Control of grape powdery mildew with synthetic, biological and organic fungicides: 2011 field trials

Ian S. Bay, James D. Eynard, Ryan W. Doody, Thien N. Nguyen, and W. Douglas Gubler

Department of Plant Pathology, University of California, Davis, CA, 95616

University of California Cooperative Extension,
Department of Plant Pathology,
University of California, Davis, December 2011

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Report Summary

Powdery mildew is an economically-important pathogen of grapes worldwide. This report details the findings of our annual powdery mildew fungicide trials on grapevine cultivar Chardonnay (*Vitis vinifera*). The trials were conducted at Herzog Ranch, near Courtland, California in 2011. Treatments were placed in four adjacent trials in the vineyard. Spraying commenced in mid April, amidst significant rainfall events that likely promoted the release of powdery mildew (*Erysiphe necator*) ascospores from overwintering chasmothecia. Powdery mildew pressure began slowly with cool temperatures early on, but quickly built to very high disease pressure levels as temperatures warmed. Spraying was completed on July 23 and treatments were evaluated for disease incidence and severity.

Trial I consisted of soft chemistry products, including biologicals, sulfurs, nutrient applications, oils, and other materials. Spray frequencies varied from weekly applications to 21 day intervals. Many applications were based on the Gubler-Thomas Risk Index, with application intervals based on the index.

Temperatures were mild during much of the 2011 growing season, providing optimal conditions for the asexual reproduction and dispersal of powdery mildew. Overall disease pressure was higher than in similar trials conducted in 2007, 2008, and 2009. By late June, heavy to severe mildew coverage was evident on untreated clusters. By the time of disease evaluation, disease severity in untreated plots in all five trials reached 95-100%.

Materials and Methods

A1. Experimental design

Experimental design	Complete randomized design with 5 replicates.		
Experimental unit	2 adjacent vines = 1 plot		
Plot area	154 ft^2 (row spacing = 11 ft, vine spacing = 7 ft)		
Area/treatment	770 ft^2 (5 reps. = 1 treatment)	Area/treatment	0.0177 acre/treatment
Volume water/acre	75 gallons (first spray)= 1.3 gallons/5 replicates 100 gallons (pre-bloom in mid-April), = 1.8 gallons/5 replicates 125 gallons (certain products), = 2.2 gallons/5 replicates 150 gallons (pre-bloom to pea-sized berries, late April - early June), = 2.7 gallons/5 reps 200 gallons (late season), = 3.5 gallons/5 reps 250 gallons (late season),= 4.4 gallons/5 reps		
Volume water/acre (Trial 5)	100 gallons (pre-bloom in mid-April), =0.7 gallons/5 replicates 150 gallons (pre-bloom to pea-sized berries, late April - early June), = 1.1 gallons/4 reps 200 gallons (late season), =1.4 gallons/4 reps 250 gallons (late season), =1.8 gallons/4 reps		
Application method	Handgun sprayers (attached to Nifty Fifty brand 25 or 50 gallon sprayers).		

B. Experimental treatments

The treatments described in this report were conducted for experimental purposes only and crops treated in a similar manner may not be suitable for commercial or other use.

Trial I

No.	Flag.	Treatment	Frequency (days)	Application rate (per acre)	FP/5 replicates
1	W	Untreated	none	none	none
2	K	Saf-T-Side	10-14 (RI)	1.0% (v/v)	67.0 ml (at 100 gal/A) 100.5 ml (at 150 gal/A) 134.0 ml (at 200 gal/A) 167 ml (at 250 gal/A)
3	G	Saf-T-Side	10-14 (RI)	1.5% (v/v)	100.5 ml (at 100 gal/A) 150.8 ml (at 150 gal/A) 201.0 ml (at 200 gal/A 250.0 ml (at 250 gal/A)
4	YKS	Saf-T-Side	10-14 (RI)	2.0 % (v/v)	134.0 ml (at 100 gal/A) 201.0 ml (at 150 gal/A) 268.0 ml (at 200 gal/A) 333.1 ml (at 250 gal/A)
5	Y	MAR-QL	10-14 (RI)	2.0% (v/v)	134.0 ml (at 100 gal/A) 201.0 ml (at 150 gal/A) 268.0 ml (at 200 gal/A) 333.1 ml (at 250 gal/A)
6	YKD	Regalia + Quintec	14	1 qt + 3 fl oz	16.8 ml + 1.6 ml
7	BS	Regalia alt Vivando	14	2 qt alt 10 fl oz	33.6 ml alt 5.2 ml
8	KS	JMS Stylet-oil alt OrCa + Regalia	7	1%(v/v) alt 1 qt + 1 qt	67.0 ml (at 100 gal/A) 100.5 ml (at 150 gal/A) 134.0 ml (at 200 gal/A) 167 ml (at 250 gal/A) alt 16.8 ml + 16.8 ml
9	O	Antica	7	0.5%	33.5 ml (at 100 gal/A) 50.3 ml (at 150 gal/A) 67.0 ml (at 200 gal/A) 83.3 ml (at 250 gal/A)
10	OS	Antica	7	1.0%	67.0 ml (at 100 gal/A) 100.5 ml (at 150 gal/A) 134.0 ml (at 200 gal/A) 167 ml (at 250 gal/A)
11	BC	Antica	7	1.5%	100.5 ml (at 100 gal/A) 150.8 ml (at 150 gal/A) 201.0 ml (at 200 gal/A 250.0 ml (at 250 gal/A)
12	GD	Antica	7	2.0%	134.0 ml (at 100 gal/A) 201.0 ml (at 150 gal/A) 268.0 ml (at 200 gal/A) 333.1 ml (at 250 gal/A)
13	B	C-8	7	0.3%	20.1 ml (at 100 gal/A) 30.2 ml (at 150 gal/A) 40.2 ml (at 200 gal/A) 50 ml (at 250 gal/A)
14	Pu	C-8	10	0.4%	26.8 ml (at 100 gal/A) 40.2 ml (at 150 gal/A) 53.6 ml (at 200 gal/A) 66.5 ml (at 250 gal/A)
15	PKD	JMS Stylet-oil	14	1.0%	67.0 ml (at 100 gal/A) 100.5 ml (at 150 gal/A) 134.0 ml (at 200 gal/A) 167 ml (at 250 gal/A)
16	KD	MBI-10605	7	0.5%	33.5 ml (at 100 gal/A) 50.3 ml (at 150 gal/A) 67.0 ml (at 200 gal/A) 83.3 ml (at 250 gal/A)
17	P	Flint	14	2.0 oz	1.0 g
18	GS	Quintec	14	4.0 fl oz	2.1 ml

19	YKC	C-8 alt Quintec	7 alt 14	0.3% alt 4.0 fl oz	20.1 ml (at 100 gal/A) 30.2 ml (at 150 gal/A) 40.2 ml (at 200 gal/A) 50 ml (at 250 gal/A) Alt 2.1 ml
20	BD	C-8 alt Quintec	10 alt 14	0.4% alt 4.0 fl oz	26.8 ml (at 100 gal/A) 40.2 ml (at 150 gal/A) 53.6 ml (at 200 gal/A) 66.5 ml (at 250 gal/A) Alt 2.1 ml
21	KC	C-8 alt Flint	7 alt 14	0.3% alt 2.0 oz	20.1 ml (at 100 gal/A) 30.2 ml (at 150 gal/A) 40.2 ml (at 200 gal/A) 50 ml (at 250 gal/A) Alt 1.0 g
22	PKS	C-8 alt Flint	10 alt 14	0.4% alt 2.0 oz	26.8 ml (at 100 gal/A) 40.2 ml (at 150 gal/A) 53.6 ml (at 200 gal/A) 66.5 ml (at 250 gal/A) Alt 1.0 g
23	OKD	C-8 alt w/ Flint alt Quintec (RI) (C-8 if RI<60, else Flint alt Quintec)	7 alt 14	0.3% alt w/ 2.0 oz alt 4.0 fl oz	20.1 ml (at 100 gal/A) 30.2 ml (at 150 gal/A) 40.2 ml (at 200 gal/A) 50 ml (at 250 gal/A) Alt w/ 1.0 g alt 2.1 ml
24	YS	C-8 alt w/ Flint alt Quintec (RI) (C-8 if RI<60, else Flint alt Quintec)	10 alt 14	0.4% alt w/ 2.0 oz alt 4.0 fl oz	26.8 ml (at 100 gal/A) 40.2 ml (at 150 gal/A) 53.6 ml (at 200 gal/A) 66.5 ml (at 250 gal/A) Alt w/ 1.0 g alt 2.1 ml
25	OKS	Flint alt Quintec	14	2.0 oz alt 4.0 fl oz	1.0 g alt 2.1 ml
26	PKC	Microthiol	7	2 lb	16.0 g
27	BKS	Exp. A	14	4.1 fl oz	2.1 ml

Trial II

No.	Flag	Treatment	Frequency (days)	Application rate (per acre)	FP/5 replicates
1	W	Untreated Control	None	None	none
2	K	Quadris Top + Dyneamic	14	14 fl oz + 0.25% (v/v)	7.3 ml + 17 ml (100 gal/A) 25.6 ml (150 gal/A) 34 ml (200 gal/A) 41.4 (250 gal/A)
3	G	Inspire Super + Dyneamic	14	20 fl oz + 0.25% (v/v)	10.5 ml + 17 ml (100 gal/A) 25.6 ml (150 gal/A) 34 ml (200 gal/A) 41.4 (250 gal/A)
4	KS	Quadris Top + Dyneamic alt Quintec	14-21 (RI)	14 fl oz+ 0.25% (v/v) alt 6.6 fl oz	7.3 ml + 17 ml (100 gal/A) 25.6 ml (150 gal/A) 34 ml (200 gal/A) 41.4 (250 gal/A) Alt 3.5 ml
5	O	Inspire Super + Dyneamic alt Quintec	14-21(RI)	20 fl oz + 0.25% (v/v) alt 6.6 fl oz	10.5 ml + 17 ml (100 gal/A) 25.6 ml (150 gal/A) 34 ml (200 gal/A) 41.4 (250 gal/A) Alt 3.5 ml
6	YKS	Exp 1 + Dyneamic	14	10.3 fl oz + 0.25% (v/v)	5.4 ml + 17 ml (100 gal/A) 25.6 ml (150 gal/A) 34 ml (200 gal/A) 41.4 (250 gal/A)

7	Y	Exp 1 + Exp 3 + Dyneamic	14	10.3 fl oz+ 6.16 fl oz + 0.25% (v/v)	5.4 ml + 3.2 ml + 17 ml (100 gal/A) 25.6 ml (150 gal/A) 34 ml (200 gal/A) 41.4 (250 gal/A)
8	YKD	Exp 2 + Dyneamic	14	8 fl oz + 0.25% (v/v)	4.2 ml + 17 ml (100 gal/A) 25.6 ml (150 gal/A) 34 ml (200 gal/A) 41.4 (250 gal/A)
9	BS	Exp 2 + Exp 3 + Dyneamic	14	5.1 fl oz + 4.1 fl oz + 0.25% (v/v)	2.7 ml + 2.1 ml + 17 ml (100 gal/A) 25.6 ml (150 gal/A) 34 ml (200 gal/A) 41.4 (250 gal/A)
10	OS	Quintec alt Flint (standard)	14-21 (RI)	6.6 fl oz alt 2 oz	3.5 ml alt 1.0 g
11	BC	Exp C	soil drench at bud break	6.84 oz	3.6 ml
12	GD	Adament then Flint then Elite 45 WP	21 then 21 then 14	4 oz then 2 oz then 4 oz	2.0 g then 1.0 g then 2.0 g
13	B	Exp C then Adament then Flint then Elite 45 WP then 21	soil drench at bud br. then 21 then 21 then 14 then 21	6.84 fl oz then 4 oz then 2 oz then 4 oz then 4 oz	3.6 ml then 2.0 g then 1.0 g then 2.0 g then 2.0 g
14	Pu	Luna Experience	21	6 fl oz	3.1 ml
15	PKD	Luna Experience alt Flint	21	6 fl oz alt 2 oz	3.1 ml alt 1.0 g
16	KD	Adament then Luna Experience then Flint	21	4 oz then 6 fl oz then 2 oz	2.0 g then 3.1 ml + then 1.0 g
17	P	Quintec + Dyneamic	21	6.6 fl oz + 0.25% (v/v)	3.5 ml + 17 ml (100 gal/A) 25.6 ml (150 gal/A) 34 ml (200 gal/A) 41.4 (250 gal/A)
18	GS	Rally + Dyneamic alt Quintec + Dyneamic	14	5 oz + 0.25% (v/v) alt 4 fl oz + 0.25% (v/v)	2.5 g + 17 ml (100 gal/A) 25.6 ml (150 gal/A) 34 ml (200 gal/A) 41.4 (250 gal/A) alt 2.1 ml + (same as above)
19	YKC	Luna Experience + Dyneamic alt Quintec + Dyneamic	21	6 fl oz + 0.25% (v/v) alt 6.6 fl oz + 0.25% (v/v)	3.1 ml + 17 ml (100 gal/A) 25.6 ml (150 gal/A) 34 ml (200 gal/A) 41.4 (250 gal/A) alt 3.5 ml + (same as above)
20	BD	Pristine + Dyneamic alt Quintec + Dyneamic	21	10.5 oz + 0.25% (v/v) alt 6.6 fl oz + 0.25% (v/v)	5.3 g + 17 ml (100 gal/A) 25.6 ml (150 gal/A) 34 ml (200 gal/A) 41.4 (250 gal/A)alt 3.5 ml + (same as above)
21	KC	Torino + Dyneamic alt Quintec + Dyneamic	14	3.4 fl oz + 0.25% (v/v) alt 4 fl oz + 0.25% (v/v)	1.8 ml + 17 ml (100 gal/A) 25.6 ml (150 gal/A) 34 ml (200 gal/A) 41.4 (250 gal/A) alt 2.1 ml + (same as above)
22	PKS	Exp. B	Start bud break - 7	0.25% (v/v)	17 ml (100 gal/A) 25.6 ml (150 gal/A) 34 ml (200 gal/A) 41.4 (250 gal/A)
23	OKD	Exp. B alt Flint alt Quintec	7 alt 14-21 (RI)	0.25% (v/v) then 2 oz then 6.6 fl oz	17 ml (100 gal/A) 25.6 ml (150 gal/A) 34 ml (200 gal/A) 41.4 (250 gal/A) then 1.0 g then 3.5 ml

24	YS	Exp. B + Flint alt Exp. B + Quintec	14-21 (RI)	0.25% (v/v) + 2 oz then 0.25%(v/v) + 6.6 fl oz	17 ml (100 gal/A) 25.6 ml (150 gal/A) 34 ml (200 gal/A) 41.4 (250 gal/A) + 1.0 g then (same as above) + 3.5 ml
25	OKS	Exp. B alt Exp. B + OV11	7 alt 14	0.25%(v/v) then 0.25% (v/v) + 1 qt	17 ml (100 gal/A) 25.6 ml (150 gal/A) 34 ml (200 gal/A) 41.4 (250 gal/A) then (same as above) + 16.8 ml

Trial 3

No.	Flag	Treatment	Frequency (days)	Application rate (per acre)	FP/5 replicates
1	W	Untreated Control	none	none	none
2	K	CX-9090	7-10 (RI)	0.5 lb	4.0 g
3	LG	CX-9090	7-10 (RI)	1.0 lb	8.0 g
4	YKS	CX-9090 alt Cueva	7-10 (RI)	0.5 lb alt 1.0% (v/v)	4.0 g alt 67.0 ml (at 100 gal/A) 100.5 ml (at 150 gal/A) 134.0 ml (at 200 gal/A) 167 ml (at 250 gal/A)
5	Y	YT669	14	6 fl oz	3.1 ml
6	YKD	YT669	14	12 fl oz	6.3 ml
7	BS	YT669 + Dyneamic	14	12 fl oz + 0.25% (v/v)	6.3 +17 ml (100 gal/A) 25.6 ml (150 gal/A) 34 ml (200 gal/A) 41.4 (250 gal/A)
8	KS	Pristine + Sylgard 309	14	8 oz + 3 fl oz/100 gal	4.0 g + 1.6 ml (at 100 gal/A) 2.4 ml (at 150 gal/A) 3.1 ml (at 200 gal/A) 3.9 ml (at 250 gal/A)
9	O	Pristine + Sylgard 309	21	12.5 oz (16 oz final appl) + 3 fl oz/100 gal	6.3 g (8g final app)+ 1.6 ml (at 100 gal/A) 2.4 ml (at 150 gal/A) 3.1 ml (at 200 gal/A) 3.9 ml (at 250 gal/A)
10	OS	Sovran + Sylgard 309 alt Vivando + Sylgard 309	14	4 oz + 3 fl oz/100 gal alt 12.8 fl oz + 3 oz/100 gal	2.0 g + 1.6 ml (at 100 gal/A) 2.4 ml (at 150 gal/A) 3.1 ml (at 200 gal/A) 3.9 ml (at 250 gal/A)alt 6.7 ml + See above
11	BC	Vivando + Sylgard 309 alt Pristine + Sylgard 309	14 alt 21	12.8 fl oz + 3 fl oz/100 gal alt 12.5 oz(16 oz final app) + 3 fl oz/100 gal	6.7 ml + 1.6 ml (at 100 gal/A) 2.4 ml (at 150 gal/A) 3.1 ml (at 200 gal/A) 3.9 ml (at 250 gal/A) alt 6.3 g (8 g final app) + See above

12	GD	Sovran + Sylgard 309 then Vivando + Sylgard 309 then Pristine + Sylgard 309 then Vivando + Sylgard 309 then Pristine + Sylgard 309	14 then 14 then 21 then 21 then 21	4 oz + 3 oz/100 gal then 12.8 fl oz + 3 fl oz/100 gal then 12.5 oz + 3 fl oz/100 gal then 15.4 fl oz + 3 fl oz/100 gal then 12.5 oz + 3 fl oz/100 gal	2.0 g + 1.6 ml (at 100 gal/A) 2.4 ml (at 150 gal/A) 3.1 ml (at 200 gal/A) 3.9 ml (at 250 gal/A) then 6.7 ml + Sylgard (see above) then 6.3 g + Sylgard (see above) then 8.1 ml + Sylgard (see above) then 6.3 g + Sylgard (see above)
13	B	Topguard	14	10 fl oz	5.2 ml
14	Pu	Viticure 4 SC + Dyneamic	14-21 (RI)	8 fl oz + 0.25%	4.2 ml + 17 ml (100 gal/A) 25.6 ml (150 gal/A) 34 ml (200 gal/A) 41.4 (250 gal/A)
15	PKD	Viticure 4SC + Microthiol + Dyneamic	14-21 (RI)	8 fl oz + 5 lb + 0.25%	4.2 ml + 40.1 g + 17 ml (100 gal/A) 25.6 ml (150 gal/A) 34 ml (200 gal/A) 41.4 (250 gal/A)
16	KD	Viticure 4 SC + Dyneamic then Pristine + Dyneamic then Mettle 1 SC + Dyneamic	14-21 (RI)	8 fl oz + 0.25% (v/v) then 6 oz + 0.25% (v/v) then 5 fl oz + 0.25% (v/v)	4.2 ml + 17 ml (100 gal/A) 25.6 ml (150 gal/A) 34 ml (200 gal/A) 41.4 (250 gal/A) then 3.0 g + Dyneamic (see above) then 2.5 ml + Dyneamic (see above)
17	P	Pristine + Dyneamic alt Viticure + Mettle + Dyneamic	14-21 (RI)	8 oz + 0.25% (v/v) alt 8 fl oz + 5 fl oz + 0.25% (v/v)	4.0 g + 17 ml (100 gal/A) 25.6 ml (150 gal/A) 34 ml (200 gal/A) 41.4 (250 gal/A) alt 4.2 ml + 2.5 ml + Dyneamic (see above)
18	GS	Luna Experience + Dyneamic then Microthiol + Dyneamic then Viticure + Dyneamic	14-21 (RI)	6 fl oz + 0.25% (v/v) then 5 lb + 0.25% (v/v) then 6 fl oz + 0.25% (v/v)	3.1 ml + 17 ml (100 gal/A) 25.6 ml (150 gal/A) 34 ml (200 gal/A) 41.4 (250 gal/A) then 40.1 g + Dyenamic (see above) then 3.2 ml + Dyneamic (see above)
19	YKC	Pristine then Sonata then Quintec then Sonata then Flint then Sonata	14	8 oz then 4 qt then 4 fl oz then 4 qt then 1.5 oz then 4 qt	4.0 g then 67.0 ml then 2.1 ml then 67.0 ml then 0.8 g then 67.0 ml
20	BD	Pristine then Rally then Quintec then Rally then Flint then Rally	14	8 oz then 4 oz then 4 fl oz then 4 oz then 1.5 oz then 4 oz	4.0 g then 2.0 g then 2.1 ml then 2.0 g then 0.8 g then 2.0 g
21	KC	Pristine then Quintec then Flint	28	8 oz then 4 fl oz then 1.5 oz	4.0 g then 2.1 ml then 0.8 g
22	OKS	Quintec alt Flint	14-21 (RI)	6.6 fl oz alt 2 oz	3.5 ml alt 1.0 g
23	BKS	BM 608 alt Flint	14 alt 14	0.5 % (v/v) alt 2 oz	33.5 ml (at 100 gal/A) 50.3 ml (at 150 gal/A) 67.0 ml (at 200 gal/A) 83.3 ml (at 250 gal/A) alt 1.0 g
24	GKS	BM 608 alt Flint	10 alt 14	0.35% (v/v) alt 2 oz	23.5 ml (100 gal/A) 35.1 ml (150 gal/A) 46.9 ml (200 gal/A) 58.3 (250 gal/A) alt 1.0 g

Trial 4

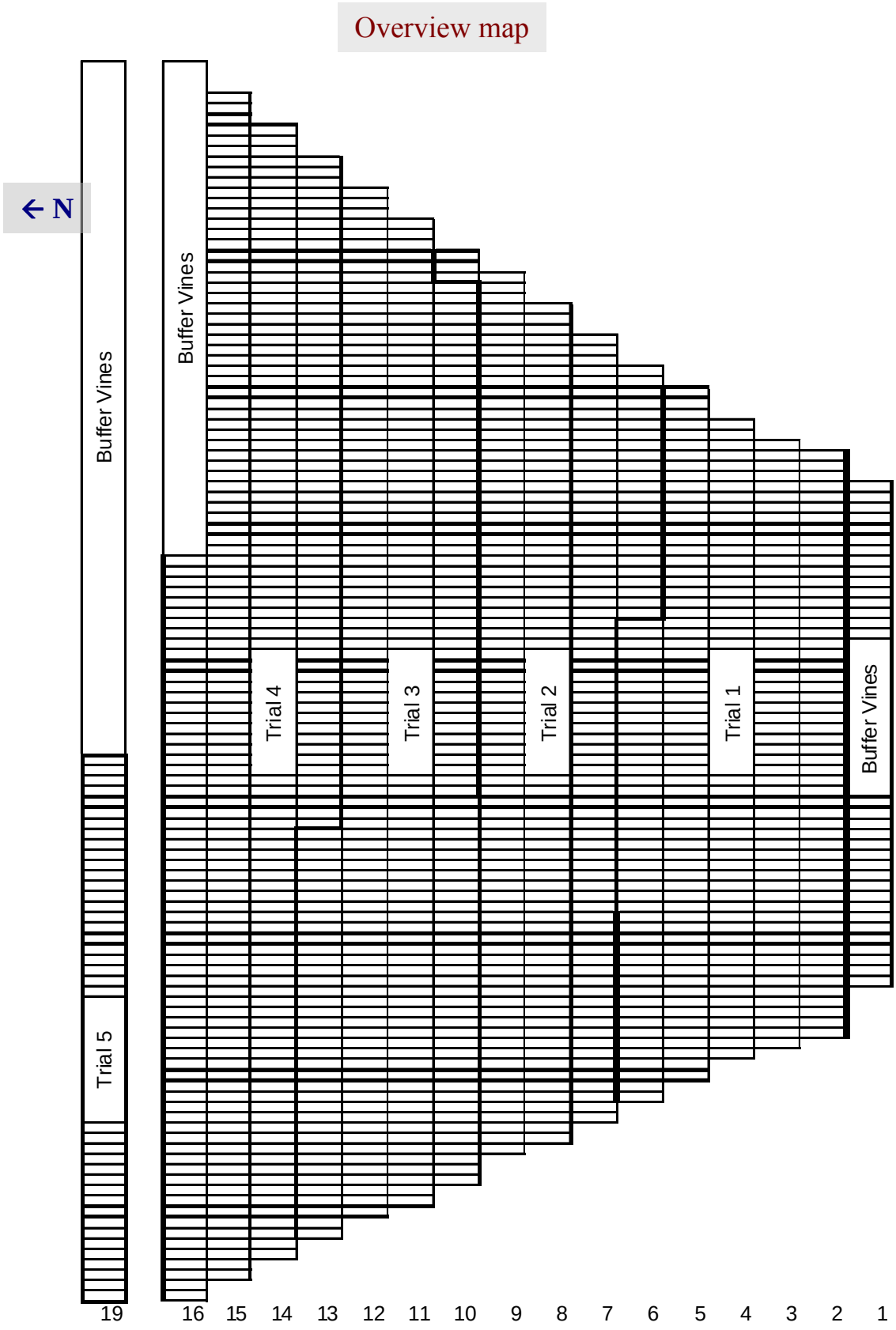
No.	Flag	Treatment	Frequency (days)	Application rate (per acre)	FP/5 replicates
1	W	Untreated Control	none	none	none
2	K	Stylet oil	7	0.5%	33.5 ml (at 100 gal/A) 50.3 ml (at 150 gal/A) 67.0 ml (at 200 gal/A) 83.3 ml (at 250 gal/A)
3	LG	Stylet oil	7	1.0%	67.0 ml (at 100 gal/A) 100.5 ml (at 150 gal/A) 134.0 ml (at 200 gal/A) 167 ml (at 250 gal/A)
4	YKS	Stylet oil	7	2.0%	134.0 ml (at 100 gal/A) 201.0 ml (at 150 gal/A) 268.0 ml (at 200 gal/A) 333.1 ml (at 250 gal/A)
5	Y	Stylet oil w/ 0.25% OE444	7	0.5%	33.5 ml (at 100 gal/A) 50.3 ml (at 150 gal/A) 67.0 ml (at 200 gal/A) 83.3 ml (at 250 gal/A)
6	YKD	Stylet oil w/ 0.5% OE444	7	0.5%	33.5 ml (at 100 gal/A) 50.3 ml (at 150 gal/A) 67.0 ml (at 200 gal/A) 83.3 ml (at 250 gal/A)
7	BS	Stylet oil w/ 1.0% OE444	7	0.5%	33.5 ml (at 100 gal/A) 50.3 ml (at 150 gal/A) 67.0 ml (at 200 gal/A) 83.3 ml (at 250 gal/A)
8	KS	Stylet oil w/ 2.0% OE444	7	0.5%	33.5 ml (at 100 gal/A) 50.3 ml (at 150 gal/A) 67.0 ml (at 200 gal/A) 83.3 ml (at 250 gal/A)
9	O	Stylet oil w/ 0.25% OE444	7	1.0%	67.0 ml (at 100 gal/A) 100.5 ml (at 150 gal/A) 134.0 ml (at 200 gal/A) 167 ml (at 250 gal/A)
10	OS	Stylet oil w/ 0.5% OE444	7	1.0%	67.0 ml (at 100 gal/A) 100.5 ml (at 150 gal/A) 134.0 ml (at 200 gal/A) 167 ml (at 250 gal/A)
11	BC	Stylet oil w/ 1.0% OE444	7	1.0%	67.0 ml (at 100 gal/A) 100.5 ml (at 150 gal/A) 134.0 ml (at 200 gal/A) 167 ml (at 250 gal/A)
12	GD	Stylet oil w/ 2.0% OE444	7	1.0%	67.0 ml (at 100 gal/A) 100.5 ml (at 150 gal/A) 134.0 ml (at 200 gal/A) 167 ml (at 250 gal/A)
13	B	Stylet oil w/ 0.25% OE444	7	2.0%	134.0 ml (at 100 gal/A) 201.0 ml (at 150 gal/A) 268.0 ml (at 200 gal/A) 333.1 ml (at 250 gal/A)
14	Pu	Stylet oil w/ 0.5% OE444	7	2.0%	134.0 ml (at 100 gal/A) 201.0 ml (at 150 gal/A) 268.0 ml (at 200 gal/A) 333.1 ml (at 250 gal/A)
15	PKD	Stylet oil w/ 1.0% OE444	7	2.0%	134.0 ml (at 100 gal/A) 201.0 ml (at 150 gal/A) 268.0 ml (at 200 gal/A) 333.1 ml (at 250 gal/A)
16	KD	Stylet oil w/ 2.0% OE444	7	2.0%	134.0 ml (at 100 gal/A) 201.0 ml (at 150 gal/A) 268.0 ml (at 200 gal/A) 333.1 ml (at 250 gal/A)

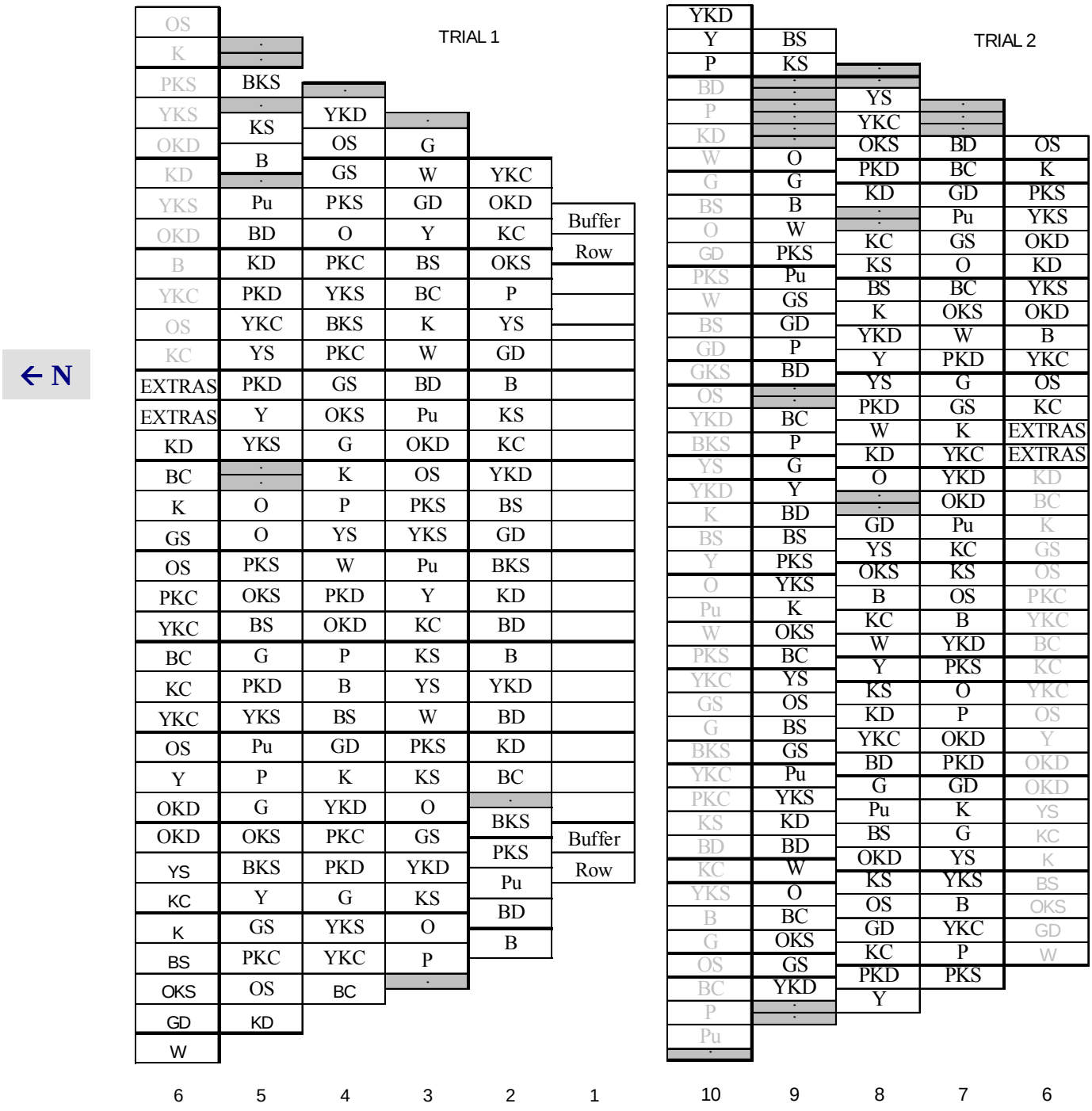
17	P	Stylet oil (until bloom) then Flint alt Quintec alt Rally	7 then 14-21 (RI) alt 14-21 (RI) alt 14-21 (RI)	1.0% then 2 oz alt 6.6 fl oz alt 5 oz	67.0 ml (at 100 gal/A) 100.5 ml (at 150 gal/A) 134.0 ml (at 200 gal/A) 167 ml (at 250 gal/A) then 1.0g alt 3.5ml alt 2.5g
18	GS	Stylet oil w/ 0.5% OE444 (until bloom) then Flint alt Quintec alt Rally	7 then 14-21 (RI) alt 14-21 (RI) alt 14-21 (RI)	1.0% then 2 oz alt 6.6 fl oz alt 5 oz	67.0 ml (at 100 gal/A) 100.5 ml (at 150 gal/A) 134.0 ml (at 200 gal/A) 167 ml (at 250 gal/A) then 1.0g alt 3.5ml alt 2.5g
19	YKC	Stylet oil w/ 1.0% OE444 (until bloom) then Flint alt Quintec alt Rally	7 then 14-21 (RI) alt 14-21 (RI) alt 14-21 (RI)	1.0% then 2 oz alt 6.6 fl oz alt 5 oz	67.0 ml (at 100 gal/A) 100.5 ml (at 150 gal/A) 134.0 ml (at 200 gal/A) 167 ml (at 250 gal/A) then 1.0g alt 3.5ml alt 2.5g
20	BD	Stylet oil (until bloom) then Flint alt Stylet oil	7 then 14 alt 7	1.0% then 2 oz alt 1.0%	67.0 ml (at 100 gal/A) 100.5 ml (at 150 gal/A) 134.0 ml (at 200 gal/A) 167 ml (at 250 gal/A) then 1.0 g alt <above>
21	KC	Stylet oil w/ 0.5% OE444 (until bloom) then Flint alt Stylet oil w/ 0.5% OE 444	7 then 14 alt 7	1.0% then 2 oz alt 1.0%	67.0 ml (at 100 gal/A) 100.5 ml (at 150 gal/A) 134.0 ml (at 200 gal/A) 167 ml (at 250 gal/A)then 1.0 g alt <above>
22	PKS	Stylet oil w/ 1.0% OE444 (until bloom) then Flint alt Stylet oil w/ 0.5% OE 444	7 then 14 alt 7	1.0% then 2 oz alt 1.0%	67.0 ml (at 100 gal/A) 100.5 ml (at 150 gal/A) 134.0 ml (at 200 gal/A) 167 ml (at 250 gal/A) then 1.0 g alt <above>
23	OKD	Torino	14-17 (RI)	3.4 fl oz	1.8 ml
24	YS	Torino + M-Pede	14-17 (RI)	3.4 fl oz + 1.0% (v/v)	1.8 ml + 67.0 ml (at 100 gal/A) 100.5 ml (at 150 gal/A) 134.0 ml (at 200 gal/A) 167 ml (at 250 gal/A)
25	OKS	Torino then Vintage then Quintec	14-17 (RI) then 10-14 (RI) then 14-21 (RI)	3.4 fl oz then 5.0 fl oz then 6.0 fl oz	1.8 ml then 2.6 ml then 3.2 ml
26	PKC	Torino then Vintage then Vivando	14-17 (RI) then 10-14 (RI) then 14-17 (RI)	3.4 fl oz then 5.0 fl oz then 10.5 fl oz	1.8 ml then 2.6 ml then 5.5 ml
27	BKS	Torino (3x) then Pristine then Vintage then Flint	14 (RI) (3x) then 14-21 (RI) then 10-14 (RI) then 14-21 RI	3.4 fl oz (3x) then 10.5 oz then 5 fl oz then 2 oz	1.8 ml (3x) then 5.3 g then 2.6 ml then 1.0 g
28	GKS	Pristine then Vintage then Flint then Torino (4x)	14-21(RI) then 10-14 (RI) then 14-21 (RI) then 14-17 (RI) (4x)	10.5 oz then 5.0 fl oz then 2.0 oz then 3.4 fl oz (4x)	5.3 g then 2.6 ml then 1.0g then 1.8 ml (4x)
29	RKD	OPA11	14	1.5 qt	24.1 ml
30	RKC	OO11	14	1.5 qt	24.1 ml

Trial 5

No.	Flag	Treatment	Frequency (days)	Application rate (per acre)	FP/4 replicates
1	W	Untreated Control			
2	B	Quintec alt Rally alt Flint	21 alt 14 alt 21	6.6 fl oz alt 4 oz alt 2 oz	1.4 ml alt .8 oz alt .4 oz
3	Pu	MANA	14	1 pint	3.4 ml
4	Y	MANA	14	2 pints	6.8 ml
5	KS	MANA	14	3 pints	8.5 ml
6	P	MANA	14	6 pints	17.0 ml
7	PKS	Kocide 3000	14	0.75 lbs	2.4 g
8	YKS	Kocide 3000	14	1.25 lbs	4.0 g
9	LG	Kocide 3000	14	1.75 lbs	5.6 g
10	OS	Kocide 3000	14	3.5 lbs	11.2 g
11	O	Orius	14	8.6 oz	1.8 fl oz
12	OKD	Incognito	14	0.8 lbs	2.6 g
13	OKS	Incognito	14	1.2 lbs	3.9 g

C. Maps of the trials

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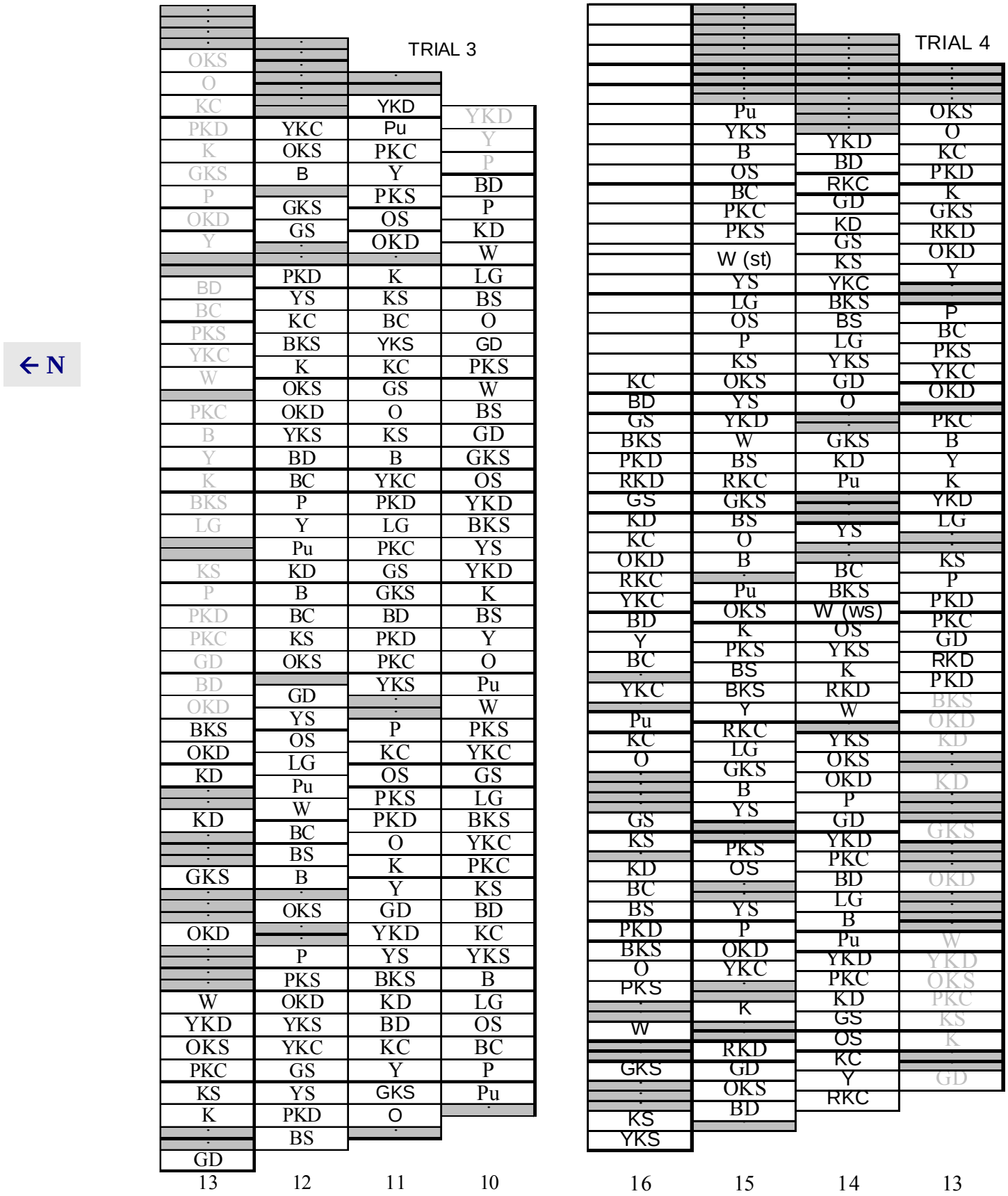
10 9 8 7 6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TRIAL 4
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Trial 5

LG
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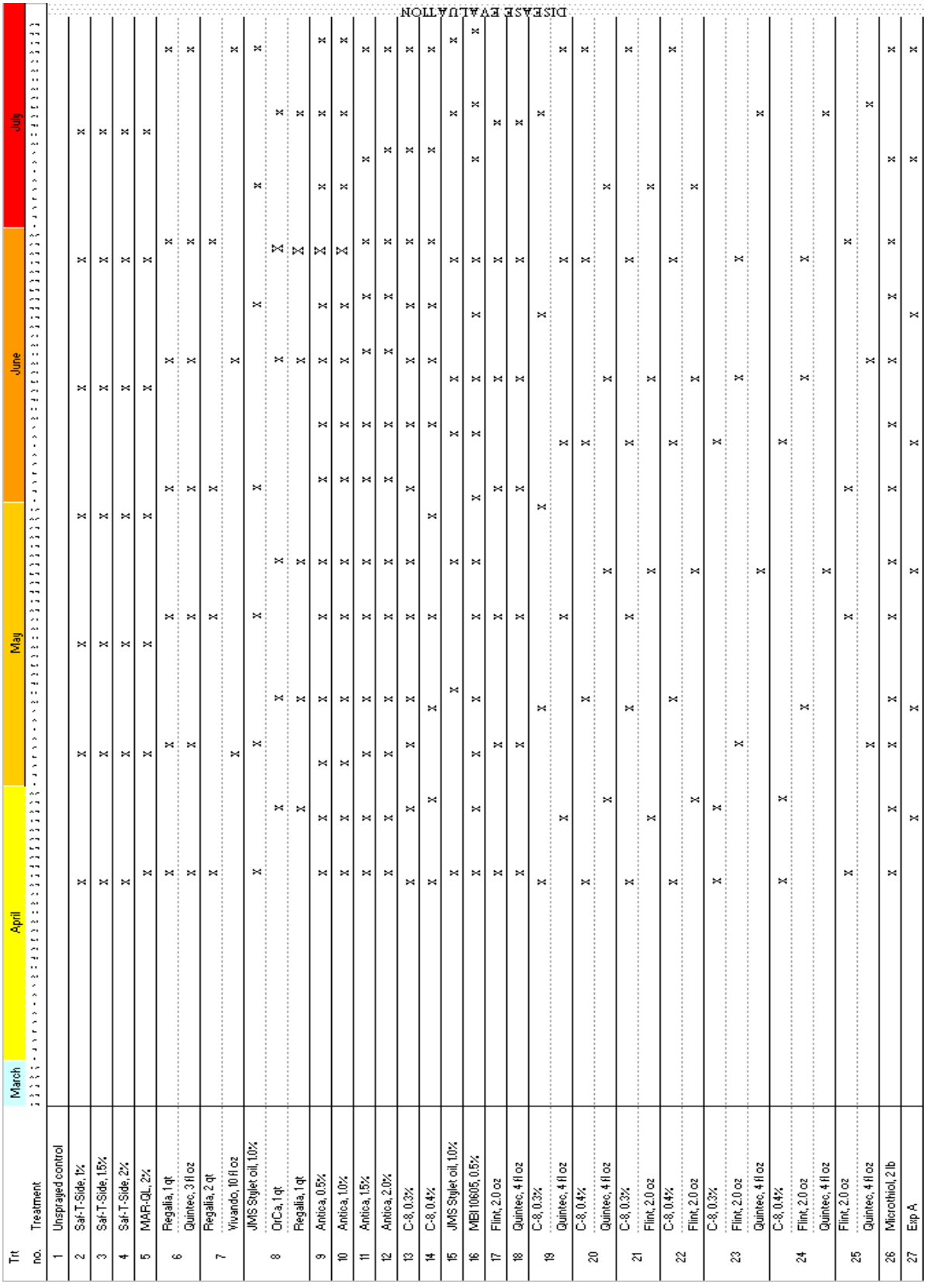
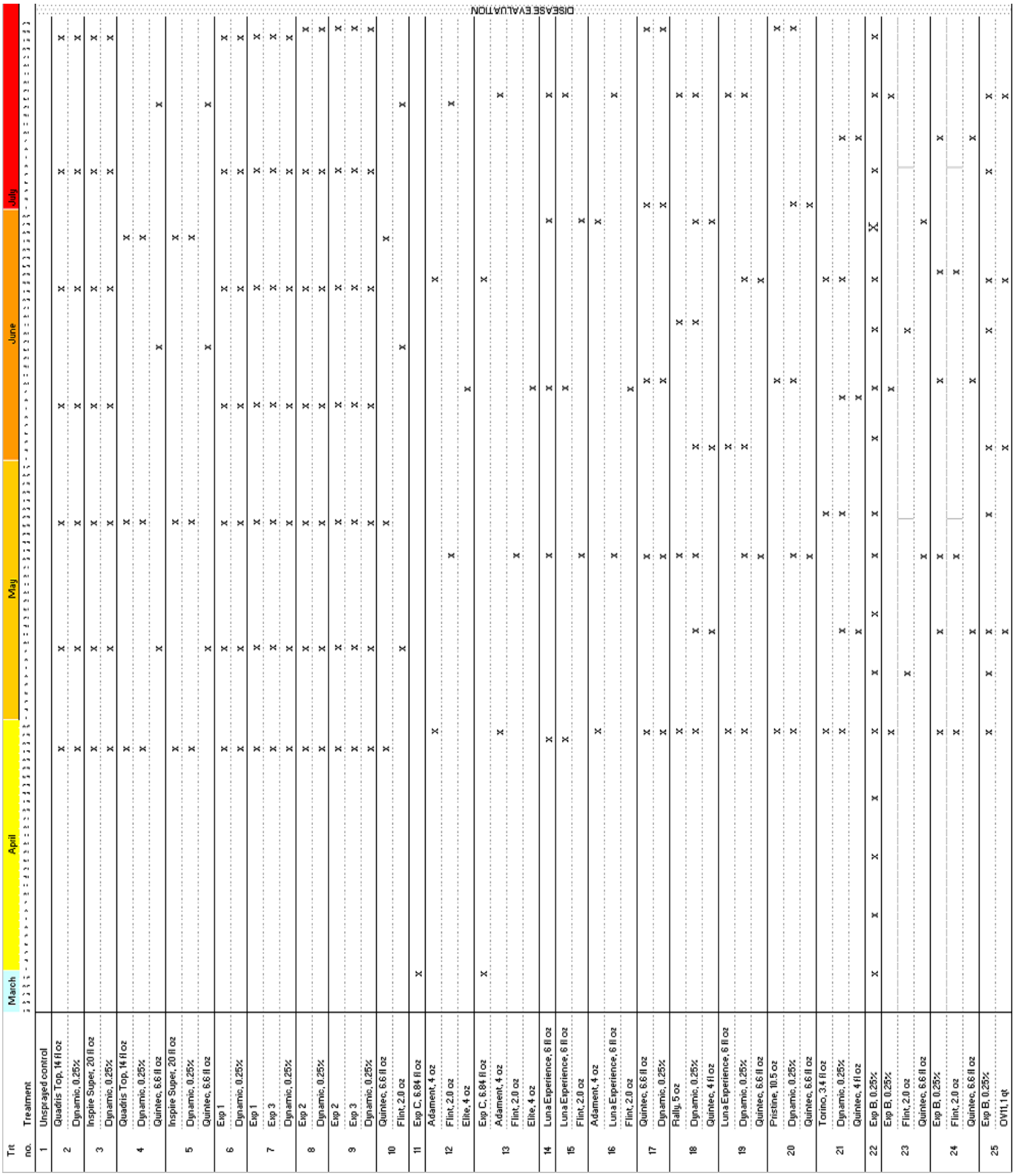
Row 19

D. Application history

TRIAL 1

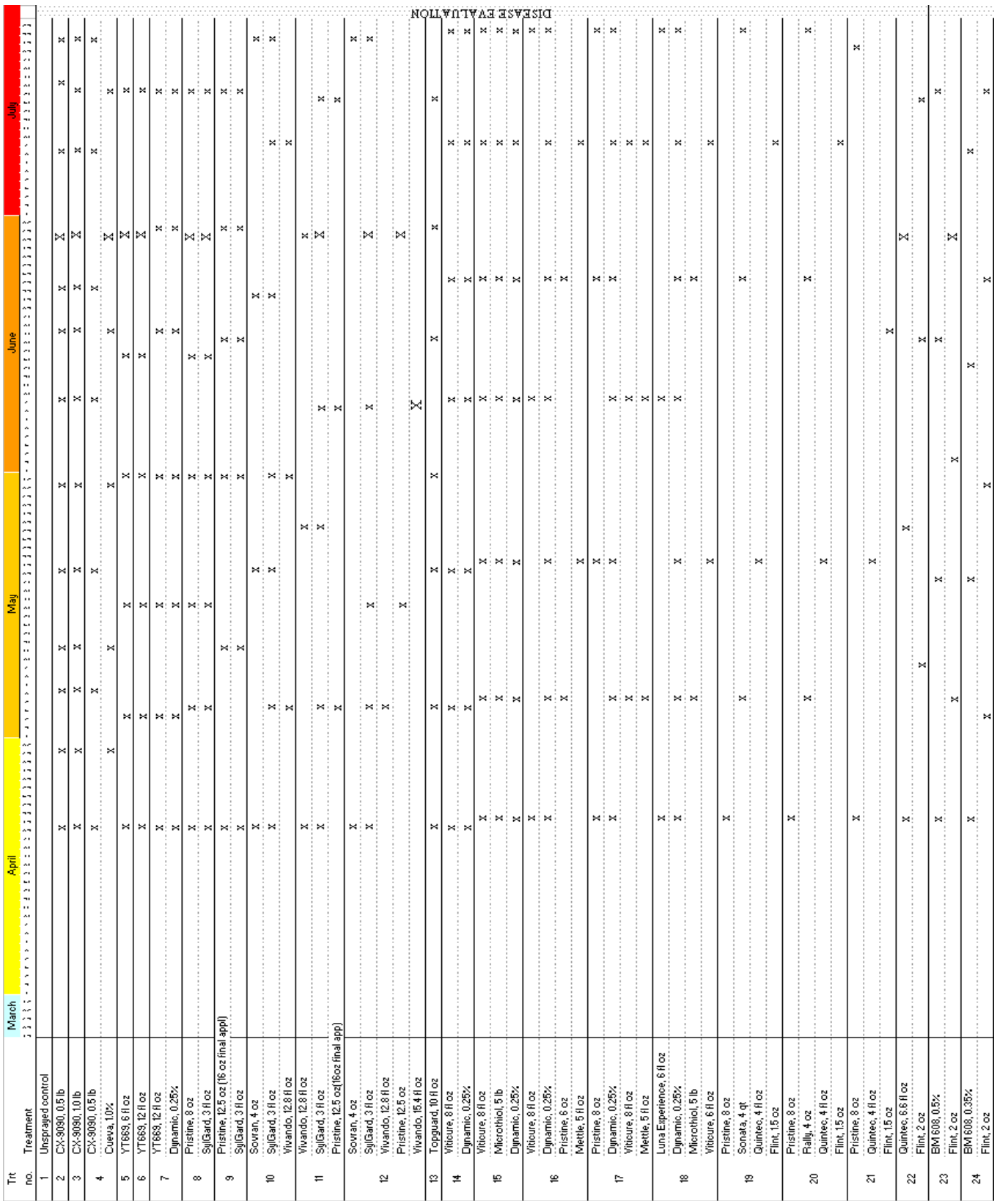


TRIAL 2



Trt no.	Treatment
1	Unsprayed control
2	Quadris Top, 14 fl oz
	Dynamic, 0.25%
3	Inspire Super, 20 fl oz
	Dynamic, 0.25%
4	Quadris Top, 14 fl oz
	Dynamic, 0.25%
	Quintec, 6.6 fl oz
5	Inspire Super, 20 fl oz
	Dynamic, 0.25%
	Quintec, 6.6 fl oz
6	Exp 1
	Dynamic, 0.25%
7	Exp 1
	Exp 3
	Dynamic, 0.25%
8	Exp 2
	Dynamic, 0.25%
9	Exp 2
	Exp 3
	Dynamic, 0.25%
10	Quintec, 6.6 fl oz
	Flint, 2.0 oz
11	Exp C, 6.84 fl oz
12	Adament, 4 oz
	Flint, 2.0 oz
	Elite, 4 oz
13	Exp C, 6.84 fl oz
	Adament, 4 oz
	Flint, 2.0 oz
	Elite, 4 oz
14	Luna Experience, 6 fl oz
15	Luna Experience, 6 fl oz
	Flint, 2.0 oz
16	Adament, 4 oz
	Luna Experience, 6 fl oz
	Flint, 2.0 oz
17	Quintec, 6.6 fl oz
	Dynamic, 0.25%
18	Rally, 5 oz
	Dynamic, 0.25%
	Quintec, 4 fl oz
19	Luna Experience, 6 fl oz
	Dynamic, 0.25%
	Quintec, 6.6 fl oz
20	Pristine, 10.5 oz
	Dynamic, 0.25%
	Quintec, 6.6 fl oz
21	Torino, 3.4 fl oz
	Dynamic, 0.25%
	Quintec, 4 fl oz
22	Exp B, 0.25%
23	Exp B, 0.25%
	Flint, 2.0 oz
	Quintec, 6.6 fl oz
24	Exp B, 0.25%
	Flint, 2.0 oz
	Quintec, 6.6 fl oz
25	Exp B, 0.25%
	OVI1, 1 qt

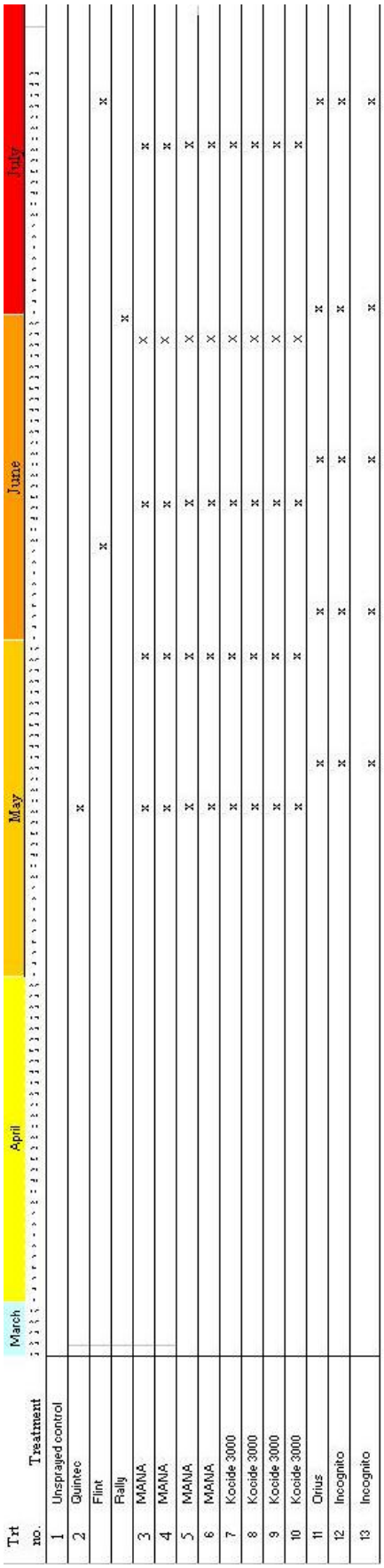
TRIAL 3



Trt no.	Treatment
1	Unsprayed control
2	CX-9090, 0.5 lb
3	CX-9090, 1.0 lb
4	CX-9090, 0.5 lb Cueva, 1.0%
5	YT669, 6 fl oz
6	YT669, 12 fl oz
7	YT669, 12 fl oz Dynamic, 0.25%
8	Pristine, 8 oz SylGard, 3 fl oz
9	Pristine, 12.5 oz (16 oz final appl) SylGard, 3 fl oz
10	Sovran, 4 oz SylGard, 3 fl oz Vivando, 12.8 fl oz
11	Vivando, 12.8 fl oz SylGard, 3 fl oz Pristine, 12.5 oz(16oz final app)
12	Sovran, 4 oz SylGard, 3 fl oz Vivando, 12.8 fl oz Pristine, 12.5 oz Vivando, 16.4 fl oz
13	Topguard, 10 fl oz
14	Viticure, 8 fl oz Dynamic, 0.25%
15	Viticure, 8 fl oz Microthiol, 5 lb Dynamic, 0.25%
16	Viticure, 8 fl oz Dynamic, 0.25% Pristine, 6 oz Mettle, 5 fl oz
17	Pristine, 8 oz Dynamic, 0.25% Viticure, 8 fl oz Mettle, 5 fl oz
18	Luna Experience, 6 fl oz Dynamic, 0.25% Microthiol, 5 lb Viticure, 6 fl oz
19	Pristine, 8 oz Sonata, 4 qt Quintec, 4 fl oz Flint, 1.5 oz
20	Pristine, 8 oz Rally, 4 oz Quintec, 4 fl oz Flint, 1.5 oz
21	Pristine, 8 oz Quintec, 4 fl oz Flint, 1.5 oz
22	Quintec, 6.6 fl oz Flint, 2 oz
23	BM1608, 0.5% Flint, 2 oz
24	BM1608, 0.35% Flint, 2 oz

TRIAL 4

Trt no.	Treatment	March	April	May	June	July	RATING
1	Unsprayed control						
2	Stylet oil, 0.5%		x x x	x x x	x x x	x x x	
3	Stylet oil, 1.0%		x x x	x x x	x x x	x x x	
4	Stylet oil, 2.0%		x x x	x x x	x x x	x x x	
5	Stylet oil, 0.5% OE444, 0.25%		x x x x x x	x x x x x x	x x x x x x	x x x x x x	
6	Stylet oil, 0.5% OE444, 0.5%		x x x x x x	x x x x x x	x x x x x x	x x x x x x	
7	Stylet oil, 0.5% OE444, 1.0%		x x x x x x	x x x x x x	x x x x x x	x x x x x x	
8	Stylet oil, 0.5% OE444, 2.0%		x x x x x x	x x x x x x	x x x x x x	x x x x x x	
9	Stylet oil, 1.0% OE444, 0.25%		x x x x x x	x x x x x x	x x x x x x	x x x x x x	
10	Stylet oil, 1.0% OE444, 0.5%		x x x x x x	x x x x x x	x x x x x x	x x x x x x	
11	Stylet oil, 1.0% OE444, 1.0%		x x x x x x	x x x x x x	x x x x x x	x x x x x x	
12	Stylet oil, 1.0% OE444, 2.0%		x x x x x x	x x x x x x	x x x x x x	x x x x x x	
13	Stylet oil, 2.0% OE444, 0.25%		x x x x x x	x x x x x x	x x x x x x	x x x x x x	
14	Stylet oil, 2.0% OE444, 0.5%		x x x x x x	x x x x x x	x x x x x x	x x x x x x	
15	Stylet oil, 2.0% OE444, 1.0%		x x x x x x	x x x x x x	x x x x x x	x x x x x x	
16	Stylet oil, 2.0% OE444, 2.0%		x x x x x x	x x x x x x	x x x x x x	x x x x x x	
17	Stylet oil, 1.0% Flint, 2 oz Quintec, 6.6 oz Rally, 5 oz.		x x x	x x x x x	x x	x x	
18	Stylet oil, 1.0% OE444, 0.5% Flint, 2 oz Quintec, 6.6 oz Rally, 5 oz.		x x x x x	x x x x	x x	x x	
19	Stylet oil, 1.0% OE444, 1.0% Flint, 2 oz Quintec, 6.6 oz Rally, 5 oz.		x x x x x x	x x x x	x x	x x	
20	Stylet oil, 1.0% Flint, 2 oz		x x x	x x x	x x x	x x x	
21	Stylet oil, 1.0% OE444, 0.5% Flint, 2 oz Stylet oil, 1.0% OE444, 0.5%		x x x x x x	x x x	x x x	x x x	
22	Stylet oil, 1.0% OE444, 1.0% Flint, 2 oz Stylet oil, 1.0% OE444, 0.5%		x x x x x x	x x x	x x x	x x x	
23	Torino, 3.4 fl oz		x	x	x	x	
24	Torino, 3.4 fl oz M-Pede, 1.0%		x x	x x	x x	x x	
25	Torino, 3.4 fl oz Vintage, 5.0 fl oz Quintec, 6.0 fl oz		x x	x x	x x	x x	
26	Torino, 3.4 fl oz Vintage, 5.0 fl oz Vivando, 10.5 fl oz		x x	x x	x x	x x	
27	Torino, 3.4 fl oz Pristine, 10.5 oz Vintage, 5.0 fl oz Flint, 2.0 oz		x x	x x	x x	x x	
28	Pristine, 10.5 oz Vintage, 5.0 fl oz Flint, 2.0 oz Torino, 3.4 fl oz		x x	x x	x x	x x	
29	OPAlt, 1.5 qt		x	x	x	x	
30	OOtt, 1.5 qt		x	x	x	x	



Trt no.	Treatment	March	April	May	June	July
1	Unsprayed control					
2	Quinteo			x		
	Flint				x	x
	Rally					x
3	MANA			x	x	x
4	MANA			x	x	x
5	MANA			x	x	x
6	MANA			x	x	x
7	Kocide 3000			x	x	x
8	Kocide 3000			x	x	x
9	Kocide 3000			x	x	x
10	Kocide 3000			x	x	x
11	Qrius			x	x	x
12	Inocgnito			x	x	x
13	Inocgnito			x	x	x

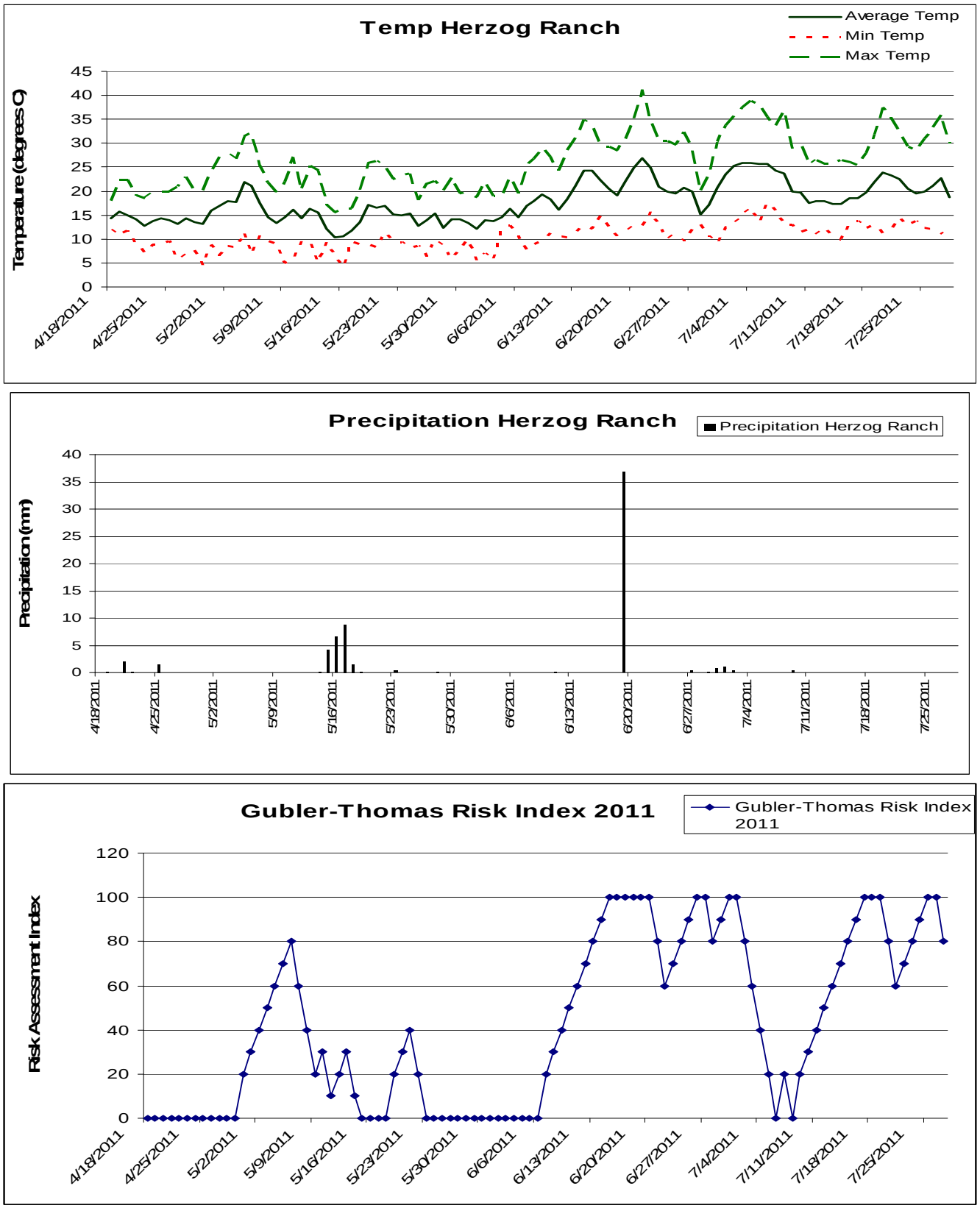
E. Vine management

During the application period (mid April to late July), vines were irrigated two times by flooding. Sucker shoots were removed by local field personnel during the third week of May 2011. Leaf removal around the clusters (on only the north facing aspect of the vines) was conducted by our research group on July 7 and 11 2011. Sucker and leaf removal were done on all five trials. Overhanging shoots were removed on July 25, 2011. Additional small-scale removal of leaves was also conducted at various times.

F. Data collection and statistics

Daily temperature, precipitation data and Gubler-Thomas Risk Index values were computed and obtained from a Metos weather station located at the site. Effect of plot position on plot mean severity was based on data values for all plots from all trials. Disease was assessed on 26 July. 20 clusters were evaluated for powdery mildew incidence and severity in each plot. Incidence was defined as the proportion of clusters in a plot hosting at least some living powdery mildew. Severity was determined by estimating the percentage of berries in a cluster that were infected; the severity value of all clusters was then averaged to give a plot wide estimate of disease severity. Visual estimates of severity were made for more heavily infected clusters. Mean incidence and severity values for each treatment along with standard error were computed. Trial models were analyzed using the ANOVA Tests for data; P-values for trials 1, 2, 3, and 4 were all $P<0.0001$. In Trial 5 the model was not significant. Means comparisons were made using Fisher's LSD with $\alpha=0.05$.

Figure 1. Weather data, powdery mildew risk index values, and disease progression in the trials from April to until disease evaluation on 26 July. (A-B) daily records of precipitation and temperatures from the Powdery Mildew index website, http://www.fieldclimate.com. (C) Powdery mildew risk index, calculated by an on site Metos weather station



Results and discussion

Table 1. Disease severity in trial 1 treatments. Product names are followed by rate (per acre) and the frequency of application. Treatment means followed by the same letter are not significantly different according to Fisher's LSD at α=0.05; alt =alternated with.

Treatment	Disease Severity %	Means Comp.
Flint, 2.0 oz alt Quintec, 4 fl oz, 14d	3.99	k
Quintec 4 fl oz, 14d	6.11	k
C-8, 0.3%, 7d alt Quintec, 4 fl oz, 14d	8.83	jk
C-8, 0.3%, 7d alt w/ Flint 2 oz alt Quintec, 4 fl oz, 14d (C-8 if RI<60, else Flint alt Quintec)	10.90	ijk
Regalia, 1 qt + Quintec, 3 fl oz 14d	15.15	hijk
Flint 2 oz, 14d	23.79	ghijk
C-8, 0.3%, 7d, alt Flint, 2 oz, 14d	24.42	ghijk
C-8, 0.4%, 10d alty w/ Flint, 2 oz, alt Quintec, 4 fl oz, 14d (RI) (C-8if RI<60, else Flint alt Quintec)	24.86	ghijk
C-8, 0.4%, 10d alty w/ Flint, 2 oz, 14d (RI)	31.77	fghij
JMS Stylet Oil, 1%, alt Orca, 1 qt + Regalia, 1 qt, 7d	33.60	fghi
Saf-t-Side, 2.0%, 10-14d (RI)	33.80	fghi
JMS Stylet Oil, 1%, 14d	35.77	fgh
Microthiol, 2 lb, 7d	42.40	fg
Saf-T-Side, 1.5%, 10-14d (RI)	43.40	fg
Saf-T-Side,1%, 10-14d (RI)	44.20	efg
C-8, 0.4%, 10d alt Quintec, 4 fl oz, 14d	50.37	def
Exp A, 4.1 fl oz, 14d	51.46	def
Regalia, 2 qt alt Vivando, 3 fl oz, 14 d	67.60	cde
Antica, 1%, 7d	72.52	bcd
C-8, 0.3%, 7d	77.45	abc
C-8, 0.4%, 7d	80.60	abc
Antica, 1.5%, 7d	82.40	abc
MBI 10605, 0.5%, 7d	82.45	abc
Antica, 0.5%, 7d	83.80	abc
Untreated	94.65	ab
MAR-QL, 2 %, 10-14d (RI)	96.10	a
Antica, 2 %, 7d	97.80	a

Table 2. Disease severity in trial 2 treatments. Product names are followed by rate (per acre) and the frequency of application. Treatment means followed by the same letter are not significantly different according to Fisher's LSD at α=0.05; alt =alternated with.

Treatment	Disease Severity (%)	Means Comp.
Quadris Top + Dyneamic, 14 fl oz + 0.25%, 14d	0.23	g
Luna Experience, 6 fl oz, 21d	0.26	g
Exp 1 + Dyneamic, 14d	0.52	g
Quadris Top + Dyneamic, 14 fl oz + 0.25% alt Quintec, 6.6 fl oz, 14-21d	0.66	g
Inspire Super + Dyneamic, 20 fl oz + 0.25%, 14-21d	0.78	g
Exp 1 + Exp 3 + Dyneamic, 14d	1.02	g
Torino + Dynaemic, 3.4 fl oz + 0.25%, alt Quintec + Dynaemic, 4 fl oz +0.25%, 14d	1.07	g
Adament, 4oz then Luna Experimece, 6 fl oz then Flint 2 oz, 21d	1.44	g
Luna Exp + Dyneamic, 6fl oz + 0.25% alt Quintec + Dyneamic, 6.6 fl oz + 0.25%, 21d	1.74	g
Exp B + Flint, 0.25% + 2 oz then Exp B + Quintec, 0.25% + 6.6 fl oz, 14-21d	2.79	g
Exp 2 + Exp 3 + Dyneamic, 14d	3.43	g
Exp B, 0.25%, 7d then Flint, 2 oz, 14-21d then Quintec, 6.6 fl oz, 14-21d	4.15	g
Quintec, 6.6 fl oz alt Flint, 2 oz, 14-21d	7.52	fg
Quintec + Dyneamic, 6.6 fl oz + 0.25%, 21d	8.02	efg
Luna Experience, 6 fl oz alt Flint, 2 oz, 21d	8.1	efg
Inspire Super + Dyneamic, 20 fl oz + 0.25% alt Quintec, 6.6 fl oz, 14-21d	9.92	defg
Pristine + Dyneamic, 10.5 oz + 0.25% alt Quintec + Dyneamic, 6.6 fl oz + 0.25%, 21d	10.54	defg
Adament, 4 0z, 21d then Flint, 2 oz, 21d then Elite 45 WP, 4 oz, 14 d	23.55	def
Rally + Dyneamic, 5 oz + 0.25% alt Quintec + Dyneamic, 6.6 fl oz + 0.25%, 21d	24.15	de
Exp C, 6.84 fl oz (soil drench at bud) then Adament, 4 oz, 21d then Flint, 2oz, 21d then Elite 45 WP, 4 oz, 14d then Adament, 4 oz, 21d	24.95	d
Exp 2 + Dyneamic, 14d	57.1	c
Exp B, 0.25%, 7 d alt Exp B + OV11, 0.25% + 1 qt, 14d	83.45	b
Exp B, 0.25%, Start bud break - 7d	87.05	ab
Untreated Control	99.9	a
Exp C, 6.84 oz soil drench at bud break	100	a

Table 3. Disease severity in trial 3 treatments. Product names are followed by rate (per acre) and the frequency of application. Treatment means followed by the same letter are not significantly different according to Fisher's LSD at α=0.05; alt =alternated with.

Treatment	Disease Severity %	Means Comp.
Pristine, 8 oz + Sylgard 309, 3 fl oz	0.42	g
Sovran, 4 oz + Sylgard 309, 3 fl oz, 14 d, Vivando, 12.8 fl oz + Sylgard 309 3 fl oz, 14d, Pristine, 12.5 oz + Sylgard 309 3 fl oz, 21d, Vivando 15.4 fl oz + Sylgard 309, 3 fl oz, 21d, Pristine, 12.5 oz + Sylgard 309, 3 fl oz, 21d	0.82	g
Pristine, 12.5 oz (16 oz final) + Sylgard 309, 3 fl oz, 21d	1.62	g
YT-669, 12 fl oz + Dyneamic 0.25%, 14d	2.01	g
Pristine, 8 oz, + Dyneamic 0.2.5% alt. Viticure, 8 fl oz + Mettle 5 fl oz + Dyneamic 0.25%, 14-21 (RI)	2.17	g
YT-669, 6 fl oz, 14d	5.57	g
Viticure 4 SC, 8 fl oz + Dyneamic, 0.25% then Pristine, 6 oz, + Dyneamic, 0.25% then Mettle, 5 fl oz + Dyneamic, 0.25%	5.75	g
Quintec, 6.6 fl oz alt. Flinlt, 2 oz, 14-21 (RI)	5.89	g
YT-669 12 fl oz, 14d	6.31	g
Luna Experience, 6 fl oz + Dyneamic, 0.25% then Microthiol, 5 lb + Dyneamic, 0.25% then Viticure, 6 fl oz + Dyneamic, 0.25%, 14-21 (RI)	6.43	g
Viticure 4SC, 8 fl oz + Dyneamic, 0.25%	6.68	g
Viticure 4 Sc, 8 fl oz + Microthiol, 5 lb, +Dyneamic, 0.25%, 14-21(RI)	7.96	g
Vivando, 12.8 fl oz + Sylgard 309 3fl oz, 14d alt. Pristine 12.5 oz (16 oz final) + Sylgard 309, 3 fl oz, 21d	7.96	g
Sovran, 4 oz + Sylgard 309, 3 fl oz, 14 d, Vivando, 12.8 fl oz + Sylgard 309 3 fl oz, 14d,	9.4	fg
Pristine, 8 oz, then Quintec, 4 fl oz, then Flint, 1.5 oz, 28d	9.9	fg
Topguard, 10 fl oz, 14d	11.92	fg
Pristine, 8 oz then Rally, 4 oz then Quintec, 4 fl oz, then Rally, 4 oz, then Flint, 1.5 oz then Rally,4 oz*	14	fg
CX-9090 0.5 lb, alt Cueva, 1%, 7-10d (RI)	26.94	def
BM 608, 0.35% 10d, alt Flint, 2 oz, 14d	31.8	cde
BM 608, 0.5% alt Flint 2 oz, 14d	34.92	cd
Pristine, 8oz then Sonata, 4qt then Quintec,4 fl ozthen Sonata, 4 qt then Flint, 1.5 oz then Sonata, 4 oz, 14d*	46.17	c
CX-9090, 1 lb, 7-10 (RI)	71.65	b
Cx-9090, 0.5 lb, 7-10 (RI)	85.35	ab
Untreated	97.9	a

*Rally and Sonata rotations w/ Pristine, Quintec and Flint had one missed spray application on approximately June 7.

Table 4. Disease severity in trial 4 treatments. Product names are followed by rate (per acre) and the frequency of application. Treatment means followed by the same letter are not significantly different according to Fisher's LSD at α=0.05; alt =alternated with.

Treatment	Disease Severity %	Means Comp.
Stylet oil w/ 1.0% OE444, 2.0%, 7d	1.9	l
Stylet oil w/ 2.0% OE444, 2.0%, 7d	3.2	lk
Stylet oil w/ 0.25% OE444, 2.0%, 7d	3.62	lk
Stylet oil w/ 0.5% OE444, 1.0%, 7d then Flint, 2 oz, 14d then Stylet oil w/ 0.5% OE444, 1.0%, 7d	4.57	lkj
Stylet oil w/ 0.5% OE444, 2.0%, 7d	6.45	lkj
Stylet oil, 2.0%, 7d	8.03	lkj
Stylet oil w/ 0.25% OE444, 0.5%, 7d	14.51	lkji
Stylet oil w/ 1.0% OE444, 1.0%, 7d	15.65	lkji
Stylet oil w/ 0.5% OE444, 1.0%, 7d then Flint, 2 oz, 14-21d alt Quintec, 6.6 fl oz, 14-21d alt Rally, 5 oz, 14-21d	16.07	lkji
Stylet oil, 1.0%, 7d then Flint, 2 0z, 14d then Stylet oil, 1.0%, 7d	18.78	lkjih
Stylet oil w/ 0.25% OE444, 1.0%, 7d	23.03	lkjihg
Torino + M-Pede, 3.4 fl oz + 1.0%, 14-17d	25.25	lkjihgf
Stylet oil w/ 1.0% OE444, 1.0%, 7d then Flint, 2 oz, 14d alt Stylet oil w/ 0.5% OE444, 1.0%, 7d	26.26	lkjihgf
Stylet oil w/ 2.0% OE444, 1.0%, 7d	27.07	lkjihgf
Stylet oil w/ 1.0% OE444, 1.0%, 7d then Flint, 2 oz, 14-21d alt Quintec, 6.6 fl oz, 14-21d alt Rally, 5 oz, 14-21d	28.19	lkjihgf
Stylet oil, 1.0%, 7d then Flint, 2 oz, 14-21d then Quintec, 6.6 fl oz, 14-21d, Rally, 5 oz, 14-21d	28.94	lkjihgf
Stylet oil w/ 0.5% OE444, 1.0%, 7d	29.17	lkjihgf
Torino, 3.4 fl oz, 14-17d	29.51	kjihgf
Stylet oil, 1.0%, 7d	31.38	jihgf
Pristine, 10.5 oz, 14-21d then Vintage, 5.0 fl oz, 10-14d then Flint, 2 oz, 14-21d then Torino, 3.4 fl oz (4x), 14-17d	36.7	ihgf
Stylet oil w/ 2.0% OE444, 0.5%, 7d	40.35	ihgfe
Stylet oil w/ 1.0% OE444, 0.5%, 7d	45.41	hgfed
Stylet oil w/ 0.5% OE444, 0.5%, 7d	46.75	hgfed
Stylet oil, 0.5%, 7d	50.85	fedcb
Torino (3x), 3.4 fl oz, 14d then Pristine, 10.5 oz, 14-21d then Vintage, 5 fl oz, 10-14d then Flint, 2 oz, 14-21d	66.89	edcb
Torino, 3.4 fl oz, 14-17d then Vintage, 5.0 fl oz, 10-14d then Vivando, 10.5 fl oz, 14-17d	67.95	dcb
Torino, 3.4 fl oz, 14-17d then Vintage, 5.0 fl oz, 10-14d then Quintec, 6.0 fl oz, 14-21d	73.87	abc
OPA11, 1.5 qt, 14d	74.45	abc
Untreated Control	97.7	a
OO11, 1.5 qt, 14d	98.7	a

Table 5. Disease severity in trial 5 treatments. Product names are followed by rate (per acre) and the frequency of application. No significant treatment differences according to one-way ANOVA.

Treatment	Disease Severity %
Quintec, 6.6 fl oz, 21 d alt Rally, 4.0 oz, 14 d alt Flint, 2.0 oz, 21 d	19.95
Kocide 3000, 0.75 lb, 14 d	23.5
Incognito, 0.8 lb, 14 d	25.3
Incognito, 1.2 lb, 14 d	29.35
Orius, 8.6 fl oz, 14 d	29.7
MANA, 2 pt, 14 d	35.4
MANA, 1 pt, 14 d	38.25
Kocide 3000, 1.25 lb, 14 d	44.85
MANA, 6 pt, 14 d	47.33
MANA, 3 pt, 14 d	50.78
Kocide 3000, 3.5 lb, 14 d	54.58
Kocide 3000, 1.75 lb, 14 d	61.08
Untreated	73.83

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VI. Appendix: Materials

Product	Active ingredient(s) and concentration	Manufacturer or distributor	Chemical class (after Adaskaveg et al. 2008)
Antica	lactic acid (10%)	Ahcil Laboratories	unknown
Adament 50WG	trifloxystrobin (25%), tebuconazole (25%)	Bayer	strobilurin (QoI) + DMI
BM 608	tea tree oil extract from *Melaleuca alterniflora* (23.8%)	Biomor Israel, Ltd	biological
C-8	caprylic acid (40%)	Summerdale, Inc.	biological
Cueva	copper octanoate (10%)	Neudorff	copper
CX-9090	*Bacillus subtilis*	Certis	biological
Dyneamic	polyalkyleneoxide modified polydimethylsiloxane, nonionic emulsifiers, methyl ester of C16-C18 fatty acids (99%)	Helena Chemical Co.	adjuvant
Elite 45 WP	tebuconazole (45%)	Bayer	DMI-triazole
Expt 1	N/A	proprietary	N/A
Expt 2	N/A	proprietary	N/A
Expt 3	N/A	proprietary	N/A
Flint 50WG	trifloxystrobin (50%)	Bayer	QoI
Exp. A	proprietary	proprietary	N/A
Incognito 85 WDG	thiophanate-methyl (85%)	Makhteshim-Agan of North America	MBC
Inspire Super 2.82	difenoconazole (8.4%), cyprodinil (24%)	Syngenta Crop Protection, Inc.	DMI + anilinopyrimidine
JMS Stylet-Oil	paraffinic oil (97.1%)	JMS Flower Farms, Inc.	oil
Kocide 3000	copper hydroxide (46.1%)	DuPont	copper
Luna Experience	fluopyram (17.54%), tebuconazole (17.54%)	Bayer	DMI-triazole/SDHI
Luna Privilege	fluopyram	Bayer	SDHI
MANA 040611	N/A	N/A	N/A
MAR-QL	proprietary	proprietary	N/A
Mettle 1 SC	tetraconazole (10-12.5%)	Isagro-USA	DMI
MicroThiol Disperss	sulfur (80%)	Ceresagri, Inc.	sulfur
M-Pede	potassium of fatty salts (49%)	Gowan, Co.	biological
OE-444	oil based adjuvant	Evonik, Inc.	adjuvant
OrCa	Calcium (7%)	Agro-K	unkown
OO11	N/A	N/A	N/A
OPA 11	N/A	N/A	N/A
Orius	tebuconazole (20%)	Makhteshim-Agan of North America	DMI-triazole
Pristine	pyraclostrobin (12.8%) boscalid (25.2%)	BASF	QoI + carboxamide
PureSpray	petroleum oil (98%)	Petro-Canada	oil
Quadris Top 2.71	azoxystrobin (18.2%), difenoconazole (11.9%)	Syngenta Crop Protection, Inc	DMI-triazole/QoI
Quintec	quinoxyfen (22.6%)	Dow AgroSciences LLP	quinoline
Rally 40 WSP	myclobutanil (40%)	Dow AgroSciences LLP	DMI-triazole
Regalia	*Reynoutria sachilinensis* extract	Marrone BioInnovations	biological
Exp B	N/A	proprietary	N/A
Safe-T-Side	petroleum oil (80%)	Brandt, Inc.	oil
OV11	proprietary	proprietary	N/A
Sonata	*Bacillus pumilus* QST 2808 (1.38%)	Agraquest	biological
Sovran	kresoxim-methyl (50%)	BASF	QoI
Sylgard 309	polysiloxane (80%)	Dow Corning Corp	adjuvant
Topguard	flutriafol (12%)	Cheminova	DMI
Torino	N/A	Gowan Co.	N/A
Vintage SC	fenarimol (11.6%)	Gowan Co.	DMI-pyrimidine
Vintre 480 SC	alcohol ethoxylate (8.92%)	OroAgri, Inc.	adjuvant
Viticure 4 SC	triflumizole (42.14%)	Crompton Manufacturing Company (Chemtura Corp.)	DMI
Vivando	metrafenone (300g/L)	BASF	N/A
YT669	picoxystrobin (250 mg/L)	DuPont	QoI

Appendix sources: (1) Adaskaveg, et al. 2011. Efficacy and timing of fungicides, bactericides and biologicals for deciduous tree fruit, nut, strawberry, and vine crops 2011, available at http://www.escholarship.org/uc/item/05b5z3vs.
(2) Janousek et al. 2008. Grape powdery mildew trials, available at http://plantpathology.ucdavis.edu/ext/gubler/fungtrials2008/file/Grape_PM_2008_web_report.pdf , (3) Bay, et al, 2010, Grape powdery mildew Trials http://plantpathology.ucdavis.edu/ext/gubler/fungtrials2010/, (4) product-specific MSDS and/or labels.