤٠ .

درس توزيع مبيدات الميثيداثيون ، فوسفاميدون والروجوديال في النخيل والبطاطس والخيار . استخدم مبيد الميثيداثيون (سوبر اسيد ٤٠٪) عن طريق حقن جذوع نخيل البلح بمعدل ٨٠ مل لكل نخلة . اخذت عينات من عروق وسعف أوراق النخيل والثمار على فترات بعد المعاملة لتحليل متبقيات المبيد . وفي تجربة أخرى رشت نباتات البطاطس المزروعة في الحقل والخيار المزروعة في البيوت المحمية بمبيد الميثيداثيون ٤٠٪ ومبيد الفوسفاميدون ٥٠٪ ، الروجوديال « دايمثويت ١١٠ جم + فينثويت ٤١٠ جم/كجم) بتركيز ٢ , ٠٪ جمعت درنات البطاطس وثمار الخيار على فترات بعد المعاملة لاجراء التحليل . استخلصت جميع العينات وحللت بطريقة الغاز كروماتوجرافي .

دلت النتائج على أن كمية الميثيداثيون في النخيل اختلفت تبعاً للوقت الذي مر على اجراء التجربة . ولم يظهر أي بقايا من المبيد في الثمار التي جمعت من الأشجار المعاملة . ومتبقيات الميثيداثيون ، الدايمثويت ، فينثويت في درنات البطاطس كانت أقل من الحد المسموح به لكل مبيد وذلك خلال ١٦ يوم وهي فترة اجراء التجربة . وكانت كمية الفوسفاميدون في البطاطس اكبر من الحد المسموح به للمبيد(٠٥و٠وجزء من المليون) خلال اجراء التجربة . وفي ثمار الخيار كانت المتبقيات لمبيدات الميثيداثيون ، دايمثويت ، فنثويت وصلت الى اقل من المسموح به بعد ١٠ أيام من الرش وفي حالة مبيد الفوسفاميدون بعد ١٥ يوم من المعاملة .

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