

How Best to Protect African Violets from INSV and Other Viruses

By Ronn Nadeau, PhD

Introduction

The western flower thrips, *Frankliniella occidentalis*, transmits impatiens necrotic spot virus (INSV), a fatal disease of African violets. The virus has brought on a sense of alarm amongst AV growers. And, as explained in the previous article, it may be that a different virus causes the severe damage to AVs that for a long time has been attributed solely to cyclamen mites. This article proposes a program for eliminating, not just controlling, thrips and mites in AV grow areas, be they in homes or commercial greenhouses. The program has three parts:

1. Physical barriers such as closed doors and windows, sealed cracks, pets not allowed in the grow area, careful people, disbudding and isolating plants home from a show.

2. Chemical barriers, prophylactic spray applications using 2-component sprays (insecticide and miticide mixtures) to establish a "clean" group of plants, and then to maintain a pest-free state of readiness against vector attack. Pesticide treatments would follow Integrated Pest Management (IPM) guidelines.

3. Vigilance and monitoring, including use of ELISA INSV testing, sticky cards, and watchful eyes.

Excellent articles on thrips and INSV have appeared in AVM over the past three years. Neil Lipson (Vol 64, No. 5, p 12) advised growers on what to do when returning plants from a show: disbud totally, add imidacloprid to the soil, put each plant in a plastic bag, spray inside the bag with Avid, and leave the plant in the bag for a week. But that seems impractical if you have a lot of plants or if you are a commercial grower. Pat Hancock (Vol 64, No. 4, p 34) stressed the need to be vigilant for thrips and for completely isolating new plants. Sandra Skalski (Vol 63, No. 3, p 50) described INSV and the related TOSPO tomato virus as nonliving infectious material needing a

vector, the western flower thrips, to get inside a plant, and said that infected thrips can transmit INSV after feeding for only 5 to 10 minutes. She advised to act quickly after detection of thrips. Disbud everything and spray three times with Conserve SC at 5-7 day intervals to catch all stages of thrips. Sandra's article has photos showing plants with INSV symptoms. Georgene Albrecht (Vol 64, No. 4, p 35) counseled growers to not be frightened by INSV, but rather to take steps to control the vector insect. The photos in Georgene's article are quite helpful. In addition, she gave information about ELISA kits that test for INSV in plant tissue.

Damage from INSV starts out mildly, can mimic other AV problems, and can be present without showing symptoms. Thus, the ELISA test for INSV is an important weapon in the struggle against this virus. Using a leaf from a suspect plant and an INSV ELISA kit, one can test for the presence of INSV in a leaf sample. If the result is positive, the plant must be discarded; if negative, it is probably free of the virus, but false negatives are possible. It is best to use a leaf sample with necrotic damage.

In agriculture it is not possible to completely eliminate mites and insects from a field. Farmers aim at *control*, which is a balancing act between how much money is put onto the field versus what the harvest will bring. However, African violets are grown continuously in greenhouses and homes. There, low levels of virus vectors cannot be tolerated because they would continuously infect plants, even if at a slow pace.

For these reasons, I advocate the preemptive, prophylactic use of pesticides to make AVs poisonous to virus vectors before the plants are infected. This strategy ensures that when a vector finds a pretreated plant, it will be incapacitated in the shortest possible time, giving the plant its best chance to remain healthy. This approach is a

bit like the prophylactic use of ivermectin in humans to kill nematodes that cause river blindness in 3rd world populations. Ivermectin is a close relative of abamectin, which is one of the four compounds proposed for use in the program under discussion.

The program proposes the use of two insecticides and two miticides, all of which are water soluble and compatible in mixtures. It uses them in insecticide/miticide pairs (2-component sprays). As explained in greater detail later in this article, the program would begin by preparing a 2-component insecticide/miticide mixture by combining some Conserve SC (spinosad) insecticide with some Abamectin (abamectin) miticide in water, and spraying three times, thoroughly, at 5-7 day intervals. In order to follow IPM guidelines for minimizing the buildup of pesticide resistance, the next round of spraying would be conducted with a different insecticide/miticide pair, Akari 5SC (fenpyroximate) and Dominion 2L (imidacloprid). The pesticide sprayings would be conducted at relatively frequent intervals to assure the integrity of the chemical barrier, especially during early spring and summer.

From my experience as an organic chemist in the field of herbicides, I am aware of the reservations that people have about using pesticides. We must use them with respect and handle them with care. That is why, in the following paragraphs, I discuss each compound, its history, toxicity, and other characteristics, in the hope that AV growers will feel confident and comfortable using them. Later in the article, I describe using these pesticides, their prices, availability, dilutions, concentrations, and suggest schedules for their advantageous application.

The four suggested liquid pesticide formulations are all water soluble and none has properties that would prevent combining any of them to make multi-component spray solutions. All four are stable as formulated and when diluted with water in spray solutions. However, the formulations and spray solutions should be kept out of sunlight to prevent photolysis of active ingredients. The four actives all have different modes of action, as indicated in the Resistance Group col-

umn of Table 1. The data in Tables 1 and 2 were mainly collected from Material Safety Data Sheets (MSDSs), product Specimen Labels, and the Hummert online catalog. Wikipedia was very helpful.

Abamectin (Identical to Avid).

The Abamectin that I use is sold by Nufarm Americas, Inc. It is called "Abamectin SPC, 0.15EC" and contains 2% abamectin in quart bottles. Abamectin is a fermentation product of a soil bacterium, *Streptomyces avermitilis*, and is a mixture of eight avermectins, but primarily avermectins B1a and avermectin B1b.

Abamectin's rat acute LD50 (300 mg/kg) puts it in Toxicity Category II, moderately toxic. The following toxicological tests gave favorable results for abamectin: mutagenicity, carcinogenicity, reproductive and developmental toxicity, and genotoxicity. Thus, of the five pesticide formulations described in this article, Abamectin is the one most toxic to mammals. However, the Abamectin MSDS states "Slightly toxic if ingested based on toxicity studies."

Abamectin is both a miticide and insecticide, but is primarily used against mites. It is effective on ten mite varieties, including cyclamen, and can suppress aphids, thrips, and whiteflies. It is effective at a low use rate, 0.0013% active ingredient in spray solution (Table 2), leaving no visible residues on foliage. This insecticide/miticide has both contact and translaminar activity, meaning that it can penetrate the leaf surface and form a reservoir of active ingredient within the leaf. Abamectin provides up to 28 days of residual activity. It is toxic to bees, but not so after treated foliage has dried. Do not use it when bees are foraging.

Conserve SC

Conserve SC, a product of Dow AgroSciences, LLC, is a formulation containing 11.6% spinosad. In 1997 it was registered as a pesticide in the United States for use on crops. Spinosad is produced by fermentation of a bacterial species named *Saccharopolyspora spinosa*.

In addition to its low acute toxicity in rats (5000 mg/kg), spinosad gave favorable results

in the following tests: chronic toxicity, carcinogenicity, developmental toxicity, reproductive toxicity, and gentoxicity. Spinosad is used for treating dogs and cats against fleas in products named Comfortis and Trifexis. Because spinosad is a natural product and has very low acute toxicity, it is on the National Organic Standards Board List of Approved Organic Pesticides.

Spinosad is primarily an insecticide but has suppressive activity against some mites. It is highly active against many insects, but the Specimen Label advises that more than one application may be needed against western flower thrips. It acts both by contact and ingestion and provides about 3 weeks of residual activity. Due to its very low mammalian toxicity, Conserve SC is labeled for use as many as five times on some crops, and the crop can be harvested as early as 1 day after an application of the insecticide. The cost for making a gallon of Conserve SC spray solution is about \$0.57, compared to \$0.23 for Abamectin SPC, \$1.25 for Akari, and 2 cents for Dominion 2L.

Akari 5SC.

Akari 5SC, produced by Sepro Corporation, has as its active ingredient 5% fenpyroximate. It is labeled for use against cyclamen mites, spider mites, and several other mites at a rate of 0.24 oz (7.2 ml) per gallon. It is a contact miticide having no translaminar or systemic activity. Therefore, good spray coverage is necessary.

The rat acute LD50 for Akari is 810 mg/kg and 600 mg/kg for male and female rats, respectively, making this a Toxicity Category III (Slightly toxic) pesticide. The following tests on fenpyroximate gave favorable results: chronic cancer, teratogenicity, reproductive effects, neurotoxicity, and mutagenicity. Akari is highly toxic to fish. Do not use near open waters.

Akari should be used in a spray schedule with a miticide from a different Resistance Group because mites are quite adept at developing resistance to miticides. It thus fits in well with Abamectin as a rotational partner because

Abamectin and Akari are in different Resistance Groups (Table 1).

Akari provides stop-feeding action together with a cessation of egg laying. Mites die in 4 to 7 days, and Akari provides 3-4 weeks of residual activity. Under severe mite conditions, shorter spray intervals should be employed, according to the Akari Label. Akari was tested on AVs at a 3X rate and found nonphytotoxic.

Dominion 2L and Mantra 1G.

Dominion 2L, a liquid formulation pesticide sold at DoMyOwnPestControl.com, has imidacloprid (21.4%) as its active ingredient. Mantra 1G is also an imidacloprid insecticide, but is formulated as the active ingredient (1%) absorbed onto inert granules.

The rat acute LD50 values for Dominion 2L and Mantra are 1190 mg/kg and >5000 mg/kg, respectively. In addition to the favorable acute toxicity data, imidacloprid gave favorable results in the following tests: rat acute dermal, eye irritant, sensitization, carcinogenicity, mutagenicity, and reproductive effects.

Imidacloprid is the most widely used insecticide in the world. The discovery of imidacloprid, with its favorable toxicity package as compared to other insecticides on the market in the 1990s, prompted the EPA to employ it to replace more toxic insecticides. It is an insect neurotoxin belonging to a class of chemicals called neonicotinoids. Because imidacloprid binds much more strongly to insect neuron receptors than to mammalian neuron receptors, it is selectively more toxic to insects than to mammals.

Imidacloprid is a systemic insecticide that readily passes through leaf surfaces and moves to other parts of the plant. When applied on soil as either the liquid or the granular formulation, imidacloprid is absorbed by roots of plants, bushes, and trees, and kill bugs that chew on those plants. It is compatible with commonly used fungicides, miticides, liquid fertilizers, and other commonly used insecticides, with which it can be combined to make multi-component spray solutions. Imidacloprid is very toxic to bees and must not be applied when bees are foraging.

Spray Schedules

The four liquid formulation pesticides have the following in common. Away from sunlight, the formulations and their spray solutions are stable under normal use. All are water soluble, permitting easy preparation of 2-pesticide spray solutions. Within the group of four liquid pesticides, two are primarily insecticides and two primarily miticides and all four are in different Resistance Groups. Mantra, the granular formulation of imidacloprid, is used separately, as explained below. None of the four is a Restricted Use pesticide.

Most importantly, all four of these pesticides have favorable toxicity ratings (Table 1). So, in my opinion, anyone who can read and follow directions and exercise care in what they are doing can advantageously use these pesticides on African violets. And if you will, think of it this way. Growing AVs is becoming more challenging, which means more interesting. Many AV growers will respond to the scientist in them and take on the challenge.

The following spray schedules are examples of how I think successful prophylactic programs can be designed for protecting African violets in the home or greenhouse. Tweak them to your liking. A lot of people know a lot more about these matters than I do, so please take my recommendations with that caveat. You must consider whether they are reasonable for your situation. Unfortunately, some of these pesticides come mainly in quart quantities, which for small growers is enough for 100 years. There will be a need for small growers to cooperatively share quart amounts.

Spray Schedule A. (You could also start with Schedule B.)

Purpose: Establish a group of AVs free of pests and INSV.

At the beginning of the overall program, it is desirable to detect and discard all plants containing INSV, because no pesticide can cure that. However, some plants in the group might have the virus and go undetected for a time. Proceed with the schedule anyway. If you are pretty sure your plant is free of the virus, great, but still proceed with Schedule A.

Start Schedule A by spraying your group of AVs with a 2-component insecticide/miticide (Conserve SC and Abamectin) solution, 3 times, 5-7 days apart. Table 2 shows that you should use 3 ml of Conserve SC and 2.4 ml (1 1/2 tsp) of Abamectin per gallon of water. When spraying, wet the plant as thoroughly as you can. If you have leftover spray solution, you can use it later, as long as you keep it away from sunlight in the meantime.

Inspect the plants throughout the Schedule A period and remove those with INSV symptoms. Monitor using sticky cards in the area. After completing the 3rd spraying, just wait and watch the plants for two or three weeks. During that time, they will still have protection due to residual activity from the initial spraying. Remove plants that look like they might have INSV. Do ELISA tests as needed. If the group or the area still has mites or thrips (unlikely), repeat Schedule A.

If the group appears free of mites, thrips, and INSV after the spraying and waiting period, proceed from there with maintenance schedules (below) while continuing to watch for INSV plants. The purpose of the maintenance schedules is to keep your plants free of pests and virus while still monitoring them carefully. If there are still INSV plants present after two Schedule A rounds, each taking around 5-6 weeks to complete, you can either conduct Schedule B sprayings on the group and continue to watch for diseased plants, or start anew using Schedule A on a new group of plants.

Spray Schedule B. Can also be used ahead of Schedule A.

Purpose: Same as with Schedule A: Establish a group of AVs free of pests and INSV.

Prepare a 2-component insecticide/miticide (Dominion 2L/Akari 5SC) solution. (If Akari is not available, use Abamectin instead.) Spray the group 3 times, 5-7 days apart. Table 2 shows that you should use 0.45 ml of Dominion 2L and 7.2 ml of Akari (or if substituting, 2.4 ml of Abamectin) per gallon of water.

The rest is the same as Schedule A. Hopefully, by this time you will have a group of plants with no pests or virus.

Spray Schedule M.

Purpose: Maintain a group of plants pest and virus free.

Spray once every 3 weeks (the pesticides in this article all have residual activity for 2-4 weeks) with any of the following 2-component solutions. Rotate the solutions. Each one contains an insecticide and a miticide. In addition, apply Mantra 1G topically to the surface of the growing medium in each pot, according to Mantra Label directions. Thus, when using Solutions M-1 and M-3, three pesticides will be in use at the same time. I think there should be no phytotoxicity problems with using multiple pesticides at the same time, because all of the pesticides discussed here are applied at low concentrations and are nonphytotoxic.

Solution

M-1
M-2
M-3
M-4

Pesticides

Conserve SC/Abamectin
Dominion 2L/Abamectin
Conserve SC/Akari 5SC
Dominion 2L/Akari 5SC

Some closing notes.

Keep good records. Proper timing of sprayings is very important. Prepare a calendar ahead of time and record everything you do. Small sprayers, quart and pint sizes, are available online. When needing to measure out small volumes of pesticide, consider preparing a more dilute stock solution from the original formulation. If you use the methods given in this article, please report your results, what worked and what did not. And finally, as a service to AV growers, I conduct tests for INSV using Agdia's ELISA Kit. I welcome questions and comments from readers. Contact me at AVSEEDS@yahoo.com.

Table 1. Toxicity and Pesticide Resistance Information

Product	Rat Acute oral LD50 (mg/kg body weight) [1]	Toxicity Category	Resistance Group
Abamectin , same as Avid (2% Avermectins, Liquid)	300 [2]	II, Moderately Toxic	6
Conserve SC (11.6% Spinosad, Liquid)	>5000 [3]	IV, Relatively nontoxic	5
Akari 5SC (5% Fenpyroximate, Liquid)	810 M, 600 F [4]	III Slightly Toxic	21
Dominion 2L (21.4% Imidacloprid, Liquid)	1190 [5]	III Slightly Toxic	4
Mantra 1G (1% Imidacloprid, Granules)	>5000 [6]	IV, Relatively nontoxic	4

[1] LD50: The higher the number, the safer the product.

"The term to describe acute toxicity is LD₅₀. LD means *lethal dose* and the

50 means that the dose was acutely lethal to 50% of the animals to whom the chemical was administered under controlled laboratory conditions." From: <http://edis.ifas.ufl.edu/pi008>.

[2] MSDS: <http://www.cdms.net/LDat/mpUJP001.pdf> (2009).

[3] MSDS: <http://www.cdms.net/ldat/mp24P000.pdf> (2010).

[4] MSDS: http://www.sepro.com/documents/Akari_MSDS.pdf (2008).

[5] MSDS: http://www.controlsolutionsinc.com/data/products/other/139_Dominion%202L_MSDS.pdf (2007).

[6] MSDS: <http://www.cdms.net/LDat/mp8ED004.pdf> (2012).

Table 2. Pesticide Label Information and Product Costs

Pesticide	Kills	Label recommended applications	Vol. of Product needed to make 1 gallon of spray sol'n, per Label directions [1]	Target conc'n of Active in Spray Solution (%) [1][2]	Cost of Product [3]	Cost to make 1 gallon of spray solution (\$) [1]	Product Volume
Abamectin , same as Avid (2% Avermectins, Liquid)	cyclamen mites , leafminers, thrips , aphids [4]	3 times, 7 days apart	0.08 oz, 2.37 ml	0.0013 [4]	\$93.20 per quart	\$0.23	1 quart, 960 ml
Conserve SC (11.6% Spinosad, Liquid)	thrips and many other insects [5]	5 times per season (max); reapp'n. 5 days (min)	0.10 oz, 2.96 ml	0.0181 [5]	\$183.75 per quart	\$0.57	1 quart, 960 ml
Akari 5SC (5% Fenpyroximate, Liquid)	cyclamen mites . Suppresses mealybugs [6]	3 times, 5 - 7 days apart	0.24 oz, 7.2 ml	0.0093 [6]	\$166.50 per quart	\$1.25	1 quart, 960 ml
Dominion 2L (21.4% Imidacloprid, Liquid)	thrips , aphids, fungus gnats, mealy bugs [7]	Begin foliar app's prior to high pest populations and reapply as needed.	0.015 oz, 0.45 ml	0.0025 [7]	\$27.95 per 27.5 oz bottle	\$0.02	27.5 pz, 825 ml
Mantra 1G (1% Imidacloprid, Granules)	thrips , aphids, fungus gnats, mealy bugs [8]	Apply 1/4 - 1/3 level teasp per 3.5 - 5 inch pot. As needed.	Granules	Granules [8]	\$46.00 per 5 lb jug	\$0.02 per 31/2 " pot	5 lb, 2270g
1. When the label suggested two acceptable rates, the higher rate (2X) was used to obtain these numbers. 2. Target % concentration of spray solution = [Volume (ml) of Product specified on Label for 1 gallon of Spray solution] X [% Active in Product] / 3840 ml. 3. Prices as of Nov, 2012. The products were purchased at Hummert, except for Dominion 2L, bought online at domyownpestcontrol.com. 4. Nufarm Abamectin Specimen Label: http://www.cdms.net/LDat/Id9OR002.pdf . 5. Dow Conserve SC Specimen Label: http://www.cdms.net/ldat/Id24P002.pdf . 6. SePRO Akari 5SC Specimen Label: http://www.entomology.umn.edu/cues/mnla/akari.pdf . 7. Dominion 2L Specimen Label: http://www.domyownpestcontrol.com/msds/Dominion_2L_label.pdf . 8. Nufarm Mantra 1G Specimen label: http://www.cdms.net/LDat/d8ED003.pdf .							

Product	% Active in Product	Amount of Product to make 1 gallon of water spray solution of the Target Percent Active (ml)	Target Concentration of Active in Spray Solution	Cost of Product	Cost to make 1 gallon spray solution (\$)	
Abamectin, same as Avid (2% Avermectins, Liquid)	2.0	2.37	#REF!	\$93.20		960
Conserve SC (11.6% Spinosad, Liquid)	11.6	2.96	#REF!	\$183.75		960
Akari 5SC (5% Fenpyroximate, Liquid)	5.0	7.20	#REF!	\$166.50		960
Dominion 2L (21.4% Imidacloprid, Liquid)	21.4	0.45	#REF!	\$27.95		825
Mantra 1G (1% Imidacloprid, Granules)	1.0	1.03	NA	\$46.00		2270