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Using OILS as PESTICIDES

Carlos E. Bográn, Scott Ludwig and Bradley Metz*

Oils have been used as pesticides for centuries and are some of the most effective, safe alternatives to synthetic insecticides and fungicides. Most oil-based products sold as pesticides are regulated by the Environmental Protection Agency (EPA) under the Federal Insecticide, Fungicide and Rodenticide Act. Exemptions are granted to edible oils and other specific exempt ingredients that are considered to pose minimum risk to humans (see *http://www.epa.gov/*). Safe and effective use of any oil as a pesticide, however, requires a basic understanding of its chemical nature, mode of action and limitations of use.

Types of oils and oil products that are commercially available for use as pesticides are listed on page 4. These include oils distilled from petroleum (also known as horticultural or mineral oils) and oils extracted from plants and animals. Most oil-based pesticides are used for insect control; but in many cases oil products also have fungicidal properties.

Petroleum (Mineral) Oils

Petroleum oils are highly refined, paraffinic oils that are used to manage pests and diseases of plants. Similar paraffinic oils are found in automotive and household lubricants and cleaners. Petroleum oils may be referred to by many names, including horticultural oil, spray oil, dormant oil, summer oil, supreme oil, superior oil, Volck oil or white mineral oil. These names usually refer to particular types, uses or brands of petroleum oil. The terms "summer oil" or "all season oil" indicate that the product can be safely used on plant foliage during the growing season. Prior to the advent of modern, highly purified oils, the term "dormant oil" referred to heavier, less refined oils. They could only be used in the fall and winter after leaf drop or in the spring before plant buds open. Because these older, dormant oil sprays would damage growing foliage, they were used mainly to combat the over-wintering stages of the pest or pathogen.

Tips for Oil Use

- Always read and follow label instructions.
- Cover all plant surfaces, especially the undersides of leaves and crevices of branches and stems where pests can hide.
- Avoid large spray droplet sizes by using proper equipment and spray pressure.
- To minimize the risk of plant injury, avoid treating when temperatures are below 40°F or above 85°F degrees or when the relative humidity is above 90 percent.
- Not all pests/diseases are susceptible to oils. When using any pesticide, proper pest identification is critical.
- Avoid treating drought-stressed plants.
- Do not mix oils with sulfur- or copper-based pesticides and avoid applying oil before or after a sulfur or copper treatment.
- Apply dormant oil sprays only after winter hardening has occurred.

* Assistant Professor and Extension Entomologist and Extension Program Specialist, The Texas A&M University System; and graduate student, Department of Entomology Texas A&M University.

Selection of Petroleum Oils

Modern, petroleum-based horticultural oils are refined to standard specifications. The unsulfonated residue (UR) is a measure of the degree of oil refinement and is expressed as a percentage. Oils contain saturated and unsaturated hydrocarbons. Saturated hydrocarbons are more stable than unsaturated hydrocarbons, which can form toxic substances when sprayed on plants. In general, the higher the UR, the less unsaturated hydrocarbon content in the oil and the less likelihood of plant injury. Dormant oils have UR between 50 and 90 percent; summer oils, between 92-96 percent. Stylet oils are highly refined horticultural oils and have UR above 99 percent. Viscosity is a measure of oil "thickness" and is expressed in time units (Saybolt seconds) required for the oil to flow through an opening of standard size. In general, the lower the viscosity, the less likelihood for plant injury. The viscosity of horticultural oils varies between 60 and 90. Distillation range is a measure of the purity of the oil fraction and is expressed as a temperature range (degrees Fahrenheit). The temperature range represents the boiling point of the oil components at 10 and 90 percent distillation. In general, the more narrow the distillation range, the more predictable the performance of the oil when sprayed on plants. Distillation ranges of 80°F or less are considered "narrow range" appropriate for spray oils. Oils with boiling points above 455 °F may damage plant foliage. Minimum and maximum boiling points of horticultural oils vary between 412 °F and 468 °F, depending on the type of oil.

Plant Oils

Plant oils include oils extracted from plant seeds, leaves, stems or flowers. They contain fatty acids and other lipids. Some of the most common fatty acids in plant oils are palmitic, steric, linoleic and olec acids. Neem oil is extracted from the neem tree, *Azadirachta indica*. Some neem oil products contain an additional active ingredient, azadirachtin. It is considered an insect anti-feeding agent and insect growth regulator. Canola oil is extracted from rape, *Brassica napus* and *B. campestris*. It is generally sold as dormant oil although there are products recommended for the growing season. Soybean oil is extracted from the widely grown legume, *Glycine max*. Soybean oil and cottonseed oil are extracted from cotton, *Gossypium hirsutum*. They are commonly used in food and feed products. Many plant oils are exempt from EPA regulations and some are sold for organic production.

Fish Oils

Fish oils are very similar in chemical composition to plant oils. They are mostly by-products of the fish processing industry. Fish oil products are often combined with plant oils, and the fish oil is listed as an inert ingredient. Some fish oil products are certified organic.

One limitation of plant and animal oils is that their natural origin contributes to a wide variation in composition and quality. This depends on geographic origin and species from which the oil is extracted. There are no well defined standards for quality and use of plant and animal oils.

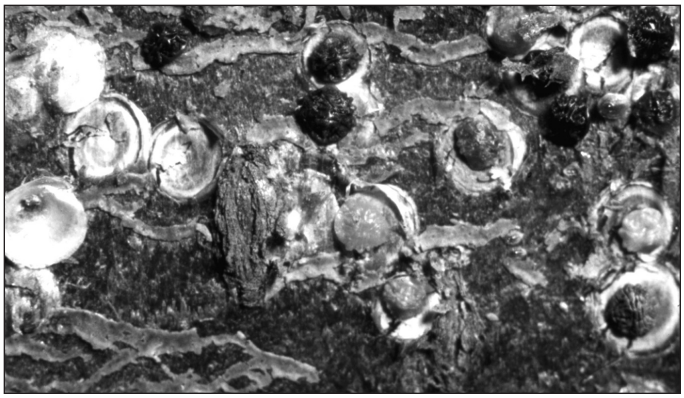
Mode of Action of Oils

Regardless of the source or type, all oil-based products have a similar mode of action. Insecticidal oils kill insects on contact by disrupting gas exchange (respiration), cell membrane function or structure. They also kill them by disrupting their feeding on oil-covered surfaces. Their toxic action is more physical than chemical and is short-lived. When used against plant pathogens, oils may smother fungal growth and reduce spore germination on treated surfaces. They are mostly fungistatic, stopping fungal growth rather than killing the pathogens. Stylet oils are highly refined oils and may control insect-vectored plant viruses in addition to insects, mites and fungal pathogens. These oils reduce the ability of aphids to acquire the virus from an infected plant and transmit it to healthy plants. Stylet oils may interfere with the virus's ability to remain in aphid mouthparts (stylets). Some plant oils that contain sulfur compounds, such as neem oil, may possess additional fungicidal activity compared to petroleum oils.

Oil-based pesticides have low residual activity and must be sprayed directly on the insect or mite. To combat plant fungal pathogens, oils generally must be applied prophylactically prior to infection. Repeated applications of oils may be needed to achieve desired levels of control.

Target Pests and Diseases

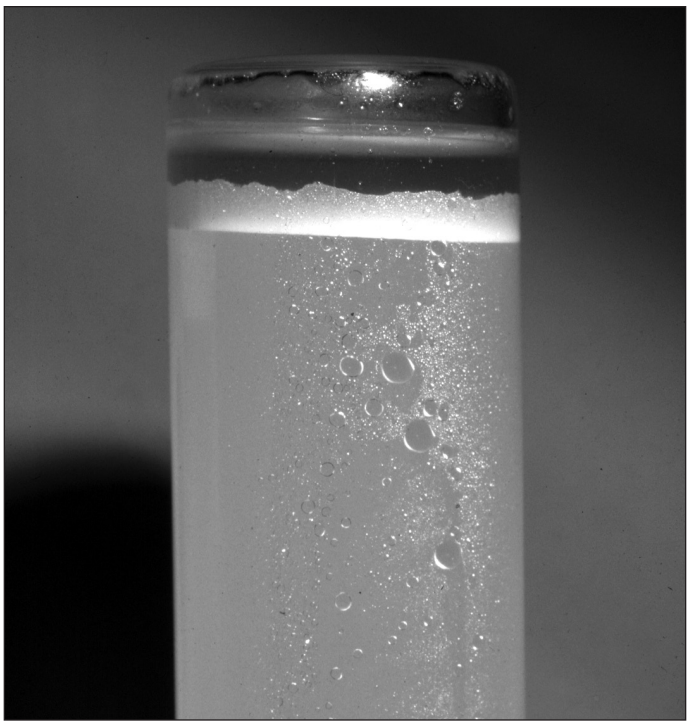
Oils are most effective against soft-bodied arthropods. They are most commonly used against mites, aphids, whiteflies, thrips, mealybugs and scale insects. Dormant oil sprays are also used against over-wintering eggs and scales. Horticultural and plant oils are commonly used to suppress certain fungal diseases, like powdery mildew and black spot on rose. Stylet oils may be used to manage insect-vectored plant viruses.



Scale insects can be controlled with horticultural oils.

Application

While oil treatments have historically targeted fruit trees and woody ornamentals, several different types of pesticidal oils are currently marketed for house plants, flowers and vegetables. Commercial oil products include emulsifiers to enable the oil to mix readily with water. These emulsifiers are generally considered to be inert, but may have some insecticidal properties. Oil formulations are generally designed to be mixed with water at concentrations of 0.5-2.0 percent (volume/volume). When applying oils, it is best to agitate hand pump sprayers frequently and keep tank spray agitators running. This reduces the risk of oil separation that could result in sprayer clogging, uneven plant coverage and possible plant injury.



Oils will separate from the carrier. Agitation is necessary to keep oils in solution.

When mixed with other pesticides, oils can enhance application efficiency. Oils often act as surfactants, and improve plant coverage and penetration of pesticides into leaf surfaces. Always read pesticide product labels carefully to make sure the product can be mixed with oil. Most labels prohibit the use of sulfur pesticides within 30 days of oil treatment. Oils may be incompatible with copper applications in some crops.

Phytotoxicity

Although generally considered safe, oils can injure susceptible plant species. Symptoms of plant injury (phytotoxicity) may be acute or chronic. They can include leaf scorching and browning, defoliation, reduced flowering and stunted growth. Phytotoxicity may be associated with plant stress, ambient temperature and humidity, and application rate. It can vary among plant species and cultivars. To reduce the risk of phytotoxicity, do not treat stressed plants. Apply when conditions are below 85 °F degrees and 90 percent humidity. Applications during the summer season are best in the morning or late evening. The longer wet oil sprays remain on foliage, the greater the chance of phytotoxicity.

During winter it is best to apply oils only when temperatures are above 40 °F. Apply dormant oils or higher rates of summer oils only after stems and buds have become winter-hardened and before buds begin to swell in the spring. Evergreen trees generally should be treated only by summer rates of all-season oils. Some evergreens, especially those with a glaucous (waxy) coat, may become discolored following an oil application. This usually does not harm the tree or shrub.

When treating a new kind of plant, it is best to apply horticultural oils to part of the plant or to a few small specimens before treating large quantities of foliage. With oils it is especially important to read, and follow label instructions and recommendations. Manufacturers' labels provide useful information about sensitive plant species based on extensive testing. Some plants most commonly listed as being oil sensitive include azalea, carnation, fuchsia, hibiscus, impatiens, photinia, rose, cryptomeria, juniper, Japanese holly and spruce.

Safety

Oils have many characteristics that make them desirable to growers and homeowners. For example, they are low in toxicity to humans, wildlife and pets. Since oils are only active for a short time, they do not

affect insect predators or parasitoids unless they are exposed to the direct spray. Oils evaporate quickly and do not generally contaminate the soil or groundwater sources. Plant and fish oils are broken down rapidly by microorganisms on plants or soil, and pose minimum risk to non-target organisms. Oils are also considered one of the few classes of pesticides to which insects and mites have not developed resistance.

Examples of Common Oil-based Products and Sources

Oily Type/Source	Insecticide/ Fungicide	Brand Name	Manufacturer
Petroleum/Paraffin	I, F	Orchex®	Columet Lubricants Co.
Petroleum/Paraffin	I, F	Ultra-Fine® Oil	Whitemite Micro-Gen
Petroleum/Paraffin	I	All Seasons® Horticultural and Dormant Spray Oil	Bonide
Petroleum/Paraffin	I, F	Saf-T-Side™	Monterrey
Petroleum/Paraffin	I	Horticultural Oil Spray	Green Light
Petroleum/Paraffin	I, F	JMS Stylet-Oil® and Organic JMS Stylet-Oil®	JMS Flower Farms, Inc.
Plant/Canola	I	Vegol Growing Season Spray Oil	Lilly Miller Brands
Plant/Clove, Cotton Seed, Garlic	I, F	GC-Mite	JH Biotech, Inc.
Plant/Corn, Cotton Seed, Garlic	F	GC-3	JH Biotech, Inc.
Plant/Cottonseed Oil	I, F	SeaCide™	Omega Protein Corp.
Plant/Neem	I, F	Trilogy®	Certis USA
Plant/Neem	I, F	Triact®	OHP, Inc.
Plant/Neem	I, F	70% Neem oil	Monterrey
Plant/Neem	I, F	Neem® Concentrate	Green Light
Plant/Neem	I, F	Rose® Defense	Green Light
Plant/Rosemary & Clove	I, F	Phyta-Guard EC	Monterrey
Plant/Sesame oil	I, F	Organocide	Organic Laboratories
Plant/Soybean	I	Golden Pest Spray Oil	Stoller Enterprises Inc.

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