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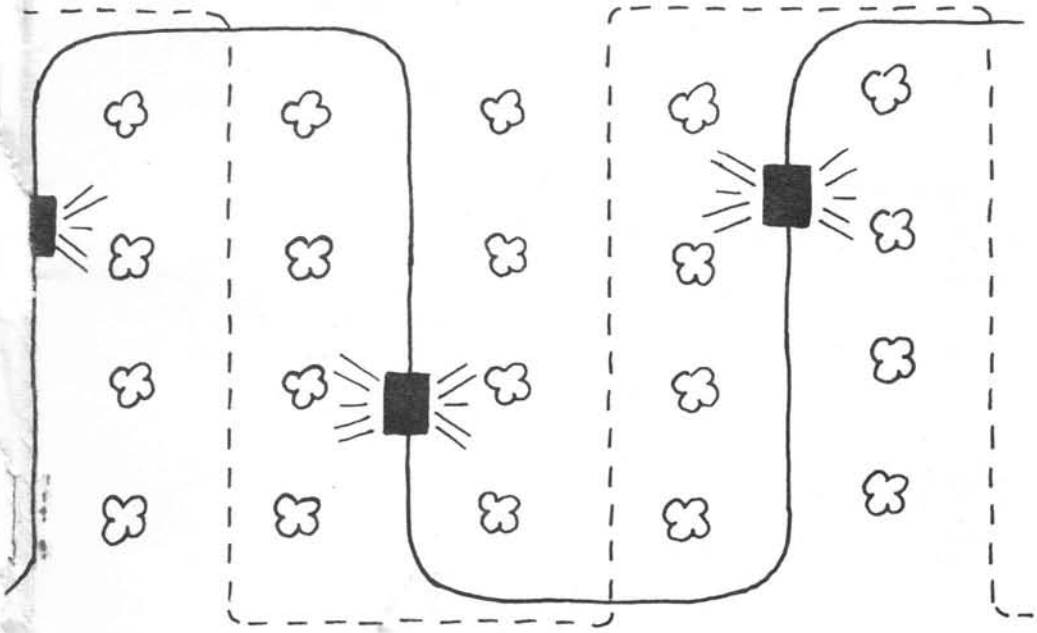

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Diagram on cover shows alternate middle row spray pattern.

REDUCED SPRAY PROGRAMS FOR CONTROL OF FRUIT PESTS IN CONNECTICUT (1975)

Richard C. Moore

Reduced spray schedules, reduced rates of pesticide and better timing of spray applications have been evaluated for three consecutive growing seasons (Moore 1973, 1974b, 1975b). Emphasis has been placed on programs which allow the survival of natural enemies of mites and aphids. Additionally, trapping data for codling moth, apple maggot, red-banded leafroller and Oriental fruit moth suggested that reduced spray programs using alternate middle row spraying or extended interval spraying would be effective in Connecticut (Moore 1975a).

Experiments on reduced spray programs were continued in 1975. The following field tests were undertaken to reduce pesticide application: (1) weekly application of reduced rates of pesticides and (2) reduced spray programs using either alternate middle row or extended interval spraying. Full sprays of pesticides (both sides of the tree sprayed) and half sprays (one side of tree sprayed) were evaluated for control of phytophagous mites and aphids and the effect on their predators. Candidate materials or new formulations or registered materials which could be incorporated into future reduced spray programs were also tested.

PROCEDURES

Experiments were conducted at Lockwood Farm, Mt. Carmel, Conn. Materials used in the reduced rate plot (Table 1), reduced spray plots (Tables 1 & 4), extended interval plot (Table 4), as well as the mite (Table 8) and aphid tests (Table 7), were applied as 10X concentrate (Moore 1971) with a tractor-mounted mistblower. Full sprays were applied at 30 gal/acre and half sprays at 15 gal/acre with the exception of Difolitan 4F, used in the reduced spray plot (Table 1) which was applied 6X using 50 gal/acre. Candidate materials were applied to apples dilute with a hydraulic sprayer at a pressure of 400 psi using a four nozzle handgun (Table 9) and to peaches as a 5X concentrate (60 gal/acre) using the mistblower (Table 11).

Seven Cortland, Red Delicious and Baldwin apple trees were sampled per 1.1 acre plots in the reduced spray program in Table 2. For the test using candidate formulations (Table 9), fruit was sampled from 4 single tree replicates consisting of one Gravenstein, one McIntosh, and two Red Delicious. In these tests, one bushel of picked and one bushel of dropped fruit were scored per tree. In the reduced spray programs

shown in Table 5, all fruit from the dwarf Lodi, McIntosh, and Red Delicious trees in these plots were picked and scored. For control of insect pests on peaches (Table 11), two replicates consisting of 3 trees of each variety (Harbelle, Red Haven, Glo Haven or Harmony) were sprayed and 1/2 bushel from each of the six treated trees was scored.

Mites were sampled as described by Moore (1971). In the reduced spray plots (Tables 3 & 6), 20 leaves were taken from 3 trees of each variety per treatment. Ten leaves per tree were taken from 3 Spartan and 3 Smoothee apple trees per treatment in the miticide test (Table 8). In the test using candidate insecticide formulations (Table 10), 20 leaves per tree were sampled from each of two Red Delicious trees.

Aphids were counted in the field on the distal 3 leaves of 5 tagged terminals on one Cortland, Red Delicious and Baldwin tree per plot in the reduced spray programs (Table 3). For the full and half spray programs, two tagged terminals on each of three Spartan and McIntosh trees were counted in the aphid test (Table 7).

A list of pesticides used and their mammalian toxicities are found in Appendix I. Apple and peach pests that these materials are registered to control are found in Appendix II.

RESULTS

Weekly concentrate (10x) applications of half sprays combining Guthion 50WP (6.0 oz/acre) and Zolone 25WP (12 or 16 oz/acre) at substantially reduced rates (Table 1) produced 92.9% fruit free from insect damage (Table 2). Most of the damage to apples was caused by apple maggot (3.4%) while the remaining apple pests were adequately controlled. Dikar 80WP applied at several rates during the season (Table 1) controlled apple scab and other diseases (Table 2).

Zolone 25WP applied at a rate of 12 oz/acre as a half spray (Table 1) was used for aphid control. Apple aphids, Aphis pomi, began to increase in this plot in mid-June reaching their peak in late June (128.2/terminal) and then declined to 47/terminal in July (Table 3). Syrphus torus, a syrphid fly larval predator, followed a similar pattern while Aphidoletes aphidimyza, a midge larvae predator, continued to increase throughout this period reaching a peak of 3.3/terminal in July. Panonychus ulmi, the European red mite (ERM), did not become numerous in this plot (Table 3) until August 26 (3.1/leaf); however, no special miticide applications were necessary other than Dikar and Zolone which were applied seasonally (Table 1). The mite predators, Amblysecius fallacis and Zetzellia mali, were at low levels throughout the season.

In the reduced spray plot (Table 1), Torak 4EC was applied at 1.5 qts per acre as a concentrate full spray at Pink, Petal Fall and First Cover. Zolone 25WP was applied at 1.5 lbs/acre as a half spray at 14 day intervals

for the remainder of the season. This program produced 94.3% fruit free from insect damage (Table 2). Apple maggot caused most damage (2.2%) while other apple pests were adequately controlled. Difolitan 4F applied 6X at Green Tip using the single application technique (3.75 gal/acre) followed by full sprays of Captan 50WP (4.5 lbs/acre) at Petal Fall and 1st Cover and half sprays of Captan at 1.5 lbs/acre for the rest of the season controlled scab and other diseases.

Apple aphids peaked in late June (230.7 per terminals), then declined to 13.4/terminal in July (Table 3). S. torus and A. aphidimyza followed similar patterns, and combined with Zolone applications, they contributed to controlling apple aphids in this plot. A delayed dormant oil spray applied at Green Tip for control of overwintering ERM eggs combined with seasonal applications of Zolone controlled ERM in this plot (Table 3).

Another reduced spray program (Table 4) was tested using Guthion 50WP applied as a full spray concentrate at 1.5 lb/acre at Pink, Petal Fall and 1st Cover followed by a candidate material, MC-9087 2EC, applied as a half spray at 1.5 qt/acre from 2nd to 8th Cover. This program produced 83.5% fruit free from insect damage (Table 5). Most damage was caused by apple maggot (8.5%) and plum curculio (3.9%). Reduced rates (Table 4) of Dikar 80WP (2, 3 and 1.5 lb/acre), combined with Benlate 50WP (6, 9 and 4.5 oz/acre) adequately controlled scab (6.4%) and other diseases.

ERM and two-spotted mites (2-S) began to increase in the reduced spray plot in mid-June (Table 6) and peaked in early July (8.0/leaf). In addition to the regular spray program, Fundal 97SP was applied as a half spray at 6 oz/acre on July 9th and 23rd. Little or no reduction of these mites was seen following the initial application; however, following the second application, ERM and 2-S were reduced to 0.6 and 0.4 mites/leaf on July 28th. The predatory mite, A. fallacis, was found in low numbers in this plot. In the check plot, ERM reached a peak in early July (6.1/leaf) and decreased markedly by late July (0.2/leaf) due to the predatory mites, A. fallacis and Z. mali. The 2-S mite was not a problem in the check plot.

The final reduced spray program tested involved the use of extended three week intervals between spray applications beginning at 2nd Cover. Guthion 50WP applied concentrated at 2.0 lb/acre at Pink, Petal Fall and 1st Cover and at 1.5 lb/acre from 2nd Cover to 6th Cover (Table 4) produced 88.7% clean fruit (Table 5). Plum curculio (3.9%), European sawfly (2.6%) and apple maggot (2.9%) caused the most damage. Apple scab was controlled (1.0%) using reduced rates of Benlate 50WP (6.0 oz/acre) combined with 70 sec spray oil (3.0 qts/acre).

ERM began to increase (Table 6) in July (5.8/leaf). Carzol 92SP applied as a full spray on July 9 did not reduce the ERM population (13.7/leaf). A second application on July 23 successfully reduced (0.2/leaf) this pest mite as well as the predatory mite, A. fallacis. Results in the check plot are reported above.

Table 7 presents the results of a test designed to evaluate the effectiveness of aphicides on the apple aphid, A. pomi, and its two predators, S. torus and A. aphidimyza. Concentrate full spray applications of Phosphamidon (4 oz/10 gal), Zolone 3EC (16 oz), HOX-1901 40WP (16 oz), AC-85258 25WP (32 oz) and U-36059 1.66EC (19.3 oz) produced a 97-100% reduction of A. pomi 7 days after application. Predators were also reduced with all full spray applications except in the HOX-1901 and AC-85258 treatments which showed an increase of A. aphidimyza. Diazinon 50WP applied as a full spray at 8 oz/10 gal reduced apple aphids 48.2% while both predators increased. Phosphamidon 8EC at the 2 oz rate reduced A. pomi 93.7% and S. torus 95.6% while A. aphidimyza increased.

Of the materials applied as half sprays, Zolone 3EC (93.7%), Zolone 1.5EC plus Malathion .067EC (96.7%) and HOX-1901 40WP (95.8%) most effectively reduced apple aphids after 7 days. A. aphidimyza increased in the Zolone EC and HOX-1901 40WP treatments. Half sprays of Diazinon 50WP at 16 and 8 oz/10 gal, and Phosphamidon 8EC at 2 oz produced 55.5, 52.9 and 6.3% reduction of apple aphids respectively, while both aphid predators increased in numbers.

A similar test was conducted to evaluate the effectiveness of miticides on the ERM and two species of predatory mites (Table 8). Fundal 97SP applied concentrate as a full spray at 4 oz/10 gal most effectively reduced ERM (96.1%) 7 days after application. All miticides as full sprays decreased the numbers of both predatory mites. Half sprays of SD-14114 50WP or 4WDS, Carzol 97SP, Fundal 97SP applied at the 4 oz rates as well as U-36054 1.66EC at 9.6 oz and AC-85258 25WP at 32 oz produced reduction of ERM ranging from 38.5% to 70.6% while numbers of the predator mite, Z. mali increased.

As shown in Table 9, Carzol 92SP applied at Pink, Petal Fall and 1st Cover followed by Guthion 50WP from 2nd to 8th Cover or Guthion applied seasonally were more effective than the four candidate insecticidal formulations tested for control of insect pests on apple. Zolone 1.5EC plus Malathion .067EC and Imidan 70WP produced approximately 80% clean fruit. Micro-encapsulated formulations of Imidan 2S and Methyl-parathion 2S, were the least effective although they did effectively control early season pests such as plum curculio, European sawfly and plant bugs.

Table 10 presents results of mite counts taken in this plot. Carzol followed by Guthion, and the encapsulated formulations of Imidan and Methyl-parathion most effectively controlled ERM.

Results of concentrate (5x) applications of materials for seasonal control of peach pests are shown in Table 11. M-3016 (Lorsban) 25WP, Torak 4EC followed by Guthion 50WP, and Imidan 70WP resulted in 88.0, 86.7 and 87.0% uninjured fruit, respectively. M-3016 25WP and Imidan 70WP most effectively controlled plum curculio. Plant bugs were most effectively controlled by Carzol 92SP. The treatment using Torak 3EC followed by Guthion 50WP was highly effective against the Oriental fruit moth.

DISCUSSION

This season 92.9% of the fruit was free from insect damage using weekly applications of half sprays of Guthion plus Zolone wettable powder in the reduced rate plot. As shown in Table 12, these results are comparatively better than those obtained using Guthion plus Imidan in 1974 or 1973 (Moore 1974, 1975). This season's results also compare favorably with those obtained in 1972 when 88.8% clean fruit was produced using Zolone EC in a full spray program (Moore 1973).

Although the reduced rate program may involve as many as 24 applications, the total amount of pesticide used is actually less than in a full spray program.

European apple sawfly and plum curculio accounted for most of the damaged fruit from 1972 to 1974 in the reduced rate plot. Apple maggot was most injurious in 1975.

Apple aphids were adequately controlled by half sprays of Zolone WP which also allowed survival of two predatory fly larvae. While 2-S mites were a problem in this plot in 1972 and 1973, ERM were predominant in 1974. Numbers of overwintering ERM from the 1974 season were low, and this most likely contributed to the lack of an ERM problem this season.

In the reduced spray plot in 1975, 94.3% of the fruit was free from insect damage using early season full spray applications of Torak followed by half sprays of Zolone WP for the remainder of the season. As shown in Table 12, 87.5% clean fruit was obtained using Imidan in a similar program in this plot in 1974 (Moore 1975) while 89.5% was produced in 1973 using full sprays of Guthion followed by half sprays of Zolone. Guthion used in a full spray program in 1972 produced 93.8% clean fruit. Because six half sprays are applied in the reduced program from 2nd to 8th Cover, there is a savings equivalent to three cover sprays if full sprays were used.

While apple maggot accounted for most of the damaged fruit in this plot in 1975, plum curculio and/or European sawfly were most injurious from 1972-1974. Apple aphids peaked in late June and then declined rapidly due to both predators and application of Zolone wettable powder. A delayed dormant oil application followed by Zolone adequately controlled ERM this season.

A second reduced spray program was tested this season in another plot consisting of dwarf apple trees which had little or no pesticide application in previous seasons. Encouragingly, 83.5% clean fruit was produced using early season full sprays of Guthion followed by half sprays of MC-9087 for the rest of the season. MC-9087 is a new material which acts as a stomach poison for insects and was expected to control apple maggot flies in a manner similar to lead arsenate; however, maggot damage was 8.5% in this plot. Dikar combined with Benlate at reduced rates effectively controlled apple scab and other diseases.

ERM and 2-S mite became a problem in this plot in late June. An initial half spray of Fundal on July 9th did not adequately reduce these mites. This failure was most likely caused by run-off during heavy rains which fell shortly after application; Fundal is a water soluble formulation. A second half spray application of Fundal on July 23rd, followed by good weather, adequately reduced ERM and 2-S mites.

Another reduced spray program using full spray of Guthion at regular intervals early in the season but applied at extended three week intervals from 2nd to 6th Cover produced 88.7% fruit free from insect damage. This program involves a savings of 2 full cover sprays and was also tested in a plot of dwarf apple trees. Based on trapping data for codling moth, apple maggot, red-banded leafroller and Oriental fruit moth over a 3-year period (1972-74), Moore (1975a) proposed that a reduced spray program using extended interval sprays would control these pests in Connecticut orchards. Of these four pests, codling moth, red-banded leafroller and Oriental fruit moth caused less than 1.0% damage to fruit while apple maggot damage was 2.9%. The apple maggot damage could be partially attributed to the fact that these trees were not sprayed in prior seasons which allowed a sizeable maggot population to establish itself in this plot.

Seasonal application of reduced rates of Benlate plus oil have been labeled for use to provide control of both apple scab and mites. Using this combination in the extended intervals plot controlled scab; however, ERM became numerous in early July and Carzol was applied. The three week interval used in this program may be too long for successful mite control using the Benlate plus oil combination.

Modification of spray techniques such as alternate middle row spraying to reduce pesticide use as well as selection of chemicals used must be considered in order to insure survival of natural enemies of orchard pests (Moore 1974a). Two spray tests were conducted this season designed to evaluate the effectiveness of aphicides and miticides on predators and prey. Programs that allowed the survival of predators with a 50% reduction of pest species of aphids or mites were considered desirable.

Diazinon 50WP applied as a full spray at 12 oz/acre or a half spray at 12 and 24 oz/acre reduced apple aphids approximately 50% while allowing two aphid predators, S. torus and A. aphidimyza, to increase. Similar results were obtained by Moore (1974b) using Thiodan 50WP at 16 oz/acre, as a half spray. In a similar test, a reduction of ERM ranging from 40 to 70% and an increase of Z. mali was obtained using half sprays of SD-14114 (Vendex), Carzol and Fundal at 6 oz/acre, U-36054 at 14.7 oz/acre and AC-85258 at 48 oz/acre.

The testing of candidate pesticides or new formulations of registered materials which might be used in future reduced spray programs is of continuing importance. Micro-encapsulated formulations of pesticides are receiving increased interest because they can (1) increase the residual life of a pesticide by slowly releasing the chemical and

(2) reduce the toxicity of the pesticide for the applicator. However, in tests this season, micro-encapsulated formulations of Imidan or Parathion were the least effective materials tested for seasonal control of apple insect pests. Carzol applied early, followed by Guthion, was the most effective treatment in this test. These three treatments were the most effective for ERM control. Of the treatments tested for seasonal control of peach insects, M-3016 (Lorsban) was the most effective. Lorsban is currently registered for control of borers on peach trees.

In conclusion, results of reduced rate or reduced spray programs over the past three seasons (Table 12) have shown that these programs can be used successfully. In addition to controlling pest species, these programs also encourage the survival of natural enemies of mites and aphids and also result in reduced costs and pesticide usage.

REFERENCES CITED

Moore, R. C. 1971. Experiments on the chemical control of fruit insects and mites in Connecticut (1971). Conn. Agric. Expt. Station Special Bull. IV: 20 pp.

Moore, R. C. 1973. Experiments on the chemical control of fruit insects and mites in Connecticut (1972). Conn. Agric. Expt. Station Special Bull. VI: 18 pp.

Moore, R. C. 1974a. Integrated pest control in orchards. Proc. Conn. Pomological Soc. (1973) 83: 12-14.

Moore, R. C. 1974b. Experiments on the chemical control of fruit insects and mites in Connecticut (1973). Conn. Agric. Expt. Station Special Bulletin VII: 19 pp.

Moore, R. C. 1975a. Determination of seasonal activity of four fruit pests using pheromone and other traps. Proc. Conn. Pomological Soc. (1974) 84: 8-14.

Moore, R. C. 1975b. Chemical and biological control of fruit pests in Connecticut (1974). Conn. Agric. Expt. Station Bull. 751: 18 pp.

Thomson, W. T. 1972. Agricultural chemicals. I. Insecticides. Thomson Publ., Fresno, Ca. 315 pp.

Vasvary, L. M. and F. C. Swift. 1966. How poisonous are pesticides? In Northeastern Pesticide Information Manual. 3 pp.

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Table 1. Schedule, rates and methods of application of pesticide combinations. Semi-dwarf apples, Mt. Carmel, Conn. 1975.

Application[1]	Date	Pesticide per Acre — Reduced Rate Plot	Date	Reduced Spray Plot
		Full Spray		Full Spray
Green tip	4/21	3.5 lb Dikar 80WP	4/21	3.75 gal Difolitan 4F[2]
Half Inch Green	4/29	Repeat above		6.0 gal Oil - 70 sec[2]
Tight cluster	5/7	Repeat above		
		Half Spray		
Pink	5/12	2.25 lb Dikar 80WP 6.0 oz Guthion 50WP 1.0 lb Zolone 25WP	5/12	1.5 qt Torak 4E
Bloom	5/16	2 25 lb Dikar 80WP		
Petal Fall	5/21	Same as Pink	5/21	4.5 lb Captan 50WP 1.5 qt Torak 4E
1st Cover	5/28	Repeat above	5/28	Repeat above
				Half Spray
2nd Cover	6/11	1.5 lb Dikar 80WP 6.0 oz Guthion 50WP 12.0 oz Zolone 25WP	6/11	1.5 lb Captan 50WP 1.5 lb Zolone 25WP
	6/19	Repeat above		
3rd Cover	6/25	Repeat above	6/25	Repeat above
	7/2	Repeat above		
4th Cover	7/9	Repeat above	7/9	Repeat above
	7/17	Repeat above		
5th Cover	7/23	Repeat above	7/23	Repeat above
	7/31	Repeat above		
6th Cover	8/6	Repeat above	8/6	Repeat above
	8/14	Repeat above		
7th Cover	8/20	9.0 oz Benlate 50WP 6.0 oz Guthion 50WP 12.0 oz Zolone 25WP	8/20	Repeat above
	8/27	Repeat above		
8th Cover	9/2	Repeat above	9/2	Repeat above

[1] Concentrate mistblower application; 30 gal/acre for Full Spray, 15 gal/acre for Half Spray, 1.1 acre/plot.

[2] Concentrate mistblower application; 50 gal/acre.

Table 2. Effectiveness of concentrate applications of reduced rates or reduced spray of insecticides and fungicides used in a seasonal schedule for controlling insect pests on semi-dwarf apples. Mt. Carmel, Conn. 1975.

Materials[1]	% uninjured fruit	% Fruit Injured By[2]							
		Plum curculio	European sawfly	Apple maggot	Codling moth	Plant bugs	San Jose scale	Other[3]	Scab
Reduced Rate Plot									
Guthion-Zolone Dikar-Benlate	92.9	1.4	0.3	3.4	0.3	0.9	1.4	0.3	1.5
Reduced Spray Plot									
Torak-Zolone Difolitan-Captan	94.3	1.7	0.1	2.2	0.5	0.7	0.3	0.2	1.0
Check	21.7	5.3	0.5	50.6	27.9	2.0	17.3	0.4	18.0

[1] Schedule, rates and method of application given in Table 1.

[2] Seven Cortland, Red Delicious and Baldwin trees sampled per plot; one bushel each of picks and drops scored per tree.

[3] Damage to fruit by leafrollers, green fruit worms and cankerworms.

Table 3. Effect of reduced rate or reduced spray schedules on green apple aphids, Aphis pomi, and European red mites, Panonychus ulmi, and their predators.

Materials[1]	Aphids and predators	Avg. No./Terminal On[2] 6/18	6/23	6/30	7/11	Mites and predators	Avg. No./Leaf On[3] 7/1	7/15	7/28	8/11	8/26
Reduced Rate Plot											
Guthion-Zolone	Aphis pomi	68.2	88.6	128 2	47.0	Panonychus ulmi	0.2	0.5	0.5	1.9	3.1
Dikar-Benlate	Syrphus torus	1.1	2.5	2.6	0.5	Amblyseius fallacis	0.03	0.03	0.01	0	0.01
	Aphidoletes aphidimyza	0.2	1.2	1.7	3.3	Zetzellia mali	0	0.1	0.1	0.3	0.2
Reduced Spray Plot											
Torak-Zolone	Aphis pomi	72.5	166.1	230.7	13.4	Panonychus ulmi	0	0	0.02	0.04	0.03
Difolitan-Captan	Syrphus torus	1.7	2.6	2.9	0.2	Amblyseius fallacis	0	0.03	0	0	0.02
	Aphidoletes aphidimyza	0.3	0.9	4.0	1.6	Zetzellia mali	0	0.01	0	0.01	0.1

[1] Schedule, rates and method of application given in Table 1.

[2] One Cortland, Red Delicious and Baldwin tree sampled per plot; 5 tagged terminals per tree.

[3] Three Cortland, Red Delicious and Baldwin trees sampled per plot; 20 leaves per tree.

Table 4. Schedule, rates and methods of application of pesticide combinations. Dwarf apples, Mt. Carmel, Conn. 1975.

		Pesticide per Acre		
Application[1]	Date	Reduced Spray Plot	Date	Extended Interval Plot
		Full Spray		Full Spray
Green tip	4/21	2.0 lb Dikar 80WP 6.0 oz Benlate 50WP	4/21	6.0 oz Benlate 50WP 3.0 qt Oil - 70 sec
Half Inch Green	4/29	Repeat above		Repeat above
Tight cluster	5/7	Repeat above		Repeat above
Pink	5/12	3.0 lb Dikar 80WP 9.0 oz Benlate 50WP 1.5 lb Guthion 50WP	5/12	9.0 oz Benlate 50WP 3.0 qt Oil - 70 sec 2.0 lb Guthion 50WP
Petal Fall	5/21	Same as Pink		Same as Pink
1st Cover	5/28	Repeat above	5/28	Repeat above
		Half Spray		21 Day Interval
2nd Cover	6/11	1.5 lb Dikar 80WP 4.5 oz Benlate 50WP 1.5 qt MC-9087 2EC	6/11	6.0 oz Benlate 50WP 3.0 qt Oil - 70 sec 1.5 lb Guthion 50WP
3rd Cover	6/25	Repeat above	7/2	Repeat above
4th Cover	7/9	Repeat above + 6.0 oz Fundal 97SP	7/9	12.0 oz Carzol 92SP
5th Cover	7/23	Repeat above	7/23	Repeat above
6th Cover	8/6	Same as 2nd Cover	8/14	Same as 2nd Cover
7th Cover	8/20	9.0 oz Benlate 50WP 1.5 qt MC-9087 2EC		
8th Cover	9/3	Repeat above	9/3	Repeat above

[1] Concentrate mistblower application; 30 gal/acre for Full Spray, 15 gal/acre for Half Spray; 0.25 acre plot.

Table 5. Effectiveness of concentrate applications of pesticides used in an extended interval or reduced spray schedule for controlling insect pests on dwarf apples. Mt. Carmel, Conn. 1975.

Materials[1]	% uninjured fruit	% Fruit Injured By[2]					
		Plum curculio	European sawfly	Apple maggot	Codling moth	Other[3]	Scab
Extended Interval Plot							
Guthion Benlate-Oil	88.7	3.9	2.6	2.9	0.9	1.1	1.0
Reduced Spray Plot							
Guthion-MC 9087 Dikar-Benlate	83.5	3.9	1.6	8.5	1.8	1.5	1.4
Check	11.1	49.2	3.5	61.2	16.2	2.7	34.1

[1] Schedule, rates and method of application given in Table 4.

[2] All fruit in plots picked and scored.

[3] Damage to fruit by plant bugs, leafrollers, green fruit worms and cankerworms.

Table 6. Effect of two summer applications of Carzol and Fundal on European red mites, Panonychus ulmi, and twospotted mites, Tetranychus urticae, and two mite predators in reduced spray schedules. Mt. Carmel, Conn. 1975.

Materials[1]	Rate/ acre	Spray dates	Mites and predators	Avg. No./Leaf On[2] 6/18	7/2	7/18	7/28	8/12
Extended Interval Plot Full Spray								
Carzol 92SP	12 oz	7/9 7/23	Panonychus ulmi	1.8	5.8	13.7	0.2	0.7
			Tetranychus urticae	0	0.03	0.2	0	0
			Amblyseius fallacis	0.1	0.1	1.3	0	0.03
			Zetzellia mali	0	0.07	0.03	0	0.1
Reduced Spray Plot Half Spray								
Fundal 97SP	6 oz	7/9 7/23	Panonychus ulmi	4.2	8.0	6.3	0.6	0.6
			Tetranychus urticae	0.7	1.9	2.0	0.4	1.2
			Amblyseius fallacis	0	0.03	0.03	0.1	0.4
			Zetzellia mali	0	0.03	0	0	0
Check	--	--	Panonychus ulmi	2.7	6.1	1.5	0.2	0.2
			Tetranychus urticae	0	0	0	0	0.2
			Amblyseius fallacis	0.2	0.3	0.2	0.03	1.7
			Zetzellia mali	0.2	0.1	0.3	0.1	0

[1] Schedule, rates and methods of application given in Table 4.

[2] Three Lodi, McIntosh and Red Delicious trees sampled per plot; 20 leaves per tree.

Table 7. Efficacy of aphicides applied concentrate as full sprays (both sides of tree) or half sprays (one side of tree) for apple aphids (Aphis pomi) and two predators. Mt. Carmel, Conn. 1975.

Material	Rate/ 10 gals[2]	Type spray	Average No./Terminal[1]						% Reduction (7 days)		
			Aphis pomi		Syrphus torus		Aphidoletes aphidimyza				
			Pre[3]	Post[4]	Pre	Post	Pre	Post	A. pomi	S. torus	A. aphidimyza
Diazinon 50WP	16 oz	Full	106.0	10.0	3.1	0.5	2.3	0.1	90.6	83.9	95.6
		Half	114.1	50.8	1.3	1.8	0.8	2.5	55.5	+	+
Diazinon 50WP	8 oz	Full	154.5	80.1	2.3	3.0	0.9	4.3	48.2	+	+
		Half	84.3	39.7	1.3	1.5	0	0.1	52.9	+	+
Phosphamidon 8EC	4 oz	Full	156.1	2.1	2.5	0.7	1.1	0.0	98.7	72.0	100.0
		Half	89.5	21.7	1.7	1.3	0	0.8	75.8	23.5	+
Phosphamidon 8EC	2 oz	Full	111.7	7.0	2.3	0.1	0.1	0.3	93.7	95.6	+
		Half	89.1	83.5	0.6	0	0	3.5	6.3	+	+
Zolone 3EC	16 oz	Full	74.3	1.3	2.1	0.3	0	0	98.3	85.7	---
		Half	113.5	7.1	2.5	1.0	0.3	1.3	93.7	60.0	+
Zolone 1.5EC + Malathion .067EC	12 oz	Full	77.8	6.3	1.3	0.3	0	0	91.9	76.9	---
		Half	94.0	3.1	2.1	0.3	1.5	0.5	96.7	85.7	66.6
HOX-1901 40WP	16 oz	Full	93.7	0	2.1	0.5	0	0.3	100.0	76.2	+
		Half	102.3	4.3	2.1	0.1	0	0.5	95.8	95.2	+
AC-85258 25WP	32 oz	Full	110.2	0.1	1.5	1.3	0.5	0.7	99.9	13.3	+
		Half	98.2	25.0	2.3	0.7	0.3	0.3	74.5	70.0	---
U-36059 1.66EC	19.3 oz	Full	94.3	3.1	2.1	0.7	0.5	0.1	96.7	66.6	80.0
		Half	118.8	18.7	1.7	0.8	0	1.1	84.3	52.9	+
Check		Full	69.5	149.0	0.6	1.1	0	5.8	+53.4	+	+
		Half	96.8	68.0	1.1	2.7	0.8	6.1	29.7	+	+

[1] Three trees per treatment, 2 terminals per tree, 3 distal leaves per terminal.
[2] Mistblower application 6/19, 30 gals/acre (full spray), 15 gals/acre (half spray).
[3] Pre-spray count, 6/18
[4] Post-spray count, 6/26

Table 8. Efficacy of miticides applied concentrate as full sprays (both sides of tree) or half sprays (one side of tree) for European red mites (Panonychus ulmi) and two predatory mites. Mt. Carmel, Conn. 1975.

Material	Rate/ 10 gals[2]	Type spray	Average No. Mites/leaf[1]						% Reduction (7 days)		
			Panonychus ulmi		Amblyseius fallacis		Zetzellia mali				
			Pre[3]	Post[4]	Pre	Post	Pre	Post	P. ulmi	A. fallacis	Z. mali
Plictran (50WP)	4 oz	Full	2.0	0.3	.03	0	.07	0	85.0	100	100
		Half	0.6	0.3	0.6	0.4	0	0	50.0	33.3	---
SD-14114 (50WP)	4 oz	Full	2.3	0.5	.07	0	0.1	.03	78.3	100	70.0
		Half	1.3	0.4	0.5	0.1	0	0.3	69.2	80.0	+
SD-14114 (4WDS)	4 oz	Full	1.9	0.4	0.1	.03	.27	0.2	78.9	70.0	25.9
		Half	1.3	0.8	0.4	0.2	0.3	0.7	38.5	45.5	+
Carzol (97SP)	4 oz	Full	2.1	0.2	0	0	0.2	.07	90.5	--	65.0
		Half	1.7	0.5	0.1	.03	0	0.1	70.6	70.0	+
Fundal (97SP)	4 oz	Full	1.8	0.07	0	0	0.1	.03	96.1	--	70.0
		Half	2.7	1.1	0.2	0	0	.03	59.3	100	+
U-36054 (1.66EC)	9.6 oz	Full	2.7	0.8	0	0	0.3	.03	70.4	--	90.0
		Half	1.0	0.5	0.7	0.1	0	0.1	50.0	85.7	+
R-28627 (25WP)	9.0 oz	Full	1.8	0.3	.07	0	0.1	0	83.3	100	100
		Half	1.0	0.3	0.6	.03	0.1	.03	70.0	95.0	70.0
AC-85258 (25WP)	32 oz	Full	2.2	0.7	0	0	.13	.07	68.2	--	46.1
		Half	2.1	1.2	0.1	0	.01	0.1	42.9	100	+
GCP-5126 (25WP)	12 oz	Full	2.4	0.7	.03	0	.13	0	70.8	100	100
		Half	1.6	0.5	0.1	0	0.3	0.1	68.8	100	66.6
Check		Full	3.1	1.8	0	0	0.2	.23	41.9	--	+15.0
		Half	1.3	1.0	0.2	0.1	0.2	0.3	23.1	50.0	+50.0

[1] Three trees per treatment, 10 leaves per tree.
[2] Mistblower application, 8/14, 30 gals/acre (full spray), 15 gals/acre (half spray).
[3] Pre-spray count, 8/14.
[4] Post-spray count, 8/21.

Table 9. Effectiveness of candidate insecticide formulations used in a seasonal program for control of insect pests on apples. Mt. Carmel, Conn. 1975.

Materials[1]	Rate/ 100 gals	% Uninjured fruit	% Fruit Injured By[3]						
			Plum curculio	European sawfly	Apple maggot	Codling moth	Plant bugs	San Jose scale	Other
Carzol[2] 97SP Guthion 50WP	6 oz 8 oz	87.6	3.9	0.9	7.9	0.9	0.4	0.5	0.2
Zolone 1.5EC + Malathion .067EC	12 oz	80.0	8.6	2.7	12.3	2.0	1.2	0.9	0.9
Imidan 70WP	12 oz	82.5	1.2	0.6	3.1	3.9	0.6	8.8	0.2
Imidan 2S	16 oz	63.3	4.8	5.3	11.6	7.9	1.1	16.2	0.5
Methyl-Parathion 2S	16 oz	73.4	1.3	1.7	25.4	4.6	0.5	1.6	0.8
Guthion 50WP	8 oz	85.5	2.5	3.1	8.0	2.3	0.1	0.2	0.1
Check		14.3	10.7	1.3	60.0	35.1	1.6	16.5	1.9

[1] Application time: Pink, 5/12; Petal Fall, 5/19; 1st Cover, 5/27; 2nd Cover, 6/10; 3rd Cover, 6/24; 4th Cover, 7/8; 5th Cover, 7/22; 6th Cover, 8/5; 7th Cover, 8/19; 8th Cover (red delicious only), 9/2; dilute handgun application, 400 gals/acre.

[2] Carzol applied Pink, Petal Fall and 1st Cover; Guthion 2nd-8th Cover.

[3] One Gravenstein, one McIntosh and two Red Delicious trees per treatment; one bushel each of picks and drops scored per tree.

Table 10. Effect of seasonal applications of candidate insecticide formulations on European red mite populations. Mt. Carmel, Conn. 1975.

Materials[1]	Rate/ 100 gals	Avg. No./Leaf On[2] 6/20	7/21	8/18
Carzol 92SP Guthion 50WP	6 oz 8 oz	0.9	0.5	0.2
Zolone 1.5EC + Malathion .067EC	12 oz	5.8	13.2	5.6
Imidan 70WP	12 oz	5.1	7.8	1.0
Imidan 2S	16 oz	0.8	0.7	0.3
Methyl-Parathion 2S	16 oz	0.4	2.6	0.6
Guthion 50WP	8 oz	13.1	8.1	3.2
Check		5.1	3.9	2.4

[1] Schedule, rates and method of application given in Table 7.

[2] Two Red Delicious trees sampled per treatment; 20 leaves per tree.

Table 11. Effectiveness of seasonal concentrate applications of insecticides for control of insect pests on peaches. Mt. Carmel, Conn. 1975.

Material	Rate/ 20 gals	Application Time[1]	% Fruit Injured By[2]				
			Uninjured fruit	Plum curculio	Plant bugs	Oriental fruit moth	Other
M-3016 25WP	32 oz	PF, SS, 1C-6C	88.0	6.1	2.9	1.5	1.7
Torak 4EC Guthion 50WP	16 oz 8 oz	PF, SS, 1C 2C-6C	86.7	9.7	2.9	0.0	0.3
Guthion 50WP Methyl-Parathion 2S	10 oz 16 oz	PS SS, 1C-6C	80.3	11.0	5.4	1.3	1.7
Zolone 25WP	24 oz	PF, SS, 1C-6C	79.6	11.5	4.2	1.1	1.3
Guthion 50WP + HOX-1901 40WP	8 oz 18 oz	PF, SS, 1C-6C	83.2	10.4	3.3	0.9	1.9
Carzol 92SP	6 oz	PF, SS, 1C-6C	82.8	10.7	1.5	3.0	2.4
Imidan 70WP	20 oz	PF, SS, 1C-6C	87.0	6.6	3.9	0.6	1.7
Check	---	---	48.1	30.8	14.6	6.6	2.1

[1] Application time: Petal Fall (PF), 5/14; Shuck Split (SS), 5/22; 1st Cover (1C), 5/29; 2nd Cover (2C), 6/12; 3rd Cover (3C), 6/27; 4th Cover (4C), 7/10; 5th Cover (5C), 7/24; 6th Cover (6C), 8/11, mistblower application, 60 gals/acre.

[2] Six trees per treatment, ½ bushel of peaches per tree sampled on 8/25.

Table 12. Comparison of reduced rate and reduced spray programs for the past 3 seasons with a full spray program applied in 1972. West Orchard, Lockwood Farm, Mt. Carmel, Conn.

Season	Materials	% Uninjured fruit	Materials	% Uninjured fruit
	Full Spray Program		Full Spray Program	
1972	Zolone	88.8	Guthion	93.8
	Reduced Rate Program		Reduced Spray Program	
1973	Guthion plus Imidan	82.8	Guthion and Zolone	89.5
1974	Guthion plus Imidan	83.7	Imidan	85.7
1975	Guthion plus Zolone	92.9	Torak and Zolone	94.3

APPENDIX I

Spray Materials Evaluated in 1975 and Their Mammalian Toxicity[1]

MATERIAL AND FORMULATION		ORAL LD_{50} mg/kg	MAMMALIAN TOXICITY RATING[2]	MANUFACTURER
AC-85258	25WP	6-9	Highly	American Cyanamid Co.
Benlate	50WP	10,000	Non-	E. I. DuPont deNemours
Captan	50WP	9,000	Non-	Stauffer Chemical Co.
Carzol	92SP	20	Highly	Nor-Am Agr. Products
Diazinon	50WP	150	Moderately	Ciba-Geigy Corporation
Difolitan	4F	6,200*	Non-	Chevron Chemical Co.
Dikar	80WP	5,000*	Non-	Rohm & Haas Company
Fundal	97SP	170	Moderately	Nor-Am Agr. Products
GCP-5126	25WP	350*	Moderately	Gulf Oil Company
Guthion	50WP	10	Highly	Chemagro Corporation
HOX-1901	40WP	411*	Moderately	Chemagro Corporation
Imidan	70WP, 2S	300*	Moderately	Stauffer Chemical Co.
M-3016	25WP	135	Moderately	Dow Chemical Co.
MC-9087	2EC	102*	Moderately	Mobil Chemical Co.
Methyl-parathion	2S	270*	Moderately	Pennwalt Corporation
Phosphamidon	8EC	20	Highly	Chevron Chemical Co.
Plictran	50WP	540	Slightly	Dow Chemical Co.
R-28627	25WP	860*	Slightly	Stauffer Chemical Co.
SD-14114	50WP, 4WDS	857*	Slightly	Shell Chemical Co.
Sunspray oil	70 sec	---	Non-	Sun Oil Company
Torak	4EC	50	Highly	Hercules Incorporated
U-36059	1.66EC	600*	Slightly	The Upjohn Company
Zolone	25WP, 3EC	100	Moderately	Rhodia Inc., Chipman Div.
Zolone + Malathion	1.5EC .067EC	100 1,375	Moderately Slightly	Rhodia Inc., Chipman Div.

[1] Acute oral toxicities as reported by Thomson (1972) or the manufacturer*

[2] According to Vasvary and Swift (1966)
EC = lbs/gal emulsifiable concentrate
F = lbs/gal flowable concentrate
S = lbs/gal micro-encapsulated solution
SP = % soluble powder
WDS = lbs/gal water dispersable suspension
WP = % wettable powder

APPENDIX II

REGISTERED MATERIALS

The following materials were registered as of December 31, 1975 for control of the indicated insect or mite pests on apples or peaches mentioned in this Bulletin. Some of these materials are registered for use against fruit pests not mentioned in this Bulletin.

Benlate 50WP:	mites
Carzol 92SP:	mites
Diazinon 50WP:	aphids, apple maggot, codling moth, leafrollers, San Jose scale
Dikar 80WP:	mites
Fundal 97SP:	codling moth, leafrollers, mites
Guthion 50WP:	aphids, apple maggot, codling moth, European sawfly, green fruit worm, leafrollers, Oriental fruit moth, plant bugs, plum curculio, mites, San Jose scale
Imidan 50WP:	aphids, apple maggot, codling moth, leafrollers, Oriental fruit moth, plant bugs, plum curculio, mites
Phosphamidon 8EC:	aphids, codling moth, leafrollers, mites, San Jose scale
Plictran 50WP:	mites
SD-14114 (Vendex) 50WP:	mites
Zolone 25WP, 3EC:	aphids, apple maggot, codling moth, leafrollers, Oriental fruit moth, plum curculio, mites

UNREGISTERED MATERIALS

AC-85258 (25WP), GCP-5126 (25WP), HOX-1901 (40WP), MC-3016 (25WP), MC-9087 (2EC), Methyl-parathion (2S), R-28627 (25WP), SD-14114 (4WDS), Torak (4EC), U-36059 (1.66EC) and Zolone (1.5EC) + Malathion (0.67EC) were used as experimental materials and are not registered for use on apple or peach pests mentioned in this Bulletin.