THE PREVENTION OF INSECT INFESTATION IN STORED DATES

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The annual production of all date varieties in Iraq in 1974 was approximately 350,000 tonnes, of which 250 - 300,000 tonnes, valued in 1974 at £13 million, were exported.

The main production area, especially of the high quality dates for export, is in the region around Basrah in the south of the country, where harvesting of the dates commences in September. In the region around Baghdad, harvesting occurs in October.

Dates are collected in the orchards and put into wooden 'field' boxes, although these boxes are being replaced by perforated plastic crates. The 'field' boxes are left in the orchards for at least two weeks to allow further ripening to occur, and insect infestation can then occur. Windfalls, which are usually insect infested, are put into the same 'field' boxes, and add to the insect infestation. These 'field' boxes are used to transport the dates to the packing sheds, and here the dates, still in boxes, can be left for several weeks before further processing.

Ephestia cautella is the most serious insect pest of post-harvested dates in Iraq, infesting dates in the orchards, packing sheds and stores (A.A. Hussain 1974). Infestation can occur when the dates are on the palms if the harvest is delayed, or if the variety is late maturing. Infestation of windfalls is common, as is infestation in the stores. The most serious insect pest of stored dates is *Oryzaephilus surinamensis*, infestation being apparent from December onwards, and reaching a peak in April.

Before packing and export, the dates are fumigated with methyl bromide. The highest quality dates are packed in cardboard cartons having a cellophane window, the cartons being contained in cardboard boxes. High quality dates are also exported in wooden boxes lined with waxed paper. Lower quality dates are exported in palm-leaf bags contained in hessian sacks. Packed dates can become re-infested with insects, either in the packing sheds, or when waiting for export. Sometimes the wooden boxes are sprayed with malathion after leaving the packing sheds.

MATERIALS AND METHOD: Four trials were done in Baghdad using export packages, or materials used to make such packages, and one trial using perforated plastic 'field' crates. Each trial compared three or four rates of pirimiphos-methyl (from 'Actellic' 50)* as deposits on the outer surfaces of the packages, with a water treatment and, in most cases, with a malathion treatment. All deposits were produced by spray application using a knapsack sprayer. The types of surface treated, and the rates and volumes of application are given in Table I. When the spray had dried, the

Table I
SUMMARY OF INSECTICIDE TREATMENTS

Trial No.	Substrate treated	Rates of application	Spray Volume
1	Cardboard boxes (containing untreated window cartons)	0.125. 0.25 and 0.5 g pirimiphos-methyl/m^2 and 1 g malathion/m^2	50 mls/m^2
2	Wooden export boxes (lined with untreated waxed paper)	As in Trial 1	50 mls/m^2
3	Waxed paper (placed in untreated wooden boxes)	0.03125, 0.0625, 0.125 and 0.25 g pirimiphos-methyl/m^2	25 mls/m^2
4	Plastic 'field' boxes	As in Trial 1	25 mls/m^2
5	Hessian sacks (containing untreated palm-leaf bags)	As in Trial 1	50 mls/m^2

relevant packages of dates, or loose dates, were put into the treated containers. Fifteen replicates of each treatment were used, and they were randomised, placed in rooms, and exposed to severe insect infestation by releasing into the rooms, at one month intervals, large numbers of laboratory-reared susceptible strains of *Tribolium castaneum*, *Oryzaephilus surinamensis* and *Ephestia cautella*.

Three replicates of each treatment were removed from the rooms and examined for biological effectiveness of the

* Registered Trade Mark of I.C.I. Plant Protection Division.

Table II
BIOLOGICAL EFFECTIVENESS OF VARIOUS TREATMENTS AFTER 3 MONTHS

Substrate treated	Rate of application	% mortality & total number insects found %	Total
Cardboard boxes	0.5 g pirimiphos-methyl/m^2	100	20
	1 g malathion/m^2	100	25
	untreated	71	24
Wooden boxes	0.5 g pirimiphos-methyl/m^2	93	68
	1 g malathion/m^2	91	55
	untreated	58	26
Waxed paper	0.125 g pirimiphos-methyl/m^2	92	24
	0.25 g pirimiphos-methyl/m^2	97	30
	untreated	42	57
Plastic 'field' boxes	0.5 g pirimiphos-methyl/m^2	100	18
	1 g malathion/m^2	100	11
	untreated	83	6
Hessian sacks	0.5 g pirimiphos-methyl/m^2	100	23
	1 g malathion/m^2	100	18
	untreated	97	30

treatment, and residue analysis, 1 week, and 1, 3 and 6 months after treatment. At the time of sampling, the inner surfaces of the containers were examined for live and dead insects, and separate random samples of dates taken for biological assessment, taint testing where relevant, and residue analysis. For the biological examination, each date was cut in half, all visible live and dead insects removed, and the dates boiled for five minutes and any hidden insects collected by floatation in kerosene (Hussain pers, comm.).

Samples of the treated containers were taken during the 3 and 6 month examinations and bioassayed with laboratory-reared susceptible strains of *T. castaneum*, *O. surinamensis* and *E. cautella*. Samples of dates from the treated containers were also taken at these times and tested for any possible taint.

RESULTS AND DISCUSSION: Irrespective of the surface treated, lower rates of application of pirimiphos-methyl were more effective than 1 g malathion/m^2. Even this relatively high rate of malathion did not prevent insect infestation, and the survival of many insects, as was obvious when malathion was applied to hessian sacks (Table III). In the second trial, where wooden boxes were treated,

Table III
BIOLOGICAL EFFECTIVENESS OF VARIOUS TREATMENTS AFTER 6 MONTHS

Substrate Treated	Rate of application	% mortality & total number insects found	
		%	Total
Cardboard boxes	0.5 g pirimiphos-methyl/m^2	100	55
	1 g malathion/m^2	96	111
	untreated	74	132
Wooden boxes	0.5 g pirimiphos-methyl/m^2	76	54
	1 g malathion/m^2	42	78
	untreated	32	56
Waxed paper	0.125 g pirimiphos-methyl/m^2	95	21
	0.25 g pirimiphos-methyl/m^2	98	51
	untreated	30	73
Plastic 'field' boxes	0.5 g pirimiphos-methyl/m^2	91	116
	1 g malathion/m^2	52	268
	untreated	52	292
Hessian sacks	0.5 g pirimiphos-methyl/m^2	100	11
	1 g malathion/m^2	26	53
	untreated	-	<1000

imperfections in the box construction prevented complete insect control, and would have even prevented a much higher rate of application from giving complete kill of insects. Improvements in the box design would be necessary to achieve better insect control. Further, the insect infestation pressure was much higher than would usually occur.

Deposits of pirimiphos-methyl were very toxic to the three bioassay species when tested 3 and 6 months after treatment (Tables IV and V). A deposit of 0.5 g pirimiphos-methyl/m^2, and

Table IV
BIOASSAY OF SUBSTRATES 3 MONTHS AFTER TREATMENT

Substrate	Treatment	% kill after 24 hours			
		Adults		Larvae'	
		T.c.	O.s.	E.c.	T.c.
Cardboard	0.25 g pirimiphos-methyl/m^2	100	100	100	100
	0.5 g pirimiphos-methyl/m^2	100	100	100	100
	1 g malathion/m^2	100	100	100	55
	untreated	0	2	19	0
Waxed paper	0.0625 g pirimiphos-methyl/m^2	100	100	100	92
	0.125 g pirimiphos-methyl/m^2	100	100	100	96
	0.25 g pirimiphos-methyl/m^2	100	100	100	100
	untreated	0	0	9	19
Wood	0.25 g pirimiphos-methyl/m^2	96	98	100	-
	0.5 g pirimiphos-methyl/m^2	100	100	100	-
	1 g malathion/m^2	100	100	100	-
	untreated	0	1	35	-

' = exposure for 48 hours

T.c. = T. castaneum; O.s. = O. surinamensis; E.c. = E. cautella

Table V
BIOASSAY OF SUBSTRATES 6 MONTHS AFTER TREATMENT

Substrate	Treatment	% kill after 48 hours			
		Adults		Larvae	
		T.c.	O.s.	T.c.	O.s.
Cardboard	0.125 g pirimiphos-methyl/m^2	100	100	100	100
	0.5 g pirimiphos-methyl/m^2	-	-	100	100
	1 g malathion/m^2	76	100	83	100
	untreated	0	3	2	0
Waxed paper	0.0625 g pirimiphos-methyl/m^2	100	100	35'	-
	0.125 g pirimiphos-methyl/m^2	100	100	50'	-
	0.25 g pirimiphos-methyl/m^2	100	100	100	-
	untreated	0	4	21	-
Wood	0.25 g pirimiphos-methyl/m^2	95	100	86'	100
	0.5 g pirimiphos-methyl/m^2	99	100	100	100
	1 g malathion/m^2	100	100	100	100
	untreated	0	8	0	0

' = all insects badly affected

T.c. = T. castaneum; O.s. = O. surinamensis

sometimes lower amounts, were at least as effective, and frequently more effective, than 1 g malathion/m^2.

Residues (Anon 1974) of pirimiphos-methyl were always low, or non-detectable, except in trials 3 and 4 (Table VI), and even in those trials the residues were lower than the figure of 0.5 ppm recommended as a residue tolerance by the FAO/WHO Joint Expert Panel on Pesticide Residues (Anon 1977). The type of treatment used in Trial 3, where waxed paper was sprayed, would probably never be used commercially as it is too time consuming, and a recommendation for the use of pirimiphos-methyl to treat perforated plastic 'field' crates (Trial 4) could not be made as no treatment prevented large numbers of insects from entering the crates by the end of the trial.

Table VI
RESULTS OF ANALYSES OF DATES FOR RESIDUES OF INSECTICIDES (mgms/kg)

Substrate Treated	Rate of application	Residues in dates after			
		1 week	1 month	3 months	6 months
Cardboard boxes	0.5 g pirimiphos-methyl/m^2	<0.01	<0.01	0.08	<0.01
	1 g malathion/m^2	<0.01	<0.01	<0.01	-
Wooden boxes	0.5 g pirimiphos-methyl/m^2	0.02	<0.01	<0.01	<0.01
	1 g malathion/m^2	<0.01	<0.01	<0.01	-
Waxed paper	0.125 g pirimiphos-methyl/m^2	0.09	0.20	0.23	-
	0.25 g pirimiphos-methyl/m^2	0.19	0.47	0.28	-
Plastic 'field' boxes	0.5 g pirimiphos-methyl/m^2	0.15	0.23	0.21	0.27
	1 g malathion/m^2	0.21	0.31	0.20	-
Hessian sacks	0.5 g pirimiphos-methyl/m^2	0.02	0.05	0.24	0.10
	1 g malathion/m^2	0.06	0.05	-	-

(limit of detection 0.01 mg/kg)

In no case was a taint detected in any of the date samples.

ACKNOWLEDGEMENTS: We are grateful to Mr. Jasim Nassaff, Minister of Agriculture, Iraq, and the Directors of I.C.I. Plant Protection Divison for their permission to publish this paper. We are also extremely grateful to Mr. R. Pascoe and staff of I.C.I. Plant Protection Division Jealott's Hill Research Station and the Iraq Date Administration for the very considerable technical assistance given.

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