

# **DETECTION OF RESISTANCE IN POPULATIONS OF *VENTURIA PIRINA* IN CALIFORNIA PEAR ORCHARDS**

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## **ABSTRACT**

Pear scab is the most common disease of pear in the north coast area of California. Scab prevention requires use of fungicides in most years for control. In recent years the most common products used against pear scab have been products that attack the pathogen in only one locus. As these materials are used over time, resistance and reduced susceptibility to the products has occurred. Spiral gradient endpoint tests were conducted to measure fungicide resistance and efficacy. Fungicide resistance in *Venturia pirina* population was shown to Flint and decreased susceptibility to several other fungicides including Elite, Luna Sensation, Sovran, and Topsin M.

**OBJECTIVES 1 and 2.** Pear Scab: Determine types of fungicide resistance in *V. pirina* population and determine distribution of fungicide resistance in *V. pirina* population.

## PROCEDURE

*V. pirina* isolates were collected by PCAs and growers in 2013. Isolates were mass cultured and maintained on appropriate media prior to being tested using the automated spiral plater for their reaction to various fungicides. The active ingredients in Elite, Flint, Fontelis, Luna Sensation, Sovran, Syllit, Topguard, Topsin and Vintage were tested (Table 1). The Automated Spiral Plater, Autoplate 400, was used to conduct the Spiral Gradient Endpoint test which measured susceptibility of spore germination to a gradient of fungicides on an agar plate. A solution of 25 ppm of the fungicide was spiral plated onto a 150 mm PDA plate. Then the plates were radially streaked with a conidial suspension of the fungal isolates. After incubation for one week, the fungi grew on parts of the plate where fungicide did not inhibit their growth. EC 50's (Effective Concentrations) were measured. EC was determined by the point on the plate where the fungal growth was inhibited by the fungicide. Each isolate was replicated at least three times and the test repeated at least one time. Appropriate data analysis was conducted for determination of the EC50 against the products and for determination of significant differences among isolates for individual products. Isolates were identified as to the location they were collected from, including pear variety, orchard, location in the orchard, location of orchard in the county, and a history of use for the product class being tested.

Table 1. Products tested in *V. pirina* spiral plater trial.

Product	Active ingredient(s)	Class	Manufacturer
Elite (Tebuzol 45 DF)	Tebuconazole	DMI-triazole (3)	United Phosphorous
Flint	Trifloxystrobin	QoI (11)	Bayer
Fontelis	Penthiopyrad	SDHI (7)	Dupont
Luna Sensation	Fluopyram/trifloxystrobin	SDHI (7)/QoI (11)	Bayer
Sovran	Kresoxim-methyl	QoI (11)	Cheminova
Syllit	Dodine	Guanidine (7)	Agriphar
Topguard	Flutriafol	DMI-triazole (3)	Cheminova
Topsin-M	Thiophanate-methyl	MBC (1)	UPI
Vintage	Fenarimol	DMI-pyrimidine (3)	Gowan

## RESULTS

Susceptibility to fungicides varied among the isolates and areas tested. Table 2 shows the number of isolates tested from each area. Hopland and Kelseyville only had one isolate each. Ukiah had the most isolates.

Table 2. Number of isolates tested from each area.

Area	Number of Isolates
Hopland	1
Kelseyville	1
Marysville	8
Redwood Valley	5
Scotts Valley	9
Ukiah	25
Upper Lake	11
Total	55

The average EC50 value for tebuconazole, the active ingredient in Elite, varied among areas (Figure 1). Overall, average EC50 values were low, indicating good activity. However, some areas had isolates that showed decreased sensitivity to tebuconazole (figure 2) especially in the Marysville, Kelseyville, Scotts Valley and Upper Valley areas. Hopland and Ukiah had isolates that were close to wild type.

Figure 1. Average EC 50 values for tebuconazole for the population of *Venturia pirina* for each area sampled.

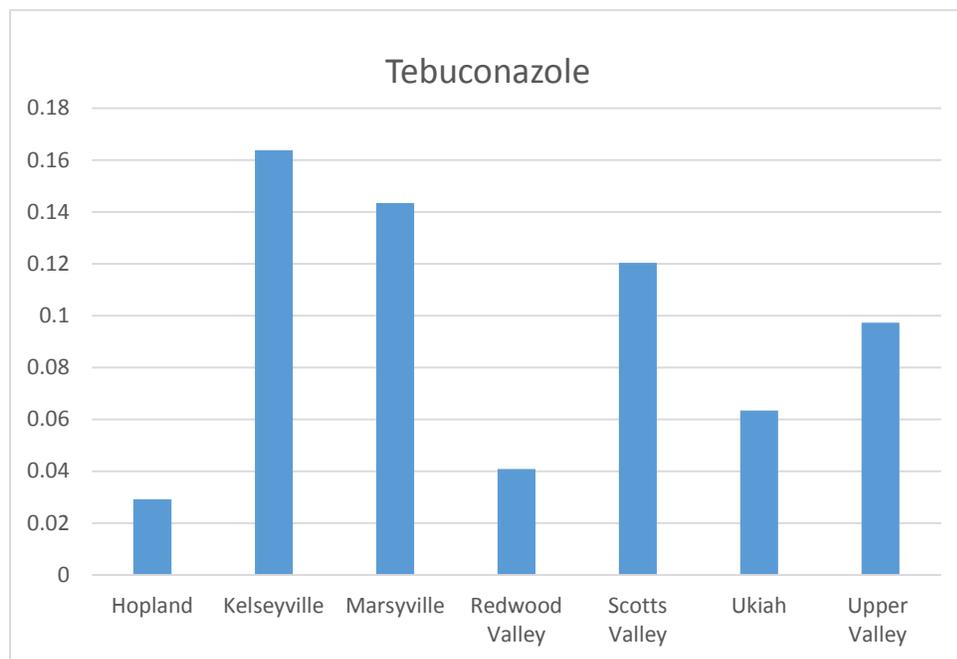
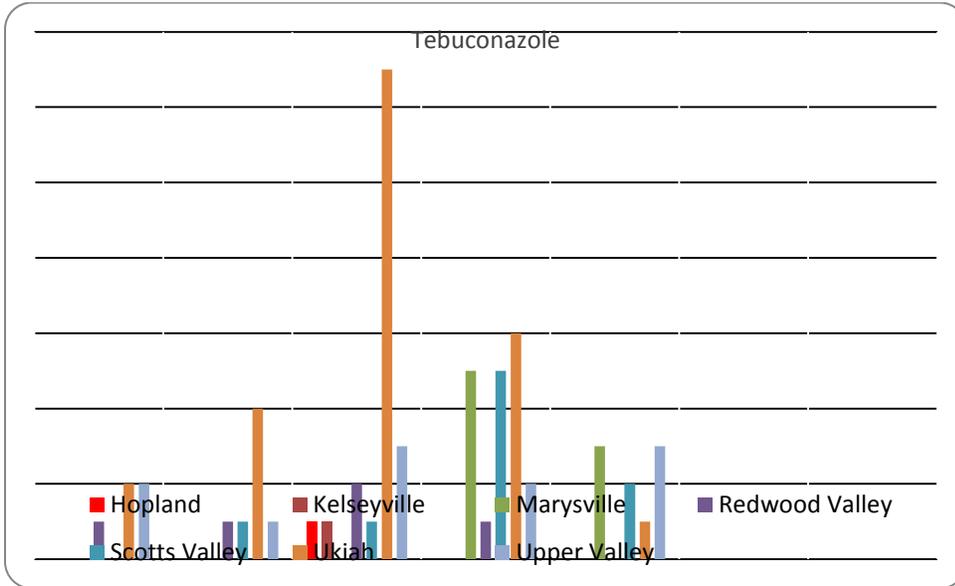


Figure 2. Isolates grouped per location and EC50 class for tebuconazole.



Trifloxystrobin, the active ingredient in Flint, had higher EC 50 values in Marysville and Upper Valley (Figure 3). Ukiah, Marysville and Upper Valley all have many isolates with possible resistance to Flint (Figure 4). Trifloxystrobin is also an active ingredient in Luna Sensation, along with fluopyram.

Figure 3. Average EC 50 values for trifloxystrobin for the population of *Venturia pirina* for each area sampled.

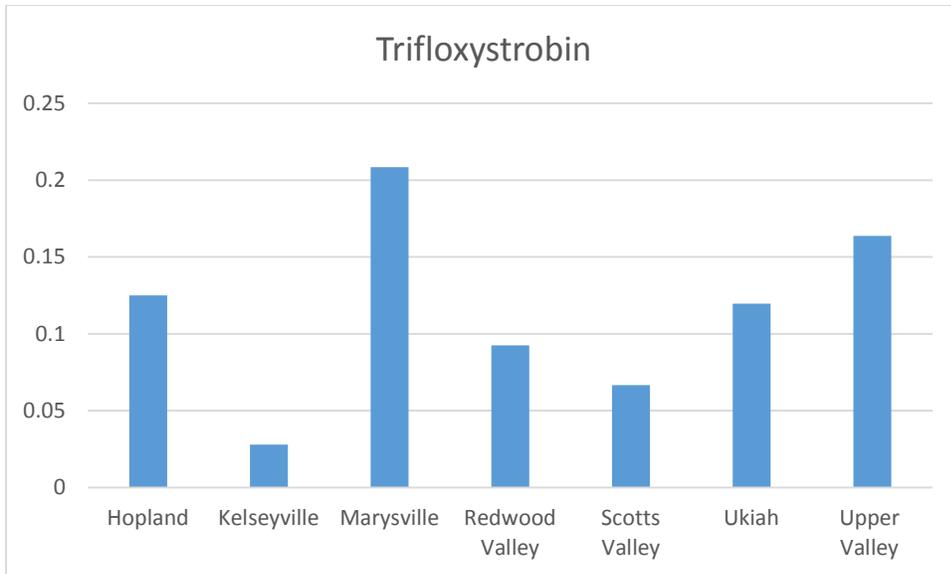
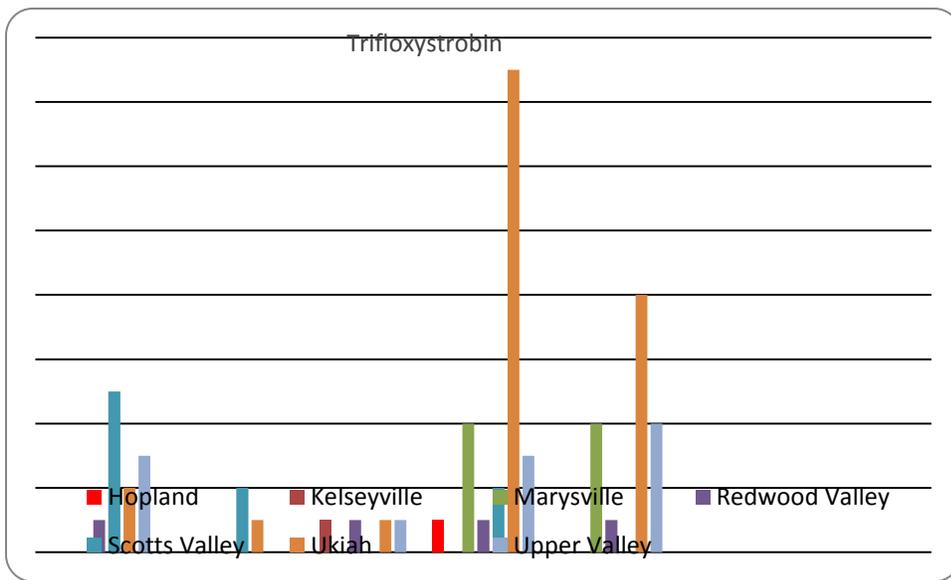


Figure 4. isolates grouped per location and EC50 class for trifloxystrobin.



Areas vary in average susceptibility to fluopyram, one of the active ingredients in Luna Sensation (Figure 5). Ukiah and Redwood Valley have lower average EC 50 values. Isolate susceptibility is varied with several areas having isolates of reduced sensitivity (Figures 5 and 6).

Figure 5. Average EC 50 values for fluopyram for the population of *Venturia pirina* for each area sampled.

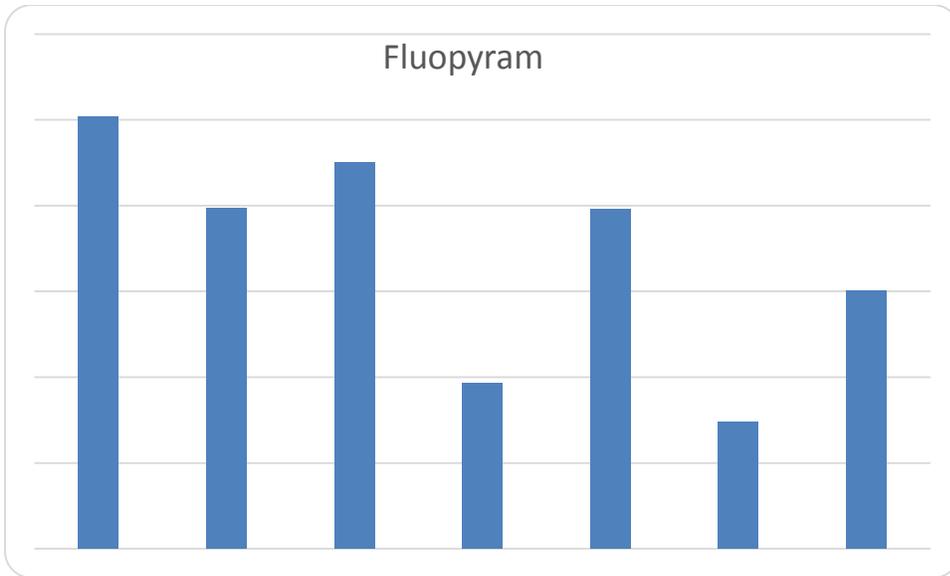
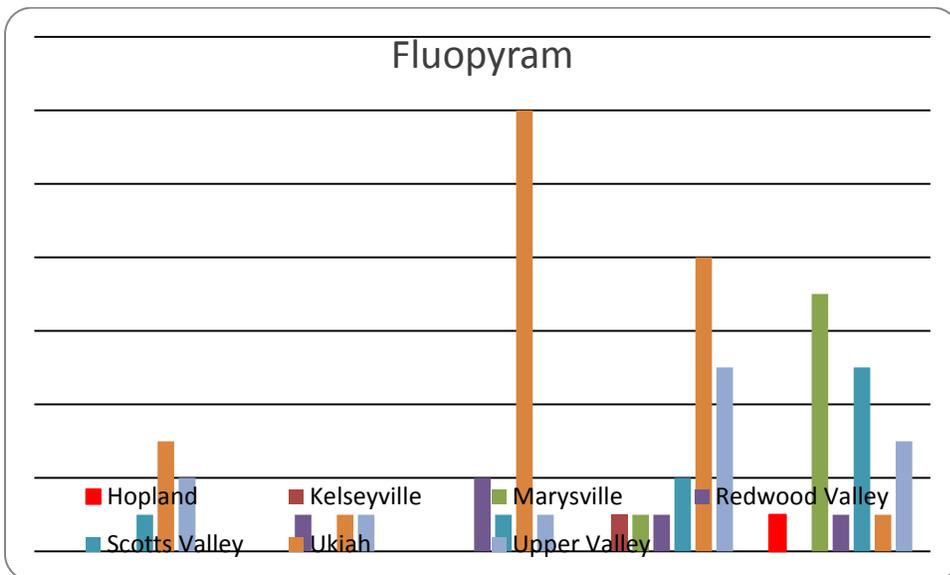


Figure 6. Isolates grouped per location and EC50 class for fluopyram.



Penthiopyrad is the active ingredient in Fontelis. As shown in Figure 7, all areas had low average EC 50 values. Nearly all isolates were wild type with good sensitivity to Penthiopyrad (Figure 8). No isolates had EC 50 values above 0.2.

Figure 7. Average EC 50 values for penthiopyrad for the population of *Venturia pirina* for each area sampled.

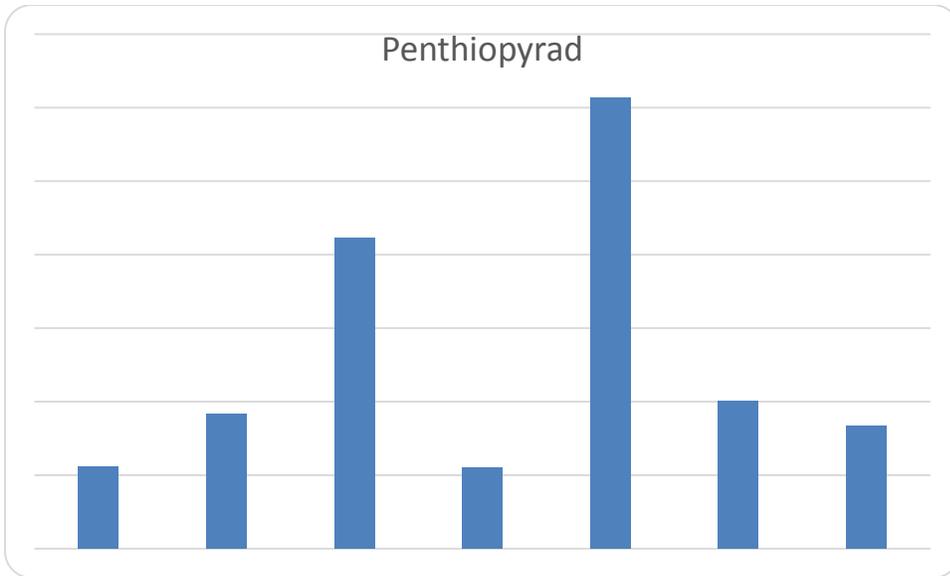
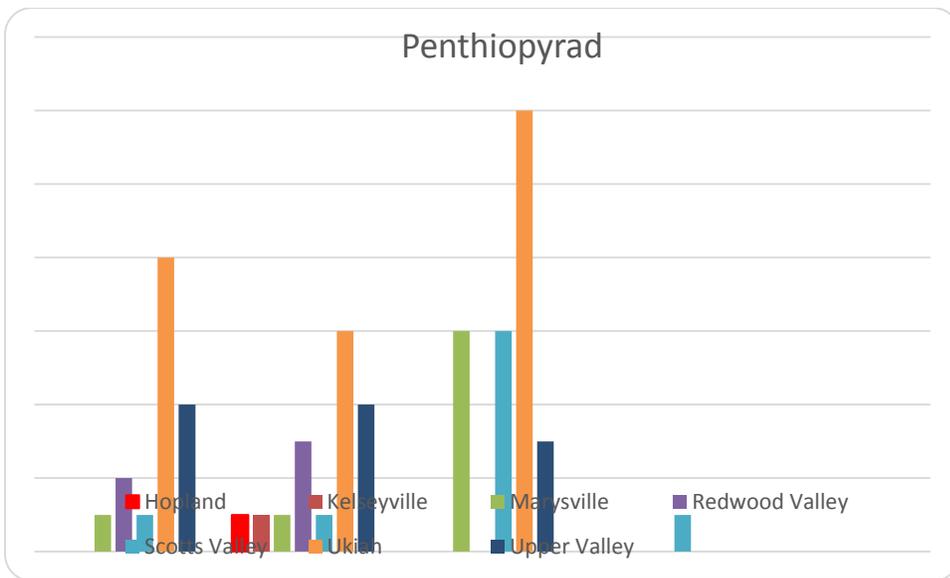


Figure 8. Isolates grouped per location and EC50 class for penthiopyrad.



Triflumizole, the active ingredient in Procure, was effective against *V. pirina*. Only Kelseyville had an area average above 0.050 (Figure 9). No isolates had EC 50 values above 0.2 (Figure 10).

Figure 9. Average EC 50 values for triflumizole for the population of *Venturia pirina* for each area sampled.

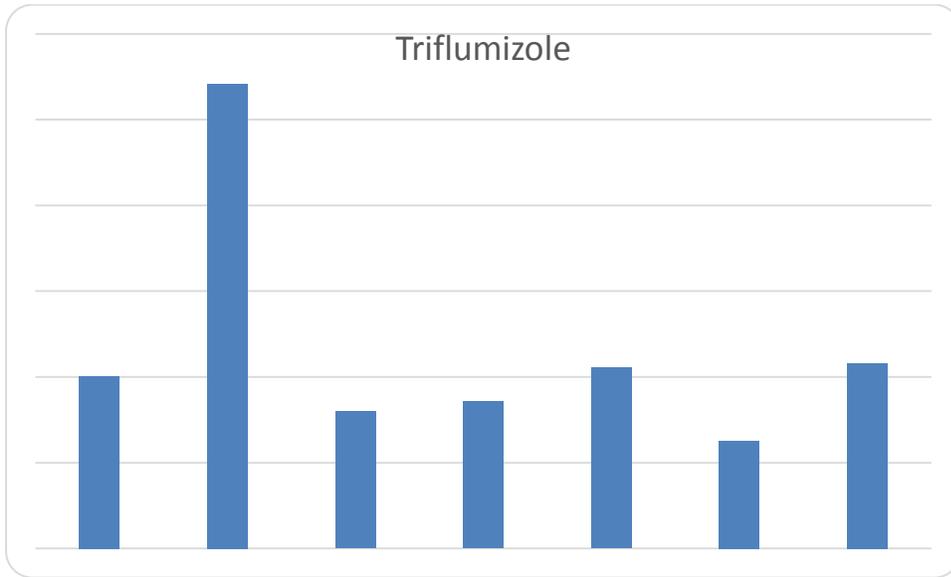
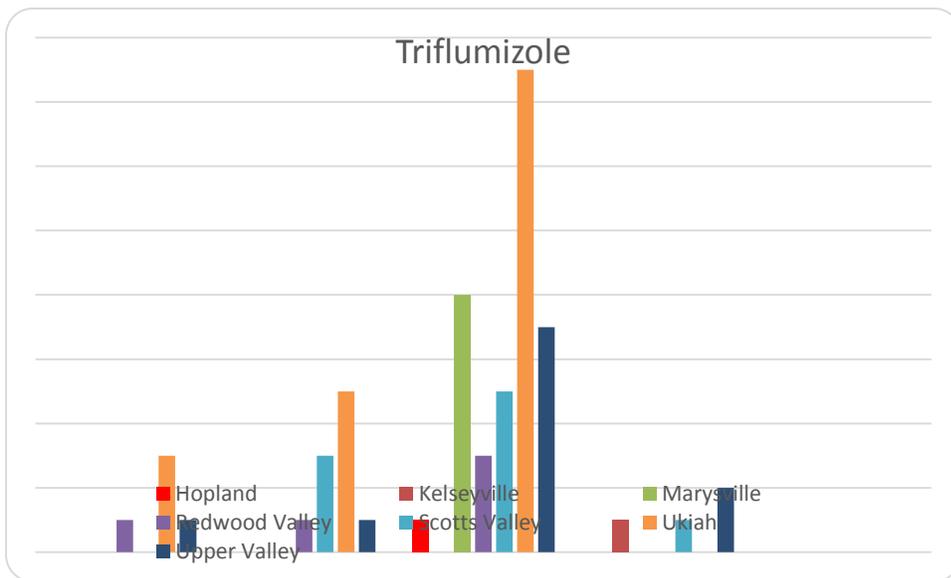


Figure 10. Isolates grouped per location and EC50 class for triflumizole.



Overall, isolates were less sensitive to kresoxim-methyl, the active ingredient in Sovran (Figure 11). In Marysville, EC50 values averaged 0.28. Figure 12 shows most isolates were in the least sensitive class (>0.2 and >0.5). This is the same class of chemistry as Flint, i.e. strobilurin so it is not surprising that there is some reduced sensitivity to Sovran.

Figure 11. Average EC 50 values for kresoxim-methyl for the population of *Venturia pirina* for each area sampled.

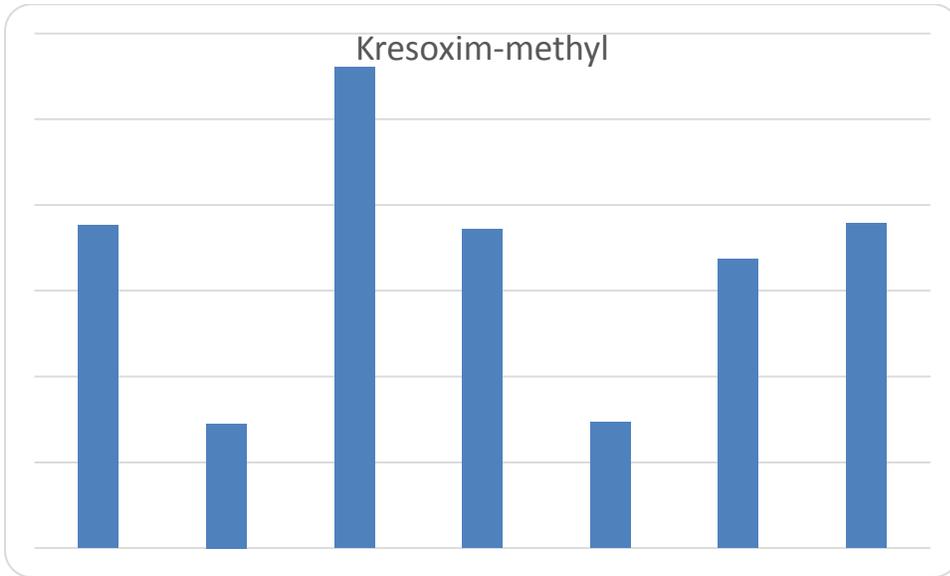


Figure 12. Isolates grouped per location and EC50 class for kresoxim-methyl.

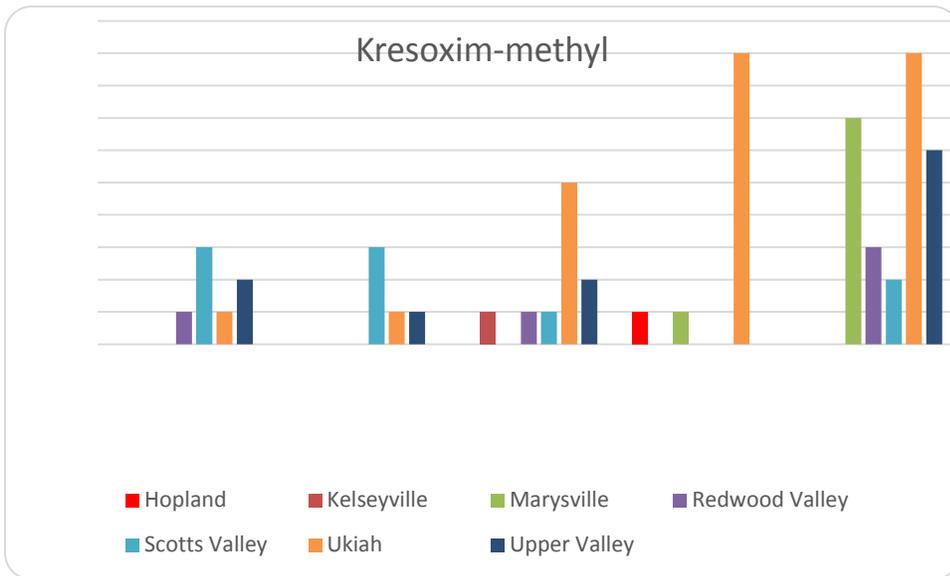


Figure 13 shows average EC 50 values for dodine, the active ingredient for Syllit were low for all areas. Most isolates were sensitive to dodine (Figure 14).

Figure 13. Average EC 50 values for dodine for the population of *Venturia pirina* for each area sampled.

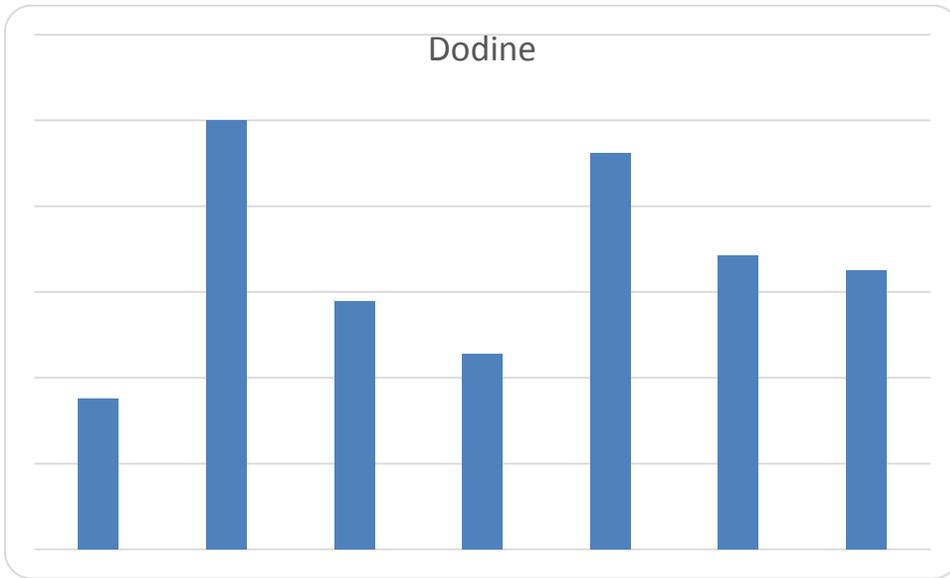
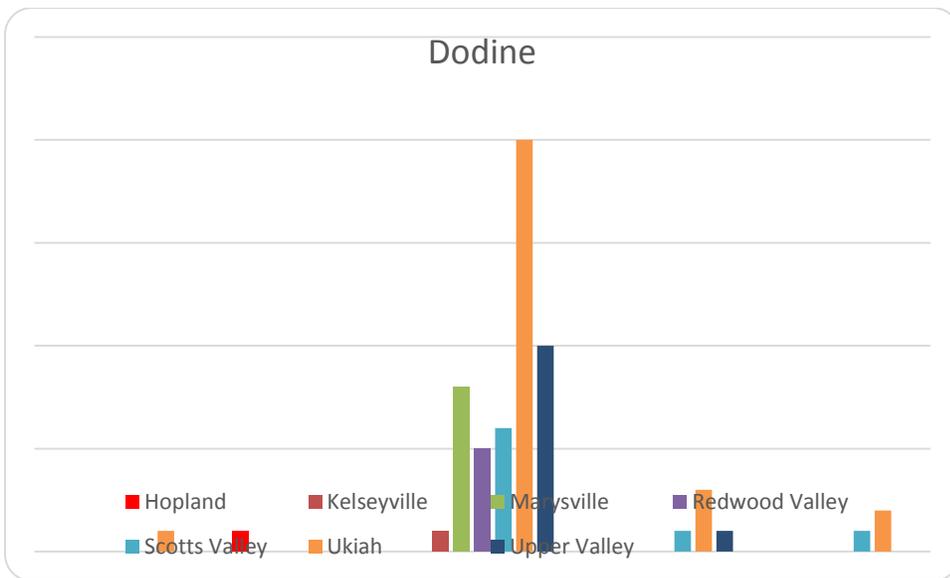


Figure 14. Isolates grouped per location and EC50 class for dodine.



Topguard (active ingredient flutriafol) had low average EC 50 values (Figure 15). Most isolates were intermediate in sensitivity (Figure 16). The DMI fungicides were shown to have reduced sensitivity in last years study so again it is not surprising that we see some reduced sensitivity for Topguard.

Figure 15. Average EC 50 values for flutriafol for the population of *Venturia pirina* for each area sampled.

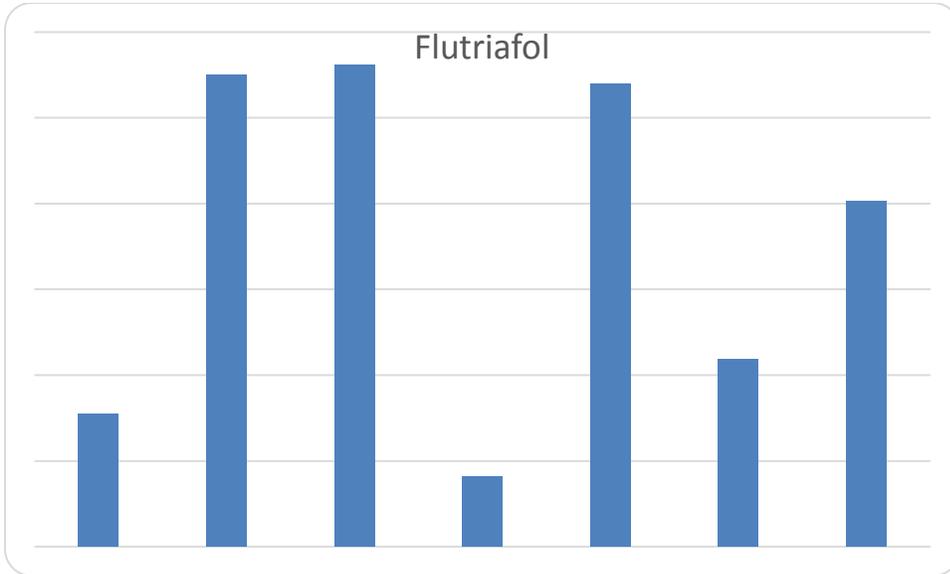
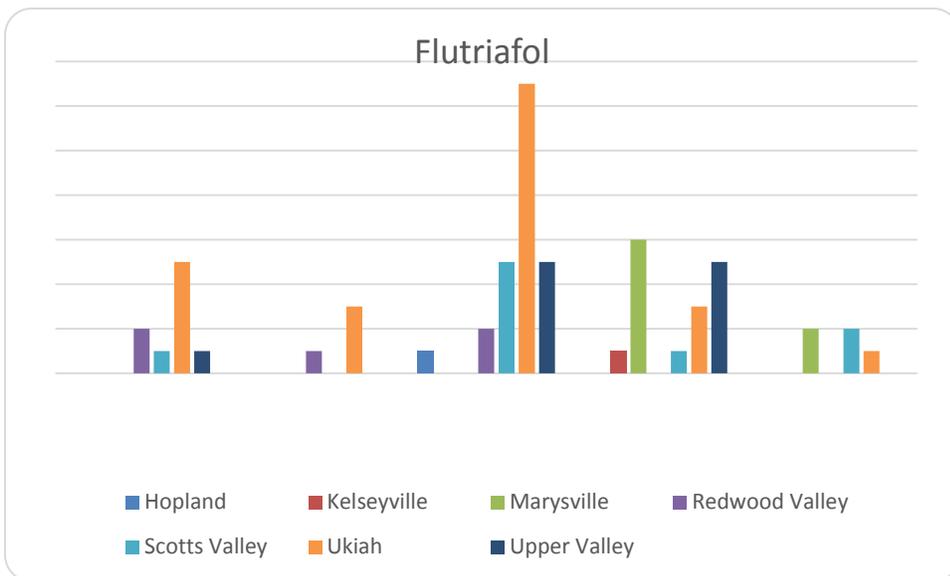


Figure 16. Isolates grouped per location and EC50 class for flutriafol.



Average EC 50 values were high for thiophanate- methyl, the active ingredient in Topsin M. Ukiah had the lowest EC 50 values. All areas had isolates with reduced sensitivity to Topsin M (Figure 18).

Figure 17. Average EC 50 values for thiophanate-methyl for the population of *Venturia pirina* for each area sampled.

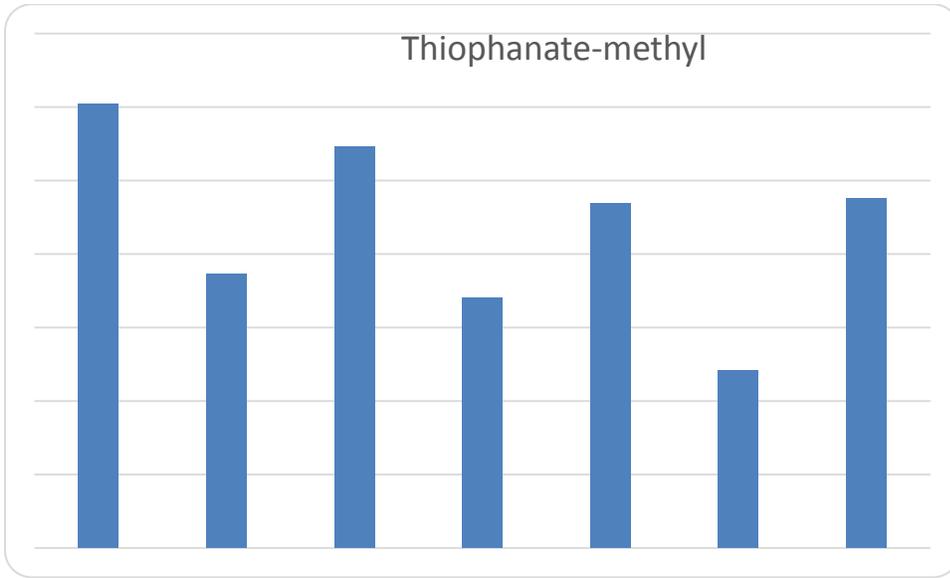
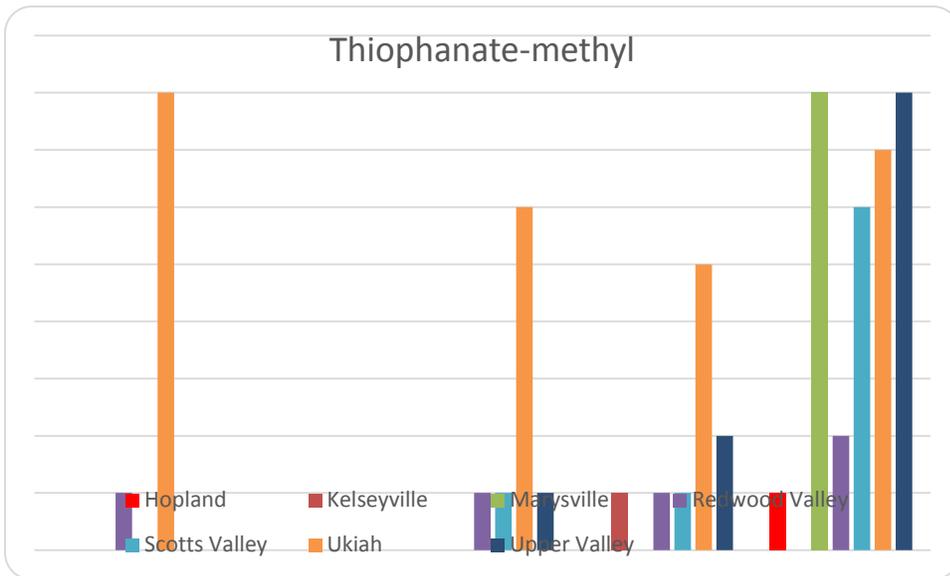


Figure 18. Isolates grouped per location and EC50 class for thiophanate-methyl.



Fenarimol (active ingredient in Vintage), had low average EC 50 values in all areas (Figure 19). Nearly all isolates were sensitive to fenarimol (Figure 20).

Figure 19. Average EC 50 values for fenarimol for the population of *Venturia pirina* for each area sampled.

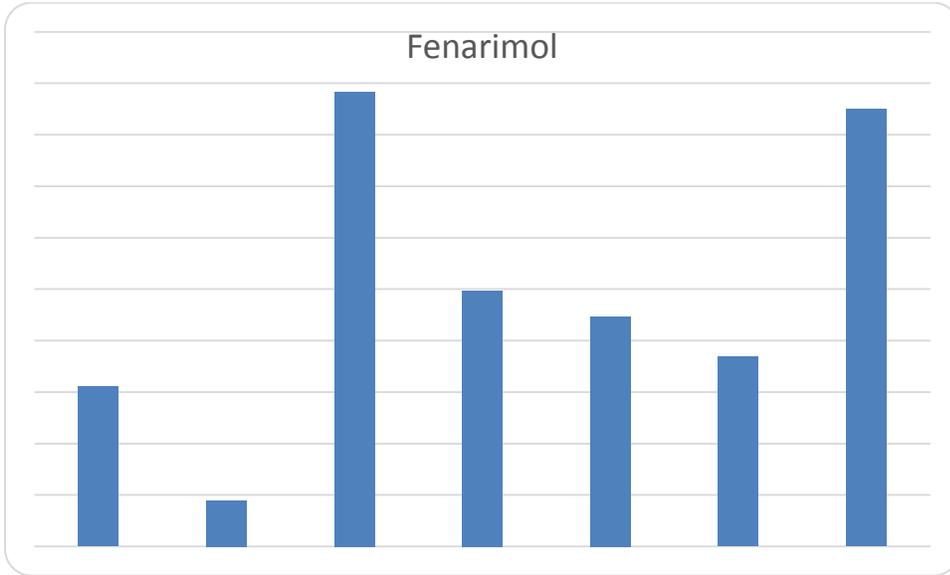


Figure 20. Isolates grouped per location and EC50 class for fenarimol.

