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Update on Pest Management and Crop Development

F R U I T J O U R N A L

August 9, 2010 VOLUME 19, No. 21 Geneva, NY

INSECTS

BEFORE THE FALL

ORCHARD RADAR DIGEST

Codling Moth

Codling moth development as of August 9.

2nd generation adult emergence at 94% and 2nd generation egg hatch at 74%.

DISEASES

BIN THERE

RETHINKING POSTHARVEST DRENCH TREATMENTS FOR APPLES

(Dave Rosenberger, Plant Pathology, Highland)

❖❖ For the past four or five decades, apple storage operators have used postharvest drenches containing diphenylamine (DPA) and a fungicide to prevent storage disorders and postharvest decays in apples that were to be stored more than three months after harvest. DPA was introduced to control the physiological disorder known as superficial scald, but scientists later learned that it also suppresses both carbon dioxide injury and some of the benzimidazole-resistant strains of *Penicillium expansum* and *Botrytis cinerea*. Thus, the combination of DPA plus a benzimidazole fungicide (e.g., Mertect 340F, or thiabendazole) provided effective control of the major postharvest pathogens for many years after benzimidazole-resistant strains of these pathogens were detected in storages and packinghouses.

Until recently, DPA could be applied only by cascading the DPA solution over filled bins of apple fruit as the fruit were brought into storages. The recycling DPA solution gradually accumulated spores of *P. expansum* and *B. cinerea* and transported those spores to wounds in fruit. The recycling DPA drenches were very effective for inoculating fruit, so postharvest fungicides had to be included in the drench solution to ensure that the DPA application did not stimulate decay problems.

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In the mid 1990's, the DPA-benzimidazole combination began to fail because *P. expansum* populations in many packinghouses had finally become resistant to the DPA-benzimidazole combination. As the incidence of blue mold decay increased, the decayed fruit left behind increasing numbers of blue mold spores on apple bins. This gradually increasing spore load was recycling from bins into drench water each fall, thereby causing the decay incidence to gradually spiral upward. Increased attention to bin sanitation helped to stem the rising losses, but the real solution came with the registration of two very effective new fungicides: Scholar (fludioxonil) and Penbotec (pyrimethanil). These and other available fungicides were described in a 2009 article in *Scaffolds Fruit Journal.*

Food Safety Issues: The recycling drenches traditionally used to apply DPA and fungicides are increasingly viewed as posing unacceptable food safety risks. The concern is that any human pathogen that might be transferred from bin runners into the drench solution could then be recycled over thousands of bushels of apples. The fact that intact apples are a very poor medium for hosting human pathogens carries little weight among food safety experts because studies have shown there is at least a slight possibility that human pathogens could survive in apple wounds and then be transferred to a consumer. When apples are floated out of bins on the packing line, the risks associated with handling the apples in a recycling water flume can be addressed by adding a biocide (e.g., chlorine) to the water to kill any introduced pathogens. However, biocides cannot be used in combination with DPA because DPA is an anti-oxidant whereas most biocides are strong oxidizers. Combining the two in a single tank or even in successive treatments would inactive either DPA or the sanitizer, or perhaps both.

One way to bypass postharvest drenches is to apply DPA as a fog after storage rooms are filled. Most storage operators in New York have found that no fungicide is needed if apples are kept dry after harvest, so an increasing number of apple storage rooms are being fogged with DPA each year.

Several packinghouse operators in New York devised a different approach for bypassing DPA drenches. They mixed up the same concentration of DPA that would be used for postharvest drenching and then sprayed 2.5 qt of the DPA solution over the top of each filled bin of apples as the bins were being moved into storage. This low volume application resulted in little if any runoff from the bottom of the bins, but it reportedly controlled storage scald and CO2 injury. This application method was not inconsistent with label instructions for Decco No-Scald DPA, but it would not have been acceptable for the DPA product marketed by Pace International because that label requires application via a high-volume drench. However, questions remained about whether this application method was really controlling scald and CO2 injury or whether the treated fruit would have escaped these disorders even if no treatment had been applied.

Research on nonrecycling drenches: The NY Apple Research and Development Program supplied funding to investigate the effectiveness of the 2.5 qt/bin treatment that will henceforth be called a nonrecycling drench (NRD). For these experiments, we constructed 24 plywood minibins that were 15

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inches square (interior measurements) by 36 inches high so that we could work with "columns" of fruit equal in depth to those in full-size commercial storage bins. Each minibin held roughly 2.4 bushels of fruit and had an interior footprint area equal to 12% of that found in a MacroPlastic model 32FV bin.

The scald control experiment was initiated on 23 September 2009. Each bin was filled by placing 50 Cortland "data fruit" in the bottom, 25 in the mid-height part of the bin, and 25 fruit at the top of the bin. The intervening spaces were filled with Golden Delicious fruit so that we could quickly separate data fruit from filler fruit when experiments were evaluated. The Cortland fruit were harvested during the early part of the harvest window and were then held at ambient temperature for two days after harvest to increase the likelihood that a high proportion of fruit would develop storage scald. Each of the following treatments was applied to four different minibins: 1) NRD water control, 2) NRD treatment with No Scald DPA at 1500 ppm, and 3) high-volume recycling drench (RD) treatment with No Scald DPA at 1500 ppm. For the NRD treatments, the volume of solution applied over the tops of our minibins was equivalent to application of 4.3 qt per full-size bin. To minimize the amount of treatment solution that might be absorbed by dry bin walls, the plywood minibins were hosed down with water several times over a 4-hr period before fruit were placed into them. We recaptured treatment solution that ran out of the bottoms of the minibins receiving the NRD treatments and found that the grower reports of 2.5 qt of retained solution per full-size bin were quite accurate. The 12 minibins used for this trial were enclosed in large plastic bags and moved into a 36° F cold room within an hour after treatments were applied.

Fruit were removed from cold air storage and evaluated for superficial scald on 1 February 2010. Fruit with scald, decay, or senescent breakdown were discarded during the first evaluation. The remaining fruit were held for an additional seven days at 70° F and were then evaluated again to determine how many additional fruit developed superficial scald during the shelf-life test. When results were tabulated, we found that 61% of fruit treated with water only (applied as a nonrecycling drench) developed scald by the end of the trial whereas fruit treated with diphenylamine in either a recycling drench or in a nonrecycling drench had only 2% of fruit with scald (Fig. 1). Furthermore, there was no significant difference between scald incidence in the tops and bottoms of bins treated with DPA regardless of which treatment method was used. Thus, although the fruit and the storage conditions in this trial were very conducive to development of superficial scald, DPA applied as a nonrecycling drench was just as effective as when it was applied using the traditional recycling drenching method.

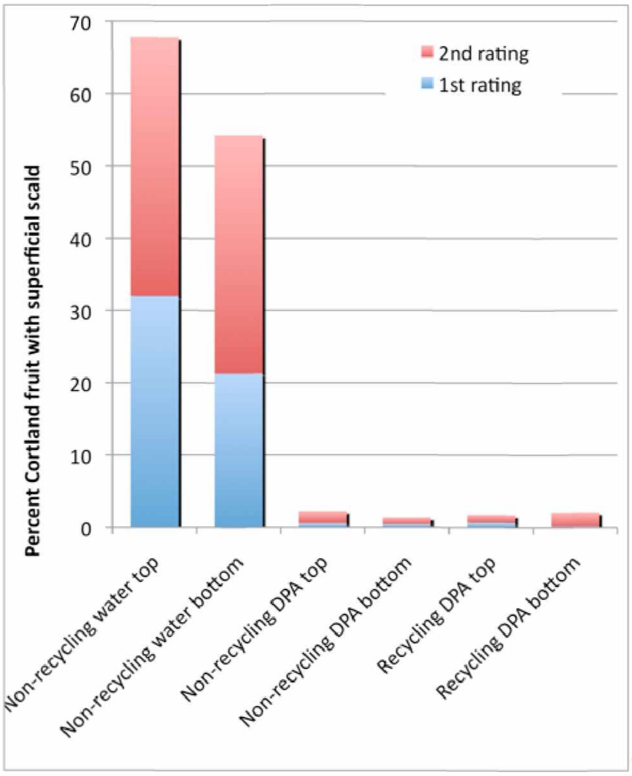

Fig 1. Effects of DPA treatments on the incidence of superficial scald noted on Cortland fruit that had been held in air storage from 23 September through 1 February and that were then evaluated a second time after a 7-day shelf-life test at 70° F. Data is presented separately for fruit from the tops of the bins and fruit from the bottom half of the bins.

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A similar experiment was conducted to determine if fungicides were needed to control postharvest decays when DPA is applied via the NRD method. Cortland fruit used in this experiment were wounded three times on each of three sides by puncturing them with a large cork fitted with three finishing nails that produced wounds that were 3 mm deep and 2 mm in diameter. Groups of 25 wounded fruit were held in plastic half-bushel bags until they could be placed in bins. After all fruit were wounded, 50 wounded data fruit (2 bags) were placed in the bottom of each minibin and 25 more data fruit were added in the middle and at the top of the each bin. As the bags of wounded fruit were emptied into the bins, they were misted with a spore suspension of *P. expansum*. As in the previous trial, the intervening spaces in each bin were filled with Golden Delicious fruit.

The following treatments were applied, using four replicate bins for each treatment and adjusting the volume of NRD treatment solution for our minibins to the equivalent of 4.3 qt per full-size bin:

1. NRD: Water control
2. NRD: No Scald DPA 1500 ppm plus Scholar 230SC 10 fl oz/100 gal plus Captan 80 1.25 lb
3. NRD: No Scald DPA 1500 ppm plus Penbotec 16 fl oz/100 gal plus Captan 80 1.25 lb
4. RD: Water control
5. RD: No Scald DPA 1500 ppm plus Scholar 230SC 10 fl oz/100 gal plus Captan 80 1.25 lb
6. RD: No Scald DPA 1500 ppm plus Penbotec 16 fl oz/100 gal plus Captan 80 1.25 lb

Following treatment, the minibins were enclosed in large plastic bags and moved into a cold room within an hour after the treatments were applied. Fruit were evaluated on 16 November after 56 days of cold storage.

Fruit in the RD water control (trt 4) developed decay at 68.7% of the wounds whereas fruit in the NRD water control (trt 1) developed decay at only 24.3% of the wounds (Fig. 2). Thus, the recycling water picked up the spores that we had misted over the Cortland fruit and effectively carried those spores into wounds whereas that occurred to a much lesser extent in the NRD treatment. When results for other treatments were converted to percent control using trt 4 as the basis for the maximum infection rate, we found that just switching away from the RD to the NRD treatment in the absence of any fungicide provided a 65% reduction in disease incidence (Fig. 2). When Scholar and Penbotec were applied as RD treatments, they provided greater than 99% control of blue mold, but they only provided 86% and 92% control, respectively, when applied as NRD treatments. In a separate trial, we added a fluorescent dye to DPA and found that only about 40% of the fruit surfaces in the minibins were contacted by the DPA/dye solutions when DPA was applied via the NRD system. Thus, the 65% reduction in decay incidence with NRD in the absence of fungicides may be closely linked to the proportion of fruit that is wetted when NRD treatments are applied.

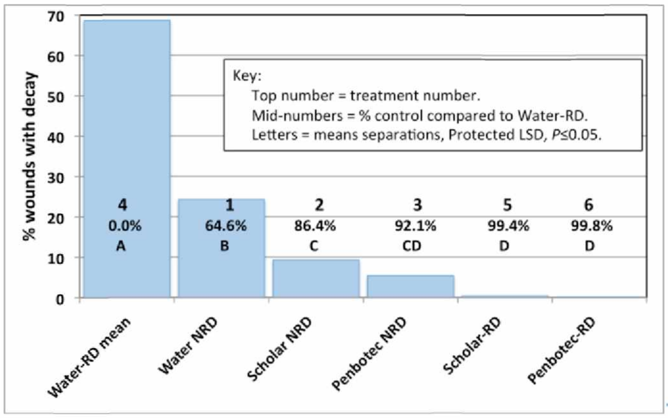

Fig 2. Effects of fungicide treatments on disease incidence in Cortland fruit that were wounded, mist-inoculated with spores of *Penicillium expansum*, then treated with water, Scholar, or Penbotec using either recycling drenches (RD) or non-recycling drenches (NRD).

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Conclusions: DPA applied via the NRD method was just as effective as DPA applied in a recycling drench, even though we know that much of the fruit surface was never wetted by the NRD-applied DPA solution. It may be that vapor action of DPA is sufficient to suppress scald on the portions of fruit not contacted by the DPA solution. Vapor activity was probably enhanced in our trial because the minibins were enclosed in polyethylene after treatments were applied, thereby slowing dilution of the DPA vapors into the storage room air. However, the 2.5-qt NRD applications reportedly have worked well in commercial storages when rooms are filled relatively rapidly, and bins in those storages were not enclosed with poly bags. Nevertheless, small storage operators who fill rooms slowly may have less success with the 2.5-qt NRD method because the ratio of treated fruit surface area to total air volume of the storage may be too low to get effective action from DPA vapors.

Is a fungicide needed if DPA is applied via the 2.5-qt NRD method? Our results are inconclusive because the answer will largely depend on how much inoculum is present on fruit and bins that are being stored. In our RD water-only treatment, the recycling solution rapidly picked up spores we had misted onto the fruit surfaces and redistributed them to a high proportion of wounds in the same way that spores in commercial DPA drenchers are redistributed to fruit wounds in the absence of an effective fungicide.

By switching to the NRD treatment system (i.e., applying water without recycling it), we reduced decay incidence by nearly 65% without using any fungicide. This reduction in decay with NRD treatment alone would have been greater if we had applied less inoculum. Previous work has shown that fruit coming from the field rarely carry more than 30,000 *P. expansum* spores per commercial-size bin whereas we misted fruit with the equivalent of 3.7 billion spores per full-size bin. Other factors in our methodology that favored disease development included having nine wounds per fruit and 100% relative humidity during storage that resulted when minibins with wet fruit were bagged. Although we achieved better disease control with RD than with NRD fungicide applications in our trial, we suspect that DPA without fungicide could be applied via the 2.5-qt NRD method, provided inoculum levels are kept low.

Keys to keeping inoculum levels low include using clean bins and sanitizing storage rooms at the end of each packing season. The latter is important because huge spore-loads can persist on floors in nonsanitized rooms and these spores will become airborne again, due to forklift traffic and blower fans, during room filling.

Finally, storage operators should use caution when adopting any new practices that might impact the quality of fruit coming out of storage. The experiments reported here provide an overview of what might be feasible, but at least one more year of research is needed before we can recommend broad-scale adoption of DPA application via the 2.5-qt NRD method.❖❖

FIELD NOTES

Regional Trap Numbers
Week Ending 8/9, Avg No./trap

Location/County	Date	STLM	OFM	LAW	CM	OBLR	AM
Lyndonville/Orleans	8/6	94.0	0.3	15.3	0.0	0.7	23.3
Waterport/Orleans	8/6	28.7	0.3	7.0	0.7	0.3	16.0
Hilton/Monroe	8/6	486	0.0	2.0	2.7	0.0	12.3
Lincoln/Wayne	8/6	97.3	0.0	15.3	3.7	0.7	8.3
Sodus-Lakesite/Wayne	8/5	16.0	0.0	1.0	1.3	0.0	4.0
Sodus-Inland/Wayne	8/5	16.7	0.3	0.0	0.3	0.3	6.3
Alton/Wayne	8/3	63.3	0.0	0.7	0.3	2.0	3.7
Wolcott/Wayne	8/3	26.7	0.0	1.7	1.7	2.7	5.0
Newfield/Tompkins	8/2	216	0.0	1.0	12.0	0.7	43.0
Lafayette/Onondaga	8/3	144	0.0	9.0	4.3	3.3	3.7
Chazy/Clinton	8/3	682	0.0	5.0	0.3	0.0	5.3
Valcour/Clinton	8/3	67.3	0.3	6.7	0.0	0.0	4.3
Peru/Clinton	8/3	528	0.3	1.7	0.0	3.3	4.3
Granville/Washington	8/6	261	7.3	24.3	7.0	6.7	0.5
Burnt Hills/Saratoga	8/6	928	0.0	0.0	26.0	9.5	4.0
Altamont/Albany	8/6	1572	0.0	0.0	12.0	3.5	7.5
Modena/Ulster	8/5	655	2.0	8.0	1.3	22.3	12.0
Marlboro/Ulster	8/5	163	4.0	13.0	10.5	3.5	8.0
Accord/Ulster	8/9	310	0.0	28.0	2.5	4.0	3.5

GENERAL INFO

UP AND COMING

EVENT REMINDERS

WAYNE COUNTY FRUITGROWER TOUR
Wednesday, August 11, from 10:30 am
Registration and 1st stop at Wafler Farms & Nursery new storage facility

Sponsored by agr.assistance, this large, informative and entertaining tour is in its 12th year, and will feature presentations on apple storage; PGR, return bloom and nutritional developments; updates on apple disease, insect, and deer control; orchard fertility; bitter pit; herbicide options, plus much more. Door prizes, lunch, high (and low) humor, BBQ/clambake dinner with a live band, growers and industry representatives from NY and surrounding states — tough to beat on a midsummer day. Free attendance.

Contact Lindsay LaMora (585-734-8904; lindsaylamora@agrassistance.com) for RSVP pre-registration and tour information.

CORNELL FRUIT PEST CONTROL FIELD DAY

The N.Y. Fruit Pest Control Field Day will take place during Labor Day week on Sept. 8 and 9 this year, with the Geneva installment taking place first (Wednesday Sept. 8), and the Hudson Valley installment on the second day (Thursday Sept. 9). Activities will commence in Geneva on the 8th, with registration, coffee, etc., in the lobby of Barton Lab at 8:30 am. The tour will proceed to the orchards to view plots and preliminary data from field trials involving new fungicides, bactericides, miticides, and insecticides on tree fruits and grapes. It is anticipated that the tour of field plots will be completed by noon. On the 9th, participants will register at the Hudson Valley Laboratory starting at 8:30, after which they will view and discuss results from field trials on apples and other fruit crops. No pre-registration is required for either event.

INSECT TRAP CATCHES
(Number/Trap/Day)

Geneva, NY

	8/2	8/5	8/9
Redbanded leafroller	0.0	0.0	0.0
Spotted tentiform leafminer	15.5	21.3	14.1
Oriental fruit moth	3.4	2.7	2.0
Lesser appleworm	0.3	0.0	0.0
American plum borer	0.3	0.2	0.0
Lesser peachtree borer	0.0	0.0	0.0
San Jose scale	1.0	3.7	0.5
Peachtree borer	0.0	0.0	0.0
Apple maggot	7.4	3.7	2.8

Highland, NY

	8/2	8/9
Redbanded leafroller	0.0	0.7
Spotted tentiform leafminer	14.6	41.1
Oriental fruit moth	0.5	3.1
Lesser appleworm	1.4	1.4
Codling moth	1.2	2.9
Obliquebanded leafroller	1.5	3.0
Apple maggot	0.6	0.6

* first catch

UPCOMING PEST EVENTS

	43°F	50°F
Current DD accumulations (Geneva 1/1–8/9/10):	2823	1982
(Geneva 1/1–8/9/2009):	2280	1476
(Geneva "Normal"):	2464	1686
(Geneva 1/1–8/16 predicted):	3047	2157
(Highland 3/1–8/9/10):	3099	2146

Coming Events:	Ranges (Normal ±StDev):	
Oriental fruit moth 3rd flight peak	2649–3239	1819–2241
Oriental fruit moth 3rd flight subsides	2928–3412	1978–2310
Redbanded leafroller 3rd flight begins	2594–2976	1768–2070
Redbanded leafroller 3rd flight peak	2717–3207	1881–2225
Lesser appleworm 2nd flight peak	2120–3130	1412–2172
Lesser appleworm 2nd flight subsides	2794–3488	1918–2422
San Jose scale 2nd gen. crawlers emerge	2746–2852	1916–2104
San Jose scale 2nd flight subsides	2639–3349	1785–2371
Apple maggot flight subsides	2772–3258	1907–2283
American plum borer 2nd flight subsides	2929–3365	2015–2381
Codling moth 2nd flight subsides	2845–3493	1922–2472
Lesser peachtree borer flight subsides	2996–3446	2017–2433
Obliquebanded leafroller 2nd flight peak	2593–3011	1758–2098
Spotted tentiform leafminer 3rd flight peak	2543–3007	1725–2087

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