MATERIAL FACT SHEET
PYRETHRUM

MATERIAL NAME: Pyrethrum

MATERIAL TYPE: Botanical

U.S. EPA TOXICITY CATEGORY: III, "Caution"

USDA – NOP STATUS:
Considered nonsynthetic, allowed. Preventive, cultural, mechanical and physical methods must be first choice for pest control, and conditions for use of a biological or botanical material must be documented in the organic system plan (NOP 2000).

ACTIVE INGREDIENT DESCRIPTION: Pyrethrum is the generic name given to a plant based insecticide derived from the powdered, dried flower heads of the pyrethrum daisy, chiefly *Chrysanthemum cinerariaefolium*, but also in *C. coccineum* and *C. marshalli.* Pyrethrins are the six constituent compounds with insecticidal properties that occur in these *Chrysanthemum* species. The pyrethrum daisy is native to southwest Asia. Kenya is the leading producer of pyrethrum followed by Australia.

Note: Pyrethroids are synthetic compounds whose structure and mode of action are similar to pyrethrins but they are not approved for use in organic production. There are many pyrethoids including Ambush®, Ammo®, Aztec®, Pounce® and Warrior ®.

HOW IT WORKS: Pyrethrum is a fast acting contact poison that 'knocks down' susceptible insects. Insects are left paralyzed by the toxic effect of pyrethrum. The normal function of the nervous system is affected, stimulating repetitive nerve discharges leading to paralysis. However, some insects are able to recover after the initial knockdown if the dose is too low.

SYNERGISTS: Mortality may be enhanced with the addition of a synergist, a chemical not considered strongly insecticidal in itself, but which enhances the activity of the material being applied. Piperonyl butoxide (PBO) is a common synthetic synergist that reduces an insect's ability to detoxify pyrethrum. It is added to most pyrethrum products. Piperonyl butoxide is not allowed under the National Organic Program. Care should be taken not to use pyrethrum products that contain prohibited synergists.

Recently, pyrethrum products containing various oils but without PBO have come on the market. Such oils may increase the efficacy of pyrethrum. Two 1987 studies examined pyrethrum augmented with nutmeg, parsley, sassafras, and safrole oils as well as PBO (Noetzel et al. 1989, Noetzel and Ricard 1989). Nutmeg oil appeared to show promise against cabbage looper. None of the synergists improved efficacy against imported cabbageworm, however. In trials against Colorado potato beetles, these synergists showed insecticidal properties with or without pyrethrum (Noetzel et al. 1989).

TYPES OF PESTS IT CONTROLS: Pyrethrum is used widely throughout the world to control many human and household pests such as mosquitoes and houseflies. While it was used widely in agriculture before World War II, cheaper and more effective synthetic products have mostly replaced it for farm use (Casida 1973, Casida and Quistad 1995). More recently, new pyrethrum products, often solvent-based and including PBO, have appeared on the agriculture market. Only a few are approved for organic production under the NOP.

FORMULATIONS AND APPLICATION GUIDELINES: Pyrethrum is sometimes available blended with rotenone to increase the range of pests controlled (i.e. flea beetles) and perhaps efficacy. However, mixing insecticides against a specific target insect is not recommended because it will promote the development of resistance. Currently, none of these mixtures is OMRI-approved.

Liquid formulations typically contain 0.1-6 % pyrethrum and up to 60% PBO (not permitted); dusts contain 0.2-0.4 % pyrethrum.

AVAILABILITY AND SOURCES: Readily available from garden and farm suppliers; however few products are approved for organic production.

OMRI LISTED PRODUCTS:

Pyganic® Crop Protection EC 5.0 II
Pyganic® Crop Protection EC 1.4 II
Safer® Brand Yard & Garden Insect Killer Concentrate II (with soap)
Safer® Brand Yard & Garden Insect Killer II (with soap)

NON-OMRI LISTED (INCOMPLETE LIST):

Pyrellin® (pyrethrum and rotenone; petroleum solvent)
Pyola® (pyrethrum and canola oil)
Pyrenone® (6%; 60% PBO) [cancelled registration]
Pyronyl® (6%; 60% PBO)
Evergreen® (6%; 60% PBO)
Diatect V®

REENTRY INTERVAL (REI) AND PRE-HARVEST INTERVAL (PHI): The EPA Workers Protection Standard requires a minimum of 12 hours before reentering a treated field.

APPLICATION TIPS:

Care should be taken not to mix pyrethrum with lime, sulfur, or soap solutions, since pyrethrum is broken down by both acid and alkaline conditions.

Pyrethrum is rapidly broken down by sunlight. Use of UV-inhibiting adjuvants may allow for a longer period of control. Growers should decide whether the advantage of having a longer activity period for pyrethrum to protect the crop from reinfestations is appropriate for their management system, or would be a concern for its impact on beneficial species.

Since pyrethrum is a contact poison the target pest must be present and hit by the spray. Flighty insects such as cucumber beetle should be sprayed early in the morning when they are sluggish and bee pollinators have not begun to fly.

EFFECT ON THE ENVIRONMENT:

Leaf persistence. Pyrethrum is quickly degraded in sunlight (Casida and Quistad 1995).

Fate in water. Pyrethrum compounds are broken down in water to nontoxic products (Extoxnet 1994)

Soil persistence. Soil application studies of pyrethrum showed a half life of only 1-2 hours (Casida and Quistad 1995). When used indoors, pyrethrum can persist much longer; up to two months or more in carpet dust (Cox 2002).

Wildlife. Pyrethrum is extremely toxic to fish such as bluegill and lake trout, while it is slightly to moderately toxic to bird species, such as mallards and bobwhite quail. Natural pyrethrins are highly fat soluble, but are easily metabolized and thus do not accumulate in the body. Because pyrethrin-I and pyrethrin-II have multiple sites in their structures that can be readily attacked in biological systems, it is unlikely that they will concentrate in the food chain (Extoxnet 1994, Casida and Quistad 1995).

Effect on beneficial arthropods. Synthetic pyrethroids are broad spectrum insecticides and are notorious for killing and repelling beneficial arthropods. However, since pyrethrum residues on the plant break down quickly, the effect on natural enemies is reduced. Pyrethrum is highly toxic to bees. The average lethal dose (LD50) for honeybees was measured at .022 micrograms per bee (Casida and Quistad 1995). Direct hits on honeybees and beneficial wasps are likely to be lethal (Cox 2002).

EFFECT ON HUMAN HEALTH:

Acute Toxicity: Compared to many other insecticides, pyrethrum is relatively non-toxic to humans and therefore only carries the signal word CAUTION. However, care is warranted.

Rats and rabbits are not affected by high dermal applications. On broken skin, pyrethrum produces irritation and sensitization, which is further aggra-

vated by sun exposure. Absorption of pyrethrum through the stomach and intestines and through the skin is slow. However, humans can absorb pyrethrum more quickly through the lungs during respiration. Response appears to depend on the pyrethrum compound used. Inhaling high levels of pyrethrum may bring about asthmatic breathing, sneezing, nasal stuffiness, headache, nausea, lack of coordination, tremors, convulsions, facial flushing and swelling, and burning and itching sensations (Extoxnet 1994).

The lowest lethal oral dose of pyrethrum is 750 mg/kg for children and 1,000 mg/kg for adults. Oral LD50 values of pyrethrins in rats range from 200 mg/kg to greater than 2,600 mg/kg. Some of this variability is due to the variety of constituents in the formulation. Mice have a pyrethrum oral LD50 of 370 mg/kg. Animals exposed to very high amounts may experience tongue and lip numbness, nausea, diarrhea, lack of coordination, tremors, convulsions, paralysis, respiratory failure, and death. Recovery from serious poisoning in mammals is fairly rapid (Extoxnet 1994).

Organ Toxicity: In mammals, tissue accumulation has not been recorded. At high doses, pyrethrum can be damaging to the central nervous system and the immune system. When the immune system is attacked by pyrethrum, allergies can be worsened. Animals fed large doses of pyrethrins may experience liver damage. Rats fed pyrethrin at high levels for two years showed no significant effect on survival, but slight, definite damage to the livers was observed. Inhalation of high doses of pyrethrum for 30 minutes each day for 31 days caused slight lung irritation in rats and dogs (Extoxnet 1994).

Fate in Humans and Animals: Pyrethrins and their metabolites are not known to be stored in the body nor excreted in the milk. The urine and feces of people given oral doses of pyrethrum contain chrysanthemumic acid and other metabolites. These metabolites are less toxic to mammals than are the parent compounds. Pyrethrins I and II are excreted unchanged in the feces. Other pyrethrum components undergo rapid destruction and detoxification in the liver and gastrointestinal tract (Extoxnet 1994).

Chronic Toxicity: Overall, pyrethrins have low chronic toxicity to humans and the most common problems in humans have resulted from the allergenic properties of pyrethrum. Patch tests for allergic reaction are an important tool in determining an individual's sensitivity to these compounds. Pyrethrum can produce skin irritation, itching, pricking sensations and local burning sensations. These symptoms may last for about two days (Extoxnet 1994). Cox (2002) reports more serious chronic effects, including circulatory and hormonal effects.

Casida and Quistad (1995) performed 90 day feeding tests on animals. They found no effects at 1000 ppm or less on rats, none at 300 ppm or less on mice, and none at 600 ppm or less on dogs.

Reproductive Effects: Rabbits that received pyrethrins orally at high doses during the sensitive period of pregnancy had normal litters. A group of rats

fed very high levels of pyrethrins daily for three weeks before first mating had litters with weanling weights much lower than normal. Overall, pyrethrins appear to have low reproductive toxicity (Extoxnet 1994).

Teratogenic Effects: A rabbit reproduction study performed showed no effect of pyrethrins on development of the offspring (Extoxnet 1994). Casida and Quistad (1995) found that in rats, there were no teratogenic effects at feeding doses of up to 600 mg/kg/day. According to the Agency for Toxic Substances and Disease Registry, part of the US Center for Disease Control, "There is no evidence that pyrethrins or pyrethroids cause birth defects in humans or affect the ability of humans to produce children" (ATSDR 2001).

Mutagenic Effects: none observed in salmonella, rat primary hepatocyte, or Chinese hamster ovary cell tests (Casida and Quistad 1995).

Carcinogenic Effects: "There is no proof that pyrethrins or pyrethroids cause cancer in people. Pyrethrins and pyrethroids do not appear to cause cancer in animals" (ATSDR 2001). However, Cox (2002) cites several studies indicating the possibility of a connection between pyrethrins and cancer, including one study showing a 3.7-fold increase in leukemia among farmers who had handled pyrethrins compared to those who had not. In 1999, a USEPA memo classified pyrethrins as "likely to be a human carcinogen by the oral route" (Cox 2002). Currently EPA is undertaking a review for pyrethrin, which is scheduled for completion and issuance of a Reregistration Eligibility Decision (RED document) in June 2006. The RED summarizes the risk assessment conclusions and outlines any risk reduction measures necessary for the pesticide to continue to be registered in the U.S. (EPA 2004).

EFFICACY

Older studies: Pyrethrum is a broad-spectrum insecticide used to control true bugs, caterpillars, beetles, aphids, flies, mites, whiteflies, thrips and leafhoppers (Casida 1973). Within these groups, pests may have a greater or lesser susceptibility to pyrethrum products. Specific pest species controlled by pyrethrum as noted in the older literature include potato leafhopper, beet leafhopper, cabbage looper, celery leaf tier, Say's stink bug, twelve-spotted cucumber beetle, six-spotted leafhopper, lygus bugs on peaches, grape thrips, flower thrips, grape leafhopper, and cranberry fruitworm. It was not considered particularly effective against flea beetles, imported cabbageworm, diamondback moth, aphids on spinach, or lygus bugs on alfalfa (Casida 1973).

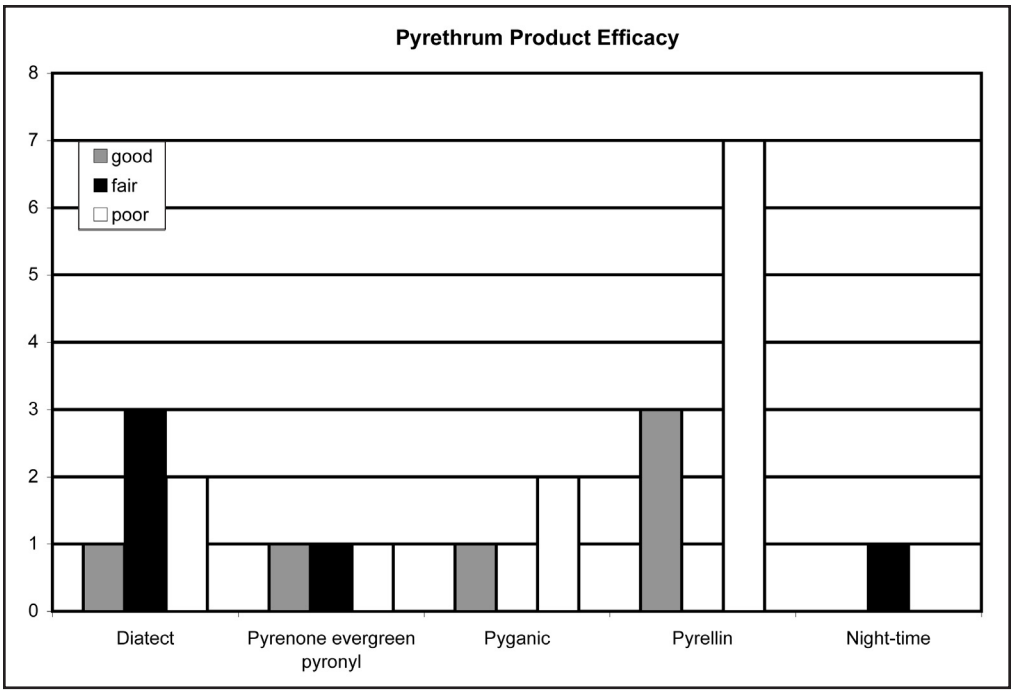
Recent studies: A summary of recent university field trials of pyrethrum products on vegetable crops commonly grown in the Northeast was compiled. These university-based trials typically test products with untreated buffer rows and other conditions that create unusually severe pest pressure.

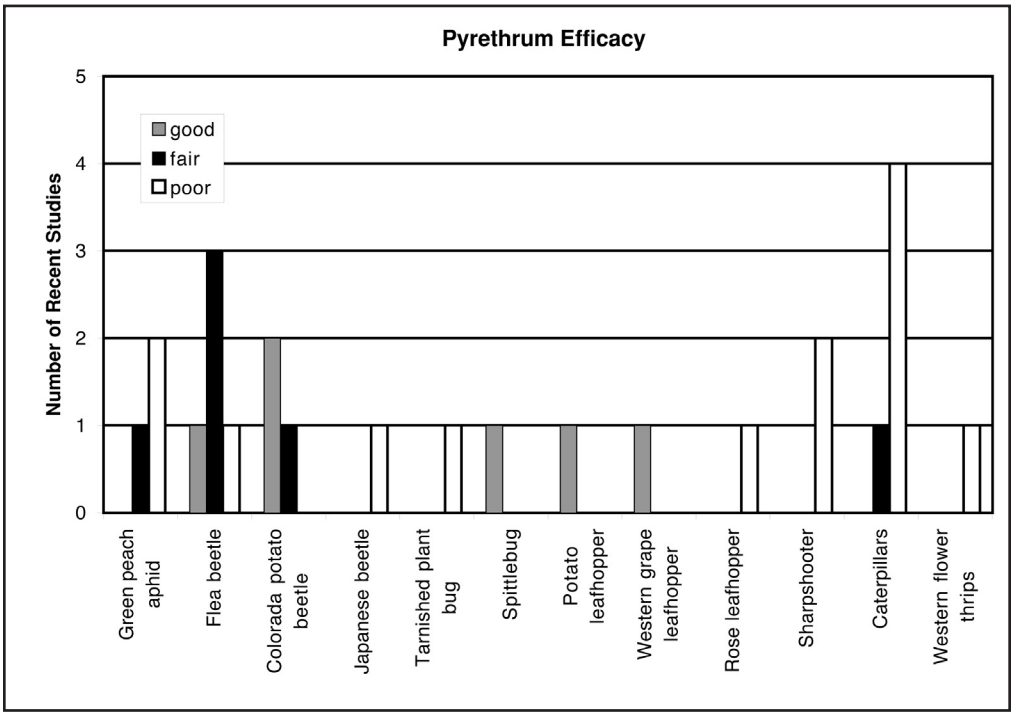
The level of pest control is likely to be higher on fields in which a good program of cultural controls has been implemented.

In the tables below,"good control" means statistically significant reductions in pest numbers or damage of 75% or more, compared to an untreated control. "Fair control" includes those with significant reductions of 50-74%, and any non-signnificant reductions of over 50%. The "poor control" group includes any results with less than 50% reduction.

RELATIVE EFFICACY OF PYRETHRUM AND PBO, AFTER SILCOX AND ROTH, 1995

Pest Reduction Relative to Untreated Control	Crop	Pest
61-100%	Celery	Beet armyworm
	Celery	Black cutworm
	Cabbage	Imported cabbageworm
	Blueberry	Blueberry spanworm
	Tomato	Greenhouse whitefly
	Cucumber	Greenhouse whitefly
	Lettuce	Greenhouse whitefly
	Cabbage	Cabbage aphid
	Apple	Green peach aphid
	Potato	Potato aphid
	Celery	Sunflower aphid
	Grape	Grape leafhopper
	Potato	Potato leafhopper
	Alfalfa	Potato leafhopper
	Grape	Variegated leafhopper
	Blueberry	Blueberry flea beetle
	Potato	Colorado potato beetle
	Potato	Potato flea beetle
	Blueberry	Blueberry thrips
	Onion	Onion thrips
	Blueberry	Blueberry sawfly
41-60%	Tomato	Beet armyworm
	Cabbage	Cabbage looper
	Tomato	Tomato fruitworm
	Apple	Apple aphid
	Potato	Tarnished plant bug
Less than 41%	Tomato	Tomato pinworm
	Sweet corn	Fall armyworm
	Sweet corn	Corn earworm
	Sweet corn	European corn borer
	Tomato	Vegetable leafminer
	Celery	Vegetable leafminer
	Blueberry	Blueberry maggot
	melon	Spider mite





REFERENCES

ATSDR 2001. Draft Public Health Statement for Pyrethrum and Pyrethroids. Agency for Toxic Substances and Disease Registry, US Dept. of Health and Human Services. http://www.atsdr.cdc.gov/toxprofiles/phs155.html

Casida, J. E. and G. B.Quistad, eds. 1995. Pyrethrum Flowers—Production, Chemistry, Toxicology, and Uses. Oxford University Press, Oxford.

Casida, J. E., ed. 1973. Pyrethrum, The Natural Insecticide. Academic Press, New York.

Cox, C. 2002. Pyrethrins/Pyrethrum Insecticide Factsheet. Journal of Pesticide Reform 22(1) 14-20.

EPA. 2004. Pesticide Reregistration Status. US Environmental Protection Agency. http://cfpub2.epa.gov/oppref/rereg/status.cfm?show=rereg

Extoxnet 1994. Pyrethrins And Pyrethroids. Pesticide Information Profiles. Extension Toxicology Network.
http://ace.ace.orst.edu/info/extoxnet/pips/pyrethri.htm

Noetzel D., M. Ricard, and J. Wiersma. 1989. Effect of 3 pyrethroid and 4 suggested synergist combinations on pyrethroid-resistant Colorado Potato Beetle, 1987. Insecticide and Acaricide Tests 14:159-160.

Noetzel, D. and M.Ricard. 1989. Control of imported cabbageworm and cabbage looper using pyrethrin, rotenone, or Asana with of without one of four "synergists". Insecticide and Acaricide Tests 14:96-97.

NOP. 2000. USDA National Organic Program regulations, 7CFR 205.206(e). http://www.ams.usda.gov/nop/

Silcox, C. A. and E. S. Roth. 1995. Pyrethrum for Control of Pests of Agriculture and Stored Products. Casida, John E. and Gary B. Quistad, eds. 1995. Pyrethrum Flowers—Production, Chemistry, Toxicology, and Uses. Oxford University Press, Oxford.