

USE OF BAKING SODA AS A FUNGICIDE

HORTICULTURE TECHNICAL NOTE

Abstract: *There has been considerable interest in the use of baking soda (sodium bicarbonate, NaHCO_3) and potassium bicarbonate (KHCO_3) to control powdery mildew and other fungal diseases of plants. This publication provides a brief survey of observations, research, and recommendations on the use of bicarbonates in horticulture.*

By **George Kuepper, Raeven Thomas, and Richard Earles**
NCAT Agriculture Specialists
November 2001

- The use of baking soda as a fungicide is not a new idea. In Alfred C. Hottes' *A Little Book of Climbing Plants*, published in 1933 by the A.T. De La Mare Co. of New York, mention is made of using one ounce of baking soda per gallon of water to control powdery mildew (PM) on climbing roses. The author credits the idea to a Russian plant pathologist, A. de Yaczenski (1).
- In the August, 1985 issue of *Organic Gardening* magazine, a short article by Warren Shultz entitled "Recipe for Resistance" reports that researchers in Japan obtained effective control of PM on cucumbers, eggplants, and strawberries. They suggested weekly sprays of $\frac{1}{4}$ ounce baking soda per gallon of water (2).
- An article in the June, 1990 issue of *Greenhouse Manager* magazine summarizes the results of three years of testing baking



soda as a fungicide for roses. Cornell University researcher Dr. R. Kenneth Horst observed suppression of PM and blackspot—both major problems for New York rose growers. Roses were sprayed every 3 to 4 days with a water solution of baking soda and insecticidal soap. The latter was included for its surfactant qualities. (Surfactants are chemical agents that alter the surface properties of a liquid.) The soap improved the effectiveness of the bicarbonate by making it stick to, and spread evenly over, the leaf surface. Further experimentation proved that the insecticidal soap itself was not responsible for suppressing the diseases. While no specific concentration of baking soda is indicated as being most effective in PM suppression, the article states that a 0.5% solution was most effective in preventing blackspot (3).

- Some of the work at Cornell has focused on controlling fungal diseases on cucurbits (4). A single spray application (to runoff) of 0.5% (wt./vol. of water) baking soda, plus 0.5% (vol./vol. of water) SunSpray UFP® horticultural oil almost completely inhibited PM on heavily infected pumpkin foliage. Baking soda *without* spray oil was ineffective, and a 2% (wt./vol. of water) solution of baking soda damaged the leaves. Baking soda/oil sprays also provided good control of urocladium leaf spot in cucumber, alternaria leaf blight in muskmelon, and gummy stem blight in muskmelon (5). Other diseases against which baking soda may prove effective include anthracnose in cucurbits (6);

rust, dollar spot, and pythium blight in turf; late blight in potato; rust in wheat; and diseases affecting peanuts, banana, and alfalfa (7).

- Researchers in Israel reported the successful use of baking soda and SunSpray oil in controlling PM on euonymus (8). In this research a 2% baking soda and 1% oil solution proved most effective (9).

- On-farm observations on melon acreage in Virginia resulted in one farm operation switching from synthetic fungicides to a baking soda/oil spray. These growers incorporated a liquid fertilizer into the mix (10).

- Research in Germany evaluated baking soda as a control for PM on 'Bacchus' grapes. Three spray applications were made, beginning when symptoms first appeared. Good control was achieved with no loss of grape quality. The optimum concentration was a 1% solution (11).

- An article in the February, 1996 issue of *GrowerTalks* magazine follows up on the continuing research at Cornell. Testing with a variety of bicarbonates revealed that selecting the correct bicarbonate for a particular disease is important. Dr. Horst's research team found that ammonium bicarbonate had the strongest effect on some diseases, while potassium and sodium bicarbonates worked best against others. Potassium bicarbonate provided the best control of PM. "Sodium bicarbonate is okay, but it's not as good," Horst is quoted as saying. "And ammonium bicarbonate doesn't do the job on powdery mildew." He points out that while



conventional chemical controls for PM are preventatives only, bicarbonates can eliminate the disease after it has already appeared on certain crops – he mentions roses and an unspecified ornamental –

provided the infection is not severe. The only plant damage associated with bicarbonates applied in the trials was foliar burning when application rates exceeded recommended concentrations. Testing established that sodium bicarbonate does not increase the levels of sodium in plant tissues, soil, or runoff water. While their precise mode of action against fungi is not understood, Horst states that bicarbonates seem to damage the cell wall membrane in PM spores. He also believes pH to be a factor in bicarbonate effectiveness. In any case, bicarbonates are contact fungicides, and kill PM within minutes (7).

- The Federal EPA ruled (as of December, 1996) that sodium and potassium bicarbonates are exempt from residue tolerances (12). This action served to facilitate the development and release of commercial bicarbonate products for horticultural use. It also lent weight to the belief that these materials are largely innocuous from a food safety perspective.

- Connecticut researchers evaluated the effects of a spray solution containing 1% each of baking soda and horticultural oil on PM infection in zucchini, pumpkin, and cantaloupe. Four applications were made and disease suppression was definitely observed, accompanied by reduced insect pest damage. These researchers maintain that the treatment is preventative – *not* curative; that it is only necessary in years where early outbreaks may threaten yields; and that spraying should accompany proper nutrition and water management (13).

- In 1998, Church & Dwight Co. (14) – the manufacturer of Arm & Hammer™ baking soda – received EPA registration for Armicarb 100®, a potassium bicarbonate formulation, for use against PM, downy mildew, botrytis, and alternaria leaf-spot (15). This product is the direct result of Dr. Horst's research at Cornell, which was funded by Church & Dwight. Armicarb 100 is now available from Helena Chemical Company (16). A similar product is sold under the name FirstStep® by the W.A. Cleary Chemical Co. (17).

- The EPA and the California Department of Environmental Protection have provided registration to Monterey Chemical Co. (18) for a product called Kaligreen®. A potassium bicarbonate fungicide for PM control, it is cleared for use on grapes, cucumbers, tobacco, roses, strawberries, and a wide range of other crops (19, 20, 21). Directions for use include the addition of a sticker-spreader surfactant and a caution against use in acidic spray mixes. Since the product contains 30% potassium it is also touted for its fertilizer value (22). One source of Kaligreen® is Peaceful Valley Farm Supply (23).

- Yet another potassium bicarbonate product, Remedy®, by Bonide™ (24), is now available from Gardener’s Supply Co. (25). This formulation, which includes a surfactant oil, is labeled for use on ornamental, nut, and fruit trees, shrubs, and many vegetable plants. Said to control PM, black spot, leaf spot, anthracnose, phoma, phytophthora, scab, botrytis, and many other diseases, Remedy is particularly targeted toward rose growers (26).

- Various carbonates and bicarbonates have been proven effective against gray mold, the number one post-harvest disease of grapes. Researchers found that carbonates were more effective than bicarbonates at reducing gray mold (*Botrytis cinerea*) spore germination, and that sodium and ammonium bicarbonates were better than potassium bicarbonate (27).

- While industry was in the process of developing bicarbonate products for commercial and home horticulture, a number of recommendations for using kitchen-grade baking soda surfaced in print. These include:

- J. Howard Garrett—a well-known horticultural columnist and radio personality in the Dallas, Texas, area—recommends baking soda sprays at a concentration of 4 teaspoons per gallon of water for control of PM, blackspot, brown patch, and other fungal diseases. He also suggests that a light soil spray of baking soda solution can suppress fungus gnat

problems, while cautioning that overuse should be avoided because of possible negative effects (sodium accumulation and alkaline pH) on the soil (28).

- The authors of an organic pest control handbook suggest the same concentration mixture as Garrett, but advise the addition of an equal quantity of liquid dish soap or insecticidal soap as a surfactant (29).
- The P. Allen Smith Gardens website advises mixing 1 heaping teaspoon of baking soda, 1 tablespoon of dormant oil, and ½ teaspoon of insecticidal or dish soap in one gallon of water as a PM spray. Stating that plants should be well hydrated prior to spraying, this source recommends irrigating a couple days in advance (30).

References:

- 1) Williams, Greg and Pat Williams. 1993. Baking soda vs. powdery mildew: *Not a new idea!* HortIdeas. June. p. 62.
- 2) Williams, Greg and Pat Williams. 1985. Baking soda for powdery mildew control. HortIdeas. September. p. 101-102.
- 3) Anon. 1990. Baking soda can ward off fungus. Greenhouse Manager. June. p. 24.
- 4) Ziv, O. and T. A. Zitter. 1992. Effects of bicarbonates and film-forming polymers on cucurbit foliar diseases. Plant Disease. Vol. 26, No. 5. p. 513-517.
- 5) Williams, Greg and Pat Williams. 1992. More on baking soda/horticultural oil vs. fungal disease. HortIdeas. June. p. 69.
- 6) Hofstetter, Bob. 1993. Homemade pesticides. The New Farm. February. p. 14-16.
- 7) Moore, Sallyann Roberts. 1996. Bicarbonates offer effective disease control. Grower Talks. February. p. 72.
- 8) Ziv, O. and A. Hagiladi. 1993. Controlling powdery mildew in euonymus with polymer coatings and bicarbonate solutions. HortScience. Vol. 28, No. 2. p. 124-126.

- 9) Williams, Greg and Pat Williams. 1993. Baking soda and horticultural oil vs. powdery mildew. HortIdeas. May. p. 51.
- 10) Byczynski, Lynn. 1995. New ideas for a new year. Growing for Market. January. p. 1, 4-5.
- 11) Williams, Greg and Pat Williams. 1997. Sodium bicarbonate for control of mildew on grapes. HortIdeas. June. p. 70.
- 12) Otten, Paul. 1997. Can kitchen products control powdery mildew? Northland Berry News. Fall. p. 20.
- 13) Elmer, Wade H. and Frank J. Farandino. 1997. Managing powdery mildew of cucurbits. The Natural Farmer. Summer. p. 26-27.
- 14) Church & Dwight Co., Inc.
469 N. Harrison St.
Princeton, NJ 08543-5297
609-683-5900
800-221-0453
- 15) Anon. 1998. EPA approves reduced-risk fungicide. The Grower. December. p. 8.
- 16) Helena Chemical Co.
225 Schilling Blvd. Suite 110
Collierville, TN 38017
901 537-7280
<http://www.helenachemical.com/sales.html>
Armicarb® is available in 5 and 25 lb. bags, for about \$5/lb. Call the number above or visit the website to locate the Helena Chemical dealer nearest you.
- 17) W. A. Cleary Chemical Co.
1049 Corporate Rt. 27
Somerset, NJ 08875
800-524-1662
FirstStep® is available in 5 lb. bags and 20 lb. cases. Call the number above for price information.
- 18) Monterey Chemical Co.
P. O. Box 35000
Fresno, CA 93745-5000
559-499-2100
<http://www.montereychemical.com>
Kaligreen is available in 5lb. and 10lb. bags. Prices vary from dealer to dealer.
- 19) Anon. 1998. Powdery mildew fungicide. The Grower. March. p. 6.
- 20) Anon. 1999. EPA expands Kaligreen label. The Grower. August. p. 10.
- 21) Anon. 2000. Label Changes (Kaligreen) American Vegetable Grower. March. p. 14.
- 22) Anon. 1998. Peaceful Valley Farm Supply 1998-1999 Main Catalog. Peaceful Valley Farm Supply. Grass Valley, CA. p. 92.
- 23) Peaceful Valley Farm Supply
P. O. Box 2209
Grass Valley, CA 95945
530-272-4769
888-784-1722
<http://www.groworganic.com>
- 24) Bonide Products, Inc.
Oriskany, NY 13424
315-736-8231
- 25) Gardener's Supply Co.
128 Intervale Rd.
Burlington, VT 05401-2850
800-863-1700
<http://www.gardeners.com>
e-mail: info@gardeners.com
- 26) Anon. 1998. Fungus remedy. B.U.G.S. Flyer. Vol. 12, No. 1. p. 5.
- 27) Anon. 1999. Baking soda and gray mold. Conference notes: ESA and APS joint meeting. IPM Practitioner. April. p. 10-11.
- 28) Garrett, J. Howard. 1989. J. Howard Garrett's Organic Manual. Lantana Publishing Co. Dallas, TX. 104 p.
- 29) Ellis, Barbara W. and Fern Marshall Bradley. 1992. The Organic Gardener's Handbook of Natural Insect and Disease Control. Rodale Press. Emmaus, PA. 534 p.
- 30) Anon. 1997. Garden lore – Baking soda solution. P. Allen Smith Gardens. Hortus Ltd. <<http://www.pallensmith.com/features/highlights/h1709c.htm>>.

IP130

The electronic version of **Use of Baking Soda as a Fungicide** is located at:

HTML

<http://www.attra.org/attra-pub/bakingsoda.html>

PDF

<http://www.attra.org/attra-pub/PDF/bakingsoda.pdf>