
FIGURE 11.1.1
GROWTH STAGES IN
APPLE
1 Dormant
2 Silver tip
3 Green tip
4 Half-inch green
5 Tight Cluster
6 Pink
7 Bloom
8 Petal Fall
9 Fruit set

11 Apples

11.1 Insecticides and Fungicides for Apples

See Sections 11.2, 11.3, 11.4, and 11.5 for comments related to this table.

Table 11.5.1 Pesticide Spray Table – Apples.

Refer to back of book for key to abbreviations and footnotes.
Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Silver Tip							
Crown rot	33	Aliette WDG	2.5-5 lb/A 0.5-1 pt/100 gal	14	12		
	4	Ridomil Gold SL	2 qts/A 0.5 pt/100 gal		48		[7.2]
European fruit lecanium		oil	2-3 gal/100 gal			High	[20.2]
European red mite		oil	2-3 gal/100 gal			High	[20.11]
Green Tip							
Apple scab	M4	Captan 80WDG	5.0 lb/A 0.65-1.25 lb/100 gal	0	24	High	[2.1,2.2]
	M4	Captan 50WP	8.0 lb/A 1.0-2.0 lb/100 gal	0	24	High	[2.1,2.2]
	M4	Captec 4L	0.5-1.0 qt/100 gal	0	24	High	[2.1,2.2]
	M3	Dithane 75DF or M45 /Manzate ProStik /Penncozeb 75DR	3.0-6.0 lb/A 1.0-2.0 lb/100 gal	BL, 77 (A)	24		[1.3,2.2]
	M3	Dithane F45/ Manzate Max	2.4-4.8 qt/A 0.8-1.6 qt/100 gal	BL, 77 (A)	24	High	[1.3,2.2]
	M3	Polyram 80DF	3.0-4.5 lb/A	BL, 77 (A)	24	High	[1.3,2.2]
	M7	Syllit FL *plus*	2.0 pts/A	7	48	High	[2.15]
	M4	Captan *or*	see rates above	0	24		[2.1,2.2]
	M3	Manzate, Penncozeb or Polyram	see rates above	BL, 77 (A)	24		[1.3,2.2]
	9	Scala	7.0-10.0 fl.oz./A	72	12	High	
	9	Vangard WG	3.0-5.0 oz/A	0	12	High	
European red mite		oil	1-2 gal/100 gal			High	[20.3,20.4]
Fire blight	M1	Bordeaux mixture, 8-10-10 *plus* oil (may also use with any copper below)	8.0 lb/100 gal 1.0 qt/100 gal				[8.4]
	M1	Champ Formula-2 4.6F	5.33-10.5 pts/A	HIG	24		
	M1	C-O-C-S WDG	8.0-11.7 lb/A	GT	24		
	M1	Cuprofix Ultra Disperss 40DF	5.0-7.5 lb/A	HIG	48		
	M1	Kocide 3000	3.5-7.0 lb/A 1.11-2.3 lb/100 gal	HIG	48		
Rosy apple aphid	1B	Lorsban 4EC	1 pt/100 gal	PB/28 (A)	96	High	[28.2,28.2a]
	1B	Lorsban 75WG	0.3-0.67 lb/100 gal	PB/28 (A)	96	High	[28.2,28.2a]

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Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Green Tip (continued)							
Rosy apple aphid (*continued*)	1B	Supracide 2EC	3-12 pts/A 1-2 pts/100 gal	PB	72	Moderate	[28.2,28.2a]
	9C	Beleaf 50SG	2.0-2.8 oz/A	21	12	Moderate	[28.2,28.2b]
American plum borer	1B	Lorsban 4EC	1.5 qt/100 gal	PB/28 (A)	96	High	[17.1]
	1B	Lorsban 75WG	2 lb/100 gal	PB/28 (A)	96	High	[17.1]
Half-Inch Green							
Apple scab	M4	Captan 80WDG	5.0 lb/A 0.65-1.25 lb/100 gal	0	24	High	[2.1,2.2]
	M4	Captan 50WP	8.0 lb/A 1.0-2.0 lb/100 gal	0	24	High	[2.1,2.2]
	M4	Captec 4L	0.5-1.0 qt/100 gal	0	24	High	[2.1,2.2]
	M3	Dithane 75DF or M45 /Manzate ProStik /Penncozeb 75DR	3.0-6.0 lb/A 1.0-2.0 lb/100 gal	BL, 77(A)	24		[1.3,2.2]
	M3	Dithane F45/ Manzate Max	2.4-4.8 qt/A 0.8-1.6 qt/100 gal	BL, 77(A)	24	High	[1.3,2.2]
	M3	Polyram 80DF	3.0-4.5 lb/A	BL, 77(A)	24	High	[1.3,2.2]
	M7	Syllit FL *plus*	2.0 pts/A	7	48		[2.15]
	M4	Captan *or*	see rates above	0	24		[2.1,2.2]
	M3	Dithane, Manzate, Penncozeb or Polyram	see rates above	BL, 77(A)	24		[1.3,2.2,2.4]
	9	Scala	7.0-10.0 fl.oz./A	72	12		
	9	Vangard WG	3.0-5.0 oz/A	0	12		
Dogwood borer	1B	Lorsban 4EC	1.5 qt/100 gal	PB/28 (A)	96	High	[17.1]
	1B	Lorsban 75WG	2 lb/100 gal	PB/28 (A)	96	High	[17.1]
European red mite		oil	1-2 gal/100 gal			High	[20.3,20.4]
Redbanded leafroller	1B	Imidan 70W	2.13-5.75 lb/A 0.75-1.0 lb/100 gal	7	4 days	High	[27.1]
Rosy apple aphid	1B	Lorsban 4EC	1 pt/100 gal	PB/28 (A)	96	High	[28.2,28.2a]
	1B	Lorsban 75WG	0.3-0.67 lb/100 gal	PB/28 (A)	96	High	[28.2,28.2a]
	1B	Supracide 2EC	3-12 pts/A 1-2 pts/100 gal	PB	72	Moderate	[28.2,28.2a]
	7C	Esteem 35WP	3-5 oz/A	45	12	High	[28.2,28.2b]
	9C	Beleaf 50SG	2.0-2.8 oz/A	21	12	Moderate	[28.2,28.2b]
San Jose scale		oil	2 gal/100 gal			High	[29.3]
	1B	Lorsban 4EC	1 pt/100 gal	PB/28 (A)	96	High	[29.3]
	1B	Lorsban 75WG	0.3-0.67 lb/100 gal	PB/28 (A)	96	High	[29.3]
	1B	Supracide 2EC	3-12 pts/A 1-2 pts/100 gal	PB	72	High	[29.3]

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Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Half-Inch Green (continued)							
	7C	Esteem 35WP *plus* oil	4-5 oz/A 2 gal/100 gal	45	12	High	[29.3]
	16	Centaur 0.7WDG	34.5 oz/A	14	12	High	[29.3,29.4]
Tight Cluster							
American plum borer	1B	Lorsban 4EC	1.5 qt/100 gal	PB/28 (A)	96	High	[17.1]
	1B	Lorsban 75WG	2 lb/100 gal	PB/28 (A)	96	High	[17.1]
Apple scab	M3	Dithane 75DF or M45 /Manzate ProStik /Penncozeb 75DR	3.0-6.0 lb/A 1.0-2.0 lb/100 gal	BL, 77 (A)	24		[1.3,2.2]
	M3	Dithane F45/ Manzate Max	2.4-4.8 qt/A 0.8-1.6 qt/100 gal	BL, 77 (A)	24	High	[1.3,2.2]
	M3	Polyram 80DF	3.0-4.5 lb/A	BL, 77 (A)	24	High	[1.3,2.2]
	M4	Captan 80WDG	5.0 lb/A 0.65-1.25 lb/100 gal	0	24		[2.1,2.2]
	M4	Captan 50WP	8.0 lb/A 1.0-2.0 lb/100 gal	0	24		[2.1,2.2]
	M4	Captec 4L	0.5-1.0 qt/100 gal	0	24		[2.1,2.2]
	M7	Syllit FL *plus*	2.0 pts/A	7	48		[2.15]
	M4	Captan *or*	see rates above	0	24		[2.2]
	M3	Dithane, Manzate, Penncozeb or Polyram	see rates above	BL, 77 (A)	24		[2.1,2.2]
	3	Inspire Super	8.5-12.0 fl.oz./A	14	12		[2.13]
	3	Indar 2F	6.0-8.0 fl.oz./A	14	12		[2.13]
	3	Rally 40WSP	5-10 oz/A 2-3 oz/100 gal		14	24	
	3	Vintage SC	6-12 fl.oz/A 3-4 fl.oz/100 gal	30	24		
	3	Topguard	13 fl.oz./A	14	12		
	7	Fontelis 1.67 SC	16-20 fl.oz./A 5.3-6.7 fl oz/100 gal	28	12		
	11	Cabrio EG	5.0-8.0 oz/A 4.0 oz/100 gal	0	12		[2.4,2.14]
	11	Flint	2.0-2.5 oz/A 0.67-0.8 oz/100 gal	14	12		[2.4,2.14]
	11	Sovran 50WDG	3.2-6.4 oz/A 1.0-1.6 oz/100 gal	30	12		[2.4,2.14]
	7,11	Luna Tranquility 500SC	11.2-16 fl oz/A 3.7-5.3 fl oz/100 gal	72	12		
	7,9	Luna Sensation 500SC	4-5.8 fl oz/A 3.3-1.9 fl oz/100 gal	14	12		
	7,11	Merivon 4.17SC	4-5.5 fl oz/A	0	12		
Dogwood borer	1B	Lorsban 4EC	1.5 qt/100 gal	PB/28 (A)	96	High	[17.1]
	1B	Lorsban 75WG	2 lb/100 gal	PB/28 (A)	96	High	[17.1]

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Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Tight Cluster (continued)							
European red mite		oil	1-2 gal/100 gal			High	[20.3,20.4]
	10A	Apollo 4SC	4-8 fl.oz./A	45	12	High	[20.5,20.5a,20.6, 20.11,20.11a]
	10A	Onager 1 EC	12-24 fl.oz./A	28	12	High	[20.5,20.5b,20.11, 20.11a]
	10A	Savey 50DF	3 oz/A	28	12	High	[20.5,20.5b,20.6, 20.11,20.11a]
	10B	Zeal	2-3 oz/A	14	12	High	[20.5,20.5b,20.9, 20.11]
Powdery Mildew		JMS Stylet-Oil	1.0-2.0 gal/100 gal	0	4		
		Vintage SC	3.0 fl.oz./100 gal	30	24		
	1	Thiophanate Methyl 85WDG	0.6-0.8 lb/A 0.2-0.3 lb/100 gal	1	48		[2.12,9.4]
	1	Topsin M 70WP	0.75-1.0 lb/A 0.2-0.25 lb/100 gal	1	48		[2.12,9.4]
	1	Topsin M WSB	0.75-1.0 lb/A 0.2-0.25 lb/100 gal	1	48		[2.12,9.4]
	3	Indar 2F	6.0-8.0 fl.oz./A	14	12		
	3	Inspire Super	8.5-12.0 fl.oz./A	14	12		
	3	Procure 480SC	8.0-16.0 fl.oz./A	14	12		
	3	Rally 40WSP	5.0-10.0 oz/A 1.6-3.3 oz/100 gal	14	24		
	11	Flint	2.0-2.5 oz/A 0.67-0.8 oz/100 gal	14	12		
	11	Sovran 50WDG	4.0-6.4 oz/A 1.0-1.6 oz/100 gal	30	12		
Rosy apple aphid	1B	Lorsban 4EC	1 pt/100 gal	PB/28 (A)	96	High	[28.2,28.2a]
	1B	Lorsban 75WG	0.3-0.67 lb/100 gal	PB/28 (A)	96	High	[28.2,28.2a]
	1B	Supracide 2EC	3-12 pts/A 1-2 pts/100 gal	PB	72	Moderate	[28.2,28.2a]
	7C	Esteem 35WP	3-5 oz/A	45	12	High	[28.2,28.2b]
	9C	Beleaf 50SG	2.0-2.8 oz/A	21	12	Moderate	[28.2,28.2b]
San Jose scale		oil	2 gal/100 gal			High	[29.3]
	1B	Lorsban 4EC	1 pt/100 gal	PB/28 (A)	96	High	[29.3]
	1B	Lorsban 75WG	0.3-0.67 lb/100 gal	PB/28 (A)	96	High	[29.3]
	1B	Supracide 2EC	3-12 pts/A 1-2 pts/100 gal	PB	72	High	[29.3]
	7C	Esteem 35WP *plus* Oil	4-5 oz/A 2 gal/100 gal	45	12	High	[29.3]
	16	Centaur 0.7WDG	34.5 oz/A	14	12	High	[29.3,29.4]
Tarnished plant bug	3	Warrior II 2.08CS	1.28-2.56 fl.oz./A	21	24	High	[33.1,33.1a,33.1b]
	3A	Ambush 25WP	6.4-25.6 oz/A	PF	12	High	[33.1,33.1a,33.1b]
	3A	Asana XL 0.66EC	4.8-14.5 fl.oz./A 2-5.8 fl.oz./100 gal	21	12	High	[33.1,33.1a,33.1b]

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Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Tight Cluster (continued)							
Tarnished plant bug (*continued*)	3A	Baythroid XL 1EC	2-2.4 fl.oz./A	7	12	High	[33.1,33.1a,33.1b]
	3A	Danitol 2.4EC	10.67-16 fl.oz./A	14	24	High	[33.1,33.1a,33.1b]
	3A	Pounce 25 WP	6.4-16 oz/A	PF	12	High	[33.1,33.1a,33.1b]
	9C	Beleaf 50SG	2-2.8 oz/A	21	12	High	[33.1,33.1a,33.1d]
	22	Avaunt 30WDG	5-6 oz/A	14	12	Moderate	[33.1,33.1a,33.1c]
	3A/6	*Gladiator EC	14-19 fl.oz./A 3.5-4.75 fl.oz./100 gal	28	12	High	[1.0,33.1,33.1a, 33.1b]
Pink							
American plum borer	1B	Lorsban 4EC	1.5 qt/100 gal	PB/28 (A)	96	High	[17.1]
	1B	Lorsban 75WG	2 lb/100 gal	PB/28 (A)	96	High	[17.1]
	4A	Assail 30SG	8 oz/A	7	12	Moderate	[17.2]
Apple scab	M3	Dithane 75DF or M45/ Manzate ProStik/ Penncozeb 75DR	3.0-6.0 lb/A 1.0-2.0 lb/100 gal	BL, 77 (A)	24		[1.3,2.2]
	M3	Dithane F45/ Manzate Max	2.4-4.8 qt/A 0.8-1.6 qt/100 gal	BL, 77 (A)	24	High	[1.3,2.2]
	M3	Polyram 80DF	3.0-4.5 lb/A	BL, 77 (A)	24	High	[1.3,2.2]
	M4	Captan 50WP	8.0 lb/A 1.0-2.0 lb/100 gal	0	24		[2.6,2.7]
	M4	Captan 80WDG	5.0 lb/A 0.65-1.25 lb/100 gal	0	24		[2.6,2.7]
	M4	Captec 4L	0.5-1.0 qt/100 gal	0	24		[2.6,2.7]
	3	Inspire Super	8.5-12.0 fl.oz./A	14	12		[2.13]
	3	Indar 2F	6.0-8.0 fl.oz./A	14	12		[2.13]
	3	Rally 40WSP	5-10 oz/A 2-3 oz/100 gal	14	24		
	3	Vintage SC	6-12 fl.oz/A 3-4 fl.oz/100 gal	30	24		
	3	Topguard	13 fl.oz./A	14	12		
	7	Fontelis	16-20 fl.oz./A	28	12		
	11	Cabrio EG	5.0-8.0 oz/A 4.0 oz/100 gal	0	12		[2.4,2.14]
	11	Flint	2.0-2.5 oz/A 0.67-0.8 oz/100 gal	14	12		[2.4,2.14]
	11	Sovran 50WDG	3.2-6.4 oz/A 1.0-1.6 oz/100 gal	30	12		[2.4,2.14]
	7,11	Luna Tranquility 500SC	11.2-16 fl oz/A 3.7-5.3 fl oz/100 gal	72	12		
	7,11	Merivon 4.17SC	4-5.5 fl oz/A	0	12		
Black Rot & White Rot	M4	Captan 80WDG	5.0 lb/A 0.65-1.25 lb/100 gal	0	24		
	M4	Captec 4L	0.5-1.0 qt/100 gal	0	24		
	M4	Captan 50WP	8.0 lb/A 1.2-2.0 lb/100 gal	0	24		
	11	Sovran 50WDG	3.2-6.4 oz/A 1.0-1.6 oz/100 gal	30	12		[2.14]

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Pink (continued)							
Blister Spot	33	Aliette WDG	2.5-5.0 lb/A 0.5-1.0 lb/100 gal	14	12		[5.1]
Cedar Apple Rust	M3	Ferbam Granuflo	3.5 lb/A 0.88 lb/100 gal	7	24		
	M3	Manzate ProStik	3.0 lb/A 1.0 lb/100 gal	BL, 77 (A)	24		[1.3,2.2]
	M3	Penncozeb 75DF	3.0 lb/A 1.0 lb/100 gal	BL, 77 (A)	24		[1.3,2.2]
	M3	Polyram 80DF	3.0 lb/A	BL, 77 (A)	24		[2.2]
	3	Inspire Super	8.5-12.0 fl.oz./A	14	12		
	3	Indar 2F	6.0-8.0 fl.oz./A	14	12		
	3	Procure 480SC	8.0-16.0 fl.oz./A	14	12		
	3	Rally 40WSP	5.0-8.0 oz/A 1.6-2.0 oz/100 gal	14	24		
	3	Vintage SC	3.0 fl.oz./100 gal	30	24		
	3	Topguard	12 fl.oz./A	14	12		
Dogwood borer	1B	Lorsban 4EC	1.5 qt/100 gal	PB/28 (A)	96	High	[17.1]
	1B	Lorsban 75WG	2 lb/100 gal	PB/28 (A)	96	High	[17.1]
	4A	Assail 30SG	8 oz/A	7	12	Moderate	[17.2]
European red mite	1A	Vydate 2L	2-4 pts/A 1-2 pts/100 gal	14	48	Moderate	[20.7a]
	10A	Apollo 4SC	4-8 fl.oz./A	45	12	High	[20.5,20.5a,20.6, 20.11,20.11a]
	10A	Onager 1 EC	12-24 fl.oz./A	28	12	High	[20.5,20.5b,20.11, 20.11a]
	10A	Savey 50DF	3 oz/A	28	12	High	[20.5,20.5b,20.6, 20.11,20.11a]
	10B	Zeal	2-3 oz/A	14	12	High	[20.5,20.5b,20.9, 20.11]
Mullein plant bug	3	Warrior II 2.08CS	1.28-2.56 fl.oz./A	21	24	High	[23.3]
	3A	Asana XL 0.66EC	4.8-14.5 fl.oz./A 2-5.8 fl.oz./100 gal	21	12	High	[23.3]
	4A	Actara 25WDG	4.5 oz/A	14/35 (A)	12	High	[23.3,23.3a]
	4A	Assail 30SG	4-8 oz/A	7	12	High	[23.3,23.3c]
	4A	Calypso 4F	2-4 fl.oz./A 0.5-1 fl.oz./100 gal	30	12	High	[23.3,23.3b]
Obliquebanded leafroller	11A	Agree 3.8WS	1-2 lb/A	0	4	Moderate	[24.1,24.2,24.3, 24.3a]
Oriental fruit moth		Checkmate CM-OFM Duel	150-200 dispensers/ acre		0	High	[14.2]
		Checkmate OFM-F 24.6S	1.32-2.93 fl.oz./A		0	Moderate	[14.2]
		Isomate-CM/OFM TT	200 ties/A		0	High	[14.2]
		Isomate OFM TT	100 ties/A		0	High	[14.2]

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Pink (continued)							
Powdery Mildew		JMS Stylet-Oil	1.0-2.0 gal/100 gal	0	4		[9.3,9.4]
	1	Thiophanate Methyl 85WDG	0.6-0.8 lb/A 0.2-0.3 lb/100 gal	1	48		[2.12,9.4]
	1	Topsin M 70WP	0.75-1.0 lb/A 0.2-0.25 lb/100 gal	1	48		[2.12,9.4]
	1	Topsin M WSB	0.75-1.0 lb/A 0.2-0.25 lb/100 gal	1	48		[2.12,9.4]
	3	Inspire Super	8.5-12.0 fl.oz./A	14	12		
	3	Indar 2F	6.0-8.0 fl.oz./A	14	12		
	3	Procure 480SC	8.0-16.0 fl.oz./A	14	12		
	3	Rally 40WSP	5.0-10.0 oz/A 1.6-3.3 oz/100 gal	14	24		
	3	Vintage SC	3.0 fl.oz./100 gal	30	24		
	11	Flint	2.0-2.5 oz/A 0.67-0.8 oz/100 gal	14	12		
	11	Sovran 50WDG	4.0-6.4 oz/A 1.0-1.6 oz/100 gal	30	12		
Rosy apple aphid	1A	Lannate 90SP	0.5-1 lb/A 0.25 lb/100 gal	14	72	High	[12.1d,28.2]
	1A	Lannate LV 2.4L	1.5-3 pt/A 0.75 pt/100 gal	14	72	High	[12.1d,28.2]
	1A	Vydate 2L	2-8 pts/A 1-2 pts/100 gal	14	48	Moderate	[28.2,28.3a]
	1B	Lorsban 4EC	1 pt/100 gal	PB/28 (A)	96	High	[28.2,28.2a]
	1B	Lorsban 75WG	0.3-0.67 lb/100 gal	PB/28 (A)	96	High	[28.2,28.2a]
	2A	Thionex 3EC	2.6 qt/A 0.5 qt/100 gal	21	7 days	Moderate	[28.2,35.1b]
	2A	Thionex 50WP	4 lb/A 0.75 lb/100 gal	21	20 days	Moderate	[28.2,35.1b]
	4A	Actara 25WDG	4.5 oz/A	14/35 (A)	12	High	[15.4,28.2,28.3b]
	4A	Assail 30SG	2.5-4 oz/A	7	12	High	[28.2,28.3c]
	4A	Calypso 4F	2-4 fl.oz./A 0.5-1 fl.oz./100 gal	30	12	High	[28.2,28.4a]
	7C	Esteem 35WP	3-5 oz/A	45	12	High	[28.2,28.2b]
	9C	Beleaf 50SG	2.0-2.8 oz/A	21	12	Moderate	[28.2,28.2b]
Spotted tentiform leafminer, Apple blotch leafminer	1A	Vydate 2L	2-4 pts/A 1 pt/100 gal	14	48	High	[30.1,30.2, 30.2a,30.3,30.3a]
	3	Warrior II 2.08CS	1.28-2.56 fl.oz./A	21	24	High	[30.1,30.1a,30.2, 30.3]
	3A	Ambush 25WP	6.4-25.6 oz/A	PF	12	High	[30.1,30.1a,30.2]
	3A	Asana XL 0.66EC	4.8-14.5 fl.oz./A 2-5.8 fl.oz./100 gal	21	12	High	[30.1,30.1a,30.1b, 30.2,30.3]
	3A	Baythroid XL 1EC	2-2.4 fl.oz./A	7	12	High	[30.1,30.1a,30.2, 30.3]

Table 11.5.1 Pesticide Spray Table – Apples.

Refer to back of book for key to abbreviations and footnotes.
Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Pink (continued)							
Spotted tentiform leafminer, Apple blotch leafminer (*continued*)	3A	Danitol 2.4EC	10.67-16 fl.oz./A	14	24	High	[30.1,30.1a,30.1b, 30.2,30.2a,30.2b, 30.3]
	3A	Pyrenone 6L	12 fl.oz./A		12	Moderate	[30.1]
	4A	Actara 25WDG	4.5 oz/A	14/35 (A)	12	High	[15.4,30.1, 30.1d,30.2,30.2a, 30.2c,30.3]
	4A	Assail 30SG	2.5 oz/A	7	12	High	[30.1,30.2,30.2a, 30.3]
	4A	Calypso 4F	2-4 fl.oz./A 0.5-1 fl.oz./100 gal	30	12	High	[30.1,30.2, 30.2a,30.2c,30.3]
	5	Delegate 25WG	4.5-7 oz/A	7	4	High	[30.1,30.1e,30.2, 30.2a,30.3]
	6	Proclaim 5SG	3.2-4.8 oz/A 0.8-1.2 oz/100 gal	14	12	High	[30.1,30.2,30.3]
	22	Avaunt 30WDG	5-6 oz/A	14	12	Moderate	[30.1,30.1d,30.2, 30.2a,30.2c,30.3]
	28	Altacor 35WDG	2.5-4 oz/A	5	4	High	[30.1,30.2, 30.2d,30.3]
	28	Belt 4SC	3-5 fl.oz./A	14	12	High	[30.1,30.2,30.2d, 30.3]
	UN	Aza-Direct 1.2L	11.5-42 fl.oz./A	0	4	High	[30.1,30.2,30.3]
	UN	Azatin XL 0.27EC	10-16 fl.oz./A	0	4	High	[30.1,30.2,30.3]
	3A/6	*Gladiator EC	19 fl.oz./A 4.75 fl.oz./100 gal	28	12	High	[1.0,30.1,30.1a, 30.2,30.3]
Tarnished plant bug	3	Warrior II 2.08CS	1.28-2.56 fl.oz./A	21	24	High	[33.1,33.1a,33.1b]
	3A	Ambush 25WP	6.4-25.6 oz/A	PF	12	High	[33.1,33.1a,33.1b]
	3A	Asana XL 0.66EC	4.8-14.5 fl.oz./A 2-5.8 fl.oz./100 gal	21	12	High	[33.1,33.1a,33.1b]
	3A	Baythroid XL 1EC	2-2.4 fl.oz./A	7	12	High	[33.1,33.1a,33.1b]
	3A	Danitol 2.4EC	10.67-16 fl.oz./A	14	24	High	[33.1,33.1a,33.1b]
	3A	Pounce 25 WP	6.4-16 oz/A	PF	12	High	[33.1,33.1a,33.1b]
	9C	Beleaf 50SG	2-2.8 oz/A	21	12	High	[33.1,33.1a,33.1d]
	22	Avaunt 30WDG	5-6 oz/A	14	12	Moderate	[33.1,33.1a,33.1c]
	3A/6	*Gladiator EC	14-19 fl.oz./A 3.5-4.75 fl.oz./100 gal	28	12	High	[1.0,33.1,33.1a, 33.1b]
Bloom							
Apple scab	M3	Dithane 75DF or M45 /Manzate ProStik /Penncozeb 75DR	3.0-6.0 lb/A 1.0-2.0 lb/100 gal	BL, 77 (A)	24		[1.3,2.2]
	M3	Dithane F45/ Manzate Max	2.4-4.8 qt/A 0.8-1.6 qt/100 gal	BL, 77 (A)	24	High	[1.3,2.2]
	M3	Polyram 80DF	3.0-4.5 lb/A	BL, 77 (A)	24	High	[1.3,2.2]
	M4	Captan 80WDG	5.0 lb/A 0.65-1.25 lb/100 gal	0	24		[2.6,2.7]
	M4	Captec 4L	0.5-1.0 qt/100 gal	0	24		[2.6,2.7]
	M4	Captan 50WP	8.0 lb/A 1.0-2.0 lb/100 gal	0	24		[2.6,2.7]

Table 11.5.1 Pesticide Spray Table – Apples.

Refer to back of book for key to abbreviations and footnotes.
Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Bloom (continued)							
Apple scab (*continued*)	3	Inspire Super	8.5-12.0 fl.oz./A	14	12		[2.13]
	3	Indar 2F	6.0-8.0 fl.oz./A	14	12		[2.13]
	3	Rally 40WSP	5-10 oz/A 2-3 oz/100 gal	14	24		
	3	Topguard	13 fl.oz./A	14	12		
	7	Fontelis	16-20 fl.oz./A	28	12		
	11	Cabrio EG	5.0-8.0 oz/A 4.0 oz/100 gal	0	12		[2.4,2.14]
	11	Flint	2.0-2.5 oz/A 0.67-0.8 oz/100 gal	14	12		[2.4,2.14]
	11	Sovran 50WDG	3.2-6.4 oz/A 1.0-1.6 oz/100 gal	30	12		[2.4,2.14]
	7,11	Luna Tranquility 500SC	11.2-16 fl oz/A 3.7-5.3 fl oz/100 gal	72	12		
	7,11	Merivon 4.17SC	4-5.5 fl oz/A	0	12		
Black Rot & White Rot	M4	Captan 80WDG	5.0 lb/A 0.65-1.25 lb/100 gal	0	24		
	M4	Captec 4L	0.5-1.0 qt/100 gal	0	24		
	M4	Captan 50WP	8.0 lb/A 1.2-2.0 lb/100 gal	0	24		
	1	Topsin M 70WP	0.75-1.0 lb/A 0.2-0.25 lb/100 gal	1	48		[10.3,10.4]
	11	Sovran 50WDG	3.2-6.4 oz/A 1.0-1.6 oz/100 gal	30	12		[2.14]
	7,11	Merivon 4.17SC	4-5.5 fl oz/A	0	12		
Blister Spot	33	Aliette WDG	2.5-5.0 lb/A 0.5-1.0 lb/100 gal	14	12		[5.1]
Blossom End Rot	M4	Captan 80WDG	5.0 lb/A 0.65-1.25 lb/100 gal	0	24		[6.2]
	M4	Captec 4L	0.5-1.0 qt/100 gal	0	24		[6.2]
	M4	Captan 50WP	8.0 lb/A 1.0-2.0 lb/100 gal	0	24		[6.2]
	1	Thiophanate Methyl 85WDG	0.6-0.8 lb/A 0.2-0.3 lb/100 gal	1	48		[6.2]
Cedar Apple Rust	M3	Ferbam Granuflo	3.5 lb/A 0.88 lb/100 gal	7	24		
	M3	Manzate ProStik	3.0 lb/A 1.0 lb/100 gal	BL, 77(A)	24		[1.3,2.2]
	M3	Penncozeb 75DF	3.0 lb/A 1.0 lb/100 gal	BL, 77(A)	24		[1.3,2.2]
	M3	Polyram 80DF	3.0 lb/A	BL, 77(A)	24		[2.2]
	3	Inspire Super	8.5-12.0 fl.oz./A	14	12		
	3	Indar 2F	6.0-8.0 fl.oz./A	14	12		
	3	Procure 480SC	8.0-16.0 fl.oz./A	14	12		
	3	Rally 40WSP	5.0-8.0 oz/A 1.6-2.0 oz/100 gal	14	24		
	3	Topguard	12 fl.oz./A	14	12		
	3	Vintage SC	3.0 fl.oz./100 gal	30	24		

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Refer to back of book for key to abbreviations and footnotes.
Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Bloom (continued)							
Codling moth		Checkmate CM-F 14.3S	2.4-4.8 fl.oz./A		4	Moderate	[14.2]
		Checkmate CM-OFM Duel	150-200 dispensers/ acre		0	High	[14.2]
		Isomate-CM/OFM TT	200 ties/ acre		0	High	[14.2]
Fire blight		Agri-mycin	24.0 oz/A 8.0 oz/100 gal	50	12		[8.3,8.10]
		Apogee 27.5%	4.5-9.0 oz/100 gal	45	12		[8.6]
		Bloomtime Biological FD	0.33 lb/A	PF	4		[8.8]
		Fireline	12.0 oz/100 gal		12		
		Firewall	24.0 oz/A 8.0 oz/100 gal	50	12		[8.3,8.10]
		Mycoshield 17WP	1.0 lb/100 gal	60	12		[8.9]
		Serenade ASO	2.0-6.0 qt/A	0	4		[8.7]
		Streptrol 17WP	24.0 oz/A 8.0 oz/100 gal	50	4		[8.3,8.10]
Lesser appleworm		Checkmate CM-OFM Duel	150-200 dispensers/ acre		0	High	[14.2]
		Isomate-CM/OFM TT	200 ties/ acre		0	High	[14.2]
Mullein plant bug	4A	Assail 30SG	4-8 oz/A	7	12	High	[23.3,23.3c]
Obliquebanded leafroller	11A	Agree 3.8WS	1-2 lb/A	0	4	Moderate	[24.1,24.2,24.3, 24.3a]
	11A	Dipel 10.3DF	0.5-2 lb/A	0	4	High	[24.1,24.2,24.3, 24.3a]
	11A	Javelin 7.5WDG	0.5-4 lb/A 0.13-1 lb/100 gal	0	4	Moderate	[24.1,24.2,24.3, 24.3a]
	18	Intrepid 2F	8-16 oz/A	14	4	High	[24.2,24.3, 24.3b]
Oriental fruit moth		Checkmate CM-OFM Duel	150-200 dispensers/ acre		0	High	[14.2]
		Checkmate OFM-F 24.6S	1.32-2.93 fl.oz./A		0	Moderate	[14.2]
		Isomate-CM/OFM TT	200 ties/ acre		0	High	[14.2]
		Isomate OFM TT	100 ties/A		0	High	[14.2]
Powdery Mildew		JMS Stylet-Oil	1.0-2.0 gal/100 gal	0	4		[9.3,9.4]
	1	Thiophanate Methyl 85WDG	0.6-0.8 lb/A 0.2-0.3 lb/100 gal	1	48		[2.12,9.4]
	1	Topsin M 70WP	0.75-1.0 lb/A 0.2-0.25 lb/100 gal	1	48		[2.12,9.4]
	1	Topsin M WSB	0.75-1.0 lb/A 0.2-0.25 lb/100 gal	1	48		[2.12,9.4]
	3	Inspire Super	8.5-12.0 fl.oz./A	14	12		
	3	Indar 2F	6.0-8.0 fl.oz./A	14	12		
	3	Procure 480SC	8.0-16.0 fl.oz./A	14	12		
	3	Rally 40WSP	5.0-10.0 oz/A 1.6-3.3 oz/100 gal	14	24		
	3	Vintage SC	3.0 fl.oz./100 gal	30	24		

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Refer to back of book for key to abbreviations and footnotes.
Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Bloom (continued)							
Powdery Mildew (*continued*)	11	Flint	2.0-2.5 oz/A 0.67-0.8 oz/100 gal	14	12		
	11	Sovran 50WDG	4.0-6.4 oz/A 1.0-1.6 oz/100 gal	30	12		
Petal Fall							
American plum borer	1B	Lorsban 4EC	1.5 qt/100 gal	PB/28 (A)	96	High	[17.1]
	1B	Lorsban 75WG	2 lb/100 gal	PB/28 (A)	96	High	[17.1]
	4A	Assail 30SG	8 oz/A	7	12	Moderate	[17.2]
Apple rust mite	21A	Nexter 75WS	5.2-10.7 oz/A	25	12	Moderate	[13.2]
	21A	Portal 0.4EC	2 pts/A	14	12	High	[13.2]
Apple scab	M3	Manzate ProStik	3.0-6.0 lb/A 1.0-2.0 lb/100 gal	BL, 77 (A)	24		[2.7]
	M3	Penncozeb 75DF	3.0-6.0 lb/A 1.0-2.0 lb/100 gal	BL, 77 (A)	24		[2.7]
	M3	Polyram 80DF	3.0 lb/A 1.0 lb/100 gal	BL, 77 (A)	24		
	M4	Captan 80WDG	5.0 lb/A 0.65-1.25 lb/100 gal	0	24		[2.7,2.6]
	M4	Captec 4L	0.5-1.0 qt/100 gal	0	24		[2.7,2.6]
	M4	Captan 50WP	8.0 lb/A 1.0-2.0 lb/100 gal	0	24		[2.7,2.6]
	3	Inspire Super	8.5-12.0 fl.oz./A	14	12		[2.13]
	3	Indar 2F	6.0-8.0 fl.oz./A	14	12		[2.13]
	3	Rally 40WSP	5-10 oz/A 2-3 oz/100 gal	14	24		
	3	Topguard	13 fl.oz./A	14	12		
	7	Fontelis	16-20 fl.oz./A	28	12		
	11	Cabrio EG	5.0-8.0 oz/A 4.0 oz/100 gal	0	12		[2.14,2.4]
	11	Flint	2.0-2.5 oz/A 0.67-0.8 oz/100 gal	14	12		[2.14,2.4]
	11	Sovran 50WDG	3.2-6.4 oz/A 1.0-1.6 oz/100 gal	30	12		[2.14,2.4]
	7,11	Luna Tranquility 500SC	11.2-16 fl oz/A 3.7-5.3 fl oz/100 gal	72	12		
	7,11	Merivon 4.17SC	4-5.5 fl oz/A	0	12		
Black Rot & White Rot	M4	Captan 80WDG	5.0 lb/A 0.65-1.25 lb/100 gal	0	24		
	M4	Captec 4L	0.5-1.0 qt/100 gal	0	24		
	M4	Captan 50WP	8.0 lb/A 1.2-2.0 lb/100 gal	0	24		
	1	Topsin M 70WP	0.75-1.0 lb/A 0.2-0.25 lb/100 gal	1	48		[10.3,10.4]
	11	Sovran 50WDG	3.2-6.4 oz/A 1.0-1.6 oz/100 gal	30	12		[2.14]
	7,11	Merivon 4.17SC	4-5.5 fl oz/A	0	12		

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Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Petal Fall (continued)							
Blossom End Rot	M4	Captec 4L	0.5-1.0 qt/100 gal	0	24		[6.2]
	M4	Captan 50WP	8.0 lb/A 1.0-2.0 lb/100 gal	0	24		
	M4	Captan 80WDG	5.0 lb/A 0.65-1.25 lb/100 gal	0	24		[6.2]
	1	Thiophanate Methyl 85WDG	0.6-0.8 lb/A 0.2-0.3 lb/100 gal	1	48		[6.2]
Cedar Apple Rust	M3	Ferbam Granuflo	3.5 lb/A 0.88 lb/100 gal	7	24		
	M3	Manzate ProStik	3.0 lb/A 1.0 lb/100 gal	BL, 77 (A)	24		[1.3,2.2]
	M3	Penncozeb 75DF	3.0 lb/A 1.0 lb/100 gal	BL, 77 (A)	24		[1.3,2.2]
	M3	Polyram 80DF	3.0 lb/A	BL, 77 (A)	24		[2.2]
	3	Indar 2F	6.0-8.0 fl.oz./A	14	12		
	3	Inspire Super	8.5-12.0 fl.oz./A	14	12		
	3	Procure 480SC	8.0-16.0 fl.oz./A	14	12		
	3	Rally 40WSP	5.0-8.0 oz/A 1.6-2.0 oz/100 gal	14	24		
	3	Topguard	12 fl.oz./A	14	12		
	3	Vintage SC	3.0 fl.oz./100 gal	30	24		
Codling moth		Cyd-X 0.06SC	1-6 fl.oz./A	0	4	Moderate	[14.1,14.3,14.3f]
		Carpovirusine 0.99SC	0.25-0.4 qt/A 0.5-1 pt/100 gal	0	4	Moderate	[14.1,14.3,14.3f]
		Checkmate CM-F 14.3S	2.4-4.8 fl.oz./A		4	Moderate	[14.2]
		Checkmate CM-OFM Duel	150-200 dispensers/ acre		0	High	[14.2]
		Checkmate Puffer CM-OFM	1-2 units/ acre		0	Moderate	[14.2]
		Isomate-CM/OFM TT	200 ties/ acre		0	High	[14.2]
	1A	Lannate 90SP	0.5-1 lb/A 0.25 lb/100 gal	14	72	High	[14.1,14.3,14.3g]
	1A	Lannate LV 2.4L	1.5-3 pts/A 1.5 pts/100 gal	14	72	High	[14.1,14.3,14.3g]
	1A	Sevin 80 Solupak	1.25-3.75 lb/A	3	12	Moderate	[14.1,14.3,14.3j]
	1A	Sevin XLR Plus 4EC	1-3 qt/A	3	12	Moderate	[14.1,14.3,14.3j]
	1B	Imidan 70W	2.13-5.75 lb/A 0.75-1.0 lb/100 gal	7	4 days	High	[14.1,14.3,14.3e]
	3A	Baythroid XL 1EC	2-2.4 fl.oz./A	7	12	Moderate	[14.1,14.3]
	4A	Assail 30SG	4-8 oz/A	7	12	High	[14.1,14.3,14.3a, 14.3c]
	4A	Calypso 4F	4-8 fl.oz./A 1-2 fl.oz./100 gal	30	12	High	[14.1,14.3,14.3e]
	5	Delegate 25WG	4.5-7 oz/A	7	4	High	[14.1,14.3]
	5	Entrust 2SC	6-10 fl.oz./A	7	4	Moderate	[14.1,14.3]
	5	Entrust 80WP	2-3 oz/A 0.67-1 oz/100 gal	7	4	Moderate	[14.1,14.3]

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Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Petal Fall (continued)							
Codling moth (*continued*)	6	Proclaim 5SG	4.8 oz/A 1.2 oz/100 gal	14	12	Moderate	[14.1,14.3,14.3h]
	11A	Deliver 18WG	0.5-2 lb/A	0	4	Moderate	[14.1,14.3]
	11A	Dipel 10.3DF	0.5-2 lb/A	0	4	Moderate	[14.1,14.3,14.3e]
	15	Rimon 0.83EC	20-40 fl.oz./A	14	12	High	[14.1,14.3,14.3i]
	18	Intrepid 2F	12-16 fl.oz./A	14	4	Moderate	[14.1,14.3,14.3b]
	22	Avaunt 30WDG	5-6 oz/A	14	12	Moderate	[14.1,14.3,14.3a]
	28	Altacor 35WDG	2.5-4.5 oz/A	5	4	High	[14.1,14.3,14.3a, 14.3b]
	28	Belt 4SC	3-5 fl.oz./A	14	12	High	[14.1,14.3]
	UN	Neemix	7-16 fl.oz./A	0	12	Moderate	[14.1,14.3]
	3A/6	*Gladiator EC	14-19 fl.oz./A 3.5-4.75 fl.oz./100 gal	28	12	Moderate	[1.0]
	4A/3A	Endigo ZC	5-6 fl.oz./A	35	24	Moderate	[1.0,14.1,14.3, 14.3k]
	4A/3A	Leverage 360	2.4-2.8 fl.oz./A	7	12	High	[1.0,14.1,14.3]
	4A/28	Voliam Flexi WDG	4-7 oz/A	35	12	High	[1.0,14.1,14.3, 14.3k]
Comstock mealybug	4A	Assail 30SG	4-8 oz/A	7	12	High	[15.2a,15.3a,15.3b]
	16	Centaur 0.7WDG	34.5 oz/A	14	12	High	[15.2a,15.3a,15.3b]
	21A	Portal 0.4EC	2 pts/A	14	12	High	[15.2a,15.3a,15.3b]
	23	Movento 240SC	6-9 fl.oz./A	7	24	High	[15.2a,15.3a,15.2b, 15.3b]
	4A/28	Voliam Flexi WDG	6-7 oz/A	35	12	High	[1.0,15.2a,15.3b, 15.4]
	6/4A	*Agri-Flex SC *plus* oil	5.5-8.5 fl.oz./A *or* 1.5-2 fl.oz./100 gal 1 gal/A *or* 1 qt/100 gal		12	High	[1.0,15.2a,15.3a, 15.3b,15.4]
Dogwood borer	1B	Lorsban 4EC	1.5 qt/100 gal	PB/28 (A)	96	High	[17.1]
	1B	Lorsban 75WG	2 lb/100 gal	PB/28 (A)	96	High	[17.1]
	4A	Assail 30SG	8 oz/A	7	12	Moderate	[17.2]
European apple sawfly	1A	Lannate LV 2.4L	1.5-3 pts/A 1.5 pts/100 gal	14	72	Low	[18.1,18.1a]
	1B	Imidan 70W	2.13-5.75 lb/A 0.75-1.0 lb/100 gal	7	4 days	High	[18.1]
	3A	Baythroid XL 1EC	2.4-2.8 fl.oz./A	7	12	Moderate	[18.1]
	4A	Actara 25WDG	4.5-5.5 oz/A	14/35 (A)	12	High	[15.4,18.1,18.2a]
	4A	Assail 30SG	5-8 oz/A	7	12	Moderate	[18.1]
	4A	Calypso 4F	4-8 fl.oz./A 1-2 fl.oz./100 gal	30	12	High	[18.1,18.2a]
	22	Avaunt 30WDG	5-6 oz/A	14	12	Moderate	[18.1,18.2a]
	28	Altacor 35WDG	2.5-4.5 oz/A	5	4	High	[18.1,18.2a]
	3A/6	*Gladiator EC	14-19 fl.oz./A 3.5-4.75 fl.oz./100 gal	28	12	Moderate	[1.0,18.1]

Table 11.5.1 Pesticide Spray Table – Apples.

Refer to back of book for key to abbreviations and footnotes.
Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Petal Fall (continued)							
European apple sawfly (*continued*)	4A/3A	Endigo ZC	5-6 fl.oz./A	35	24	Moderate	[1.0,15.4,18.1]
	4A/28	Voliam Flexi WDG	6-7 oz/A	35	12	High	[1.0,15.4,18.1]
	6/4A	*Agri-Flex SC *plus* oil	5.5-8.5 fl.oz./A *or* 1.5-2 fl.oz./100 gal 1 gal/A *or* 1 qt/100 gal	35	12	High	[1.0,15.4,18.1]
European red mite	6	*Agri-Mek 8SC	2.25-4.25 fl.oz./A 0.5-1 fl.oz./100 gal	28	12	High	[20.8,20.9]
	10A	Apollo 4SC	4-8 fl.oz./A	45	12	High	[20.5,20.5a,20.6, 20.11,20.11a]
	10A	Onager 1 EC	12-24 fl.oz./A	28	12	High	[20.5,20.5b,20.11, 20.11a]
	10A	Savey 50DF	3 oz/A	28	12	High	[20.5,20.5b,20.6, 20.11,20.11a]
	10B	Zeal	2-3 oz/A	14	12	High	[20.5,20.5b,20.9, 20.11]
	12B	Vendex 50WP	1-2 lb/A 4-8 oz/100 gal	14	48	Low	[20.11,20.11c]
	20B	Kanemite 15SC	31 fl.oz./A	14	12	High	[20.9,20.9b,20.11, 20.11c]
	21A	Nexter 75WS	4.4-5.2 oz/A	25	12	High	[20.9,20.9a, 20.11]
	21A	Portal 0.4EC	2 pt/A	14	12	High	[20.9,20.9a,20.11]
	UN	Acramite 50WS	0.75-1 lb/A	7	12	High	[20.9,20.9a,20.11]
	3A/6	*Gladiator EC	19 fl.oz./A 4.75 fl.oz./100 gal	28	12	High	[1.0,20.8,20.9]
	6/4A	*Agri-Flex SC *plus* oil	5.5-8.5 fl.oz./A *or* 1.5-2 fl.oz./100 gal 1 gal/A *or* 1 qt/100 gal	35	12 12	High	[1.0,20.8,20.9]
Fire blight		Agri-mycin	24.0 oz/A 8.0 oz/100 gal	50	12		[8.3,8.10]
		Apogee 27.5%	4.5-9.0 oz/100 gal	45	12		[8.6]
		Firewall	24.0 oz/A 8.0 oz/100 gal	50	12		[8.3,8.10]
		Streptrol 17WP	24.0 oz/A 8.0 oz/100 gal	50	4		[8.3,8.10]
Green fruitworms	1A	Lannate 90SP	0.5-1 lb/A 0.25 lb/100 gal	14	72	High	[21.1,21.1a]
	1A	Lannate LV 2.4L	1.5-3 pt/A 0.75 pt/100 gal	14	72	High	[21.1,21.1a]
	2A	Thionex 3EC	2.6 qt/A 0.5 qt/100 gal	21	7 days	High	[21.1,35.1b]
	2A	Thionex 50WP	4 lb/A 0.75 lb/100 gal	21	20 days	High	[21.1,35.1b]
	3	Warrior II 2.08CS	1.28-2.56 fl.oz./A	21	24	High	[21.1,21.1b]
	3A	Asana XL 0.66EC	4.8-14.5 fl.oz./A 2-5.8 fl.oz./100 gal	21	12	High	[21.1,21.1b]
	3A	Baythroid XL 1EC	1.4-2 fl.oz./A	7	12	High	[21.1,21.1b]
	3A	Danitol 2.4EC	16 fl.oz./A	14	24	High	[21.1,21.1b]

Table 11.5.1 Pesticide Spray Table – Apples.

Refer to back of book for key to abbreviations and footnotes.
Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Petal Fall (continued)							
Green fruitworms (*continued*)	3A	Pounce 25 WP	6.4-16 oz/A	PF	12	High	[21.1,21.1b]
	6	Proclaim 5SG	3.2-4.8 oz/A 0.8-1.2 oz/100 gal	14	12	High	[21.1]
	28	Altacor 35WDG	2.5-4 oz/A	5	4	High	[21.1]
	28	Belt 4SC	3-5 fl.oz./A	14	12	High	[21.1]
	3A/6	*Gladiator EC	14-19 fl.oz./A 3.5-4.75 fl.oz./100 gal	28	12	High	[1.0,21.1]
	4A/3A	Endigo ZC	5-6 fl.oz./A	35	24	High	[1.0,21.1,21.1d]
	4A/3A	Leverage 360	2.4-2.8 fl.oz./A	7	12	High	[1.0]
	4A/28	Voliam Flexi WDG	4-7 oz/A	35	12	High	[1.0,21.1,21.1d]
Lesser appleworm		Checkmate CM-OFM Duel	150-200 dispensers/ acre		0	High	[14.2]
		Isomate-CM/OFM TT	200 ties/ acre		0	High	[14.2]
	1A	Lannate 90SP	0.5-1 lb/A 0.25 lb/100 gal	14	72	High	[14.1a]
	1A	Lannate LV 2.4L	1.5-3 pts/A 1.5 pts/100 gal	14	72	High	[14.1a]
	1A	Sevin 80 Solupak	1.25-3.75 lb/A	3	12	Moderate	[14.1a,14.3j]
	1A	Sevin XLR Plus 4EC	1-3 qt/A	3	12	Moderate	[14.1a,14.3j]
	3A	Baythroid XL 1EC	2-2.4 fl.oz./A	7	12	Moderate	[14.1a]
	4A	Assail 30SG	4-8 oz/A	7	12	High	[14.1a,14.3a,14.3c]
	5	Delegate 25WG	4.5-7 oz/A	7	4	High	[14.1a]
	6	Proclaim 5SG	4.8 oz/A 1.2 oz/100 gal	14	12	Moderate	[14.1a]
	11A	Deliver 18WG	0.5-2 lb/A	0	4	Moderate	[14.1a]
	15	Rimon 0.83EC	20-40 fl.oz./A	14	12	High	[14.1a,14.3i]
	18	Intrepid 2F	12-16 fl.oz./A	14	4	Moderate	[14.1a,14.3b]
	22	Avaunt 30WDG	5-6 oz/A	14	12	Moderate	[14.1a,14.3a]
	28	Altacor 35WDG	2.5-4.5 oz/A	5	4	High	[14.1a,14.3a,14.3b]
	28	Belt 4SC	3-5 fl.oz./A	14	12	High	[14.1a]
	UN	Neemix	7-16 fl.oz./A	0	12	Moderate	[14.1a]
	4A/28	Voliam Flexi WDG	4-7 oz/A	35	12	High	[1.0, 14.1a,14.3k]
	4A/3A	Endigo ZC	5-6 fl.oz./A	35	24	Moderate	[1.0,14.1a,14.3k]
	4A/3A	Leverage 360	2.4-2.8 fl.oz./A	7	12	High	[1.0,14.1a]
Mullein plant bug	4A	Assail 30SG	4-8 oz/A	7	12	High	[23.3,23.3c]
	4A	Calypso 4F	2-4 fl.oz./A 0.5-1 fl.oz./100 gal	30	12	High	[23.3,23.3b]
	4A/28	Voliam Flexi WDG	4-7 oz/A	35	12	High	[1.0,23.3]
Obliquebanded leafroller	1A	Lannate 90SP	0.5-1 lb/A 0.25 lb/100 gal	14	72	Moderate	[24.2,24.2a,24.2c]
	1A	Lannate LV 2.4L	1.5-3 pt/A 0.75 pt/100 gal	14	72	Moderate	[24.2,24.2a,24.2c]
	3	Warrior II 2.08CS	1.28-2.56 fl.oz./A	21	24	Moderate	[24.2,24.3,24.3b, 24.3c]
	3A	Ambush 25WP	6.4-25.6 oz/A	PF	12	Moderate	[24.2]
	3A	Asana XL 0.66EC	4.8-14.5 fl.oz./A 2-5.8 fl.oz./100 gal	21	12	Moderate	[24.2,24.3,24.3b, 24.3c,24.3d]
	3A	Baythroid XL 1EC	2.4-2.8 fl.oz./A	7	12	Moderate	[24.2,24.3,24.3c]

Table 11.5.1 Pesticide Spray Table – Apples.

Refer to back of book for key to abbreviations and footnotes.
Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Petal Fall (continued)							
Obliquebanded leafroller (*continued*)	3A	Danitol 2.4EC	16 fl.oz./A	14	24	Moderate	[24.2,24.2d,24.3, 24.3b,24.3c]
	3A	Pounce 25 WP	6.4-16 oz/A	PF	12	Moderate	[24.2]
	5	Delegate 25WG	4.5-7 oz/A	7	4	High	[24.2,24.3,24.3b]
	5	Entrust 2SC	6-10 fl.oz./A	7	4	High	[24.2,24.3,24.3b]
	5	Entrust 80WP	2-3 oz/A 0.67-1 oz/100 gal	7	4	High	[24.2,24.3,24.3b]
	6	Proclaim 5SG	3.2-4.8 oz/A 0.8-1.2 oz/100 gal	14	12	High	[24.2,24.2e,24.3, 24.3b]
	11A	Agree 3.8WS	1-2 lb/A	0	4	Moderate	[24.1,24.2,24.3, 24.3a]
	11A	Deliver 18WG	0.5-2 lb/A	0	4	Moderate	[24.1,24.2,24.3, 24.3a]
	11A	Dipel 10.3DF	0.5-2 lb/A	0	4	High	[24.1,24.2,24.3, 24.3a]
	11A	Javelin 7.5WDG	0.5-4 lb/A 0.13-1 lb/100 gal	0	4	Moderate	[24.1,24.2,24.3, 24.3a]
	15	Rimon 0.83EC	20-40 fl.oz./A	14	12	High	[14.3i,24.2,24.3]
	18	Intrepid 2F	8-16 oz/A	14	4	High	[24.2,24.3, 24.3b]
	28	Altacor 35WDG	2.5-4.5 oz/A	5	4	High	[24.2,24.3, 24.3b]
	28	Belt 4SC	3-5 fl.oz./A	14	12	High	[24.2,24.3,24.3b]
	3A/6	*Gladiator EC	14-19 fl.oz./A 3.5-4.75 fl.oz./100 gal	28	12	Moderate	[1.0,24.2,24.3, 24.3b,24.3c]
	4A/3A	Endigo ZC	5-6 fl.oz./A	35	24	Moderate	[1.0,24.2,24.3, 24.3b,24.3c,24.4]
	4A/28	Voliam Flexi WDG	4-7 oz/A	35	12	High	[1.0,24.2,24.3, 24.3b,24.4]
Oriental fruit moth		Checkmate CM-OFM Duel	150-200 dispensers/ acre		0	High	[14.2]
		Checkmate OFM-F 24.6S	1.32-2.93 fl.oz./A		0	Moderate	[14.2]
		Checkmate Puffer CM-OFM	1-2 units/ acre		0	Moderate	[14.2]
		Isomate-CM/OFM TT	200 ties/ acre		0	High	[14.2]
		Isomate OFM TT	100 ties/A		0	High	[14.2]
	1B	Imidan 70W	2.13-5.75 lb/A 0.75-1.0 lb/100 gal	7	4 days	High	[14.1a]
	3A	Baythroid XL 1EC	2-2.4 fl.oz./A	7	12	Moderate	[14.1a]
	4A	Assail 30SG	4-8 oz/A	7	12	High	[14.1a,14.3,14.3a, 14.3c]
	4A	Calypso 4F	4-8 fl.oz./A 1-2 fl.oz./100 gal	30	12	High	[14.1a]
	5	Delegate 25WG	4.5-7 oz/A	7	4	High	[14.1a]
	5	Entrust 2SC	6-10 fl.oz./A	7	4	Moderate	[14.1a]
	5	Entrust 80WP	2-3 oz/A 0.67-1 oz/100 gal	7	4	Moderate	[14.1a]

Table 11.5.1 Pesticide Spray Table – Apples.

Refer to back of book for key to abbreviations and footnotes.
Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Petal Fall (continued)							
Oriental fruit moth (*continued*)	6	Proclaim 5SG	4.8 oz/A 1.2 oz/100 gal	14	12	Moderate	[14.1a]
	11A	Deliver 18WG	0.5-2 lb/A	0	4	Moderate	[14.1a]
	11A	Dipel 10.3DF	0.5-2 lb/A	0	4	Moderate	[14.1a]
	15	Rimon 0.83EC	20-40 fl.oz./A	14	12	High	[14.3i]
	18	Intrepid 2F	12-16 fl.oz./A	14	4	Moderate	[14.1a, 14.3b]
	22	Avaunt 30WDG	5-6 oz/A	14	12	Moderate	[14.1a,14.3a,]
	28	Altacor 35WDG	2.5-4.5 oz/A	5	4	High	[14.1,14.3,14.3a, 14.3b]
	28	Belt 4SC	3-5 fl.oz./A	14	12	High	[14.1a]
	UN	Neemix	7-16 fl.oz./A	0	12	Moderate	[14.1a]
	4A/28	Voliam Flexi WDG	4-7 oz/A	35	12	High	[1.0,14.1a,14.3k]
	4A/3A	Endigo ZC	5-6 fl.oz./A	35	24	Moderate	[1.0,14.1a,14.3k]
	4A/3A	Leverage 360	2.4-2.8 fl.oz./A	7	12	High	[1.0,14.1a]
Oystershell scale	1A	Sevin 4F	1.5-3 qt/A	3	12	High	[25.1]
	1A	Sevin 80 Solupak	1.88-3.75 lb/A	3	12	High	[25.1]
	1A	Sevin XLR Plus 4EC	1.5-3 qt/A	3	12	High	[25.1]
	16	Centaur 0.7WDG	34.5 oz/A	14	12	High	
Plum curculio		Surround 95WP	25-50 lb/A	0	4	Moderate	[12.2,26.2]
	1A	Sevin 4F	1.5-3 qt/A	3	12	Moderate	[26.2,26.4c]
	1A	Sevin 80 Solupak	1.88-3.75 lb/A	3	12	Moderate	[26.2,26.4c]
	1A	Sevin XLR Plus 4EC	1.5-3 qt/A	3	12	Moderate	[26.2,26.4c]
	1B	Imidan 70W	2.13-5.75 lb/A 0.75-1.0 lb/100 gal	7	4 days	High	[26.2,26.4a]
	3	Warrior II 2.08CS	1.28-2.56 fl.oz./A	21	24	Moderate	[26.2]
	3A	Baythroid XL 1EC	2.4-2.8 fl.oz./A	7	12	Moderate	[26.2]
	3A	Danitol 2.4EC	16 fl.oz./A	14	24	Moderate	[26.2]
	4A	Actara 25WDG	4.5-5.5 oz/A	14/35 (A)	12	High	[26.2,26.4a,26.4b]
	4A	Calypso 4F	4-8 fl.oz./A 1-2 fl.oz./100 gal	30	12	High	[26.2,26.4a]
	22	Avaunt 30WDG	5-6 oz/A	14	12	High	[26.2,26.4a]
	3A/6	*Gladiator EC	14-19 fl.oz./A 3.5-4.75 fl.oz./100 gal	28	12	Moderate	[1.0,26.2]
	4A/28	Voliam Flexi WDG	6-7 oz/A	35	12	High	[1.0,26.2,26.4b]
	6/4A	*Agri-Flex SC *plus* oil	5.5-8.5 fl.oz./A *or* 1.5-2 fl.oz./100 gal 1 gal/A *or* 1 qt/100 gal		12	High	[1.0,26.2,26.4b]
Powdery Mildew		JMS Stylet-Oil	1.0-2.0 gal/100 gal	0	4		[9.3,9.4]
	1	Thiophanate Methyl 85WDG	0.6-0.8 lb/A 0.2-0.3 lb/100 gal	1	48		[2.12,9.4]
	1	Topsin M 70WP	0.75-1.0 lb/A 0.2-0.25 lb/100 gal	1	48		[2.12,9.4]
	1	Topsin M WSB	0.75-1.0 lb/A 0.2-0.25 lb/100 gal	1	48		[2.12,9.4]
	3	Inspire Super	8.5-12.0 fl.oz./A	14	12		
	3	Indar 2F	6.0-8.0 fl.oz./A	14	12		
	3	Procure 480SC	8.0-16.0 fl.oz./A	14	12		

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Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Petal Fall (continued)							
Powdery Mildew (*continued*)	3	Rally 40WSP	5.0-10.0 oz/A 1.6-3.3 oz/100 gal	14	24		
	3	Vintage SC	3.0 fl.oz./100 gal	30	24		
	11	Flint	2.0-2.5 oz/A 0.67-0.8 oz/100 gal	14	12		
	11	Sovran 50WDG	4.0-6.4 oz/A 1.0-1.6 oz/100 gal	30	12		
Redbanded leafroller	1A	Lannate 90SP	0.5-1 lb/A 0.25 lb/100 gal	14	72	High	[12.1d,27.2]
	1A	Lannate LV 2.4L	1.5-3 pt/A 0.75 pt/100 gal	14	72	High	[12.1d,27.2]
	1B	Imidan 70W	2.13-5.75 lb/A 0.75-1.0 lb/100 gal	7	4 days	High	[27.1]
	3A	Baythroid XL 1EC	2.4-2.8 fl.oz./A	7	12	High	[27.2]
	5	Delegate 25WG	4.5-7 oz/A	7	4	High	[27.2]
	6	Proclaim 5SG	3.2-4.8 oz/A 0.8-1.2 oz/100 gal	14	12	High	[27.2]
	11A	Agree 3.8WS	1-2 lb/A	0	4	High	[24.1,27.2]
	11A	Deliver 18WG	0.5-2 lb/A	0	4	High	[24.1,27.2]
	11A	Dipel 10.3DF	0.5-2 lb/A	0	4	High	[24.1,27.2]
	11A	Javelin 7.5WDG	0.5-4 lb/A 0.13-1 lb/100 gal	0	4	High	[24.1,27.2]
	15	Rimon 0.83EC	20-40 fl.oz./A	14	12	High	[14.3i]
	28	Altacor 35WDG	2.5-4.5 oz/A	5	4	High	[27.2]
	28	Belt 4SC	3-5 fl.oz./A	14	12	High	[27.2]
	3A/6	*Gladiator EC	14-19 fl.oz./A 3.5-4.75 fl.oz./100 gal	28	12	High	[1.0,27.2]
	4A/3A	Endigo ZC	5-6 fl.oz./A	35	24	High	[1.0,27.2]
	4A/3A	Leverage 360	2.4-2.8 fl.oz./A	7	12	High	[1.0,27.2]
Rosy apple aphid	1A	Lannate 90SP	0.5-1 lb/A 0.25 lb/100 gal	14	72	High	[12.1d,28.2]
	1A	Lannate LV 2.4L	1.5-3 pt/A 0.75 pt/100 gal	14	72	High	[12.1d,28.2]
	2A	Thionex 3EC	2.6 qt/A 0.5 qt/100 gal	21	7 days	Moderate	[28.2,35.1b]
	2A	Thionex 50WP	4 lb/A 0.75 lb/100 gal	21	20 days	Moderate	[28.2,35.1b]
	4A	Admire Pro 4.6SC	2.8 fl.oz./A	7	12	High	[28.2]
	4A	Assail 30SG	2.5-4 oz/A	7	12	High	[28.2,28.3c]
	4A	Calypso 4F	2-4 fl.oz./A 0.5-1 fl.oz./100 gal	30	12	High	[28.2,28.4a]
	9C	Beleaf 50SG	2.0-2.8 oz/A	21	12	Moderate	[28.2,28.2b]
	23	Movento 240SC	6-9 fl.oz./A	7	24	Moderate	[28.4b]
	3A/6	*Gladiator EC	14-19 fl.oz./A 3.5-4.75 fl.oz./100 gal	28	12	Moderate	[1.0]
	4A/3A	Leverage 360	2.4-2.8 fl.oz./A	7	12	High	[1.0,28.2]
	4A/28	Voliam Flexi WDG	6-7 oz/A	35	12	High	[1.0,15.4]

Table 11.5.1 Pesticide Spray Table – Apples.

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Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Petal Fall (continued)							
San Jose scale	23	Movento 240SC	6-9 fl.oz./A	7	24	High	[29.4,29.4b]
Spotted tentiform leafminer, Apple blotch leafminer	1A	Lannate 90SP	0.5-1 lb/A 0.25 lb/100 gal	14	72	High	[12.1d,30.2,30.2a, 30.2b,30.3]
	1A	Lannate LV 2.4L	1.5-3 pts/A 0.75 pt/100 gal	14	72	High	[12.1d,30.2,30.2a, 30.3]
	3	Warrior II 2.08CS	1.28-2.56 fl.oz./A	21	24	High	[30.1,30.1a,30.2, 30.3]
	3A	Ambush 25WP	6.4-25.6 oz/A	PF	12	High	[30.1,30.1a,30.2]
	3A	Asana XL 0.66EC	4.8-14.5 fl.oz./A 2-5.8 fl.oz./100 gal	21	12	High	[30.1,30.1a,30.1b, 30.2,30.3]
	3A	Baythroid XL 1EC	2-2.4 fl.oz./A	7	12	High	[30.1,30.1a,30.2, 30.3]
	3A	Danitol 2.4EC	10.67-16 fl.oz./A	14	24	High	[30.1,30.1a,30.1b, 30.2,30.2a,30.2b, 30.3]
	4A	Actara 25WDG	4.5 oz/A	14/35(A)	12	High	[15.4,30.1, 30.1d,30.2,30.2a, 30.2c,30.3]
	4A	Admire Pro 4.6SC	2.8 fl.oz./A	7	12	High	[30.2,30.2a,30.3]
	4A	Assail 30SG	2.5 oz/A	7	12	High	[30.1,30.2,30.2a, 30.3]
	4A	Calypso 4F	2-4 fl.oz./A 0.5-1 fl.oz./100 gal	30	12	High	[30.1,30.2, 30.2a,30.2c,30.3]
	5	Delegate 25WG	4.5-7 oz/A	7	4	High	[30.1,30.1e,30.2, 30.2a,30.3]
	5	Entrust 2SC	6-10 fl.oz./A		4	High	[30.2,30.3]
	5	Entrust 80WP	2-3 oz/A 0.67-1 oz/100 gal	7	4	High	[30.2,30.3]
	6	Proclaim 5SG	3.2-4.8 oz/A 0.8-1.2 oz/100 gal	14	12	High	[30.1,30.2,30.3]
	15	Rimon 0.83EC	20-40 fl.oz./A	14	12	High	[14.3i,30.2]
	22	Avaunt 30WDG	5-6 oz/A	14	12	Moderate	[30.1,30.1d,30.2, 30.2a,30.2c,30.3]
	28	Altacor 35WDG	2.5-4 oz/A	5	4	High	[30.1,30.2, 30.2d,30.3]
	28	Belt 4SC	3-5 fl.oz./A	14	12	High	[30.1,30.2,30.2d, 30.3]
	UN	Aza-Direct 1.2L	11.5-42 fl.oz./A	0	4	High	[30.1,30.2,30.3]
	UN	Azatin XL 0.27EC	10-16 fl.oz./A	0	4	High	[30.1,30.2,30.3]
	3A/6	*Gladiator EC	19 fl.oz./A 4.75 fl.oz./100 gal	28	12	High	[1.0,30.1,30.1a, 30.2,30.3]
	4A/3A	Endigo ZC	5-6 fl.oz./A	35	24	High	
	4A/3A	Leverage 360	2.4-2.8 fl.oz./A	7	12	High	[1.0,15.4,30.2, 30.3]
	4A/28	Voliam Flexi WDG	4-7 oz/A	35	12	High	[1.0,15.4,30.2, 30.3]
	6/4A	*Agri-Flex SC *plus* oil	5.5-8.5 fl.oz./A *or* 1.5-2 fl.oz./100 gal 1 gal/A *or* 1 qt/100 gal	35	12	High	[1.0,15.4,30.2]

Table 11.5.1 Pesticide Spray Table – Apples.

Refer to back of book for key to abbreviations and footnotes.
Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Petal Fall (continued)							
Tarnished plant bug	3	Warrior II 2.08CS	1.28-2.56 fl.oz./A	21	24	High	[33.1,33.1a,33.1b]
	3A	Ambush 25WP	6.4-25.6 oz/A	PF	12	High	[33.1,33.1a,33.1b]
	3A	Asana XL 0.66EC	4.8-14.5 fl.oz./A 2-5.8 fl.oz./100 gal	21	12	High	[33.1,33.1a,33.1b]
	3A	Baythroid XL 1EC	2-2.4 fl.oz./A	7	12	High	[33.1,33.1a,33.1b]
	3A	Danitol 2.4EC	10.67-16 fl.oz./A	14	24	High	[33.1,33.1a,33.1b]
	3A	Pounce 25 WP	6.4-16 oz/A	PF	12	High	[33.1,33.1a,33.1b]
	9C	Beleaf 50SG	2-2.8 oz/A	21	12	High	[33.1,33.1a,33.1d]
	22	Avaunt 30WDG	5-6 oz/A	14	12	Moderate	[33.1,33.1a,33.1c]
	3A/6	*Gladiator EC	14-19 fl.oz./A 3.5-4.75 fl.oz./100 gal	28	12	High	[1.0,33.1,33.1a, 33.1b]
	4A/3A	Endigo ZC	5-6 fl.oz./A	35	24	High	[1.0,15.4,33.1]
	4A/3A	Leverage 360	2.4-2.8 fl.oz./A	7	12	High	[1.0,33.1]
White apple leafhopper, Potato leafhopper	1A	Lannate 90SP	0.5-1 lb/A 0.25 lb/100 gal	14	72	High	[12.1d,35.1]
	1A	Lannate LV 2.4L	1.5-3 pt/A 0.75 pt/100 gal	14	72	High	[12.1d,35.1]
	1A	Sevin 4F	0.5-1.5 qt/A	3	12	High	[35.1,35.1a]
	1A	Sevin 80 Solupak	0.63-1.88 lb/A	3	12	High	[35.1,35.1a]
	1A	Sevin XLR Plus 4EC	0.5-1.5 qt/A	3	12	High	[35.1,35.1a]
	1A	Vydate 2L	2-4 pt/A 1-2 pt/100 gal	14	48	High	[35.1,35.1a]
	2A	Thionex 3EC	2.6 qt/A 0.5 qt/100 gal	21	7 days	High	[35.1,35.1b]
	2A	Thionex 50WP	4 lb/A 0.75 lb/100 gal	21	20 days	High	[35.1,35.1b]
	3	Warrior II 2.08CS	1.28-2.56 fl.oz./A	21	24	High	[35.1]
	3A	Ambush 25WP	6.4-25.6 oz/A	PF	12	High	[35.1]
	3A	Asana XL 0.66EC	4.8-14.5 fl.oz./A 2-5.8 fl.oz./100 gal	21	12	High	[35.1]
	3A	Baythroid XL 1EC	1.4-2 fl.oz./A	7	12	High	[35.1]
	3A	Danitol 2.4EC	10.67-16 fl.oz./A	14	24	High	[35.1]
	4A	Actara 25WDG	2-2.75 oz/A	14/35(A)	12	High	[15.4,35.1,35.1c]
	4A	Admire Pro 4.6SC	2.8 fl.oz./A	7	12	High	[35.1]
	4A	Assail 30SG	2.5-4 oz/A	7	12	High	[35.1]
	4A	Calypso 4F	2-4 fl.oz./A 0.5-1 fl.oz./100 gal	30	12	High	[35.1,35.1c]
	6	*Agri-Mek 8SC	2.25-4.25 fl.oz./A 0.5-1 fl.oz./100 gal	28	12	High	[35.1]
	16	Centaur 0.7WDG	9-12 oz/A	14	12	Moderate	[35.1]
	21A	Portal 0.4EC	2 pt/A	14	12	High	[35.1]
	22	Avaunt 30WDG	5-6 oz/A	14	12	High	[35.1,35.1c]
	UN	Aza-Direct 1.2L	12.5-42 fl.oz./A	0	4	Moderate	[35.1]
	UN	Neemix	7-16 fl.oz./A	0	4	Moderate	[35.1]
	3A/6	*Gladiator EC	19 fl.oz./A 4.75 fl.oz./100 gal	28	12	High	[1.0,35.1]
	4A/28	Voliam Flexi WDG	4-7 oz/A	35	12	High	[1.0,15.4,35.1]

Table 11.5.1 Pesticide Spray Table – Apples.

Refer to back of book for key to abbreviations and footnotes.
Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Petal Fall (continued)							
White apple leafhopper, Potato leafhopper (*continued*)	4A/3A	Endigo ZC	5-6 fl.oz./A	35	24	High	[1.0,15.4,35.1]
	4A/3A	Leverage 360	2.4-2.8 fl.oz./A	7	12	High	[1.0,35.1]
	6/4A	*Agri-Flex SC *plus* oil	5.5-8.5 fl.oz./A *or* 1.5-2 fl.oz./100 gal 1 gal/A *or* 1 qt/100 gal	35	12	High	[1.0,15.4,35.1]
Additional Summer Sprays							
American plum borer	1B	Lorsban 4EC	1.5 qt/100 gal	PB/28 (A)	96	High	[17.1]
	1B	Lorsban 75WG	2 lb/100 gal	PB/28 (A)	96	High	[17.1]
	4A	Assail 30SG	8 oz/A	7	12	Moderate	[17.2]
Apple aphid, Spirea aphid		M-Pede 49L	2 gal/100 gal		12	Moderate	[11.1]
	1A	Lannate 90SP	0.5-1 lb/A 0.25 lb/100 gal	14	72	High	[11.1]
	1A	Lannate LV 2.4L	1.5-3 pt/A 0.75 pt/100 gal	14	72	High	[11.1]
	1A	Vydate 2L	2-8 pt/A 1-2 pt/100 gal	14	48	High	[11.1,11.1e]
	2A	Thionex 3EC	2.6 qt/A 0.5 qt/100 gal	21	7 days	High	[11.1,35.1b]
	2A	Thionex 50WP	4 lb/A 0.75 lb/100 gal	21	20 days	High	[11.1,35.1b]
	3	Warrior II 2.08CS	1.28-2.56 fl.oz./A	21	24	High	[11.1]
	3A	Asana XL 0.66EC	4.8-14.5 fl.oz./A 2-5.8 fl.oz./100 gal	21	12	High	[11.1]
	3A	Danitol 2.4EC	16 fl.oz./A	14	24	High	[11.1,11.1c]
	3A	Pyrenone 6L	12 fl.oz./A		12	Moderate	[11.1]
	4A	Admire Pro 4.6SC	2.8 fl.oz./A see label	7	12	High	[11.1]
	4A	Assail 30SG	2.5-4 oz/A	7	12	High	[11.1]
	4A	Calypso 4F	2-4 fl.oz./A 0.5-1 fl.oz./100 gal	30	12	High	[11.1]
	9C	Beleaf 50SG	2-2.8 oz/A	21	12	High	[11.1]
	23	Movento 240SC	6-9 fl.oz./A	7	24	High	[11.1,11.1d]
	UN	Aza-Direct 1.2L	12.5-42 fl.oz./A	0	4	Moderate	[11.1]
	3A/6	*Gladiator EC	14-19 fl.oz./A 3.5-4.75 fl.oz./100 gal	28	12	High	[1.0]
	4A/3A	Leverage 360	2.4-2.8 fl.oz./A	7	12	High	[1.0,11.1]
	4A/28	Voliam Flexi WDG	6-7 oz/A	35	12	High	[1.0,11.1]
	6/4A	*Agri-Flex SC *plus* oil	5.5-8.5 fl.oz./A *or* 1.5-2 fl.oz./100 gal 1 gal/A *or* 1 qt/100 gal	35	12	High	[1.0,11.1,11.1a]
Apple maggot		Surround 95WP	25-50 lb/A	0	4	Moderate	[12.2,12.1]
	1A	Lannate LV 2.4L	1.5-3 pt/A 0.75 pt/100 gal	14	72	Moderate	[12.1,12.1c,12.1d]
	1B	Imidan 70W	2.13-5.75 lb/A 0.75-1.0 lb/100 gal	7	4 days	High	[12.1,12.1a]
	3A	Baythroid XL 1EC	2.4-2.8 fl.oz./A	7	12	High	[12.1,12.1a]

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Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Additional Summer Sprays (continued)							
Apple maggot (*continued*)	3A	Danitol 2.4EC	16 fl.oz./A	14	24	High	[12.1,12.1a,12.1b]
	4A	Assail 30SG	8 oz/A	7	12	High	[12.1,12.1a]
	4A	Calypso 4F	4-8 fl.oz./A 1-2 fl.oz./100 gal	30	12	High	[12.1,12.1a]
	22	Avaunt 30WDG	5-6 oz/A	14	12	Moderate	[12.1,12.1a]
	3A/6	*Gladiator EC	14-19 fl.oz./A 3.5-4.75 fl.oz./100 gal	28	12	Moderate	[1.0]
	4A/3A	Endigo ZC	5-6 fl.oz./A	35	24	High	[1.0,12.1,12.1a, 15.4]
Apple rust mite	21A	Nexter 75WS	5.2-10.7 oz/A	25	12	Moderate	[13.2]
	21A	Portal 0.4EC	2 pts/A	14	12	High	[13.2]
Apple scab	M4	Captec 4L	0.5-1.0 qt/100 gal	0	24		[2.6,2.7]
	M4	Captan 50WP	8.0 lb/A 1.0-2.0 lb/100 gal	0	24		[2.6,2.7]
	M4	Captan 80WDG	5.0 lb/A 0.65-1.25 lb/100 gal	0	24		[2.6,2.7]
	3	Inspire Super	8.5-12.0 fl.oz./A	14	12		[2.13]
	3	Indar 2F	6.0-8.0 fl.oz./A	14	12		[2.13]
	3	Rally 40WSP	5-10 oz/A 2-3 oz/100 gal	14	24		
	3	Topguard	13 fl.oz./A	14	12		
	11	Cabrio EG	5.0-8.0 oz/A 4.0 oz/100 gal	0	12		[2.4,2.14]
	11	Flint	2.0-2.5 oz/A 0.67-0.8 oz/100 gal	14	12		[2.4,2.14]
	11	Sovran 50WDG	3.2-6.4 oz/A 1.0-1.6 oz/100 gal	30	12		[2.4,2.14]
	7	Fontelis	16-20 fl.oz./A	28	12		
	7,11	Luna Tranquility 500SC	11.2-16 fl oz/A 3.7-5.3 fl oz/100 gal	72	12		
	7,11	Merivon 4.17SC	4-5.5 fl oz/A	0	12		
Bitter Rot	M4	Captan 80WDG	2.5-5.0 lb/A 0.625 lb/100 gal	0	24		
	M4	Captec 4L	1.0 pt/100 gal	0	24		
	M4	Captan 50WP	4.0 lb/A 1.0 lb/100 gal	0	24		
Black Rot & White Rot	M4	Captec 4L	0.5-1.0 qt/100 gal	0	24		
	M4	Captan 50WP	8.0 lb/A 1.2-2.0 lb/100 gal	0	24		
	M4	Captan 80WDG	5.0 lb/A 0.65-1.25 lb/100 gal	0	24		
	11	Flint	1.5 oz/A 0.5 oz/100 gal	14	12		[2.14]
	11	Sovran 50WDG	3.2-6.4 oz/A 1.0-1.6 oz/100 gal	30	12		[2.14]
	7,11	Pristine 38WDG	14.5-18.5 fl.oz./A	0	12		
Blister Spot	33	Aliette WDG	2.5-5.0 lb/A 0.5-1.0 lb/100 gal	14	12		[5.1]

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Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Additional Summer Sprays (continued)							
Cedar Apple Rust	3	Topguard	12 fl.oz./A	14	12		
Climbing cutworms: Darksided, Dingy, Mottled, Spotted, Variegated	1A	Lannate LV 2.4L	1.5-3 pt/A 0.75 pt/100 gal	14	72	High	[16.2,16.2a]
	11A	Dipel 10.3DF	0.5-2 lb/A	0	4	Moderate	[16.2]
Codling moth		Carpovirusine 0.99SC	0.25-0.4 qt/A 0.5-1 pt/100 gal	0	4	Moderate	[14.1,14.3,14.3f]
		Checkmate CM-F 14.3S	2.4-4.8 fl.oz./A		4	Moderate	[14.2]
		Checkmate CM-OFM Duel	150-200 dispensers/ acre		0	High	[14.2]
		Checkmate Puffer CM-OFM	1-2 units/ acre		0	Moderate	[14.2]
		Cyd-X 0.06SC	1-6 fl.oz./A	0	4	Moderate	[14.1,14.3,14.3f]
		Isomate-CM/OFM TT	200 ties/ acre		0	High	[14.2]
		Surround 95WP	25-50 lb/A	0	4	Moderate	[14.1,14.3,12.2]
	1A	Lannate 90SP	0.5-1 lb/A 0.25 lb/100 gal	14	72	High	[14.1,14.3,14.3g]
	1A	Lannate LV 2.4L	1.5-3 pts/A 1.5 pts/100 gal	14	72	High	[14.1,14.3,14.3g]
	1A	Sevin 80 Solupak	1.25-3.75 lb/A	3	12	Moderate	[14.1,14.3,14.3j]
	1A	Sevin XLR Plus 4EC	1-3 qt/A	3	12	Moderate	[14.1,14.3,14.3j]
	1B	Imidan 70W	2.13-5.75 lb/A 0.75-1.0 lb/100 gal	7	4 days	High	[14.1,14.3,14.3e]
	3A	Baythroid XL 1EC	2-2.4 fl.oz./A	7	12	Moderate	[14.1,14.3]
	4A	Assail 30SG	4-8 oz/A	7	12	High	[14.1,14.3,14.3a, 14.3c]
	4A	Calypso 4F	4-8 fl.oz./A 1-2 fl.oz./100 gal	30	12	High	[14.1,14.3,14.3e]
	5	Delegate 25WG	4.5-7 oz/A	7	4	High	[14.1,14.3]
	5	Entrust 2SC	6-10 fl.oz./A	7	4	Moderate	[14.1,14.3]
	5	Entrust 80WP	2-3 oz/A 0.67-1 oz/100 gal	7	4	Moderate	[14.1,14.3]
	11A	Deliver 18WG	0.5-2 lb/A	0	4	Moderate	[14.1,14.3]
	11A	Dipel 10.3DF	0.5-2 lb/A	0	4	Moderate	[14.1,14.3,14.3e]
	15	Rimon 0.83EC	20-40 fl.oz./A	14	12	High	[14.1,14.3,14.3i]
	18	Intrepid 2F	12-16 fl.oz./A	14	4	Moderate	[14.1,14.3,14.3b]
	22	Avaunt 30WDG	5-6 oz/A	14	12	Moderate	[14.1,14.3,14.3a]
	28	Altacor 35WDG	2.5-4.5 oz/A	5	4	High	[14.1,14.3,14.3a, 14.3b]
	28	Belt 4SC	3-5 fl.oz./A	14	12	High	[14.1,14.3]
	UN	Neemix	7-16 fl.oz./A	0	4	Moderate	[14.1,14.3]
	3A/6	*Gladiator EC	14-19 fl.oz./A 3.5-4.75 fl.oz./100 gal	28	12	Moderate	[1.0]

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Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Additional Summer Sprays (continued)							
Codling moth (*continued*)	4A/3A	Endigo ZC	5-6 fl.oz./A	35	24	Moderate	[1.0,14.1,14.3, 14.3k]
	4A/28	Voliam Flexi WDG	4-7 oz/A	35	12	High	[1.0,14.1,14.3, 14.3k]
	4A/3A	Leverage 360	2.4-2.8 fl.oz./A	7	12	High	[1.0,14.1,14.3]
Comstock mealybug	4A	Assail 30SG	4-8 oz/A	7	12	High	[15.2a,15.3a,15.3b]
	16	Centaur 0.7WDG	34.5 oz/A	14	12	High	[15.2a,15.3a,15.3b]
	21A	Portal 0.4EC	2 pts/A	14	12	High	[15.2a,15.3a,15.3b]
	23	Movento 240SC	6-9 fl.oz./A	7	24	High	[15.2a,15.2b,15.3a, 15.3b]
	6/4A	*Agri-Flex SC *plus* oil	5.5-8.5 fl.oz./A *or* 1.5-2 fl.oz./100 gal 1 gal/A *or* 1 qt/100 gal	35	12	High	[1.0,15.2a,15.3a, 15.3b,15.4]
Dogwood borer	1B	Lorsban 4EC	1.5 qt/100 gal	PB/28 (A)	96	High	[17.1]
	1B	Lorsban 75WG	2 lb/100 gal	PB/28 (A)	96	High	[17.1]
	4A	Assail 30SG	8 oz/A	7	12	Moderate	[17.2]
European corn borer	5	Delegate 25WG	4.5-7 oz/A	7	4	High	[19.2]
	11A	Dipel 10.3DF	0.5-2 lb/A	0	4	Moderate	[19.2]
European red mite	6	*Agri-Mek 8SC	2.25-4.25 fl.oz./A 0.5-1 fl.oz./100 gal	28	12	High	[20.8,20.9]
	10A	Apollo 4SC	4-8 fl.oz./A	45	12	High	[20.5,20.5a,20.6, 20.11,20.11a]
	10A	Onager 1 EC	12-24 fl.oz./A	28	12	High	[20.5,20.5b,20.11, 20.11a]
	10A	Savey 50DF	3 oz/A	28	12	High	[20.5,20.5b,20.6, 20.11,20.11a]
	10B	Zeal	2-3 oz/A	14	12	High	[20.5,20.5b,20.9, 20.11]
	12B	Vendex 50WP	1-2 lb/A 4-8 oz/100 gal	14	48	Low	[20.11,20.11c]
	20B	Kanemite 15SC	31 fl.oz./A	14	12	High	[20.9,20.9b,20.11, 20.11c]
	21A	Nexter 75WS	4.4-5.2 oz/A	25	12	High	[20.9,20.9a, 20.11]
	21A	Portal 0.4EC	2 pt/A	14	12	High	[20.9,20.9a,20.11]
	UN	Acramite 50WS	0.75-1 lb/A	7	12	High	[20.9,20.9a,20.11]
	3A/6	*Gladiator EC	19 fl.oz./A 4.75 fl.oz./100 gal	28	12	High	[1.0,20.8,20.9]
Fire blight		Apogee 27.5%	4.5-9.0 oz/100 gal	45	12		[8.6]
		Firewall	24.0 oz/A 8.0 oz/100 gal	50	12		[8.5]
Japanese beetle	1A	Sevin 4F	1.5-3 qt/A	3	12	High	[22.2]
	1A	Sevin 80 Solupak	1.88-3.75 lb/A	3	12	High	[22.2]
	1A	Sevin XLR Plus 4EC	1-5-3 qt/A	3	12	High	[22.2]
	1B	Imidan 70W	2.13-5.75 lb/A 0.75-1.0 lb/100 gal	7	4 days	High	[22.2]

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Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Additional Summer Sprays (continued)							
Japanese beetle (*continued*)	4A	Assail 30SG	5-8 oz/A	7	12	High	[22.2]
	4A	Calypso 4F	4-8 fl.oz./A 1-2 fl.oz./100 gal	30	12	High	[22.2]
	3A/6	*Gladiator EC	14-19 fl.oz./A 3.5-4.75 fl.oz./100 gal	28	12	Moderate	[1.0,22.2]
	4A/3A	Endigo ZC	5-6 fl.oz./A	35	24	High	[1.0,22.2]
Lesser appleworm		Checkmate CM-OFM Duel	150-200 dispensers/ acre		0	High	[14.2]
		Checkmate Puffer CM-OFM	1-2 units/ acre		0	High	[14.2]
		Isomate-CM/OFM TT	200 ties/ acre		0	High	[14.2]
	3A	Asana XL 0.66EC	4.8-14.5 fl.oz./A 2-5.8 fl.oz./100 gal	21	12	High	[14.1a]
	3A	Baythroid XL 1EC	2-2.4 fl.oz./A	7	12	Moderate	[14.1a]
	4A	Assail 30SG	4-8 oz/A	7	12	High	[14.1a,14.3a,14.3c]
	5	Delegate 25WG	4.5-7 oz/A	7	4	High	[14.1a]
	15	Rimon 0.83EC	20-40 fl.oz./A	14	12	High	[14.1a,14.3i]
	18	Intrepid 2F	12-16 fl.oz./A	14	4	Moderate	[14.1a,14.3b]
	22	Avaunt 30WDG	5-6 oz/A	14	12	Moderate	[14.1a,14.3a]
	28	Altacor 35WDG	2.5-4.5 oz/A	5	4	High	[14.1a,14.3a,14.3b]
	28	Belt 4SC	3-5 fl.oz./A	14	12	High	[14.1a]
	3A/6	*Gladiator EC	14-19 fl.oz./A 3.5-4.75 fl.oz./100 gal	28	12	Moderate	[1.0,14.1a]
	4A/3A	Endigo ZC	5-6 fl.oz./A	35	24	Moderate	[1.0,14.1a,14.3k]
	4A/3A	Leverage 360	2.4-2.8 fl.oz./A	7	12	High	[1.0,14.1a]
	4A/28	Voliam Flexi WDG	4-7 oz/A	35	12	High	[1.0,14.1a,14.3k]
Obliquebanded leafroller	1A	Lannate 90SP	0.5-1 lb/A 0.25 lb/100 gal	14	72	Moderate	[24.2,24.2a,24.2c]
	1A	Lannate LV 2.4L	1.5-3 pt/A 0.75 pt/100 gal	14	72	Moderate	[24.2,24.2a,24.2c]
	3	Warrior II 2.08CS	1.28-2.56 fl.oz./A	21	24	Moderate	[24.2,24.3,24.3b, 24.3c]
	3A	Asana XL 0.66EC	4.8-14.5 fl.oz./A 2-5.8 fl.oz./100 gal	21	12	Moderate	[24.2,24.3,24.3b, 24.3c,24.3d]
	3A	Baythroid XL 1EC	2.4-2.8 fl.oz./A	7	12	Moderate	[24.2,24.3,24.3c]
	3A	Danitol 2.4EC	16 fl.oz./A	14	24	Moderate	[24.2,24.2d,24.3, 24.3b,24.3c]
	5	Delegate 25WG	4.5-7 oz/A	7	4	High	[24.2,24.3,24.3b]
	5	Entrust 2SC	6-10 fl.oz./A		4	High	[24.2,24.3,24.3b]
	5	Entrust 80WP	2-3 oz/A 0.67-1 oz/100 gal	7	4	High	[24.2,24.3,24.3b]
	6	Proclaim 5SG	3.2-4.8 oz/A 0.8-1.2 oz/100 gal	14	12	High	[24.2,24.2e,24.3, 24.3b]
	11A	Agree 3.8WS	1-2 lb/A	0	4	Moderate	[24.1,24.2,24.3, 24.3a]
	11A	Deliver 18WG	0.5-2 lb/A	0	4	Moderate	[24.1,24.2,24.3, 24.3a]

Table 11.5.1 Pesticide Spray Table – Apples.

Refer to back of book for key to abbreviations and footnotes.
Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Additional Summer Sprays (continued)							
Obliquebanded leafroller (*continued*)	11A	Dipel 10.3DF	0.5-2 lb/A	0	4	High	[24.1,24.2,24.3, 24.3a]
	11A	Javelin 7.5WDG	0.5-4 lb/A 0.13-1 lb/100 gal	0	4	Moderate	[24.1,24.2,24.3, 24.3a]
	15	Rimon 0.83EC	20-40 fl.oz./A	14	12	High	[14.3i,24.2,24.3]
	18	Intrepid 2F	8-16 oz/A	14	4	High	[24.2,24.3, 24.3b]
	28	Altacor 35WDG	2.5-4.5 oz/A	5	4	High	[24.2,24.3,24.3b]
	28	Belt 4SC	3-5 fl.oz./A	14	12	High	[24.2,24.3,24.3b]
	3A/6	*Gladiator EC	14-19 fl.oz./A 3.5-4.75 fl.oz./100 gal	28	12	Moderate	[1.0,24.2,24.3, 24.3b,24.3c]
	4A/3A	Endigo ZC	5-6 fl.oz./A	35	24	Moderate	[1.0,24.2,24.3, 24.3b,24.3c,24.4]
	4A/28	Voliam Flexi WDG	4-7 oz/A	35	12	High	[1.0,24.2,24.3, 24.3b,24.4]
Oriental fruit moth		Checkmate CM-OFM Duel	150-200 dispensers/ acre		0	High	[14.2]
		Checkmate OFM-F 24.6S	1.32-2.93 fl.oz./A		0	Moderate	[14.2]
		Isomate-CM/OFM TT	200 ties/ acre		0	High	[14.2]
		Isomate OFM TT	100 ties/A		0	High	[14.2]
	1B	Imidan 70W	2.13-5.75 lb/A 0.75-1.0 lb/100 gal	7	4 days	High	[14.1a]
	3	Warrior II 2.08CS	1.28-2.56 fl.oz./A	21	24	Moderate	[14.1a]
	3A	Asana XL 0.66EC	4.8-14.5 fl.oz./A 2-5.8 fl.oz./100 gal	21	12	High	[14.1a]
	3A	Baythroid XL 1EC	2-2.4 fl.oz./A	7	12	Moderate	[14.1a]
	4A	Assail 30SG	4-8 oz/A	7	12	High	[14.1a,14.3,14.3a, 14.3c]
	4A	Calypso 4F	4-8 fl.oz./A 1-2 fl.oz./100 gal	30	12	High	[14.1a]
	5	Delegate 25WG	4.5-7 oz/A	7	4	High	[14.1a]
	5	Entrust 2SC	6-10 fl.oz./A		4	Moderate	[14.1a]
	5	Entrust 80WP	2-3 oz/A 0.67-1 oz/100 gal	7	4	Moderate	[14.1a]
	15	Rimon 0.83EC	20-40 fl.oz./A	14	12	High	[14.3i]
	18	Intrepid 2F	12-16 fl.oz./A	14	4	Moderate	[14.1a,14.3b]
	22	Avaunt 30WDG	5-6 oz/A	14	12	Moderate	[14.1a,14.3a]
	28	Altacor 35WDG	2.5-4.5 oz/A	5	4	High	[14.1,14.3,14.3a, 14.3b]
	28	Belt 4SC	3-5 fl.oz./A	14	12	High	[14.1a]
	3A/6	*Gladiator EC	14-19 fl.oz./A 3.5-4.75 fl.oz./100 gal	28	12	Moderate	[1.0,14.1a]
	4A/3A	Endigo ZC	5-6 fl.oz./A	35	24	Moderate	[1.0,14.1a,14.3k,]
	4A/3A	Leverage 360	2.4-2.8 fl.oz./A	7	12	High	[1.0,14.1a]
	4A/28	Voliam Flexi WDG	4-7 oz/A	35	12	High	[1.0,14.1a,14.3k]
Oystershell scale	1A	Sevin 4F	1.5-3 qt/A	3	12	High	[25.1]
	1A	Sevin 80 Solupak	1.88-3.75 lb/A	3	12	High	[25.1]

Table 11.5.1 Pesticide Spray Table – Apples.

Refer to back of book for key to abbreviations and footnotes.
Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Additional Summer Sprays (continued)							
Oystershell scale (*continued*)	1A	Sevin XLR Plus 4EC	1.5-3 qt/A	3	12	High	[25.1]
	16	Centaur 0.7WDG	34.5 oz/A	14	12	High	
Plum curculio		Surround 95WP	25-50 lb/A	0	4	Moderate	[12.2,26.2]
	1A	Sevin 4F	1.5-3 qt/A	3	12	Moderate	[26.2,26.4c]
	1A	Sevin 80 Solupak	1.88-3.75 lb/A	3	12	Moderate	[26.2,26.4c]
	1A	Sevin XLR Plus 4EC	1.5-3 qt/A	3	12	Moderate	[26.2,26.4c]
	1B	Imidan 70W	2.13-5.75 lb/A 0.75-1.0 lb/100 gal	7	4 days	High	[26.2,26.4a]
	3	Warrior II 2.08CS	1.28-2.56 fl.oz./A	21	24	Moderate	[26.2]
	3A	Baythroid XL 1EC	2.4-2.8 fl.oz./A	7	12	Moderate	[26.2]
	3A	Danitol 2.4EC	16 fl.oz./A	14	24	Moderate	[26.2]
	4A	Actara 25WDG	4.5-5.5 oz/A	14/35 (A)	12	High	[26.2,26.4a,26.4b]
	4A	Calypso 4F	4-8 fl.oz./A 1-2 fl.oz./100 gal	30	12	High	[26.2,26.4a]
	22	Avaunt 30WDG	5-6 oz/A	14	12	High	[26.2,26.4a]
	4A/28	Voliam Flexi WDG	6-7 oz/A	35	12	High	[1.0,26.2,26.4b]
	6/4A	*Agri-Flex SC *plus* oil	5.5-8.5 fl.oz./A *or* 1.5-2 fl.oz./100 gal 1 gal/A *or* 1 qt/100 gal	35	12	High	[1.0,26.2,26.4b]
Powdery Mildew		JMS Stylet-Oil	1.0-2.0 gal/100 gal	0	4		[9.3,9.4]
	1	Thiophanate Methyl 85WDG	0.6-0.8 lb/A 0.2-0.3 lb/100 gal	1	48		[2.12,9.4]
	1	Topsin M 70WP	0.75-1.0 lb/A 0.2-0.25 lb/100 gal	1	48		[2.12,9.4]
	1	Topsin M WSB	0.75-1.0 lb/A 0.2-0.25 lb/100 gal	1	48		[2.12,9.4]
	3	Inspire Super	8.5-12.0 fl.oz./A	14	12		
	3	Indar 2F	6.0-8.0 fl.oz./A	14	12		
	3	Procure 480SC	8.0-16.0 fl.oz./A	14	12		
	3	Rally 40WSP	5.0-10.0 oz/A 1.6-3.3 oz/100 gal	14	24		
	3	Vintage SC	3.0 fl.oz./100 gal	30	24		
	11	Flint	2.0-2.5 oz/A 0.67-0.8 oz/100 gal	14	12		
	11	Sovran 50WDG	4.0-6.4 oz/A 1.0-1.6 oz/100 gal	30	12		
Redbanded leafroller	1A	Lannate 90SP	0.5-1 lb/A 0.25 lb/100 gal	14	72	High	[12.1d,27.2]
	1A	Lannate LV 2.4L	1.5-3 pt/A 0.75 pt/100 gal	14	72	High	[12.1d,27.2]
	1B	Imidan 70W	2.13-5.75 lb/A 0.75-1.0 lb/100 gal	7	4 days	High	[27.1]
	3A	Baythroid XL 1EC	2.4-2.8 fl.oz./A	7	12	High	[27.2]
	5	Delegate 25WG	4.5-7 oz/A	7	4	High	[27.2]
	6	Proclaim 5SG	3.2-4.8 oz/A 0.8-1.2 oz/100 gal	14	12	High	[27.2]
	11A	Agree 3.8WS	1-2 lb/A	0	4	High	[24.1,27.2]

Table 11.5.1 Pesticide Spray Table – Apples.

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Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Additional Summer Sprays (continued)							
Redbanded leafroller (*continued*)	11A	Deliver 18WG	0.5-2 lb/A	0	4	High	[24.1,27.2]
	11A	Dipel 10.3DF	0.5-2 lb/A	0	4	High	[24.1,27.2]
	11A	Javelin 7.5WDG	0.5-4 lb/A 0.13-1 lb/100 gal	0	4	High	[24.1,27.2]
	15	Rimon 0.83EC	20-40 fl.oz./A	14	12	High	[14.3i]
	28	Altacor 35WDG	2.5-4.5 oz/A	5	4	High	[27.2]
	28	Belt 4SC	3-5 fl.oz./A	14	12	High	[27.2]
	3A/6	*Gladiator EC	14-19 fl.oz./A 3.5-4.75 fl.oz./100 gal	28	12	High	[1.0,27.2]
	4A/3A	Endigo ZC	5-6 fl.oz./A	35	24	High	[1.0,27.2]
	4A/3A	Leverage 360	2.4-2.8 fl.oz./A	7	12	High	[1.0,27.2]
San Jose scale	1B	Imidan 70W	2.13-5.75 lb/A 0.75-1.0 lb/100 gal	7	4 days	Moderate	[29.4]
	4A	Admire Pro 4.6SC	2.8 fl.oz./A	7	12	Moderate	[29.4]
	4A	Assail 30SG	8 oz/A	7	12	Moderate	[29.4,29.4a]
	7C	Esteem 35WP	4-5 oz/A	45	12	High	[29.4]
	16	Centaur 0.7WDG	34.5 oz/A	14	12	High	[29.3,29.4]
	23	Movento 240SC	6-9 fl.oz./A	7	24	High	[29.4,29.4b]
	4A/3A	Endigo ZC	5-6 fl.oz./A	35	24	Moderate	[1.0,15.4,29.4]
	4A/3A	Leverage 360	2.4-2.8 fl.oz./A	7	12	Moderate	[1.0,29.4]
Sooty Blotch & Flyspeck	M3	Indar 2F	6.0-8.0 fl oz/A	14	12		
	M3	Inspire Super	8.5-12.0 fl oz/A	14	12		
	M3	Ziram 76DF, 76 WDG	1.0 lb/100 gal	14	48		
	M4	Captan 80WDG	2.5 lb/A 0.625 lb/100 gal	0	24		
	M4	Captec 4L	4 qt/A 0.5-1.0 qt/100 gal	0	24		
	M4	Captan 50WP	4.0 lb/A 1.0 lb/100 gal	0	24		
	1	Thiophanate Methyl 85WDG	0.6-0.8 lb/A 0.2-0.3 lb/100 gal	1	48		
	1	Topsin M 70WP	3.2-4.0 oz/100 gal	1	48		[10.1,10.2]
	1	Topsin M WSB	3.2-4.0 oz/100 gal	1	48		[10.1,10.2]
	1	Topsin M 70WP, WDG	0.75-1 lb/A 4-6 oz/100 gal	1	48	1	[10.1]
	1	or Thiophanate-methyl 85WDG *plus:*	.6-.8 lb/A .2-.3 lb/100 gal	1	48		[10.2]
	M4	Captan 50WP	4 lb/A 1 lb/100 gal	0	24		
	M4	or Captan 80WDG	2.5 lb/A 5/8 lb/100 gal	0	24		
	M4	or Captan 4L	1 pt/100 gal	0	24		
	M3	or Manzate/ Penncozeb 75DF or 80WP	3 lb/A 1 lb/100 gal	77	24		[2.8]
	M3	or Manzate/Dithane/ Penncozeb Flowable	2.4 qt/A see label	77	24		
	M3	or Polyram 80DF	3 lb/A 1 lb/100 gal	77	24		

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Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Additional Summer Sprays (continued)							
Sooty Blotch & Flyspeck (*continued*)	11	Flint	2.0-2.5 oz/A 0.67-0.8 oz/100 gal	14	12		
	11	Sovran 50WDG	4.0-6.4 oz/A 1.0-1.6 oz/100 gal	30	12		
	11	Cabrio EG	5.0-8.0 oz/A 4.0 oz/100 gal	0	12		
	7,11	Pristine 38WDG	14.5-18.5 oz/A	0	12		
Spotted tentiform leafminer, Apple blotch leafminer	1A	Lannate 90SP	0.5-1 lb/A 0.25 lb/100 gal	14	72	High	[12.1d,30.2,30.2a, 30.2b,30.3]
	1A	Lannate LV 2.4L	1.5-3 pts/A 0.75 pt/100 gal	14	72	High	[12.1d,30.2,30.2a, 30.3]
	1A	Vydate 2L	2-4 pts/A 1 pt/100 gal	14	48	High	[30.1,30.2, 30.2a,30.3,30.3a]
	3	Warrior II 2.08CS	1.28-2.56 fl.oz./A	21	24	High	[30.1,30.1a,30.2, 30.3]
	3A	Asana XL 0.66EC	4.8-14.5 fl.oz./A 2-5.8 fl.oz./100 gal	21	12	High	[30.1,30.1a,30.1b, 30.2,30.3]
	3A	Baythroid XL 1EC	2-2.4 fl.oz./A	7	12	High	[30.1,30.1a,30.2, 30.3]
	3A	Danitol 2.4EC	10.67-16 fl.oz./A	14	24	High	[30.1,30.1a,30.1b, 30.2,30.2a,30.2b, 30.3]
	4A	Actara 25WDG	4.5 oz/A	14/35 (A)	12	High	[15.4,30.1, 30.1d,30.2,30.2a, 30.2c,30.3]
	4A	Admire Pro 4.6SC	2.8 fl.oz./A	7	12	High	[30.2,30.2a,30.3]
	4A	Assail 30SG	2.5 oz/A	7	12	High	[30.1,30.2,30.2a, 30.3]
	4A	Calypso 4F	2-4 fl.oz./A 0.5-1 fl.oz./100 gal	30	12	High	[30.1,30.2, 30.2a,30.2c,30.3]
	5	Delegate 25WG	4.5-7 oz/A	7	4	High	[30.1,30.1e,30.2, 30.2a,30.3]
	5	Entrust 2SC	6-10 fl.oz./A	7	4	High	[30.2,30.3]
	5	Entrust 80WP	2-3 oz/A 0.67-1 oz/100 gal	7	4	High	[30.2,30.3]
	6	*Agri-Mek 8SC	2.25-4.25 fl.oz./A 0.5-1 fl.oz./100 gal	28	12	High	[30.3]
	6	Proclaim 5SG	3.2-4.8 oz/A 0.8-1.2 oz/100 gal	14	12	High	[30.1,30.2,30.3]
	15	Rimon 0.83EC	20-40 fl.oz./A	14	12	High	[14.3i,30.2]
	28	Altacor 35WDG	2.5-4 oz/A	5	4	High	[30.1,30.2, 30.2d,30.3]
	28	Belt 4SC	3-5 fl.oz./A	14	12	High	[30.1,30.2,30.2d, 30.3]
	UN	Aza-Direct 1.2L	11.5-42 fl.oz./A	0	4	High	[30.1,30.2,30.3]
	UN	Azatin XL 0.27EC	10-16 fl.oz./A	0	4	High	[30.1,30.2,30.3]
	3A/6	*Gladiator EC	19 fl.oz./A 4.75 fl.oz./100 gal	28	12	High	[1.0,30.1,30.1a, 30.2,30.3]

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Refer to back of book for key to abbreviations and footnotes.
Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Additional Summer Sprays (continued)							
Spotted tentiform leafminer, Apple blotch leafminer (*continued*)	4A/3A	Endigo ZC	5-6 fl.oz./A	35	24	High	[1.0,15.4,30.2, 30.3]
	4A/3A	Leverage 360	2.4-2.8 fl.oz./A	7	12	High	[1.0,30.2,30.3]
	4A/28	Voliam Flexi WDG	4-7 oz/A	35	12	High	[1.0,15.4,30.2, 30.3]
	6/4A	*Agri-Flex SC *plus* oil	5.5-8.5 fl.oz./A *or* 1.5-2 fl.oz./100 gal 1 gal/A *or* 1 qt/100 gal	35	12	High	[1.0,15.4,30.2]
Spotted wing Drosophila	1B	Imidan 70W	2.13-5.75 lb/A 0.75-1.0 lb/100 gal	7	4 days	Moderate	[31.2]
	5	Delegate 25WG	4.5-7 oz/A	7	4	Moderate	[31.2,31.2a]
	5	Entrust 2SC	6-10 fl.oz./A		4	High	[31.2,31.2b]
	5	Entrust 80WP	1.5-3 oz/A	7	4	High	[31.2,31.2b]
Stink bugs, incl. Brown marmorated stink bug		Surround 95WP	25-50 lb/A	0	4	Moderate	[12.2,32.2a]
	1A	Lannate 90SP	0.75 lb/A	14	72	High	[32.2a,32.2b]
	1A	Lannate LV 2.4L	2.25 pt/A	14	72	High	[32.2a,32.2b]
	1A	Vydate 2L	1.5-3 pt/A	14	48	Moderate	[32.2a,32.2b]
	2A	Thionex 3EC	2.67 qt/A 0.5 qt/100 gal	21	7 days	High	[32.2a,32.2b,32.2c]
	2A	Thionex 50WP	4 lb/A 0.75 lb/100 gal	21	20 days	High	[32.2a,32.2b,32.2c]
	3	Warrior II 2.08CS	1.28-2.56 fl.oz./A	21	24	Moderate	[32.2a]
	3A	Asana XL 0.66EC	4.8-14.5 fl.oz./A 2-5.8 fl.oz./100 gal	21	12	Moderate	[32.2a]
	3A	Baythroid XL 1EC	2.0-2.4 fl.oz./A	7	12	Moderate	[32.2a]
	3A	Danitol 2.4EC	10.7-21.3 fl.oz./A	14	24	Moderate	[32.2a,32.2b]
	4A	Actara 25WDG	4.5-5.5 oz/A	14/35 (A)	12	Moderate	[15.4,32.2a,32.2b]
	3A/6	*Gladiator EC	14-19 fl.oz./A 3.5-4.75 fl.oz./100 gal	28	12	Moderate	[1.0,32.2a]
	4A/3A	Endigo ZC	5-6 fl.oz./A	35	24	High	[1.0, 15.4,32.2a]
	4A/3A	Leverage 360	2.4-2.8 fl.oz./A	7	12	Moderate	[1.0,32.2a]
	4A/28	Voliam Flexi WDG	6.0-7.0 oz/A	35	12	Moderate	[1.0,15.4,32.2a]
Twospotted spider mite	10B	Zeal	2-3 oz/A	14	12	High	
	12B	Vendex 50WP	1-2 lb/A 4-8 oz/100 gal	14	48	Moderate	
	20B	Kanemite 15SC	31 fl.oz./A	14	12	High	
	21A	Nexter 75WS	8.8-10.7 oz/A	25	12	Moderate	
	21A	Portal 0.4EC	2 pt/A	14	12	High	
	UN	Acramite 50WS	0.75-1 lb/A	7	12	High	
Variegated leafroller, Sparganothis fruitworm	1A	Lannate 90SP	0.5-1 lb/A 0.25 lb/100 gal	14	72	High	[12.1d,34.1]
	1A	Lannate LV 2.4L	1.5-3 pt/A 0.75 pt/100 gal	14	72	High	[12.1d,34.1]
	11A	Deliver 18WG	0.5-2 lb/A	0	4	Moderate	[24.1,34.1,34.1a]
	11A	Dipel 10.3DF	0.5-2 lb/A	0	4	Moderate	[24.1,34.1,34.1a]
	11A	Javelin 7.5WDG	0.5-4 lb/A 0.13-1 lb/100 gal	0	4	Moderate	[24.1,34.1,34.1a]

Table 11.5.1 Pesticide Spray Table – Apples.

Refer to back of book for key to abbreviations and footnotes.
Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Additional Summer Sprays (continued)							
Variegated leafroller, Sparganothis fruitworm (*continued*)	3A/6	*Gladiator EC	14-19 fl.oz./A 3.5-4.75 fl.oz./100 gal	28	12	High	[1.0,34.1]
	4A/3A	Leverage 360	2.4-2.8 fl.oz./A	7	12	High	[1.0,34.1,34.1a]
White apple leafhopper, Potato leafhopper	1A	Lannate LV 2.4L	1.5-3 pt/A 0.75 pt/100 gal	14	72	High	[12.1d,35.1]
	1A	Lannate 90SP	0.5-1 lb/A 0.25 lb/100 gal	14	72	High	[12.1d,35.1]
	1A	Sevin 4F	0.5-1.5 qt/A	3	12	High	[35.1,35.1a]
	1A	Sevin 80 Solupak	0.63-1.88 lb/A	3	12	High	[35.1,35.1a]
	1A	Sevin XLR Plus 4EC	0.5-1.5 qt/A	3	12	High	[35.1,35.1a]
	1A	Vydate 2L	2-4 pt/A 1-2 pt/100 gal	14	48	High	[35.1,35.1a]
	2A	Thionex 3EC	2.6 qt/A 0.5 qt/100 gal	21	7 days	High	[35.1,35.1b]
	2A	Thionex 50WP	4 lb/A 0.75 lb/100 gal	21	20 days	High	[35.1,35.1b]
	3	Warrior II 2.08CS	1.28-2.56 fl.oz./A	21	24	High	[35.1]
	3A	Asana XL 0.66EC	4.8-14.5 fl.oz./A 2-5.8 fl.oz./100 gal	21	12	High	[35.1]
	3A	Baythroid XL 1EC	1.4-2 fl.oz./A	7	12	High	[35.1]
	3A	Danitol 2.4EC	10.67-16 fl.oz./A	14	24	High	[35.1]
	4A	Actara 25WDG	2-2.75 oz/A	14/35 (A)	12	High	[15.4,35.1,35.1c]
	4A	Admire Pro 4.6SC	2.8 fl.oz./A	7	12	High	[35.1]
	4A	Assail 30SG	2.5-4 oz/A	7	12	High	[35.1]
	4A	Calypso 4F	2-4 fl.oz./A 0.5-1 fl.oz./100 gal	30	12	High	[35.1,35.1c]
	16	Centaur 0.7WDG	9-12 oz/A	14	12	Moderate	[35.1]
	21A	Portal 0.4EC	2 pt/A	14	12	High	[35.1]
	22	Avaunt 30WDG	5-6 oz/A	14	12	High	[35.1,35.1c]
	UN	Aza-Direct 1.2L	12.5-42 fl.oz./A	0	4	Moderate	[35.1]
	UN	Neemix	7-16 fl.oz./A	0	4	Moderate	[35.1]
	4A/3A	Endigo ZC	5-6 fl.oz./A	35	24	High	[1.0,15.4,35.1]
	4A/3A	Leverage 360	2.4-2.8 fl.oz./A	7	12	High	[1.0,35.1]
	4A/28	Voliam Flexi WDG	4-7 oz/A	35	12	High	[1.0,15.4,35.1]
	6/4A	*Agri-Flex SC *plus* oil	5.5-8.5 fl.oz./A *or* 1.5-2 fl.oz./100 gal 1 gal/A *or* 1 qt/100 gal	35	12	High	[1.0,15.4,35.1]
Woolly apple aphid	1B	Diazinon 50WP	1 lb/100 gal	21/PF (A)	96	High	[36.1,36.1b]
	2A	Thionex 3EC	2.6 qt/A 0.5 qt/100 gal	21	7 days	Moderate	[35.1b,36.1]
	2A	Thionex 50WP	4 lb/A 0.75 lb/100 gal	21	20 days	Moderate	[35.1b,36.1]
	4A	Admire Pro 4.6SC	7-10.5 fl.oz./A	7	12	Moderate	[36.2]
	4A	Assail 30SG	2.5-4 oz/A	7	12	Moderate	[36.1,36.1a]

Table 11.5.1 Pesticide Spray Table – Apples.

Refer to back of book for key to abbreviations and footnotes.
Rate key: /A = per acre; /100 gal = per 100 gal water

Pest	IRAC & FRAC	Product	Rates	PHI (days)	REI (hrs)	Efficacy	Comments (see text)
Additional Summer Sprays (continued)							
Woolly apple aphid (*continued*)	9C	Beleaf 50SG	2.0-2.8 oz/A	21	12	Moderate	[36.1]
	23	Movento 240SC	6-9 fl.oz./A	7	24	High	[29.4b,36.1]
Postharvest							
Crown rot	4	Ridomil Gold SL	2 qt/A 0.5 pt/100 gal		48		[7.2]
Control of Storage Disorders							
Apple scab	M3	Penncozeb 75DF	3.0-6.0 lb/A 1.0-2.0 lb/100 gal	BL, 77(A)	24		[2.7]
Control of Storage Disorders							
Storage rots	1	Mertect 340F *plus*	1 pt/100 gal				[37.1]
	M4	Captan 50WP *or*	2.5 lb/100 gal				
	M4	Captan 80WP *or*	1.6 lb/100 gal				
	M4	Captec 4L	1.25 qt/100 gal				
		Penbotec	16-32 fl oz/100 gal				[37.1]
	12	Scholar SC	10-16 fl oz/100 gal 16-32 fl oz/200,000 lb fruit				[37.1]
Storage scald		No Scald DPA-EC-283	2.5-5 pt/100 gal				[38.1]
Senescent break-down (McIntosh)		Dowflake Process Grade	25 lb/100 gal				[39.1]

11.2 Apple Disease Notes

11.2.1 Apple Rust Diseases

• Biology & Cultural

Varieties that are susceptible to cedar apple rust include: Arlet, Braeburn, Fuji, Gala, Ginger Gold, Goldrush, Golden Delicious, Idared, Jonathan, Lodi, Mutsu (Crispin), and Rome. All varieties are susceptible to quince rust under favorable weather conditions. See Table 6.2.3 for a precise listing of temperature and wetting periods necessary to cause cedar-apple rust infections. Maintain short intervals during periods of wet weather in orchards where quince rust fruit infections have been a problem. Quince rust infections are most likely to develop when long wetting periods (48 hours or more) occur between tight cluster and first cover and the average temperature is greater than
50°F.

Refer to the reference materials list at the end of this publication for a Fact Sheet containing more details on the biology and management of this pest.

11.2.2 Apple Scab

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this pest.

• Pesticide Application Notes

[1.3] The EBDC fungicides (mancozeb, maneb, Polyram) are labeled for use on apples in one of two different ways: (i) at a rate of 1.5-2 lb/100 gal (maximum 6 lb/A, no more than 24 lb/A per year), not to be applied after bloom; OR (ii) at a reduced rate of 3 lb/A (maximum 21 lb/A per year), which may be applied to within 77 days of harvest. The latter rate is adequate for control of rust diseases, and the extended timing is necessary to control rust infections on terminal leaves. It is illegal to combine or integrate the two treatment regimes.

[2.1] See discussion of inoculum reduction in the disease management section. Scab fungicide sprays beginning at green tip are absolutely essential in orchards with high carry-over inoculum or orchards where scab control with SI fungicides was less than satisfactory in previous years. If early season infections are allowed to become established, even the best fungicide programs will not prevent development of fruit scab in orchards where the scab fungus has developed resistance to all three of the fungicide groups (dodine, benzimidazoles, SI′s) that previously provided presymptom and postinfection activity against apple scab.

[2.2] Fungicide rates per acre should never be reduced below either (i) 50% of the per-acre rate listed on the label or (ii) 1.5 multiplied by the Amt/100 gal listed on the label. This applies even when spraying small trees. Although tree-row volume calculations may suggest that lower rates are appropriate, applying less than 50% of the

per-acre rate has frequently resulted in unsatisfactory scab control and/or more rapid development of fungicide resistance. In orchards with SI-resistant scab, a combination of a mancozeb fungicide at 3 lb/A plus a captan formulation that supplies 1.5 lb of active ingredient/A has provided excellent scab control when used in prebloom and bloom sprays. (A captan rate of 1.5 lb active ingredient/A translates to 3 lb/A of Captan 50W, 30 oz/A of 80W, or 1.5 qt/A for the 4L formulations.) This combination provides a better residual activity through heavy rains than would be available from either product used alone and it preserves the option of using mancozeb sprays after petal fall. The mancozeb-captan combination cannot be used close to prebloom oil sprays because of captan-oil incompatibilities. For reasons of economy and resistance management, it is recommended that SI and strobilurin fungicides not be used until pink, even when fungicidal protection is needed earlier; in such cases, make a single application of an alternative fungicide (captan, copper, EBDC) at green tip and half-inch green, then begin the SI/strobilurin program at pink. Do not apply captan or sulfur within 10 days of an oil spray. Do not apply liquid captan formulations with sulfur on sulfur-sensitive varieties. A further discussion of apple scab fungicide characteristics is presented in the section "Apple Scab Fungicides" and in Table 6.1.3.

[2.4] Sovran and Flint are excellent protectants, but they have only 48-72 hours of post-infection activity compared with 72-96 hr for the SI fungicides. Sovran and Flint also lack the presymptom activity that makes the SI fungicides so effective (in the absence of SI resistance) for arresting scab epidemics after primary scab lesions become visible in trees. Sovran and Flint have proven very effective against apple scab when applied at 7-9-day intervals to control primary scab, but they have not performed as well when used to control secondary scab in trees where scab lesions are already visible. Sovran and Flint control rust diseases fairly well when used as protectants, but they have little or no post-infection activity against rust diseases. CAUTION: Sovran has caused moderate to severe phytotoxicity (leaf burning) on several sweet cherry varieties when sprayed directly onto them at high labeled rates. The most sensitive varieties were: Somerset, Sweetheart, Valera, Van, and Vandalay; these varieties might also be injured by spray drift containing Sovran. Minor to moderate injury occurred on Cavalier, Coral Champagne, Emperor Francis, Royalton, Schmidt, Summit, and Viva; there is less danger of injury due to spray drift on these varieties. Many other sweet and sour cherry varieties (including Bing, Brooks, Cashmere, Gold, Hardy Giant, Hartland, Hedelfingen, Hudson, Kristin, Lapins, Lambert, Montmorency, Napoleon, Nelson Black Sweet, Rainier, Royal Ann, Sam, Stark Crimson, Stella, Sue, Tehranivee, Tulare, Ulster, Vega, Vic, Viscount, and Windsor) showed no injury when sprayed directly with high labeled rates. The Sovran manufacturer recommends: (i) Do not apply Sovran near or allow drift onto cherries in the highly sensitive group (Somerset, etc.); and (ii) thoroughly rinse spray equipment (tanks, hoses, nozzles) after spraying Sovran and before using this equipment on sensitive cherry varieties.

[2.6] Primary inoculum pressure is generally at a peak from pink through bloom—this is a critical time to maintain full coverage with proper fungicide rates.

[2.7] Serious losses from apple scab are usually the result of secondary spread to developing fruits. Therefore, it is important to carefully check blocks for the presence of primary scab lesions from petal fall through the early cover spray period. This is particularly important because fruit are most susceptible to infection during the first few weeks of their development. If scab is detected, the management strategy should be to (i) thoroughly protect the sensitive young fruitlets from fungal spores that are present, AND (ii) limit the number of new spores that can be produced. To protect fruitlets, use (a) the full rate of captan (e.g., 2 lb/100 gal of the 50WP formulation), or (b) the reduced rate of an EBDC fungicide (if allowable) supplemented with a half rate of captan, or (c) a strobilurin fungicide combined with a contact fungicide. To limit new spore production, use (a) an SI fungicide through 2nd cover (to prevent new leaf lesions), or (b) a registered strobilurin fungicide (to prevent new leaf lesions and suppress spore production from existing lesions). SI's should be used only in orchards where there is no resistance to these fungicides. With repeated use, these options will speed the development of resistance. Thus, they should be viewed as emergency "rescue" operations, and increased care should be taken in future seasons to avoid the development of primary scab that necessitated their use.

[2.8] It is illegal to use the 6 lb/A rate of the EBDC fungicides after bloom. It also is illegal to use the reduced rate (3 lb/A) after bloom if the rate for any of the sprays prior to petal fall exceeded 3 lb/A.

[2.9] The danger of primary scab is over after 1st cover except when drought conditions delay spore release. If primary scab has been well controlled, fungicide schedules and rates can be relaxed after the danger of primary infection is past. For best control of mildew, apply an SI or strobilurin fungicide through 2nd cover on bearing trees and through 4th cover on non-bearing trees.

[2.13] Sensitivity to the SI fungicides (Rally, Procure, Vintage, Indar, Topguard, Inspire Super) is declining among some populations of the apple scab and powdery mildew fungi. These materials still provide apple scab control in some orchards, but they are totally ineffective in other orchards. Declining efficacy usually appears in orchards with a history of regular SI use (3-5 applications for 10+ yr) under high disease pressure, whereas no decline is apparent in orchards where the materials have been used sparingly or in tight schedules with low levels of inoculum. In order to maintain the usefulness of these products, it is recommended that they be used: (a) at full rates with thorough spray coverage; (b) only in tank-mix combinations with another effective scab fungicide; and (c) no more than 2-3 times per season.

[2.14] Fungicide resistance to Sovran, Cabrio, and Flint is begining to develop in the Northeastern US. The primary strategies for reducing this risk of resistance are to rotate the strobilurins with unrelated fungicides, to limit the number of seasonal applications of strobilurin fungicides

(e.g., 3-4 per year), and to tank mix strobilurins with captan when treating trees with visible scab lesions.

[2.15] Fungicide resistance to dodine (Syllit) appears to be decreasing in prevalence, but because of previous resistance concerns, we still recommend that dodine be applied with either captan or a mancozeb fungicide. Syllit use should still be restricted to pre-bloom to mimize resistance concerns and maximize against the disease to which it works (i.e. apple scab). (CAUTION: Applications of dodine after bloom may cause russeting on russet-sensitive varieties). Recently, the pomace and some cultivar restrictions have been removed from the label

11.2.3 Black Rot & White Rot

• Biology & Cultural

Black rot inoculum is retained within trees in dead wood (e.g., old fire blight strikes) and fruitlet mummies; therefore, it is important to remove these sources to whatever extent possible. The critical periods for controlling black rot fruit infections are (a) from the 1st through 3d cover sprays, when fruitlets killed by thinning applications become infected (they become inoculum sources), and (b) during late summer, when maturing fruit are especially susceptible. Where black rot was not controlled well the previous year, protectant sprays may be needed at 2-3-week intervals until late August.

Black rot cankers cannot be controlled with fungicide sprays. Cankers develop primarily after wood has been weakened by other factors (e.g., drought, winter injury). However, the white rot fungus may establish superficial cankers on trees that receive only mancozeb and/or SI sprays during the primary scab period. Those superficial cankers can suddenly girdle limbs if trees become severely drought-stressed. Using a copper fungicide at green tip and/or including a fungicide with activity against black rot/white rot (e.g. Captan, Sovran, or Flint) in the prebloom scab control program should help to control superficial white rot cankers.

• Pesticide Application Notes

[2.8] It is illegal to use the 6 lb/A rate of the EBDC fungicides after bloom. It also is illegal to use the reduced rate (3 lb/A) after bloom if the rate for any of the sprays prior to petal fall exceeded 3 lb/A.

[2.14] Fungicide resistance to Sovran, Cabrio, and Flint is begining to develop in the Northeastern US. The primary strategies for reducing this risk of resistance are to rotate the strobilurins with unrelated fungicides, to limit the number of seasonal applications of strobilurin fungicides (e.g., 3-4 per year), and to tank mix strobilurins with captan when treating trees with visible scab lesions.

[10.3] Captan is relatively weak against sooty blotch and very weak against flyspeck; if using Captan for control of summer rot diseases, tank-mix with Topsin M, Prophyt, Flint or Sovran if sooty blotch and fly speck control are needed.

[10.4] For the best residual control of all summer diseases during the 30-50-day interval between the last spray and harvest, use Pristine or Captan combined Topsin M in the last application.

11.2.4 Blister Spot

• Pesticide Application Notes

[5.1] This is an economic problem primarily on the Mutsu cultivar, but Fuji occasionally shows symptoms when planted near Mutsu. Apply the 1st spray 10-14 days after petal fall. A delay in applying this spray will significantly reduce control in most years. Two additional sprays should be applied at weekly intervals if any rain occurs. Do not apply more than 3 sprays. The use of 2-4 lb Kocide /100 gal between green tip and 1/2-inch green in the spring may reduce overwintering inoculum and provide a small amount of additional control. Additionally, application of Aliette (or phosphorous acid or phosphite products) during pink, petal fall, and early cover sprays may also reduce infections.

11.2.5 Blossom End Rot

• Biology & Cultural

Blossom end rots can be caused by *Botrytis cinerea, Sclerotinia sclerotiorum,* and *Botryosphaeria obtusa*. It occurs sporadically and is most likely to become a problem if the weather is warm and wet between bloom and 1st cover and in orchards where only mancozeb, Polyram, or SI fungicides were applied during bloom and at petal fall. McIntosh, Delicious, Rome, and Paulared are most commonly affected.

• Pesticide Application Notes

[6.2] Where blossom end rot has occurred before, use captan, Sovran, Topsin M or Thiophanate-methyl in the bloom, petal fall, and 1st cover sprays if the weather conditions are favorable for infection.

11.2.6 Cedar Apple Rust

• Pesticide Application Notes

[1.3] The EBDC fungicides (mancozeb, maneb, Polyram) are labeled for use on apples in one of two different ways: (i) at a rate of 1.5-2 lb/100 gal (maximum 6 lb/A, no more than 24 lb/A per year), not to be applied after bloom; OR (ii) at a reduced rate of 3 lb/A (maximum 21 lb/A per year), which may be applied to within 77 days of harvest. The latter rate is adequate for control of rust diseases, and the extended timing is necessary to control rust infections on terminal leaves. It is illegal to combine or integrate the two treatment regimes.

[2.2] Fungicide rates per acre should never be reduced below either (i) 50% of the per-acre rate listed on the label or (ii) 1.5 multiplied by the Amt/100 gal listed on the label. This applies even when spraying small trees. Although tree-row volume calculations may suggest that lower rates are appropriate, applying less than 50% of the per-acre rate has frequently resulted in unsatisfactory scab control and/or more rapid development of fungicide resistance. In orchards with SI-resistant scab, a combination

of a mancozeb fungicide at 3 lb/A plus a captan formulation that supplies 1.5 lb of active ingredient/A has provided excellent scab control when used in prebloom and bloom sprays. (A captan rate of 1.5 lb active ingredient/A translates to 3 lb/A of Captan 50W, 30 oz/A of 80W, or 1.5 qt/A for the 4L formulations.) This combination provides a better residual activity through heavy rains than would be available from either product used alone and it preserves the option of using mancozeb sprays after petal fall. The mancozeb-captan combination cannot be used close to prebloom oil sprays because of captan-oil incompatibilities. For reasons of economy and resistance management, it is recommended that SI and strobilurin fungicides not be used until pink, even when fungicidal protection is needed earlier; in such cases, make a single application of an alternative fungicide (captan, copper, EBDC) at green tip and half-inch green, then begin the SI/strobilurin program at pink. Do not apply captan or sulfur within 10 days of an oil spray. Do not apply liquid captan formulations with sulfur on sulfur-sensitive varieties. A further discussion of apple scab fungicide characteristics is presented in the section "Apple Scab Fungicides" and in Table 6.1.3.

11.2.7 Crown Rot (Collar Rot)

• Biology & Cultural

Crown rot is primarily associated with trees on moderately to highly susceptible rootstocks (particularly MM.106 and young trees on M.26). It can also develop on moderately resistant rootstocks planted in poorly drained sites or in very wet years. Seedling and M.9 appear to be the least susceptible of the common rootstocks.

Refer to the reference materials list at the end of this publication for a Fact Sheet containing more details on the biology and management of this pest.

• Pesticide Application Notes

[7.2] Ridomil should be considered in sections of the orchard where crown rot has been a problem, or where the combination of marginal drainage and rootstock susceptibility indicates a potential problem. Make a solution containing .5 pts Ridomil Gold 4SL in 100 gal of water and apply this solution to the soil around the trunk at the following rate: Trunk diameter at 12 inches above soil line Quantity of Diluted Solution <1 inch 1 qt. 1-3inches 3 qts. >5 inches 4 qts. Apply just as growth begins in the spring and repeat immediately after harvest. Do not apply to newly planted trees. Ridomil is an effective protective fungicide, but is unlikely to cure trees in moderate to severe stages of decline.

11.2.8 Fire Blight

• Biology & Cultural

Fire blight is a potentially damaging disease on highly susceptible varieties such as Crispin (Mutsu), Fuji, Gala, Gingergold, Greening, Honeycrisp, Idared, Jonathan, Lady Apple, Monroe, Paulared, Rome, SweeTango, and Wayne. Most other varieties can become infected if warm, wet weather prevails during bloom. The potential for tree loss is especially high when susceptible varieties are grown on susceptible M.26 and M.9 rootstocks (or interstems), because fire blight can move from the scion or infected root suckers into the rootstock and kill the tree.

Pruning out infected shoots to limit the spread of shoot blight is of questionable benefit on large trees but is recommended on young or small trees, particularly those on M.9 or M.26 rootstocks or interstems. To effectively limit damage, strikes should be pruned out as soon as they appear throughout the terminal growth period. Pruning cuts should be made into healthy second year wood (if applicable) to minimize the abundance of fire blight spreading in asymptomatic tisse. Begin checking for symptoms about 90-100 degree days (base 55°F) after an expected infection event such as rain during bloom or summer hailstorm. Degree day information can be sourced from the NYS IPM NEWA network web site at newa.cornell.edu. Should fire blight develop, it is also important to maintain control of pear psylla and potato leafhopper because these insects can contribute to shoot blight infections. Recent research indicates that aphids and white apple leafhopper are less important in spread of fire blight.

• Monitoring & Forecasting

Fire blight outbreaks almost always originate with infections that occur during bloom. Therefore, preventing blossom blight is arguably the most critical component in blight control programs. Streptomycin (strep) is by far the most effective product for preventing blossom blight except in orchards where strep-resistant strains of the pathogen are present. There is no evidence that repeated use of strep sprays during bloom will contribute to development of strep resistance. However, repeated use of strep AFTER bloom has consistently resulted in strep resistance in all geographic areas where it has been tried. Therefore, routine use of strep after bloom must be avoided.

The need for streptomycin sprays during bloom depends upon a combination of both orchard risk factors and weather risk factors. Orchards are considered "at-risk" if any of the following apply, and risk is compounded where more than one of the following applies:

1. Trees are less than 6 years old
2. Trees are highly susceptible cultivars (see 8.1).
3. Fire blight was observed in the orchard in either of the previous two seasons.
4. Fire blight was observed in orchards within a half-mile of the orchard during the previous season.

Precise timing is critical for maximizing the effectiveness of strep sprays because bacterial populations build very rapidly in flowers during warm weather. A strep application will protect only those blossoms that are open when the application is made, and strep will not redistribute after sprays have dried. Thus, protection from strep sprays can be optimized by making applications just prior to wetting events so that all open blossoms are protected during the actual infection event.

Two different fire blight forecast models, MaryBlyt™ and Cougarblight 2010, can be used to predict

fire blight risk and assist in timing strep sprays. For Cougarblight predictions, consult the NEWA disease forecasting webpage (newa.nrcc.cornell.edu/newaModel/apple_disease). This disease forecast system provides disease prediction information updated on an hourly basis. The MaryBlyt™ model can be downloaded to any computer with the Windows operating system from the following website: www.caf.wvu.edu/Kearneysville/Maryblyt/. Attempting to time strep sprays without using one of these models will often result in control failures.

If one cannot access spray timing information from one of the blossom blight models, then at-risk orchards should be protected with streptomycin if weather has been relatively warm since full pink AND forecasts indicate the probability of rain or showers in the next 24 hr at temperatures greater than 60°F. A program to initiate spraying once 200 degree hours (base 65°F) have accumulated since full pink (first open blossom in the orchard) has proven effective in several locations and should serve as an approximate guideline. [Example: To calculate degree hours for a particular day, assume 6 hr at the low, and 12 hr at the average of the two. Thus, for a day with a high of 80°F, a low of 60°F, and the average of 70°F, the of accumulated degree hours can be calculated as: 6 hr x 15 degrees above 65 for the high + 6 hr x 0 degrees above 65 for the low + 12 hr x 5 degrees above 65 for the average, or 90 + 0 + 60 = 150 accumulated degree hours]. Thus, once 200 or more degree hours have accumulated, strep should be sprayed before the next forecasted rain, providing that temperatures are 60°F or higher.

The need for additional streptomycin treatments should be determined by continuing to monitor weather conditions carefully (i.e., model outputs or degree hour and heat unit accumulation following treatment) so long as any open blossoms remain on trees. On the NEWA Cougarblight model webpage it is possible to enter the streptomycin treatment date to re-set the model to calculate the need for additional treatment. This monitoring is particularly critical during hot weather at mid-bloom where flowers may open following streptomycin application and enough heat units are accumulated to put theses newly opened blossoms at risk for infection within a day or two of the previous strep spray. In these instances, streptomycin should be reapplied to protect newly opened blossoms before the next rain occurs. However, streptomycin can provide control if applied within 24 hr after a wetting event begins. Antibacterial activity depends upon absorption by the blossoms; therefore, streptomycin must dry on the trees to be effective. Thorough coverage is essential for control. Alternate row spraying is not recommended with streptomycin, but if it is used the rates applied per acre must be the same as for every-row applications. The application of streptomycin at concentrations greater than 6X has been associated with reduced levels of control and is therefore, not recommended. Refer also to [8.5] and [8.7].

For at-risk orchards, consider including streptomycin in the petal fall spray if trees still have any open flowers, or if no strep spray was applied within the previous 3-4 days and the degree hours over 65° either currently exceed or are expected to exceed 145 (= a MaryBlyt EIP of 75) within the next few days. The objective of including strep in the petal fall spray is to protect the lingering bloom that is especially prevalent in young high-density orchards. Alternatively, one could continue applying strep with timings suggested by the MaryBlyt or Cougarblight models to protect late flowers during the interval after 50-80% petal fall, and using these models to time strep sprays after petal fall can be especially important if flowers linger for more than a few days after petal fall and for newly planted trees that will tend to bloom later than established trees.

Streptomycin sprays at 4 oz/100 gal should never be made under any circumstances because field observations suggest that this low rate can lead to incomplete control in cases where some flowers receive less than optimum coverage due to imperfect spray distribution. Therefore, all applications of streptomycin should be at 8 oz/100 gal of dilute spray or at 1.5 lb/A for trees that require 300 gal/A for complete coverage. Where rates are calculated using tree-row volume, the minimum Amt/A for strep applied with an airblast sprayer is 12 oz/A even if tree-row volume calculations would suggest a lower rate.

Regulaid or other penetrating adjuvants that enhances uptake should no longer be applied with streptomycin regardless of whether or not there is quick drying conditions. Given the application paradigm of tankmixing bloom thinners, bactericides, fungicides, and insecticides from bloom to petal to 1st cover, the potential for overthinning and damage of young developing fruit is great to warrant the use of Regulaid with streptomycin. Applications of streptomycin plus Regulaid over a short time interval may result in excessive yellowing of young leaves and leaf margins.

Streptomycin should NEVER be applied when there are no flowers on the trees except when orchards with visible fire blight have been damaged by hail (see [8.5]).

• Pesticide Application Notes

[8.3] Fire blight outbreaks almost always originate with infections that occur during bloom. Therefore, preventing blossom blight is arguably the most critical component in blight control programs. Streptomycin (strep) is by far the most effective product for preventing blossom blight except in orchards where strep-resistant strains of the pathogen are present. There is no evidence that repeated use of strep sprays during bloom will contribute to development of strep resistance. However, repeated use of strep AFTER bloom has consistently resulted in strep resistance in all geographic areas where it has been tried. Therefore, routine use of strep after bloom must be avoided.

The need for streptomycin sprays during bloom depends upon a combination of both orchard risk factors and weather risk factors. Orchards are considered "at-risk" if any of the following apply, and risk is compounded where more than one of the following applies: 1. Trees are less than 6 years old 2. Trees are highly susceptible cultivars (see 8.1). 3. Fire blight was observed in the orchard in either of the previous two seasons. 4. Fire blight

was observed in orchards within a half-mile of the orchard during the previous season.

Precise timing is critical for maximizing the effectiveness of strep sprays because bacterial populations build very rapidly in flowers during warm weather. A strep application will protect only those blossoms that are open when the application is made, and strep will not redistribute after sprays have dried. Thus, protection from strep sprays can be optimized by making applications just prior to wetting events so that all open blossoms are protected during the actual infection event.

Two different fire blight forecast models, MaryBlytTM and Cougarblight 2010, can be used to predict fire blight risk and assist in timing strep sprays. For Cougarblight predictions, consult the NEWA disease forecasting webpage (newa.nrcc.cornell.edu/ newaModel/ apple_disease). This disease forecast system provides disease prediction information updated on an hourly basis. The MaryBlytTM model can be downloaded to any computer with the Windows operating system from the following website: www.caf.wvu.edu/Kearneysville/ Maryblyt/. Attempting to time strep sprays without using one of these models will often result in control failures.

If one cannot access spray timing information from one of the blossom blight models, then at-risk orchards should be protected with streptomycin if weather has been relatively warm since full pink AND forecasts indicate the probability of rain or showers in the next 24 hr at temperatures greater than 60°F. A program to initiate spraying once 200 degree hours (base 65°F) have accumulated since full pink (first open blossom in the orchard) has proven effective in several locations and should serve as an approximate guideline. [Example: To calculate degree hours for a particular day, assume 6 hr at the low, and 12 hr at the average of the two. Thus, for a day with a high of 80°F, a low of 60°F, and the average of 70°F, the of accumulated degree hours can be calculated as: 6 hr x 15 degrees above 65 for the high + 6 hr x 0 degrees above 65 for the low + 12 hr x 5 degrees above 65 for the average, or 90 + 0 + 60 = 150 accumulated degree hours]. Thus, once 200 or more degree hours have accumulated, strep should be sprayed before the next forecasted rain, providing that temperatures are 60°F or higher.

The need for additional streptomycin treatments should be determined by continuing to monitor weather conditions carefully (i.e., model outputs or degree hour and heat unit accumulation following treatment) so long as any open blossoms remain on trees. On the NEWA Cougarblight model webpage it is possible to enter the streptomycin treatment date to re-set the model to calculate the need for additional treatment. This monitoring is particularly critical during hot weather at mid-bloom where flowers may open following streptomycin application and enough heat units are accumulated to put theses newly opened blossoms at risk for infection within a day or two of the previous strep spray. In these instances, streptomycin should be reapplied to protect newly opened blossoms before the next rain occurs. However, streptomycin can provide control if applied within 24 hr after a wetting event begins. Antibacterial activity depends upon absorption by the blossoms; therefore, streptomycin must dry on the trees to be effective. Thorough coverage is essential for control. Alternate row spraying is not recommended with streptomycin, but if it is used the rates applied per acre must be the same as for every-row applications. The application of streptomycin at concentrations greater than 6X has been associated with reduced levels of control and is therefore, not recommended. Refer also to [8.5] and [8.7].

For at-risk orchards, consider including streptomycin in the petal fall spray if trees still have any open flowers, or if no strep spray was applied within the previous 3-4 days and the degree hours over 65° either currently exceed or are expected to exceed 145 (= a MaryBlyt EIP of 75) within the next few days. The objective of including strep in the petal fall spray is to protect the lingering bloom that is especially prevalent in young high-density orchards. Alternatively, one could continue applying strep with timings suggested by the MaryBlyt or Cougarblight models to protect late flowers during the interval after 50-80% petal fall, and using these models to time strep sprays after petal fall can be especially important if flowers linger for more than a few days after petal fall and for newly planted trees that will tend to bloom later than established trees.

We no longer recommend streptomycin sprays at 4 oz/100 gal under any circumstances because field observations suggest that this low rate can lead to incomplete control in cases where some flowers receive less than optimum coverage due to imperfect spray distribution. Therefore, all applications of streptomycin should be at 8 oz/100 gal of dilute spray or at 1.5 lb/A for trees that require 300 gal/A for complete coverage. Where rates are calculated using tree-row volume, the minimum Amt/A for strep applied with an airblast sprayer is 12 oz/A even if tree-row volume calculations would suggest a lower rate.

Regulaid at 1 pt/100 gal (or another adjuvant that enhances uptake) should be applied with streptomycin when sprays are applied under rapid drying conditions, but Regulaid should be omitted if sprays are applied under slow drying conditions or when strep is being applied for the second or third time prior to petal fall. Repeated use of streptomycin plus Regulaid over a short time interval may result in excessive yellowing of young leaves and leaf margins. Regulaid should always be included with streptomycin in the petal fall application so as to enhance uptake into clusters and young terminal shoots. Streptomycin should NEVER be applied when there are no blossoms on the trees except when orchards with visible fire blight have been damaged by hail (see [8.5]).

[8.4] Copper applied at green tip will not eliminate the need for streptomycin at bloom. However, it is effective in reducing the population of overwintering fire blight bacteria and is a useful component of an overall fire blight control program. Thorough coverage of the entire tree is necessary for maximum effectiveness, so dilute or high gallonage sprays are preferred. This is also an effective scab spray, but is likely to cause injury if applied beyond 1/4-inch to 1/2-inch green. The oil should be added at a rate of

1 qt per 100 gal of actual spray solution in the tank (i.e., do not concentrate the oil). Oil is added to increase efficiency of the copper, but will not control mites when applied at this time and rate. If using Bordeaux mix, prepare as described in the section "Fungicides." Add the oil after adding lime, but before making the mix up to final volume. Several other commercial copper formulations in addition to those listed are labeled for this use on apples. Although they have not been tested, research on other crops suggests that most copper formulations should give comparable rates of control at comparable rates of metallic copper.

[8.5] To reduce the chance of developing resistance, the routine use of streptomycin to control the spread of shoot infections is discouraged. However, an application of streptomycin is recommended following a hailstorm in fire blight-affected orchards, provided that such a spray can be applied without violating the preharvest interval. This application may be critical if even moderate amounts of blight were present before the storm. Sprays should be completed within 24 hr after the start of the hail.

[8.6] Apogee is a growth regulator that has given good control of fire blight infection of shoots, but is ineffective for control of blossom infections. Apogee should be applied in late bloom or early petal fall (when shoots are 1-3 inches long) at 6-12 oz/ 100 gal, with a second application 3-4 weeks later (Important: see recommendation and comments under "Growth Regulator Uses in Apples" section for more information about Apogee and water quality requirements). Because Apogee has no effect on preventing or slowing fire blight infections for at least 10 days after application, the need for application must be determined prior to the appearance of fire blight symptoms in the orchard. The need for application should be based upon the number of fire blight infection periods that occur during bloom and the severity of fire blight the previous season, as well as the susceptibility of the scion variety and rootstock. If Apogee is to be applied to trees less than 5 years old, the rate of application should be reduced to 3-6 oz/100 gal, and the grower must balance the benefit of shoot blight control against the drawback of reduced shoot growth. Apogee may affect thinning programs (see "Growth Regulator Uses in Apples").

[8.7] Serenade can be integrated into a fire blight control program, but it has been consistently less effective than streptomycin. Therefore, Serenade should be used only in rotational programs with streptomycin and not as the sole bactericide for fire blight management. Research at Geneva suggests that streptomycin should be the first product applied during bloom, particularly when conditions are very favorable for the development of fire blight. Serenade should be applied 24 hr after the infection event.

[8.8] Bloomtime Biological can be included in the fire blight control program for blossom blight. This biopesticide is consistently less effective than streptomycin, but may be a viable option in orchards with low levels of fire blight inoculum and during environmental conditions indicative of a low risk of infection. Research conducted in New England suggests that this product can provide up to 50% control when applied during bloom compared to streptomycin. In contrast to Serenade, (see above) this material should be applied prior to infection events.

[8.9] Mycoshield is registered for fire blight and can be included in the management program for blossom blight. This antibiotic is consistently less effective than streptomycin, but may be viable option as a resistance management tool when used in rotation with streptomycin. Use primarily in orchards with low levels of fire blight inoculum. Research conducted in New England suggests that this product may only provide up to 50% control when applied during bloom compared to streptomycin.

[8.10] The recommended action plan for fire blight management in New England is as follows: All fire blight cankers should be removed during winter pruning. Copper applications should be made at green tip. NEWA (newa.cornell.ecu) warnings of fire blight infection periods should be heeded, and recommended materials sprayed promptly. Prohexadione-Calcium (Apogee) sprays should be used at high rate, applied at 2-3 inches shoot growth. Fire blight strikes should be pruned out promptly and destroyed. If severe blossom blight occurs contact CCE for SR Ea testing. In all regions of New England the following action plan is recommended for newly planted orchards:

1. If possible, plant varieties grafted on fire blight-resistant rootstocks.
2. Trees should be carefully examined for fire blight infections before planting. Infected trees should be discarded. Samples should be submitted for strep-resistance testing.
3. Immediately after planting a copper spray should be applied. Wait until to the soil has settled to avoid phytoxicity issues.
4. Planting should be scouted at 7-day intervals for fire blight strikes until June 30. Infected tree should be removed. Plantings also need to be scouted 7-10 days after hail or severe summer storms and at the end of the season (mid-September). The NEWA/NRCC disease forecasting models for fire blight (newa.nrcc.cornell.edu/ newaModel/apple_disease) can assist by providing an estimate of symptom emergence following a storm or other trauma event.
5. If possible, remove flowers before they open. Since most new plantings have many blossoms the first year, and many orchards are high density (i.e. 1000-2000 trees per acre), blossom removal may not be possible. If practiced, the blossoms should be removed before there is a high risk of FB infection.
6. Apply copper, tank mix of streptomycin and oxytetracycline at the full label rate for each during any remaining bloom based on blossom blight predictions. The NEWA/NRCC disease forecasting models for fire blight (newa.nrcc.cornell.edu/ newaModel/apple_disease) will run nearly until August, and have an adjustable bloom date to account asynchronous or late bloom in new plantings.
7. Trees should receive a second copper spray at a stage equivalent to bloom. 48 hours REI before blossom removal.

8. Samples of any infections seen after planting should be submitted for streptomycin resistance testing.

11.2.9 Powdery Mildew

• Biology & Cultural

Powdery mildew survives the winter in vegetative or fruit buds that were infected the previous season. Winter temperatures below -11°F can kill the mycelium in the buds and temperatures below -24°F can kill many of the infected buds, thereby reducing overwintering infections and inoculum potential for the next growing season. Baldwin, Cortland, Crispin, Gala, Ginger Gold, Honeycrisp, Idared, Jonathan, Monroe, Paulared, and Rome are highly susceptible varieties. Other less-susceptible varieties may also become seriously diseased in certain years, particularly if planted near trees where mildew is not well controlled. Rain is not necessary for infection to occur; therefore, mildew sprays must be maintained even during prolonged dry spells when scab sprays aren't necessary. Mildew develops slowly at temperatures below 50°F so mildew sprays are relatively unimportant until temperatures regularly exceed this level. Refer to the reference materials list at the end of this publication for a Fact Sheet containing more details on the biology and management of this pest.

• Pesticide Application Notes

[2.12] Apple scab and powdery mildew resistance to Topsin M and Thiophanate-methyl may occur throughout New England. Once resistance develops it will persist indefinitely. Thus, these products should NOT be relied upon for apple scab or mildew control in orchards or regions with a long history of use.

[9.3] JMS Stylet Oil also provides mite control but has incompatibility problems with several other pesticides, including captan and sulfur. Refer to label for specific restrictions.

[9.4] Do not delay powdery mildew applications beyond pink.

11.2.10 Sooty Blotch and Fly Speck

• Biology & Cultural

Sooty blotch and fly speck develop gradually during periods of very high humidity; thus they are favored by frequent showers, prolonged cloudy weather, poor air circulation, dense tree canopies, and clustered fruit. These diseases are particularly damaging when rainy weather persists through summer and allows repeated cycles of secondary spread. Inoculum for sooty blotch and flyspeck often comes from alternate hosts in adjacent woods and hedgerows, such as trees, shrubs, vines, particularly wild brambles. Removal of these plants to whatever extent possible (e.g., bush-hogging fencerows or ditchbanks) will aid in disease control. Summer pruning, which increases air movement through the tree canopy, also aids in control of these diseases. After spores land on unprotected fruit, approximately 200 hr of accumulated wetting (as recorded on NEWA stations are required before flyspeck and sooty blotch will become evident on fruit. Note that older data suggested that 270 hr of accumulated wetting was required before disease became evident on fruit, but the 270 hr was for wetting periods recorded with string recorders. The electronic recorders used on NEWA stations are slightly less sensitive to dews and marginal wettings, so the appropriate thresholds for completion of the incubation period are 200 hr (electronic) or 270 hr (string) of accumulated wetting. Refer to the reference materials list at the end of this publication for a Fact Sheet containing more details on the biology and management of this pest.

• Pesticide Application Notes

[2.14] Fungicide resistance to Sovran, Cabrio, and Flint is begining to develop in the Northeastern US. The primary strategies for reducing this risk of resistance are to rotate the strobilurins with unrelated fungicides, to limit the number of seasonal applications of strobilurin fungicides (e.g., 3-4 per year), and to tank mix strobilurins with captan when treating trees with visible scab lesions.

[2.8] It is illegal to use the 6 lb/A rate of the EBDC fungicides after bloom. It also is illegal to use the reduced rate (3 lb/A) after bloom if the rate for any of the sprays prior to petal fall exceeded 3 lb/A.

[10.1] Sooty blotch and fly speck develop gradually during periods of very high humidity; thus they are favored by frequent showers, prolonged cloudy weather, poor air circulation, dense tree canopies, and clustered fruit. These diseases are particularly damaging when rainy weather persists through summer and allows repeated cycles of secondary spread. Inoculum for sooty blotch and flyspeck often comes from alternate hosts in adjacent woods and hedgerows, such as trees, shrubs, vines, particularly wild brambles. Removal of these plants to whatever extent possible (e.g., bush-hogging fencerows or ditchbanks) will aid in disease control. Summer pruning, which increases air movement through the tree canopy, also aids in control of these diseases. After spores land on unprotected fruit, 270 hr of accumulated wetting are required before flyspeck will become evident on fruit. Refer to the reference materials list at the end of this publication for a Fact Sheet containing more details on the biology and management of this pest.

[10.2] Ascospores of the flyspeck fungus can be blown into orchards beginning near petal fall, but fungicides applied for scab control are usually adequate to control these early season infections. The real risk of flyspeck infection escalates when secondary spores become available in woodlots and hedgerows. This occurs after approximately 270 hours of accumulated wetting (rains and dew periods) counting from petal fall. Topsin M, Sovran, Flint, Inspire Super, and Pristine all arrest development of flyspeck infections on fruit if they are applied after infections have occurred, but the infections resume growing after fungicide residues are depleted. Applications of Topsin M, Sovran, Flint, Inspire Super, or Pristine should then be renewed at 14-21 day intervals. If all fungicide coverage is removed by heavy rains (> 3 inches after the last spray) during late August or early September, a late-

season spray may be needed to control disease on cultivars that will not be harvested within 25-30 days after fungicide coverage is depleted. Effectiveness of late-season sprays is largely dependent on spray coverage within the tree.

11.3 Apple Insect and Mite Notes

11.3.1 American Plum Borer

• Pesticide Application Notes

[17.1] One coarse spray of Lorsban to trunk burr knots between half-inch green and petal fall. Alternatively, if fresh borer activity is noted in early July, apply one spray of Lorsban in early July. Only 1 application of any chlorpyrifos material allowed per year in apples. PHI = 28 days.

[17.2] One coarse spray of Assail to trunk between pink and mid-June. If fresh borer activity is noted in early July, follow up with one additional spray of Assail before early August.

11.3.2 Apple Aphid, Spirea Aphid

• Pesticide Application Notes

[1.0] For best effectiveness and insecticide resistance management, the use of pre-mixes should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.

[11.1] Suggested action threshold: 30-40% of all terminals infested, OR 50% or more of the terminals with at least 1 aphid and less than 20% of the terminals with predators, OR 10% of fruit with honeydew or aphids.

[11.1a] Multiple applications of *Agri-Flex or Voliam Flexi in pome fruit require applicator to not exceed a total of 0.172 lbs a.i. of thiamethoxam containing products per acre per growing season.

[11.1c] *Danitol will also provide suppression of European red mite.

[11.1d] Movento must be used with a spray adjuvant that has spreading and penetrating properties.

[11.1e] *Vydate applied in the summer against leafminer will also control apple aphid.

[35.1b] Do not apply more than 2 applications of *Thionex during fruiting period.

11.3.3 Apple Maggot

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet and Sampling Guide containing details on the biology and management of this pest.

• Monitoring & Forecasting

Refer to the NEWA Apple Insect Models website (newa.cornell.edu/index.php?page=apple-insects) for current information on the occurrence, development and management of this pest in your specific location.

• Pesticide Application Notes

[1.0] For best effectiveness and insecticide resistance management, the use of pre-mixes should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.

[12.1] *Asana and *Warrior applied against other pests during this period will also control apple maggot. Suggested action threshold: capture of 1 fly on red sphere trap hung in block, or of 5 flies on red sphere baited with apple volatiles.

[12.1a] 2-4 sprays at 14-day intervals beginning late June to early July.

[12.1b] *Danitol will also provide suppression of European red mite.

[12.1c] Protective sprays at 7-day intervals beginning late June to early July.

[12.1d] Do not use *Lannate on Early McIntosh, Dutchess, or Wealthy varieties.

[12.2] Frequent applications (7-10-day intervals) of Surround and maximal coverage (minimum of 100 gal/A) are advised while there is active foliar growth.

[15.4] Multiple applications of thiamethoxam-containing products in pome fruit require applicator to not exceed a total of 0.172 lbs a.i. per acre per growing season.

11.3.4 Apple Rust Mite

• Biology & Cultural

Occurs from late June to harvest, particularly on varieties with pubescent leaves; does not generally coincide with high red mite populations, as feeding tends to condition foliage to be less suitable for red mite development. Low numbers are valuable as prey for predator mites. Injury is a yellowish browning of leaves or white blotches on upper leaf surfaces.

• Pesticide Application Notes

[13.2] Use a maximum of 2 miticide applications per season; Suggested action threshold: >200 mites/leaf.

11.3.5 Climbing Cutworms: Darksided, Dingy, Mottled, Spotted, Variegated

• Pesticide Application Notes

[16.2] Apply spray when migrating larvae, or shoot or fruit injury, are first observed, usually in August. Do not use *Lannate on Early McIntosh, Dutchess, or Wealthy varieties.

[16.2a] Do not use *Lannate on Early McIntosh, Dutchess, or Wealthy varieties.

11.3.6 Codling Moth

• Biology & Cultural

Refer to the reference materials list at the end of this publication for Fact Sheets containing details on the biology and management of codling moth and oriental fruit moth.

• Monitoring & Forecasting

Control of 1st generation oriental fruit moth larvae generally coincides with the petal fall application window. Sprays against the summer generations of oriental fruit moth should be timed to start approximately at the 10% hatch point, 175-200 DD (base 45°F) after the respective first sustained adult catches of the 2nd and 3rd broods, with follow-up applications on a 10–14-day interval. For orchards not receiving regular apple maggot sprays, or where codling moth is otherwise a significant problem, a developmental model predicts the appropriate larval treatment period for CM as 250-360 degree-days (base 50°F) after 1st adult catch for each generation, and approximately 150 DD after this same biofix date for insecticides with ovicidal activity. Refer to the NEWA Apple Insect Models website (newa.cornell.edu/index.php?page=apple-insects) for current information on the occurrence, development and management of these pests in your specific location.

• Biological & Non-chemical Control

Better control of target species is obtained when pheromone disruption begins with the first generation of the season; regardless, products for disruption should be applied before first flight of the generation being targeted. Products directed against oriental fruit moth (Checkmate OFM-F, Isomate-M 100) are additionally active against lesser appleworm. Combination products (Checkmate CM-OFM Duel, Isomate-CM/OFM TT) are active against the above species as well as codling moth. The need for re-application depends on residual field life of specific formulations: Isomate-M 100, 90 days; Checkmate OFM-F and CM-F, 14-21 days. Insecticide sprays or double the rate of pheromones may be needed in border rows of orchards adjacent to sources of adult immigration or in other high pressure situations.

• Pesticide Application Notes

[1.0] For best effectiveness and insecticide resistance management, the use of pre-mixes should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.

[12.2] Frequent applications (7-10-day intervals) of Surround and maximal coverage (minimum of 100 gal/A) are advised while there is active foliar growth.

[14.1] For orchards not receiving regular apple maggot sprays, or where codling moth is otherwise a significant problem, a developmental model predicts the appropriate larval treatment period for CM as 250-360 degree-days (base 50°F) after 1st adult catch for each generation, and approximately 150 DD after this same biofix date for insecticides with ovicidal activity. Refer to the NEWA Apple Insect Models website (newa.cornell.edu/index.php?page=apple-insects) for current information on the occurrence, development and management of these pests in your specific location.

[14.2] Better control of target species is obtained when pheromone disruption begins with the first generation of the season; regardless, products for disruption should be applied before first flight of the generation being targeted. Combination products (Checkmate CM-OFM Duel, Isomate-CM/OFM TT) are active against the above species as well as codling moth. The need for re-application depends on residual field life; for Checkmate OFM-F and CM-F, 14-21 days. Insecticide sprays or double the rate of pheromones may be needed in border rows of orchards adjacent to sources of adult immigration or in other high pressure situations.

[14.3] *Asana or *Warrior applied during this period will also provide control of these pests, as will a spray program as noted for apple maggot. Suggested action threshold: Avg. of >5 CM adults/week caught per pheromone trap once 150-360 DD (base 50°F) have accumulated since biofix; see [14.1].

[14.3a] Altacor, Avaunt and Assail applied at this time will also control European apple sawfly; Avaunt will control plum curculio.

[14.3b] Altacor and Intrepid provide only suppression of codling moth.

[14.3c] Use of a non-ionic surfactant is recommended with Assail.

[14.3e] Calypso, Dipel, and Imidan not registered for lesser appleworm.

[14.3f] §Carpovirusine and §Cyd-X labeled for use against codling moth only.

[14.3g] *Lannate not registered for oriental fruit moth.

[14.3h] *Proclaim used against codling moth should be applied at egg hatch and may be followed up with a second application in 7-14 days.

[14.3i] Rimon is limited to 1 application per season.

[14.3j] Use Sevin for codling moth and lesser appleworm; do not use within 30 days of full bloom unless fruit thinning is desired.

[14.3k] Do not exceed 0.172 lb a.i./A of thiamethoxam- containing products per acre per growing season.

11.3.7 Comstock Mealybug

• Biology & Cultural

This pest problem is apparently encouraged by excessive use of synthetic pyrethroids (more than 2 applications/season).

Refer to the reference materials list at the end of this publication for a Fact Sheet containing more details on the biology and management of this pest.

• Pesticide Application Notes

[1.0] For best effectiveness and insecticide resistance management, the use of pre-mixes should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.

[15.2a] One spray advised against newly emerged crawlers, usually in late May (petal fall period). In severe cases, sprays against the 2nd generation may also be elected.

[15.2b] Movento must be used with a spray adjuvant having spreading and penetrating properties.

[15.3a] Spray when crawlers 1st appear in summer, usually early Aug., and a 2nd spray 7-10 days later.

[15.3b] Actara applied against other pests at this time will provide control of Comstock mealybug.

[15.4] Multiple applications of thiamethoxam-containing products in pome fruit require applicator to not exceed a total of 0.172 lbs a.i. per acre per growing season.

11.3.8 Dogwood Borer

• Biology & Cultural

Refer to the reference materials list at the end of this publication for Fact Sheets containing details on the biology and management of these pests. American plum borer can be a problem particularly in orchards adjacent to stone fruit plantings.

• Pesticide Application Notes

[17.1] One coarse spray of Lorsban to trunk burr knots between half-inch green and petal fall. Alternatively, if fresh borer activity is noted in early July, apply one spray of Lorsban in early July. Only 1 application of any chlorpyrifos material allowed per year in apples. PHI = 28 days.

[17.2] One coarse spray of Assail to trunk between pink and mid-June. If fresh borer activity is noted in early July, follow up with one additional spray of Assail before early August.

11.3.9 European Apple Sawfly

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this pest.

• Pesticide Application Notes

[1.0] For best effectiveness and insecticide resistance management, the use of pre-mixes should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.

[15.4] Multiple applications of thiamethoxam-containing products in pome fruit require applicator to not exceed a total of 0.172 lbs a.i. per acre per growing season.

[18.1] Particularly a problem in northern New England; 1 spray at petal fall. Suggested action threshold: Cumulative capture of 3 adults/trap by 90% petal fall if no insecticide was applied at pink, or of 6 adults if an insecticide was applied at pink (white sticky-board trap).

[18.1a] Do not use *Lannate on Early McIntosh, Dutchess, or Wealthy varieties.

[18.2a] Actara, Avaunt, Calypso and Lorsban will also control plum curculio when applied at this time.

11.3.10 European Corn Borer

• Biology & Cultural

Control of broadleaf weeds under trees is important.

• Pesticide Application Notes

[19.2] 1st generation spray: when migrating larvae, or shoot or fruit injury are first observed, usually in mid-June; 2nd generation: when larvae or injury to shoots or fruit is observed, usually in August. Be sure to note PHI limitations.

11.3.11 European Fruit Lecanium

• Pesticide Application Notes

[20.2] Oil is recommended at the 2-3 gal rate during the dormant period. This spray will also control European fruit lecanium.

11.3.12 European Red Mite

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet and other resources containing details on the biology and management of this pest.

• Biological & Non-chemical Control

The predaceous mite, *Typhlodromus pyri*, which is native to apple production regions in western N.Y., can successfully control populations of European red mite in commercial apple orchards so that no applications of miticides are required for seasonal control when selective pesticide programs are followed. Refer to Tables 6.1.2 and 7.1.2 for ratings of pesticide effects on predatory mites, and to IPM Pub. No. 215 (*Achieving Biological Control of European Red Mite in Northeast Apples: An Implementation Guide for Growers*) for guidelines to implementing this approach.

• Pesticide Application Notes

[1.0] For best effectiveness and insecticide resistance management, the use of pre-mixes should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.

[20.2] Oil is recommended at the 2-3 gal rate during the dormant period. This spray will also control European fruit lecanium.

[20.3] Good coverage is essential. Phytotoxicity from oil is more likely if sprays are concentrated more than 3X.

[20.4] Use 2 gal rate until tight cluster; reduce to 1 gal from tight cluster to pink. Good coverage is essential (300 gal/A recommended). San Jose scale, lecanium scale, and red bug are also controlled. See the "Acaricides" section of Fruit Crop Protectants for information on mixing and compatibility with fungicides. Suggested action threshold: 10% of spurs with eggs.

[20.5] One spray of Zeal, Apollo, Onager or Savey no later than pink bud stage (and at pink only if no spray was applied earlier) to control newly hatching larvae, in enough water to obtain adequate coverage; best efficacy is achieved when application is made as late as possible before bloom.

[20.5a] The rate of formulated Apollo in finish spray solution should be 4-8 oz per acre.

[20.5b] Zeal, Onager and Savey limited to 1 application per season.

[20.6] Tank mixing Apollo or Savey with oil at tight cluster can extend period of residual efficacy in the summer.

[20.7a] *Vydate may provide some mite suppression at pink; effective also on leafminer larvae and rosy apple aphid. Complete coverage of all leaf surfaces is required for best results.

[20.8] *Agri-Mek, *Agri-Flex, and *Gladiator can be used to control mites anytime from petal fall to about 4 weeks afterward, but is most effective when applied before foliage begins to harden off, generally within the first 2 weeks after petal fall. Must be applied in combination with a horticultural spray oil (not a dormant oil).

[20.9] Treatment generally not recommended at petal fall unless all previous sprays were either omitted or completely ineffective. Suggested action threshold: 1 mite/leaf or 30% of leaves with one or more mites. See Tables 6.1.2 and 7.1.2 for information about effects of pesticides on predatory mites.

[20.9a] Acramite, Zeal,Nexter, and Portal limited to 1 application per season.

[20.9b] Kanemite limited to a maximum of 2 applications per season.

[20.11] If oil is not to be used during the summer, 1 application of Acramite, Apollo, Kanemite, Nexter, Onager, Portal, Savey, Zeal or *Vendex at 1st to 2nd cover, as needed. Suggested action threshold: refer to Figs. 7.1.4-7.1.6 for appropriate (date-dependent) threshold and sampling procedure.

[20.11a] Apollo, Onager and Savey are primarily ovicides that will not directly reduce adult mite numbers.

[20.11c] For *Vendex, a 2nd application may be elected 10-14 days later (or, for Kanemite, 21 days later), as needed.

11.3.13 Green Fruitworms

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this pest.

• Pesticide Application Notes

[1.0] For best effectiveness and insecticide resistance management, the use of pre-mixes should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.

[21.1] Growers can usually wait until petal fall to assess the need for this treatment. Suggested action threshold: 3 larvae/tree on standard-size tree (27-40 trees/A); 1 larva/tree at density of 140 trees/A (semi-dwarf planting), lower for more closely spaced plantings.

[21.1a] Do not use *Lannate on Early McIntosh, Dutchess, or Wealthy varieties.

[21.1b] It is recommended that pyrethroids not be used more than 1-2 times/season in any orchard.

[21.1d] Do not exceed 0.172 lb a.i./A of thiamethoxam-containing products per acre per growing season.

[35.1b] Do not apply more than 2 applications of *Thionex during fruiting period.

11.3.14 Japanese Beetle

• Biology & Cultural

Adults emerge from the soil between early July and mid-August to feed on numerous trees and shrubs. In apple trees, beetles devour the tissue between the veins, leaving a lace-like skeleton. Severely injured leaves turn brown and often drop. Adults are most active during the warmest parts of the day and prefer to feed on plants that are fully exposed to the sun.

• Pesticide Application Notes

[1.0] For best effectiveness and insecticide resistance management, the use of pre-mixes should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.

[22.2] Although pheromone traps are available and can be hung in the orchard in early July to detect the beetles' presence, they are generally NOT effective at trapping out the beetles. Fruit and foliage may be protected from damage by applying protective sprays; repeated applications may be required.

11.3.15 Lesser Appleworm

• Pesticide Application Notes

[1.0] For best effectiveness and insecticide resistance management, the use of pre-mixes should be reserved for situations when multiple pest species are

present and appropriately matched to the combination of active ingredients and modes of action contained in the product.

[14.1a] Control of 1st generation oriental fruit moth larvae generally coincides with the petal fall application window. Sprays against the summer generations of oriental fruit moth should be timed to start approximately at the 10% hatch point, 175-200 DD (base 45°F) after the respective first sustained adult catches of the 2nd and 3rd broods, with follow-up applications on a 10–14-day interval. Sprays against oriental fruit moth should generally also provide control of lesser appleworm.

[14.2] Better control of target species is obtained when pheromone disruption begins with the first generation of the season; regardless, products for disruption should be applied before first flight of the generation being targeted. Products directed against oriental fruit moth (Checkmate OFM-F, Isomate OFM TT) are incidentally active against lesser appleworm. Combination products (Checkmate CM-OFM Duel, Isomate-CM/OFM TT) are active against the above species as well as codling moth. The need for re-application depends on residual field life; for Checkmate OFM-F and CM-F, 14-21 days. Insecticide sprays or double the rate of pheromones may be needed in border rows of orchards adjacent to sources of adult immigration or in other high pressure situations.

[14.3a] Altacor, Avaunt and Assail applied at this time will also control European apple sawfly; Avaunt will control plum curculio.

[14.3b] Altacor and Intrepid provide only suppression of codling moth

[14.3c] Use of a non-ionic surfactant is recommended with Assail.

[14.3i] Rimon is limited to 1 application per season.

[14.3j] Use Sevin for codling moth and lesser appleworm; do not use within 30 days of full bloom unless fruit thinning is desired.

[14.3k] Do not exceed 0.172 lb a.i./A of thiamethoxam-containing products per acre per growing season.

11.3.16 Mullein Plant Bug

• Biology & Cultural

Although predaceous on aphids and mites, nymphs occasionally damage fruit by feeding on flowers or young fruitlets. Damage appears as raised corky lesions and, in severe cases, fruit deformities. Most problematic in Red and Golden Delicious, Northern Spy, Empire and Spartan varieties.

Refer to the reference materials list at the end of this publication for a Fact Sheet containing more details on the biology and management of this pest.

• Monitoring & Forecasting

During bloom, tap 2 yr-old flower-bearing shoots over a black beating tray, especially in problem spots and those in proximity to areas containing mullein and evening primrose. Suggested action threshold: 10 nymphs per 40 limbs (4 on each of 10 trees). High populations can also be predicted from pheromone trap catches the preceding fall (more than 6/trap/day any time after Sept. 1).

• Pesticide Application Notes

[1.0] For best effectiveness and insecticide resistance management, the use of pre-mixes should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.

[23.3] Susceptible to most insecticides applied at petal fall, but much damage has usually occurred by then. *Asana or Lorsban applied at pink against other pests will provide incidental control.

[23.3a] Actara will also control spotted tentiform leafminer, rosy apple aphid and tarnished plant bug when applied at this time; Multiple applications of Actara in pome fruit require applicator to not exceed a total of 0.172 lbs a.i. of thiamethoxam containing products per acre per growing season.

[23.3b] Calypso will also control rosy apple aphid, spotted tentiform leafminer, 1st generation oriental fruit moth, and will suppress San Jose scale.

[23.3c] Assail will also control codling moth, European apple sawfly, rosy apple aphid, leafminers, and leafhoppers. Do not spray when bees are actively visiting the area.

11.3.17 Obliquebanded Leafroller

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet and Sampling Guide containing details on the biology and management of this pest.

• Monitoring & Forecasting

Refer to the NEWA Apple Insect Models website (newa.cornell.edu/index.php?page=apple-insects) for current information on the occurrence, development and management of this pest in your specific location.

• Pesticide Application Notes

[1.0] For best effectiveness and insecticide resistance management, the use of pre-mixes should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.

[14.3i] Rimon is limited to 1 application per season.

[24.1] B.t. materials are most effective against smaller larvae.

[24.2] Spray at petal fall to control overwintered larvae. Suggested action threshold: 3% infested tips (clusters and terminals); refer to Fig. 7.1.2 for sampling procedure.

[24.2a] Do not use *Lannate on Early McIntosh, Dutchess, or Wealthy varieties.

[24.2c] *Lannate will also control white apple leafhopper.

[24.2d] *Danitol will also provide suppression of European red mite.

[24.2e] Addition of a penetrating surfactant will improve efficacy of *Proclaim; application at petal fall will also control spotted tentiform leafminer. *Proclaim use limited to 4.8 oz/A of formulated product per season.

[24.3] Suggested action threshold for summer brood larvae: 3% infested terminals, refer to Fig. 7.1.2 for sampling procedure.

[24.3a] For Bt products, greater efficacy against summer brood larvae has been shown with 2-4 sprays at the low rate on a 7-day interval, starting 10-12 days after first adult catch.

[24.3b] 2-3 sprays, 10-14 days apart, against larvae, starting 360 DD (base 43°F) after 1st adult trap catch.

[24.3c] It is recommended that pyrethroids not be applied more than 1-2 times/season in any orchard.

[24.3d] Use high rate of *Asana in problem orchards.

[24.4] Do not exceed 0.172 lb a.i./A of thiamethoxam-containing products per acre per growing season.

11.3.18 Oriental Fruit Moth

• Pesticide Application Notes

[1.0] For best effectiveness and insecticide resistance management, the use of pre-mixes should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.

[14.1] For orchards not receiving regular apple maggot sprays, or where codling moth is otherwise a significant problem, a developmental model predicts the appropriate larval treatment period for CM as 250-360 degree-days (base 50°F) after 1st adult catch for each generation, and approximately 150 DD after this same biofix date for insecticides with ovicidal activity. Refer to the NEWA Apple Insect Models website (newa.cornell.edu/index.php?page=apple-insects) for current information on the occurrence, development and management of these pests in your specific location.

[14.1a] Control of 1st generation oriental fruit moth larvae generally coincides with the petal fall application window. Sprays against the summer generations of oriental fruit moth should be timed to start approximately at the 10% hatch point, 175-200 DD (base 45°F) after the respective first sustained adult catches of the 2nd and 3rd broods, with follow-up applications on a 10–14-day interval. Sprays against oriental fruit moth should generally also provide control of lesser appleworm.

[14.2] Better control of target species is obtained when pheromone disruption begins with the first generation of the season; regardless, products for disruption should be applied before first flight of the generation being targeted. Products directed against oriental fruit moth (Checkmate OFM-F, Isomate OFM TT) are incidentally active against lesser appleworm. Combination products (Checkmate CM-OFM Duel, Isomate-CM/OFM TT) are active against the above species as well as codling moth. The need for re-application depends on residual field life; for Checkmate OFM-F and CM-F, 14-21 days. Insecticide sprays or double the rate of pheromones may be needed in border rows of orchards adjacent to sources of adult immigration or in other high pressure situations.

[14.3] *Asana or *Warrior applied during this period will also provide control of these pests, as will a spray program as noted for apple maggot. Suggested action threshold: Avg. of >5 CM adults/week caught per pheromone trap once 150-360 DD (base 50°F) have accumulated since biofix; see [14.1].

[14.3a] Altacor, Avaunt and Assail applied at this time will also control European apple sawfly; Avaunt will control plum curculio.

[14.3b] Altacor and Intrepid provide only suppression of codling moth.

[14.3c] Use of a non-ionic surfactant is recommended with Assail.

[14.3i] Rimon is limited to 1 application per season.

[14.3k] Do not exceed 0.172 lb a.i./A of thiamethoxam- containing products per acre per growing season.

11.3.19 Oystershell Scale

• Pesticide Application Notes

[25.1] Apply sprays at petal fall and 1st cover. Be aware of Sevin's fruit-thinning effects.

11.3.20 Plum Curculio

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this pest.

• Monitoring & Forecasting

Because the length of plum curculio's immigration and oviposition period is affected by weather patterns after petal fall, spray coverage should be maintained until 308 DD (base 50°F) from petal fall. Refer to the NEWA Apple Insect Models website (newa.cornell.edu/index.php?page=apple-insects) for current information on the occurrence, development and management of this pest in your specific location.

• Pesticide Application Notes

[1.0] For best effectiveness and insecticide resistance management, the use of pre-mixes should be reserved for situations when multiple pest species are present and appropriately matched to the combination of

active ingredients and modes of action contained in the product.

[12.2] Frequent applications (7-10-day intervals) of Surround and maximal coverage (minimum of 100 gal/A) are advised while there is active foliar growth.

[26.2] Petal fall and 1st cover sprays in Western New England; petal fall, 1st and 2nd cover sprays in Eastern New England and problem areas in Western New England.

[26.4a] Actara, Avaunt, Calypso, and Imidan will also control European apple sawfly when applied at this time;

[26.4b] Multiple applications of Actara, *Agri-Flex or Voliam Flexi in pome fruit require applicator to not exceed a total of 0.172 lbs a.i. of thiamethoxam containing products per acre per growing season.

[26.4c] Do not use Sevin within 30 days of full bloom unless fruit thinning is desired.

11.3.21 Redbanded Leafroller

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this pest.

• Pesticide Application Notes

[1.0] For best effectiveness and insecticide resistance management, the use of pre-mixes should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.

[12.1d] Do not use *Lannate on Early McIntosh, Dutchess, or Wealthy varieties.

[14.3i] Rimon is limited to 1 application per season.

[24.1] B.t. materials are most effective against smaller larvae.

[27.1] Sprays effective against adults during 1/2-inch green and larvae at petal fall and 1st cover. 3 applications advised in problem orchards not receiving summer applications of effective insecticides for other pests, starting in early June and at 12- to 14-day intervals to control second brood. Suggested action threshold: 2-3 larvae/tree.

[27.2] Control is obtained from sprays applied at petal fall and 1st cover. 3 applications advised in problem orchards not receiving summer applications of effective insecticides for other pests, starting in early June and at 12- to 14-day intervals to control second brood. Suggested action threshold: 2-3 larvae/tree.

11.3.22 Rosy Apple Aphid

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet and Sampling Guide containing details on the biology and management of this pest.

• Monitoring & Forecasting

Examine fruit clusters at the pink stage for the presence of wingless adults and nymphs. Suggested action threshold: one infested cluster.

• Pesticide Application Notes

[1.0] For best effectiveness and insecticide resistance management, the use of pre-mixes should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.

[12.1d] Do not use *Lannate on Early McIntosh, Dutchess, or Wealthy varieties.

[15.4] Multiple applications of thiamethoxam-containing products in pome fruit require applicator to not exceed a total of 0.172 lbs a.i. per acre per growing season.

[28.2] Research indicates greater effectiveness if control applied no later than pink bud; difficult to control after pink, as most damage has already occurred by this time. Good coverage is required for adequate control. Pyrethroids will provide effective control at pink, but because of their toxicity to predatory mites, they are not recommended unless treatment is also required to control spotted tentiform leafminer and tarnished plant bug at this time. Suggested action threshold: 1 colony/100 fruit clusters.

[28.2a] One spray of Lorsban, even if mixing with oil, or of *Supracide, from green tip to tight cluster.

[28.2b] One spray of Esteem at half-inch green, or one spray of Beleaf from green tip to pink bud.

[28.3a] *Vydate may give some mite suppression when applied at pink. Do not exceed 4 pt *Vydate per acre.

[28.3b] Actara will also control spotted tentiform leafminer, mullein plant bug and tarnished plant bug when applied at pink.

[28.3c] Assail will also control mullein plant bug, spotted tentiform leafminer, 1st generation oriental fruit moth, and will suppress San Jose scale.

[28.4a] Calypso will also control plum curculio.

[28.4b] Movento must be used with a spray adjuvant having spreading and penetrating properties; Movento applied at petal fall to first cover will provide San Jose scale crawler control.

[35.1b] Do not apply more than 2 applications of *Thionex during fruiting period.

11.3.23 San Jose Scale

• Biology & Cultural

Pruning to open up canopy is advised.

Refer to the reference materials list at the end of this publication for a Fact Sheet containing more details on the biology and management of this pest.

• Monitoring & Forecasting

1st generation crawler emergence starts about 3 wk after petal fall (500 DD base 50°F from March 1, or 310 DD after 1st male catch); 2nd in late July-August (1451 DD from March 1, or 400 DD after 1st male catch of the 2nd generation).

• Pesticide Application Notes

[1.0] For best effectiveness and insecticide resistance management, the use of pre-mixes should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.

[15.4] Multiple applications of thiamethoxam-containing products in pome fruit require applicator to not exceed a total of 0.172 lbs a.i. per acre per growing season.

[29.3] Prebloom sprays more effective if applied dilute, at high volume; for severe infestations, follow up with summer applications of appropriate materials. Suggested action threshold: 3-6 encrusted areas/tree.

[29.4] 2 sprays against first and peak (7-10 days later) crawler activity in both generations. Suggested action threshold: 1-2 crawlers/trap (sticky tape around limb).

[29.4a] The addition of horticultural oil will improve performance of Assail.

[29.4b] Movento must be used with a spray adjuvant having spreading and penetrating properties; most effective when used at petal fall to first cover.

11.3.24 Spotted Tentiform Leafminer, Apple Blotch Leafminer

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet and Sampling Guide containing details on the biology and management of this pest.

• Monitoring & Forecasting

Refer to the NEWA Apple Insect Models website (newa.cornell.edu/index.php?page=apple-insects) for current information on the occurrence, development and management of this pest in your specific location.

• Pesticide Application Notes

[1.0] For best effectiveness and insecticide resistance management, the use of pre-mixes should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.

[12.1d] Do not use *Lannate on Early McIntosh, Dutchess, or Wealthy varieties.

[14.3i] Rimon is limited to 1 application per season.

[15.4] Multiple applications of thiamethoxam-containing products in pome fruit require applicator to not exceed a total of 0.172 lbs a.i. per acre per growing season.

[30.1] Suggested prebloom action threshold: 2 or more eggs/fruit cluster leaf; refer to Fig. 7.1.1 for sampling procedure.

[30.1a] Pyrethroids will also control rosy apple aphid and tarnished plant bug at pink.

[30.1b] Do not exceed 14.5 oz of *Asana per acre per treatment; *Asana and *Danitol not registered for apple blotch leafminer.

[30.1d] Actara and Avaunt will also control mullein plant bug and tarnished plant bug, and Actara will control rosy apple aphid, when applied at pink.

[30.1e] Improved activity of Delegate may be obtained by addition of an adjuvant such as horticultural mineral oil.

[30.2] Suggested action threshold: against sap-feeding larvae, if mines exceed 1/leaf, or if eggs exceeded 2/leaf at pink. (Refer to Fig. 7.1.3 for sampling procedure.)

[30.2a] Application at petal fall will also control white apple leafhopper.

[30.2b] *Danitol and *Lannate 90SP not labeled for apple blotch leafminer.

[30.2c] Actara, Avaunt and Calypso will also control plum curculio and European apple sawfly when applied at petal fall.

[30.2d] Altacor and Belt will also control codling moth, oriental fruit moth, and obliquebanded leafroller, and Altacor will additionally control European apple sawfly.

[30.3] Suggested action threshold: if 2nd brood sap-feeding mines exceed 2/leaf on mature terminal leaves. Before first tissue-feeding mines appear, examine 10 mature terminal leaves from each of 5 trees. (Refer to Fig. 7.1.7 for sampling procedure).

[30.3a] For 2nd brood: Do not apply *Vydate within 30 days of bloom.

11.3.25 Spotted Wing Drosophila

•Biology & Cultural

This is an exotic species of vinegar fruit fly, a group normally attracted to damaged and rotting fruit. But in contrast to endemic Drosophila fruit flies, it has a serrated ovipositor and will lay eggs in intact ripening fruit on the tree; it is also a pest of berry fruit crops. Originally known from Japan, it has now been found in NY, as well as in nearby states such as New England, PA, NJ, and MI. Refer to the reference materials list (17.4.2, Other References) at the end of this publication for fact sheets containing details on the biology and management of this species.

• Pesticide Application Notes

[31.2] Apply at first signs of adult activity. If repeated applications are necessary, rotate active ingredients to avoid promoting resistance in local populations.

[31.2a] Delegate labeled for suppression only.

[31.2b] §Entrust use requires the user to have a copy of the appropriate 2(ee) recommendation in their possession at time of use.

11.3.26 Stink Bugs (including Brown Marmorated Stink Bug)

• Biology & Cultural

A number of native stink bug species can sometimes cause fruit damage in all tree fruits under conditions that are not fully understood. Adult feeding during bloom and shuck split can cause the fruit to abort, and feeding later in the summer can cause a deep catfacing injury such as that caused by tarnished plant bug, or depressed, dimpled, corky or water-soaked areas on the skin. All tree fruits are attacked, especially peaches and apples. Other species of stink bugs are predators. Elimination of alternate host broadleaf weeds, especially legumes, in the orchard will contribute to management efforts. If control is needed, insecticides should be timed to kill immigrating adults as they appear in the orchards to prevent feeding damage and subsequent mating and egglaying.

The brown marmorated stink bug is an invasive species from Asia that was first documented in Allentown, PA in 2001. This insect has spread across a number of eastern US States, and now extends to the west coast as well. It was first documented in NY in the Hudson Valley Region in 2008. Although it can be found throughout NY in and around structures and vehicles, extensive monitoring efforts in 2011 and 2012 have resulted in very few detections in agricultural crops; however, reports of sightings have been increasing. Refer to the reference materials list (17.4.2, Other References) at the end of this publication for fact sheets containing details on the biology and management of brown marmorated stink bug.

• Pesticide Application Notes

[1.0] For best effectiveness and insecticide resistance management, the use of pre-mixes should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.

[12.2] Frequent applications (7-10-day intervals) of Surround and maximal coverage (minimum of 100 gal/A) are advised while there is active foliar growth.

[15.4] Multiple applications of thiamethoxam-containing products in pome fruit require applicator to not exceed a total of 0.172 lbs a.i. per acre per growing season.

[32.2a] Apply at first signs of infestation; BMSB are very mobile pests, and may reinfest the treated area quickly. If repeated applications are necessary, rotate active ingredients to avoid promoting resistance in local populations.

[32.2b] This is a FIFRA Section 2(ee) recommendation for BMSB control; the labeling must be in the possession of the user at the time of pesticide application.

[32.2c] Do not make more than 3 applications per year; do not exceed a maximum of 2.0 lbs active ingredient per year.

11.3.27 Tarnished Plant Bug

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this pest.

• Pesticide Application Notes

[1.0] For best effectiveness and insecticide resistance management, the use of pre-mixes should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.

[15.4] Multiple applications of thiamethoxam-containing products in pome fruit require applicator to not exceed a total of 0.172 lbs a.i. per acre per growing season.

[33.1] Suggested action threshold: 2-3 bleeding sites/10-terminal sample.

[33.1a] One spray advised at tight cluster to petal fall if an unusually high prebloom population is present.

[33.1b] A pyrethroid at pink will also control spotted tentiform leafminer and rosy apple aphid. It is recommended that pyrethroids not be used more than 1-2 times/season in any orchard.

[33.1c] Avaunt will also control mullein plant bug and spotted tentiform leafminer.

[33.1d] Actara and Beleaf will control rosy apple aphid, when applied at pink.

11.3.28 Variegated Leafroller, Sparganothis Fruitworm

• Pesticide Application Notes

[1.0] For best effectiveness and insecticide resistance management, the use of pre-mixes should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.

[12.1d] Do not use *Lannate on Early McIntosh, Dutchess, or Wealthy varieties.

[24.1] B.t. materials are most effective against smaller larvae.

[34.1] Occasionally a problem in southern New England; in July if needed. Suggested action threshold: 3 larvae/tree on standard-size tree (27-40 trees/A); 1 larva/tree at density of 140 trees/A (semi-dwarf planting), lower for more closely-spaced plantings.

[34.1a] Bt products and *Leverage not registered for Sparganothis fruitworm.

11.3.29 White Apple Leafhopper, Potato Leafhopper

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this pest.

• Pesticide Application Notes

[1.0] For best effectiveness and insecticide resistance management, the use of pre-mixes should be reserved for situations when multiple pest species are present and appropriately matched to the combination of active ingredients and modes of action contained in the product.

[12.1d] Do not use *Lannate on Early McIntosh, Dutchess, or Wealthy varieties.

[15.4] Multiple applications of thiamethoxam-containing products in pome fruit require applicator to not exceed a total of 0.172 lbs a.i. per acre per growing season.

[35.1] At petal fall or as nymphs appear later in summer. Will also control rose leafhopper. Suggested action threshold: average of 1 nymph/leaf.

[35.1a] Do not use Sevin or *Vydate before 2nd cover unless fruit thinning is desired. Sevin not labeled for potato leafhopper.

[35.1b] Do not apply more than 2 applications of *Thionex during fruiting period.

[35.1c] Actara, Avaunt and Calypso will also control plum curculio and European apple sawfly when applied at petal fall.

11.3.30 Woolly Apple Aphid

• Biology & Cultural

Refer to the reference materials list at the end of this publication for a Fact Sheet containing details on the biology and management of this pest.

• Pesticide Application Notes

[29.4b] Movento must be used with a spray adjuvant having spreading and penetrating properties; most effective when used at petal fall to first cover.

[35.1b] Do not apply more than 2 applications of *Thionex during fruiting period.

[36.1] In July when small colonies appear on periphery of canopy. Repeat applications may be necessary. Suggested action threshold: as nymphs migrate to terminals.

[36.1a] Use of a non-ionic surfactant or horticultural mineral oil is recommended with Assail.

[36.1b] Do not repeat *Diazinon applications closer than 14 days. Slight russeting may occur on some varieties, such as Golden delicious.

[36.2] Chemigation of Admire Pro into root-zone through low-pressure drip, trickle, micro-sprinkler or equivalent equipment.

11.4 Storage Disorders

11.4.1 Storage Rots

• Pesticide Application Notes

[37.1] Postharvest drench treatment of apples for control of storage rots is not recommend except when fruit must also be treated with diphenylamine (DPA) or calcium chloride. Holding tanks in postharvest drenching equipment must have good agitation to keep fungicides in suspension, and solutions must be replenished regularly as directed on the product labels.

Mertect 340F (thiabendazole) is no longer effective in many storages because strains of *Penicillium expansum* have developed resistance to the thiabendazole-plus-DPA combination. Storage operators who have noted decay problems in recent years should either switch to Penbotec or Scholar for their postharvest treatments, or they should use a mixture of Mertect 340F plus the full label rate of captan.

Penbotec and Scholar are fungicides with modes of action that are different from each other and from that of Mertect 340F. Both of these fungicides are very effective against both blue mold (*P. expansum*) and gray mold (*B. cinerea*). Both are compatible with DPA and calcium chloride. Both are recommended for use as the sole fungicide in postharvest drenches (i.e., they do not need to be combined with captan).

To slow selection of pathogens with resistance to Penbotec and Scholar, it is recommended that storage operators alternate use of these products from one year to the next. Much of the inoculum for *P. expansum* recycles from one year to the next on apple bins. By using Penbotec in one season and Scholar the next (or Scholar the first year and Penbotec the next year), spore populations on bins will not be subjected to selection pressure by the same fungicide in successive years.

Some countries that import apples from the US may not accept fruit treated with Penbotec, Scholar, or Captan. For the latest information on maximum residue levels (MRL's) that have been established in various countries, check the following website: mrldatabase.com.

None of the postharvest treatments will control pinpoint scab, latent bitter rot or black rot infections that are present at harvest, or postharvest decays caused by *Alternaria*.

Chlorinated water can also be used to disinfect fruit after harvest. Numerous commercial formulations of calcium hypochlorite and sodium hypochlorite are available with postharvest labels. However, chlorine only kills spores in the treatment solution and on the fruit surface at the time of treatment. It does not provide any residual protection. *Chlorine is **not** compatible with diphenylamine.* Thus, chlorination is most useful for disinfesting flume water on apple packing lines rather than as postharvest treatment prior to storage. Follow directions on the product label for maintaining appropriate levels of chlorine in treatment solutions.

11.4.2 Storage Scald

• Pesticide Application Notes

[38.1] Active ingredient may vary according to manufacturer: use label instructions to check rate required to obtain desired concentration. See Table 11.5.1 for varietal requirements.

Table 11.5.1 Recommended diphenylamine concentrations for varieties in New England subject to scald.

Variety	Diphenylamine (ppm)	Variety	Diphenylamine (ppm)
Baldwin	1000-1500	Idared	1000
Braeburn	1000	Jonagold	1000
Cortland	2000	McIntosh	1000
Delicious	1000-1500	Mutsu	2000
Empire	1000	Rome	1500
Golden Delicious	1000	Stayman	1500

11.4.3 Senescent Breakdown (McIntosh)

• Pesticide Application Notes

[39.1] The addition of calcium chloride to the postharvest scald and storage rot treatment is effective in reducing McIntosh breakdown. Only calcium chloride that meets Food Chemical Codex specifications can be used in postharvest treatment of apples. Calcium treatment will be of little benefit to apples harvested after the projected optimum harvest date. Fruit injury from calcium chloride has been found to be associated with iron in the solution. Coat steel tanks or use plastic tanks and piping to minimize this problem.

11.5 Notes on Scald Control

11.5.1 Materials

All DPA (diphenylamine) formulations are suspensions and become weaker with use. Replenishment with full-strength material does not replace the DPA removed by the apples. Test kits are available to determine concentrations of make-up material. Do not exceed 30 bins or 750 bushels/100 gal of made-up DPA; empty the reservoir tank and start again with fresh material.

Cartons containing apples that have been treated postharvest with DPA and fungicide must be so labeled.

11.5.2 Application Equipment

Bins of apples are sometimes dipped into a tank containing postharvest preservatives, but more often the bins are moved by conveyors, rollers, or truck bed under a cascade of the preservatives. The bins should be moved slowly under the cascade, with 35-40 gal of preservatives being delivered into each bin. The pump should be sized to deliver 35-40 gal of preservatives/bin at the desired rate of bin movement under the cascade. If stacked bins are moved under the cascade, the top bins should receive 35-40 gal and side nozzles should be positioned to deliver additional gallonage to the lower bins, even though drainage holes are provided in the bin floors. Application equipment is commercially available, but operators usually fabricate their applicators to meet the needs of their own operation. Dirty truckloads should be rinsed with clean water before treatment to minimize the accumulation of dirt in the reservoir tank.

11.5.3 Variety Requirements

Materials and concentrations for the major apple varieties in New England are listed in Table 11.5.1. Important: DPA retards chlorophyll loss in Golden Delicious and, therefore, should not be used unless the apples have developed full yellow color at harvest.

The very low susceptibility of Empire to scald indicates that it can be safely stored without any preservative treatment. However, if preservative treatment is demanded, then use 1000 ppm DPA in the drench solution.

11.6 Growth Regulator Use In Apples

11.6.1 Chemical Thinning

Fruit thinning is a management practice that reduces yield in the current season but results in increased fruit size and also increased return bloom and yield in the next season. Large fruit size is best obtained with consistent cropload reductions each year through chemical thinning. The use of growth regulating chemicals to thin apple trees is not an exact science and each grower must weigh and evaluate the many factors that affect chemical thinning response in deciding on a thinning program. Although the recommendations in this section are based on research and experience, growers are cautioned that their success with chemical thinning depends on many factors and they should use these recommendations only as a guide.

11.6.2 Weather Factors That Affect Thinning Response

Frost. Frost before application of thinners can greatly increase the amount of thinning obtained from chemical thinners. Frost at bloom can damage fruitlets and reduce seed set, which can result in increased natural drop and greater chemical thinning response. Frost can also damage spur leaves, resulting in greater chemical uptake and thus greater thinning response. Wherever flowers and leaves have been damaged by frost, extreme caution should be used with chemical thinners. Typically, lower rates would be used in such cases. Surfactants and oil additives should be avoided following a frost and may cause overthinning.

Sunlight Levels before Application. The amount of sunlight for the 3-5 days preceding application of chemical

thinners may have an important effect on chemical uptake and response. Intense cloudy weather before application of thinners can result in increased chemical uptake and thus the potential for greater thinning response, due to greater succulence of the leaves and a thin wax cuticle. In addition, intense cloudy weather results in reduced carbohydrate supply for fruit growth and reduced fruit growth rate. This results in increased natural drop.

Temperature at Time of Application. The uptake of chemical thinners is greater at higher temperatures than at lower temperatures. The optimum is between 70-80°F. Above 80°F, uptake is substantially greater than below 80°F. The time of day applications are made appears to be unimportant. Applications made in the morning or evening when it is cool have a longer drying time on the leaf, resulting in a slow but sustained uptake of chemical, while at higher temperatures during mid-day, drying times are shorter, resulting in a short but rapid uptake of chemical. Thus, the total amount of chemical taken into the plant appears to be very similar regardless of the time of day. Recent research results also indicate that similar thinning is achieved regardless of the time of day applications are made.

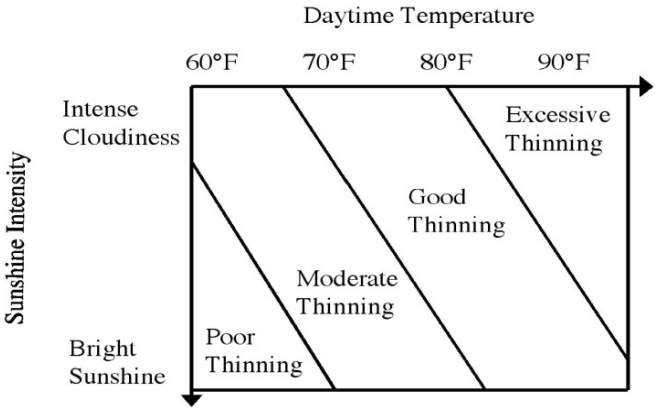

Figure 11.6.1. The interaction of temperature and sunlight intensity on thinner action.

Weather After Application. Temperature and sunlight levels for the 5-day period after application of thinners are the predominant weather factors affecting chemical thinning response. The interaction of temperature and sunlight affect the production and demand for carbohydrates within the tree. Warmer temperatures increase carbohydrate production (photosynthesis) up to about 80F but higher temperatures reduce photosynthesis. The demand for carbohydrate to support fruit growth and shoot growth increases linearly with increasing temperature. Increasing sunlight level increases photosynthesis. The combined effects of sunlight and temperature on chemical thinning are complex but a simplification is presented in Fig. 11.6.1. A more sophisticated estimate of the effects of light intensity and temperature on thinning is given by the Cornell Carbohdyrate thinning model available on the web at www.newa.cornell.edu

Night temperatures are also an important factor to consider. Warm night temperatures greater than 60°F give greater thinning response. With high night temperatures, fruits use up the carbohydrates that were produced during the day at a fast rate, resulting in a deficit of resources for fruit growth and causing the weakest fruits to drop. The greatest thinning can result if warm night temperatures are combined with intense cloudy/warm daytime weather. Under these conditions, the tree produces little reserves during the day and at night the fruits use up all of the reserves produced during the day, making the fruits very susceptible to the stress caused by chemical thinners. Under these conditions, excessive fruit drop can result. The least effective thinning is achieved when bright, warm daytime weather is accompanied by low night temperatures. Under these conditions, the tree produces large amounts of carbohydrates during the day and the fruits use them up at a slow rate during the night. With a large surplus of carbohydrates there is little stress created by chemical thinners and the thinning response is poor. At the time of application of thinnes, growers should critically examine the weather forecast for the upcoming 3-7-day period and adjust rates up or down 50% based on forecasted temperatures and sunlight levels. The Cornell Apple Carbohydrate Thinning Model available on the web at www.newa.cornell.edu is a simple tool that calculates the combined effects of forecasted temperature and sunlight for the upcoming 5 day period on tree carbohydrate balance and recommends an adjustement in thinning rates based on the carbohydrate balance.

11.6.3 Tree Factors That Affect Thinning Response

Pollination. Poor cross-pollination results in low viable seed number per fruit, greater post-bloom fruit drop and greater sensitivity to chemical thinners. In contrast, high seed numbers per fruit result in more difficult-to-thin conditions. In general, if seed numbers are less than 5, thinning rates should be reduced.

Initial Cropload (Fruit Set). A high initial cropload usually results in a relatively high final cropload, regardless of chemical thinning program. Therefore, to achieve a given cropload each year, the initial cropload must be considered when determining the aggressiveness of the thinning program. Growers should use a more aggressive thinning program when initial fruit set is high and a less aggressive thinning program when initial fruit set is lower.

Fruit Size at Time of Application. Fruitlets are more sensitive to NAA and BA at 10-12mm fruit diameter than at smaller or larger sizes. In warm years, when fruit growth rate is rapid, chemical thinners should be applied slightly before fruits reach 10 mm diameter (8-10 mm). In cool years, when fruit growth rate is slow, the application of chemical thinners should be delayed until fruits are 12-15 mm in diameter. Growers should attempt to time chemical

thinner application according to a suitable weather window within the preferred fruit size range.

Sensitivity of the Tree. The internal physiological status of the tree determines its sensitivity to chemical thinners. Growers should use a less aggressive thinning program under conditions when tree carbohydrate supply for the fruitlets is expected to be low, and a more aggressive thinning program when tree carbohydrate supply is expected to be high. The carbohydrate supply available to the fruitlets is a function of temperature and sunlight which affect photosynthesis (supply) and respiration (demand) of fruits and vegetative organs. The carbohydrate supply at the time of thinning is difficult to estimate without the aid of a computer model (developed by Alan Lakso) to calculate carbohydrate supply and demand. This model has been modified into a simple and useful chemical thinning tool for use by growers and consultants in estimating the sensitivity of the tree to chemical thinners. It is available on the web at www.newa.cornell.edu . In addition the sensitivity of a tree is increased by: 1) heavy croploads the previous year. 2) cloudy weather prior to and after application of chemical thinners. 3) heavy insect and disease damage to foliage during the previous season. 4) severe winter temperatures that damage vascular tissues necessary for the transport of reserves from the root to the top in the spring. 5) warm temperatures in late winter and early spring (Feb. 15-April 15), which cause the tree to use its carbohydrate reserves before bloom.

11.6.4 Chemicals Registered for Thinning in New England

Naphthaleneacetic acid (NAA) is an auxin-type growth regulator that induces fruit thinning at rates from 2.5-15 ppm depending on variety. NAA has some thinning activity from full bloom until fruits are 20 mm in diameter, with the optimum thinning activity when fruit diameter is between 10-12mm fruit size. It is sold as a sodium salt (Fruitone-N and Fruitone-L, PoMaxa). The two formulations give very similar thinning responses if used at the same rate of NAA. NAA stimulates ethylene production in the tree and at high concentrations also inhibits photosynthesis and fruit growth rate for a period of 7-10 days after application. The inhibition of fruit growth rate results in abscission of the weaker fruit on the tree. At early timings such as full bloom or petal fall, there appears to be little negative impact on fruit growth rate from NAA, which results in more modest thinning than at later timings (10-12mm). In some years and with some varieties like Empire, the temporary inhibition of fruit growth caused by NAA results in little gain in final fruit size at harvest. This negative side effect is most common if NAA is applied at rates greater than 10 ppm and at fruit sizes larger than 8 mm. High rates of NAA should be avoided on small fruited varieties. High rates of NAA may also cause pygmy fruit with Delicious and Fuji.

Naphthaleneacetamide (NAD or NAAm) is an amide form of NAA but has much lower activity than NAA. As a consequence, it is a mild but safe thinner that is used at rates from 25-50 ppm. Late timings result in pygmy fruit with Delicious, and are ineffective with other varieties. It is often used at petal fall on early ripening varieties and on certain hard-to-thin varieties such as Macoun.

6-Benzyl Adenine (BA) is a cytokinin-type growth regulator that induces fruit thinning at rates from 35-150 ppm. BA can be used from petal fall to 20 mm fruit size, but the thinning response is poor at either end of that window. The best response is when fruits are 10-12 mm in diameter. It is most effective when temperatures are warm (>70°F) for a 3-5-day period after application. It is sold in three formulations as either Maxcel (1.9% BA), or RiteWay (1.9% BA) or Exilis Plus (2.0% BA). The primary advantage of BA is that it results in larger fruit size than with other thinners due to a stimulation of cell division. The primary disadvantage of BA is that it often does not thin adequately by itself. However, when combined with Carbaryl it has performed satisfactorily. In some cases, the use of BA alone has resulted in significant fruit size improvement even though there was little thinning.

Carbaryl is a carbamate insecticide that also has moderate thinning action. It is relatively safe and has the added advantage of having good insecticidal properties on leafhoppers and plum curculio. It is relatively rate-insensitive, with similar thinning response from 0.25 lb up to 1.0 lb A.I./100 gallons. One of its best features is that it selectively removes the weaker fruits within the cluster, leaving predominantly one fruit per cluster. Carbaryl has been shown to enhance the effectiveness of NAA or BA when used in a tank mix. Currently it is most commonly used in combination with NAA or BA. Recent research indicates that the major mite predator mite in N.Y. (*Typhlodromus pyri*) has developed resistance to carbaryl. Thus, Carbaryl can be used in N.Y. without disrupting biological mite control programs. Carbaryl is very toxic to bees and the wettable powder particles of Carbaryl, which are similar in size to pollen grains, can be picked up by bees and carried back to the hive. The liquid formulations of carbaryl are not picked up as easily by bees, so their use is much safer. The liquid formulations have made it possible to apply Carbaryl at a wide range of timings from petal fall to 20 mm fruit size. The liquid formulations of carbaryl have significant amounts of added surfactants and thus have greater thinning activity than the wettable powder formulations. Under cloudy, rainy weather conditions, the liquid formulations may cause fruit skin damage, especially when foliar nutrients or captan are included in the thinning spray. With cloudy, rainy weather, we recommend the wettable powder formulations. With bright sunshine, we recommend the liquid formulations. The wettable powder formulation is also recommended following a frost since the surfactants included in the liquid formulation can cause significantly greater uptake of Carbaryl and overthinning.

***Vydate** is a broad spectrum carbamate insecticide that also has moderate thinning activity. It is similar to carbaryl in

thinning action and is used from 0.25 to 1.0 lb A.I./100 gallons. It is not commonly used in N.Y. for thinning since it is reported to be more toxic to predator mites. However, in pest control programs that do not attempt to conserve predatory mites, *Vydate can be useful as both a thinning agent and a broad spectrum insecticide. Like carbaryl, it is usually combined with NAA and BA for greater thinning.

Ethephon (Ethrel) is a growth regulator that stimulates ethylene production by the plant. It can be used to thin apple trees from full bloom to 20 mm fruit size. Its thinning action is highly affected by temperature and if temperatures in the 3-5 days after application rise above 80F it can give excessive thinning. In some cases it has defruited the trees. Nevertheless, it does have the advantage that it will thin large fruit (up to 20 mm). Ethrel also has a significant positive effect on return bloom in addition to the thinning effect. Ethrel can also be used as a return bloom enhancer after the thinning period is over. For this use, it is applied at low rates after the window for thinning has passed (usually 4-6 weeks after full bloom).

11.6.5 Chemicals Not Registered for Thinning that Influence Cropload

Lime sulfur is a foliar fungicide that, if used during bloom or during the early post-bloom period at rates of 2.5-3 gal/100 gal, will cause significant thinning. Lime sulfur in combination with oil or fish oil is used increasingly in organic apple production systems. Growers who use lime sulfur should account for the thinning action of this material when they develop their thinning programs.

Ammonium Thiosulfate (ATS) is a foliar nitrogen fertilizer that, if used during bloom at rates of 2-4 gal/100 gal, will cause significant thinning. Growers who use ATS should account for the thinning action of this material when they develop their thinning programs.

Oil or Fish oil are foliar insecticides that also significantly enhance chemical thinner response. Combinations of lime sulfur and oil (2%) or carbaryl and oil (0.25%) or BA and carbaryl and oil (0.25%) give greater thinning than either product alone. The use of oils near or with thinners should be considered with caution. They should only be used when leaf tissue is healthy and non-damaged. Oils with thinners should not be combined with Captan fungicide. The oils cause increase uptake of Captan which is toxic to the plant. The use of oils near or with chemical thinners should be avoided before or after a frost since the oil acts as a penetrant and can significantly increase chemical uptake and thinning response.

11.6.6 Spray Timings

Chemical thinning can be done at various times depending on the chemical used, beginning with full bloom and ending when fruits have reached 20 mm in diameter. The following four timing windows during the growing season should be considered when applying thinners.

50-80% Bloom. Bloom thinning can be done with caustic thinning chemicals such as ATS or with hormone-type thinners such as NAA. The timing window with caustic thinners is very narrow (1-2 days) since the goal is to allow the king bloom to be pollinated and then apply the chemical to prevent further pollination of other flowers. Thinning response with the caustic blossom thinners is not weather-dependent, but fruit skin injury can occur with high rates and slow drying conditions. Often a second application is needed 1-2 days after the first application. We suggest timings of 30% bloom for the first spray and 80% bloom for the second spray. Use of NAA at full bloom generally gives a moderate thinning response and is quite safe Bloom thinning is increasingly seen as necessary for biennial bearing varieties like Honeycrisp and for hard to thin varieties like Gala.

Petal Fall (1 week after full bloom). Thinning at petal fall has the advantage of allowing some assessment of pollination before making the decision about aggressiveness of thinning. As with bloom thinning, the objective is to remove a portion of the crop before competition between fruits reduces fruit size. In addition, after petals have fallen and bee hives have been removed from the orchard, Carbaryl can be used as a thinner. Thinning response with NAA, Carbaryl or BA at petal fall is usually moderate, thus the petal fall timing can be viewed as safe. Petal fall sprays alone are unlikely to provide adequately thinning in most years. Petal fall sprays are usually used as part of a multi-spray program, which allows a portion of the crop to be removed at petal fall and the balance of the thinning to be done 7-10 days later at 10-12 mm fruit diameter. Research trials indicate that the best timing for the petal fall spray is about 2-4 days after petal fall when king fruit diameter is about 5-6mm.

8-14 mm fruit size (2-3 weeks after full bloom). The traditional time to apply chemical thinners (hormone-type thinners) is when king fruits are 10 mm in diameter. By that time, growers can accurately assess fruit set. Growers should apply chemical thinners anytime when king fruits are between 10 and 14 mm when there is a satisfactory weather window as outlined above. When king fruit diameter exceeds 15 mm, the effectiveness of NAA and BA declines rapidly. The major disadvantages of waiting until the 10 mm timing is that this limits growers to only one opportunity to reduce cropload, and if poor weather conditions result in poor thinning, then expensive hand thinning will be required. A more successful approach is to use a multiple spray thinning program of which the 10mm spray is key spray.

15-20 mm fruit size (3-4 weeks after full bloom). Thinning when fruits are larger than 15 mm should only be done on an emergency or rescue basis when earlier attempts to reduce cropload have failed. Ethrel with oil, Carbaryl

with oil or BA plus Carbaryl plus oil as an adjuvant can be used for this purpose.

4-7 weeks after full bloom. With some varieties that are strongly biennial in their cropping pattern, an additional 3-4 weekly chemical sprays are useful to enhance repeat bloom the following year without causing additional thinning. This is done once fruitlets have exceeded 20 mm in diameter, when they are less susceptible to chemical thinners. Low doses of Ethephon (Ethrel) or NAA have a positive effect on repeat bloom without causing additional thinning when applied weekly between 4-7 weeks after bloom. This treatment is particularly useful on large-fruited varieties that are biennial. We suggest that NAA be used for varieties ripening in late August or early September while either NAA or Ethrel can be used for varieties ripening in late September or October.

11.6.7 Suggested Strategies for New England Growers

The myriad of possible combinations of chemicals, timings, rates and varieties provides a great number of possible thinning programs for growers. We suggest three basic thinning programs for NE growers:

1. **Single application at 10-14 mm fruit size.** For easy-to-thin varieties like McIntosh, Cortland, Gingergold, Mutsu, Idared and Granny Smith, a single application at the 10-14 mm fruit stage produces reliable results. Our suggested approach is to use Carbaryl at 0.5lb AI/100 and then add either NAA or BA at a rate that fits the variety, fruit set and environmental conditions. See Table 11.6.2 for specific variety recommendations.
2. **Multiple spray applications.** For hard-to-thin varieties like Empire, Gala, Jonamac, Macoun, Spur Delicious, Golden Delicious, Spur Rome, Fuji etc., we recommend multiple applications. With two, three or four opportunities to thin the trees, risks associated with over or under thinning are reduced. For very difficult to thin varieties we suggest growers begin with a Bloom Spray, followed by a Petal Fall Spray and then followed with a third spray at the 10-14 mm stage. A fourth spray, if needed, could be applied at the 15-20 mm stage. For moderately hard to thin varieties we suggest growers begin with a Petal Fall Spray followed by a second spray at the 10-14mm stage. A third spray if needed could be applied at the 15-20mm stage. See Table 11.6.2 for specific recommendations.
3. **Repeat bloom enhancer.** Regardless of the thinning program used, biennial bearing varieties should receive additional sprays of either NAA or Ethrel about 4-7 weeks after bloom to enhance repeat bloom. This program is useful for easy-to-thin biennial triploid varieties such as Jonagold and Mutsu and it is also useful for hard-to-thin, strongly biennial varieties such as Honeycrisp, Fuji and Golden Delicious. We suggest applying 4 weekly sprays of low doses of Ethrel or NAA about 4-7 weeks after bloom. See Table 11.6.2 for specific recommendations.

11.6.8 Summary

- The time of day when thinning applications are made has little effect on thinning response, thus, growers should not be too concerned about the temperature at time of application.
- Dark, cloudy weather for 2 or more days after application of thinners will increase thinning response; therefore, growers should reduce the rate of thinner if intense cloudy weather preceeds or follows application.
- High night temperatures (>60°F) and high day temperatures (>85°F) after application of thinners will increase thinning response; thus, growers should critically examine the weather forecast for the 3-5-day period following application of thinners to adjust rates of chemicals used based on forecasted night and daytime temperatures and sunlight levels. The Cornell Apple Carbohydrate thinning model which is availale in an easy to use tool on the web at www.newa.cornell.edu gives an estimate of the combined effects of temperature and sunlight on thinning efficacy.
- Optimum application timing of chemical thinners is when fruit size is 10-11 mm in warm years and 12-15 mm in cool years.
- Growers should attempt to time chemical thinner applications according to a suitable weather window within the desired fruit size range.
- High rates of NAA reduce fruit growth rate and should be avoided on small-fruited varieties such as Empire, Jonamac and Gala.
- BA alone is a mild thinner and should always be used in combination with carbaryl when thinning is desired.
- Return bloom can be enhanced by late June and early July applications of low doses of Ethrel or NAA.
- To reduce the risk of over thinning or under thinning, a multiple spray program should be employed on hard-to-thin varieties.

Table 11.6.1. Chemicals registered for use in apple thinning in New England.

Timing	Chemical	Commercial Product Name	Typical rates of formulated product/100 gallons based on a full TRV gallonage per acre	Max. rate of formulated product/acre
Bloom	Ammonium Thiosulfate	ATS (foliar nutrient)	2-4 gal	—
	Naphthaleneacetic Acid-Sodium	Fruitone-N, Fruitone-L	2-4 oz (5-10ppm)	24 oz

Table 11.6.1. Chemicals registered for use in apple thinning in New England.

Timing	Chemical	Commercial Product Name	Typical rates of formulated product/100 gallons based on a full TRV gallonage per acre	Max. rate of formulated product/acre
Petal Fall	Naphthaleneacetamide	Amid-Thin W	4-8 oz (25-50ppm)	2 lb
	Naphthaleneacetic Acid-Sodium	Fruitone-N, Fruitone-L, PoMaxa	2-4 oz (5-10ppm)	16 oz
	Carbaryl	Sevin XLR Plus, Sevin 4F	0.5-1.5 pt	6 pt
	Carbaryl	Sevin 80S	0.3-0.9 lb	3.6 lb
	Benzyl Adenine	Maxcel, Exilis Plus, RiteWay	32-64 fl oz (50-100ppm)	308 fl oz
8-13mm Fruit Size	Benzyl Adenine	Maxcel, Exilis Plus, RiteWay	32-64 fl oz (50-100ppm)	308 fl oz
	Naphthaleneacetic Acid-Sodium	Fruitone-N, Fruitone-L, PoMaxa	2-6 oz (5-15ppm)	24 oz
	Carbaryl	Sevin XLR Plus, Sevin 4F	0.5-1.5 pt	6 pt
	Carbaryl	Sevin 80S	0.3-0.9 lb	3.6 lb
15-20mm Fruit Size	Ethephon	Ethrel	1-1.5 pt (300-450ppm)	6 pt
	Carbaryl	Sevin XLR Plus Sevin 4F	0.5-1.5 pt	6 pt
	Carbaryl	Sevin 80S	0.3-0.9 lb	3.6 lb

*Tree Row Volume Gallonage (TRV) = (Tree Height X Tree Width X 43,560 X 0.7) / (Between Row Spacing X1,000).

Table 11.6.2. Recommendations for thinning specific apple varieties in New England.

The chemicals and rates suggested in this table are the "best suggestion" of the authors for mature trees with a heavy fruit set and "normal" fruit thinning weather. Our rates should be adjusted up or down by 50% depending on weather conditions, pollination, fruit set and tree sensitivity. Other chemicals, rates, timings and combinations may also work.

	APPLICATION TIMING			
	30-80% Full Bloom	**Petal Fall 5-6mm (1 week after bloom)**	**8-14 mm fruit size (2-3 weeks after bloom)**	**Return Bloom Enhancer (4-7 weeks after bloom)**
VARIETY	*Rates are per 100 gallons based on a full dilute TRV application**			
Ben Davis			3 oz Fruitone** plus 1 pt Sevin	
Cameo		2 oz Fruitone plus 1 pt Sevin	3 oz Fruitone plus 1 pt Sevin	0.5 pt Ethrel (4 weekly sprays) **OR** 3 oz Fruitone (4 weekly sprays)
Cortland			2 oz Fruitone	
Delicious (Spur Type)	2 gal ATS	2 oz Fruitone plus 1 pt Sevin	64 oz 6-BA plus 1 pt Sevin plus 1 qt Ultrafine spray oil **OR** 3 oz Fruitone plus 1 pt Sevin	0.5 pt Ethrel (4 weekly sprays) **OR** 3 oz Fruitone (4 weekly sprays
Delicious (Non-Spur Type)		1 pt Sevin	48 oz 6-BA plus 1 pt Sevin **OR** 2 oz Fruitone plus 1 pt Sevin	
Early McIntosh		5.5 oz Amide Thin plus 1 pt Sevin		

Table 11.6.2. Recommendations for thinning specific apple varieties in New England.

The chemicals and rates suggested in this table are the "best suggestion" of the authors for mature trees with a heavy fruit set and "normal" fruit thinning weather. Our rates should be adjusted up or down by 50% depending on weather conditions, pollination, fruit set and tree sensitivity. Other chemicals, rates, timings and combinations may also work.

	APPLICATION TIMING			
	30-80% Full Bloom	**Petal Fall 5-6mm (1 week after bloom)**	**8-14 mm fruit size (2-3 weeks after bloom)**	**Return Bloom Enhancer (4-7 weeks after bloom)**
VARIETY	*Rates are per 100 gallons based on a full dilute TRV application**			
Empire		2 oz Fruitone plus 1 pt Sevin	64 oz 6-BA plus 1 pt Sevin **OR** 3 oz Fruitone plus 1 pt Sevin	
Fortune		2 oz Fruitone plus 1 pt Sevin	3 oz Fruitone plus 1 pt Sevin	0.5 pt Ethrel (4 weekly sprays) **OR** 3 oz Fruitone (4 weekly sprays)
Fuji	2 gal ATS	64 oz 6-BA plus 1 pt Sevin	64 oz 6-BA plus 1 pt Sevin	0.5 pt Ethrel (4 weekly sprays) **OR** 3 oz Fruitone (4 weekly sprays)
Gala	2 gal ATS	3 oz Fruitone plus 1 pt Sevin	64 oz 6-BA plus 1 pt Sevin	
Gingergold			2 oz Fruitone plus 1 pt Sevin	
Golden Delicious (without use of Provide)		3 oz Fruitone plus 1 pt Sevin	64 oz 6-BA plus 1 pt Sevin **OR** 6 oz Fruitone plus 1 pt Sevin	0.5 pt Ethrel (4 weekly sprays) **OR** 2 oz Fruitone (4 weekly sprays)
Golden Delicious (with use of Provide)		3 oz Fruitone plus 1 pt Sevin	48 oz 6-BA plus 1 pt Sevin **OR** 4 oz Fruitone plus 1 pt Sevin	0.5 pt Ethrel (4 weekly sprays) **OR** 2 oz Fruitone (4 weekly sprays)
Granny Smith			2 oz Fruitone plus 1 pt Sevin	
Honeycrisp	2 gal ATS	4 oz Fruitone plus 1 pt Sevin	3 oz Fruitone plus 1 pt Sevin	3 oz Fruitone (4 weekly sprays)
Idared			2 oz Fruitone plus 1 pt Sevin	
Jerseymac		2 oz Fruitone plus 1 pt Sevin	3 oz Fruitone plus 1 pt Sevin	
Jonagold			3 oz Fruitone plus 1 pt Sevin	0.5 pt Ethrel (4 weekly sprays) **OR** 2 oz Fruitone (4 weekly sprays)
Jonamac	2 gal ATS	3 oz Fruitone plus 1 pt Sevin	64 oz 6-BA plus 1 pt Sevin **OR** 3 oz Fruitone plus 1 pt Sevin	
Jonathan			2 oz Fruitone plus 1 pt Sevin	
Lady Apples		3 oz Fruitone plus 1 pt Sevin	4 oz Fruitone plus 1 pt Sevin	

Table 11.6.2. Recommendations for thinning specific apple varieties in New England.

The chemicals and rates suggested in this table are the "best suggestion" of the authors for mature trees with a heavy fruit set and "normal" fruit thinning weather. Our rates should be adjusted up or down by 50% depending on weather conditions, pollination, fruit set and tree sensitivity. Other chemicals, rates, timings and combinations may also work.

	APPLICATION TIMING			
	30-80% Full Bloom	**Petal Fall 5-6mm (1 week after bloom)**	**8-14 mm fruit size (2-3 weeks after bloom)**	**Return Bloom Enhancer (4-7 weeks after bloom)**
VARIETY	*Rates are per 100 gallons based on a full dilute TRV application**			
Liberty		3 oz Fruitone plus 1 pt Sevin	64 oz 6-BA plus 1 pt Sevin **OR** 3 oz Fruitone Plus 1 pt Sevin	
Lodi		5.5 oz Amide Thin plus 1 pt Sevin		
Macoun	2 gal ATS	3 oz Fruitone plus 1 pt Sevin	64 oz 6-BA plus 1 pt Sevin **OR** 4 oz Fruitone plus 1 pt Sevin	3 oz Fruitone (4 weekly sprays)
Milton			2 oz Fruitone plus 1 pt Sevin	
McIntosh (Non-Spur Type)			2 oz Fruitone or PoMaxa plus 1 pt Sevin **OR** 36 oz 6-BA plus 1 pt Sevin	
McIntosh (Spur Type)			3 oz Fruitone or PoMaxa plus 1 pt Sevin **OR** 48 oz 6-BA plus 1 pt Sevin	
Mutsu (Crispin)			2 oz Fruitone or Pomaxa plus 1 pt Sevin	0.5 pt Ethrel (4 weekly sprays) **OR** 3 oz Fruitone (4 weekly sprays)
Northern Spy		3 oz Fruitone plus 1 pt Sevin	2 oz Fruitone plus 1 pt Sevin	0.5 pt Ethrel (4 weekly sprays) **OR** 3 oz Fruitone (4 weekly sprays)
Autumn Crisp		2 oz Fruitone plus 1 pt Sevin	64 oz 6-BA plus 1 pt Sevin **OR** 3 oz Fruitone plus 1 pt Sevin	
Paulared		3 oz Fruitone plus 1 pt Sevin	3 oz Fruitone plus 1 pt Sevin	
Quinte		5.5 oz Amide Thin plus 1 pt Sevin		
R.I. Greening			3 oz Fruitone plus 1 pt Sevin	
Rome Beauty (Non Spur)			2 oz Fruitone plus 1 pt Sevin	

Table 11.6.2. Recommendations for thinning specific apple varieties in New England.

The chemicals and rates suggested in this table are the "best suggestion" of the authors for mature trees with a heavy fruit set and "normal" fruit thinning weather. Our rates should be adjusted up or down by 50% depending on weather conditions, pollination, fruit set and tree sensitivity. Other chemicals, rates, timings and combinations may also work.

	APPLICATION TIMING			
	30-80% Full Bloom	**Petal Fall 5-6mm (1 week after bloom)**	**8-14 mm fruit size (2-3 weeks after bloom)**	**Return Bloom Enhancer (4-7 weeks after bloom)**
VARIETY	*Rates are per 100 gallons based on a full dilute TRV application**			
Rome Beauty (Spur)		2 oz Fruitone plus 1 pt Sevin	3 oz Fruitone plus 1 pt Sevin **OR** 64 oz 6-BA plus 1 pt Sevin	
Spartan and Acey Mac		3 oz Fruitone plus 1 pt Sevin	64 oz 6-BA plus 1 pt Sevin **OR** 3 oz Fruitone plus 1 pt Sevin	
Stayman			2 oz Fruitone plus 1 pt Sevin	
Sweetango (with Provide)			2 oz Fruitone plus 1 pt Sev	
Tydeman			2 oz Fruitone plus 1 pt Sevin	
Vista Bella			2 oz Fruitone plus 1 pt Sevin	
Wealthy			3 oz Fruitone plus 1 pt Sevin	
Yellow Newtown			3 oz Fruitone plus 1 pt Sevin	
Yellow Transparent		5.5 oz AmideThin plus 1 pt Sevin		

* All rates are amounts per 100 gal assuming a full dilute tree row volume (TRV) spray. Rate per acre = amount/hundred gallons X hundreds of gallons per acre TRV dilute. Tree Row Volume dilute gallonage (TRV)= (Tree Height X Tree Width X 43560 X 0.7) / (Between Row Spacing X1000). The rate per acre may safely be concentrated 3X.

** Fruitone is sold either as the traditional powder (Fruitone-N) or as the new liquid (Fruitone-L). The recommended rates are the same in either fluid ounces or lb ounces.

Table 11.6.3. Conversion of ppm Maxcel or RiteWay BA thinners to fluid ounces for various TRV gallonages.

Dilute Gallonage per Acre	**PPM Maxcel**					
	25	**50**	**75**	**100**	**125**	**150**
	Fluid ounces per acre*					
50	8	16	24	32	40	48
100	16	32	48	64	80	96
150	24	48	72	96	120	144
200	32	64	96	128	160	192
250	40	80	120	160	200	240
300	48	96	144	192	240	288
350	56	112	168	224	280	
400	64	128	192	256		

*To convert fluid ounces to milliliters, multiply fluid ounces by 29.57.

Table 11.6.4. Conversion of ppm Exilis Plus to fluid ounces for various TRV gallonages.

Dilute Gallonage per Acre	PPM Exilis					
	25	50	75	100	125	150
	*Fluid ounces per acre**					
50	7.5	15	22.5	30	37.5	45
100	15	30	45	60	75	90
150	22.5	45	67.5	90	112.5	135
200	30	60	90	120	150	180
250	37.5	75	112.5	150	187.5	225
300	45	90	135	180	225	270
350	52.5	105	157.5	210	262.5	
400	60	150	180	240		

*To convert fluid ounces to milliliters, multiply fluid ounces by 29.57.

Table 11.6.5. Conversion of ppm Fruitone N to ounces (lb.) or Fruitone-L or PoMaxa to fluid ounces for various dilute TRV gallonages.

Dilute Gallonage per Acre	PPM Fruittone N or Fruitone-L, PoMaxa				
	2.5	5	7.5	10	12.5
	*Ounces (lb.) per acre for Fruitone-N or fluid ounces for Fruitone-L**				
50	0.5	1	1.5	2	2.5
100	1	2	3	4	5
150	1.5	3	4.5	6	7.5
200	2	4	6	8	10
250	2.5	5	7.5	10	12.5
300	3	6	9	12	15
350	3.5	7	10.5	14	17.5
400	4	8	12	16	20

*To convert ounces (lb) to grams, multiply fluid ounces by 28.3. To convert fluid ounces to milliliters, multiply fluid ounces by 29.57.

Table 11.6.6. Conversion of ppm of Amide-Thin W to ounces (lb.) for various dilute TRV gallonages.

Dilute Gallonage per Acre	PPM Amide-Thin W				
	10	20	30	40	50
	*Ounces (lb.) per acre**				
50	0.8	1.6	2.4	3.2	4
100	1.6	3.2	4.8	6.4	8
150	2.4	4.8	7.2	9.6	12
200	3.2	6.4	9.6	12.8	16
250	4	8	12	16	20
300	4.8	9.6	14.4	19.2	24
350	5.6	11.2	16.8	22.4	28
400	6.4	12.8	19.2	25.6	32

* To convert ounces (lb) to grams multiply, ounces by 28.3.

Table 11.6.7. Conversion of ppm of Ethrel to fluid ounces for various dilute TRV gallonages.

Dilute Gallonage per Acre	PPM Ethrel			
	150	300	450	600
	Fluid ounces per acre*			
50	4	8	12	16
100	8	16	24	32
150	12	24	36	48
200	16	32	48	64
250	20	40	60	80
300	24	48	72	96
350	28	56	84	112
400	32	64	96	128

*To convert fluid ounces to milliliters, multiply fluid ounces by 29.57.

Table 11.6.8. Conversion of lb. a.i. of Sevin XLR Plus or Sevin 4F to fluid ounces for various dilute TRV gallonages.

Dilute Gallonage per Acre	lb. ai. of Sevin XLR Plus or Sevin 4F			
	0.25	0.5	0.75	1.0
	*Fluid ounces per acre**			
50	4	8	12	16
100	8	16	24	32
150	12	24	36	48
200	16	32	48	64
250	20	40	60	80
300	24	48	72	96
350	28	56	84	112
400	32	64	96	128

*To convert fluid ounces to milliliters, multiply fluid ounces by 29.57.

11.7 Other Growth Regulator Uses In Apples

In addition to their use in chemical thinning, growth regulating chemicals are also used in apple production to modify tree growth and fruit development. Since growth regulating chemicals affect plant metabolism, good spray coverage and good uptake of the chemical are essential for proper response.

11.7.1 Growth Regulator Chemicals Registered in New England

BA/GA (Promalin, Perlan or Typy) are growth regulators containing a combination of equal parts of benzyl adenine (a cytokinin) and GA 4+7 (gibberellins). They are used to stimulate growth of fruits and/or lateral branches. Their primary effect on fruit growth is to increase the length:diameter ratio (typiness) of the fruit. Their primary use is with Delicious and Gala, where typiness can be an important marketing advantage. They have their best effect on typiness in a narrow timing window when king blooms are open. At later timings and at high rates, they can cause fruit thinning. The best response is obtained when temperatures are warm (>70°F) and the spray is applied as a fine mist in 50-100 gallons of water.

BA+GA is also used to induce lateral branching of nursery trees and young orchard trees, but at rates of 5-10 times those used to increase typiness. Applications are made on nursery trees when the tree is 28-48" high (mid-June through late July), while on young trees planted in the orchard trees, applications are made earlier, when shoots are ½ inch long (near half inch green). BA+GA can also be applied at bud break by painting or spraying it on the swollen buds.

GA 4+7 (Provide, Novagib, TypRus) are commercial formulations of gibberellins A4+7. They are used on apples to reduce fruit russeting. Russeting is associated with high humidity early in the season, frost and certain strains of yeast. Certain fungicides such as captan and Polyram reduce russeting by controlling these strains of yeast, but it GA 4+7 reduces russeting by stimulating cell division on skin surface to allow sufficient wax production to prevent cracks in the was layer. We recommend three-four sprays of GA 4+7 beginning at petal fall and continued every 7-10

days. The most susceptible varieties to russeting are: Golden Delicious, Fuji, Rome, Cortland, Idared, Crispin Jonagold and Sweetango. The use of a 4 spray program of GA 4+7 can induce some thinning. We recommend a lower rate of chemical thinners when GA 4+7 is used for russet control (see Table 11.6.2 for specific variety recommendations). The use of GA 4+7 may interact with the use of other growth regulators such as Apogee, since GA 4+7 is a gibberellin and Apogee inhibits synthesis of gibberelins.

Ethephon (Ethrel) is a growth regulator that stimulates ethylene production by the plant. It can be used to thin apples and improve flower bud development when used within a few weeks of bloom, and to improve fruit color and advance fruit maturation when used near harvest. Its use near harvest significantly reduces fruit storage life and shelf life, and can cause excessive fruit drop if fruits are not harvested within 10 days after application

Naphthaleneacetic acid (NAA) is an auxin-type growth regulator that can induce fruit thinning early in the season and reduce fruit drop late in the season. At very high rates, it can stop the development of watersprouts and rootsuckers. Its use as a chemical thinner is described in the thinning section. Its primary use as a growth regulator is to reduce preharvest drop. When it is used to reduce drop, it does not delay ripening, which may result in overripe fruit that have a shorter storage life if harvest is delayed. The level of drop control depends on rate, with 20 ppm giving better control than 10 ppm; however, the higher rate also advances ripening and may shorten fruit storage life. When combined with ReTain its negative effects on fruit ripening and storage life can be mitigated.

The use of NAA to control rootsuckers is with a formulation that is more active (Tre-Hold) and at rates 1,000 times that of its use as a chemical thinner or for drop control. The Tre-Hold formulation must never be used for thinning or drop control.

Prohexadione-calcium (Apogee) is a growth regulator that reduces vegetative growth by inhibiting the synthesis of gibberellins, which are naturally occurring plant hormones that control cell elongation. Growers can expect about a 40-50% reduction in growth from Apogee.

Apogee also limits fire blight development in apple shoots but will not protect against blossom blight infection. Although Apogee has no pesticidal activity on the fire blight bacteria itself, it affects the development of the shoot blight by causing a cessation of shoot growth, which in turn makes the shoots less susceptible to fire blight development. In order to get the maximum benefit in growth reduction and fireblight protection, it is important to make the first application when shoots are 1-3 inches long. This means Apogee must be applied at or before petal fall to have a large effect on shoot growth. Later applications will be less effective at stopping shoot growth. The onset of shoot growth control and resistance against shoot fire blight infections occurs 10 to 14 days after treatment. Thus, apple trees must be treated in a protective manner before shoot blight symptoms develop. After resistance is acquired, it should last from 4-6 weeks. To maintain fire blight protection, a second spray is required if shoots begin to grow again. A low dose provides growth controls for only about 3-4 weeks, while a high dose controls growth for 6-8 weeks. At least two applications will be required to achieve season-long growth control in most New England orchards.

Apogee-treated apple trees usually set more fruit than untreated trees and often Apogee negates the efficacy of chemical thinners, thus it is important that no Apogee be applied either 10 days before or 10 days after the application of chemical thinners. It may also be necessary to use a more agressive thinning strategy. This may mean using an increased dosage of a chemical thinner (30-50% more) or multiple applications of chemical thinners to achieve desired crop load and fruit size. High rates of Apogee (>18 oz/acre/year) can reduce return bloom in some years. Apogee may cause fruit finish and cracking problems on Empire apples.

ReTain is a commercial formulation of aminoethoxyvinylglycine (AVG). It is used to reduce preharvest drop and to delay harvest. It acts by inhibiting the synthesis of ethylene in the plant. Since ethylene production by the fruit increases dramatically as fruits ripen, ReTain must be applied several weeks before fruits are mature to hold ethylene production in check. This is usually 3-4 weeks before normal harvest. ReTain will generally delay harvest and fruit drop by 7-10 days, thus giving growers flexibility with harvest date. ReTain also delays other aspects of fruit ripening such as color development, starch degradation and firmness loss, but if harvest is delayed 7-10 days, ReTain-treated fruits achieve normal color and maturity. The combination of ReTain and NAA (Fruitone) has given better drop control that either chemical alone. A split application of ReTain plus NAA at 4 weeks before harvest followed by a second application of ReTain plus NAA at 2 weeks before harvest has given the longest drop control.

Table 11.7.1. Growth regulator uses in apples.

Timing	Product	Concentration	Rate of Formulated Product
Improve Shape (Typiness) of Delicious and Gala Apple Fruits			
Early King Bloom to 50% Bloom	Promalin, Perlan, Typy	25-50 ppm	1-2 pt/100 gal
Apply as a fine mist using 50-100 gallons/acre. Do not apply more than 2 pt/acre. Fruit thinning may occur at high rates. Use of a surfactant increases both typiness and thinning responses.			
Induction of Lateral Branching in Young Trees			
1/2" of Terminal Shoot Growth	Promalin Perlan, Typy, Maxcel	250-500 ppm	0.5-1 pt/5 gal
Include a non-ionic surfactant and apply as a directed spray to areas where additional branching is desired. This practice is more effective in the second and third growing seasons after planting. Response on weak or low-vigor trees is usually disappointing.			
Vegetative Growth Control/Fire Blight Suppression			
1-3 inches of new growth	Apogee	125-250 ppm	4.5-9 oz (lb)*/100 gal
(Late bloom-early petal fall)			
The first application should be made as soon as shoot growth begins with a second spray 3-4 weeks after the first. In some cases a third application may be required. Do not apply Apogee within 10 days of chemical thinners. Do not apply more than 48 ounces of Apogee per acre within any 21-day interval, and a max of 99 oz of Apogee per acre per season. Always use a surfactant and a water conditioner such as ammonium sulfate, Choice or Quest (these products control "hard water" deactivation of Apogee). Do not tank-mix with sprays containing calcium. Use of Apogee may necessitate use of increased chemical thinning to achieve desired crop load. Apogee must be applied well in advance of the appearance of fire blight symptoms to be effective for fire blight suppression. To control vigor in only the top of the tree, direct spray to the top of the tree.			
Induction of Lateral Branching in Nursery Trees			
When terminal Shoot is 28-48" long	Promalin	125-500ppm	0.25-1 pt/5 gal
	Maxcel	250-500ppm	128 oz/40 gal
Include a non-ionic surfactant and apply as a directed spray to areas where additional branching is desired when terminal shoot is at the height where branches are desired. Apply a second, third and fourth spray at 2 week intervals to stimulate additional branching as the shoot grows.			
Suppression of "Physiological" Fruit Russeting			
Petal Fall	TypRus 2% Liquid	15-20 ppm	10-13 fl oz/acre
	Pro-Vide 10 SG	15-25ppm	60-100 g/acre
Apply 2-4 applications beginning at petal fall and continuing at 7-10 day intervals. Spray at 100 gallons per acre. Max of 40 oz of ProVide per season. Do not use a surfactant when applying Pro-Vide.			
Increased Flower Bud Development			
Non bearing trees			
2-4 weeks after full bloom	Ethrel	300-450 ppm	1-1.5 pt/100 gal
Bearing trees			
4-6 weeks after full bloom	Ethrel or	150 ppm	0.5 pt/100 gal
	NAA	7.5ppm	3 oz*/100gal
Spray trees with enough water to uniformly cover the canopy. Apply 4 weekly applications. Avoid use of Ethrel on Macoun, Honeycrisp and McIntosh due to advanced ripening.			
Preharvest Fruit-Drop Control			
3-4 weeks before anticipated harvest	ReTain	30-130 ppm	84-333g/acre or 1/4-1 pouch
Varieties differ significantly in their sensitivity to ReTain. With some varieties the full rate reduces fruit color excessively. We recommend with Empire, Delicious, Jonagold, Idared and Rome a full rate of ReTain (1 pouch per acre) applied 4 weeks before harvest. For McIntosh we recommend a half rate of ReTain (1/2 pouch per acre) applied 3 weeks before harvest combined with 10ppm NAA. This will give 2 weeks of drop control. For longer drop control apply a second spray of a half rate of ReTain (1/2 pouch) at 1 week before harvest. For Gala we recommend a 1/3 rate (1/3 pouch per acre) applied 2 weeks before harvest. For Honeycrisp which is the most sensitive variety to ReTain we recommend a 1/4 rate (1/4 pouch per			

Table 11.7.1. Growth regulator uses in apples.

Timing	Product	Concentration	Rate of Formulated Product
acre) applied 2 weeks before harvest. Apply in sufficient water to ensure thorough but not excessive coverage. For mature trees, this should be 100 gal/acre. An organosilicone surfactant (12 oz/100 gal) should be used with ReTain. In hot years apply ReTain at least 4 weeks before harvest. In cooler years apply ReTain 3 weeks before anticipated harvest.			
Drop of first sound fruit	Fruitone-N, Fruitone-L, PoMaxa	10-20 ppm	4-8 oz*/ 100 gal
	Fruit-Fix 800	10-20 ppm	0.6-1.2 fl. oz./100 gal
Varieties such as McIntosh which are highly prone to preharvest drop require careful monitoring to determine when fruit drop is beginning. Limb-tapping should be used to help determine the onset of drop as fruit near maturity. Approximate duration of drop control varies with dosage: 10 ppm = 6 days; 20 ppm = 10 days. Do not make more than 2 applications. High rates of NAA advance fruit maturity and may shorten fruit storage life.When NAA is combined with ReTain at 3 or 2 weeks before harvest the negative effects of NAA on fruit maturity and storage life can be eliminated.			
Promote Fruit Coloring, Promote Uniform Ripening, Advance Fruit Maturation			
2 weeks before normal harvest	Ethrel	150-300 ppm	0.5-1 pt / 100 gal
If fruit is to placed in CA storage then harvest should be done 7 days after application. If fruit is to be left on the tree longer than 7 days after application of Ethrel then apply NAA at 10-20 ppm 3 days after Ethrel application to help control preharvest drop. Ethrel will cause excessive fruit preharvest drop about 10 days after application if NAA is not used. Any delay in harvest or cooling of fruit treated with Ethrel will result in unacceptable softening and short storage life.			

*To convert ounces (lb) to grams, multiply ounces by 28.3. To convert fluid ounces to milliliters, multiply fluid ounces by 29.57.

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