WHY YOU SHOULD BUY A BACKPACK BLOWER, LAWN TRIMMER OR ALTERNATOR FROM A COMPANY THAT'S FAMOUS FOR SOMETHING ELSE.

It's only natural for people to think of John Deere as a tractor company. But if we can build tractors that run well and last a long time, there's no reason why our other products shouldn't do the same.

Take our two power blowers. The smaller one has a 21-cc engine whose 130-mile-per-hour windstream will blast leaves, twigs and snow out of your way in a mighty big hurry. It weighs less than nine pounds.

No. 4 Power Blower

The backpack model tips in at only 10 pounds more. With 40 cc, it does all its baby brother can do plus heavier duty tasks. And it has an optional spray attachment for even more versatility.

Need a lawn trimmer? John Deere offers five models. From a feather-light electric for lawn trimming to gasoline-powered models designed to handle everything from playgrounds to forest preserves.

90G Flexible Disk Trimmer

If you ever need auxiliary power, check our portable alternators. Five of them, from just over 2,000 watts to a powerful 6,500 watts. All have spark-arresting mufflers, on-board circuit breakers and low-vibration steel base frames.

John Deere also has five high-pressure washers. So there's a model for any job. From cleaning a golf cart to washing and waxing a school bus.

And that's only the beginning. John Deere has welders, space heaters, battery chargers, chain saws, air compressors, centrifugal pumps and a variety of power and hand tools.

Model 500 Portable Alternator

They're all built the same way. To last.

Just like the tractors we're famous for.

Nothing Runs Like a Deere®

For nearest dealer or free folder, write John Deere, Dept. 70, Moline, IL 61265. Or call 800-447-9126 (Illinois call, 800-322-6796).

Circle No. 112 on Reader Inquiry Card

CUSHMAN® FRONT

SIX GOOD REASONS TO MAKE IT YOUR FIRST CHOICE.

1 Plenty of power, plus economy.

Choose either the 18-hp OMC® air-cooled engine or the 4-cycle water-cooled diesel. Both deliver the power and performance you need. The Front Line mower is designed from the engine up, not from the tractor down, so every working component complements the power plant.

2 Fast, maneuverable, simple operation.

Hydrostatic drive and wheel-type steering make operation easy. Single rear turning wheel, and split front-wheel traction-assist pedals allow smooth, zero-turning radius; the driver's hands stay on the wheel. Mechanical clutch direct-drive PTO gives you a powerful tractor that's built to take it.

3 The cleanest of cuts.

The three heat-treated blades with air-lifts along with the Cushman deck and baffle design cut the grass cleanly. Clippings are lifted up and discharged out the chute evenly, eliminating the blade drag that eats up power. Choose a 60″ or 72″ deck; both offer top-mounted grease fittings and covers that remove with just two wing nuts. The 72″ deck also comes with wash-out holes so collected debris can be flushed out during normal maintenance.

4 No scalping.

Rear deck rollers work along with the front wheels to keep the deck and blades off the ground, even over rough terrain. Springs are also available to absorb deck weight and allow the deck to "float" with the contour of the ground. (These anti-scalp packages are optional, depending on the contours of your particular turf.)

5 Year-round versatility.

The Cushman Front Line doesn't go out of service when the mowing season is over. It can work for you all year 'round when you add accessories like the ROPS structure and weathertite cab, 60″ rotary broom (gas unit only) and the 48″ snow thrower.

6 Service when you need it.

Your Cushman Front Line dealer stocks parts for the engines, tractors and decks, and services the entire unit. He's an experienced, thoroughly trained professional, dedicated to keeping your Front Line mower in service.

For a free on-site demonstration of the Front Line quality, contact a Cushman Front Line dealer today. Or call us at 402-435-7208 for the location of your nearest dealer.

CUSHMAN® FRONT LINE.™

It stands to reason.

3109 Cushman, P.O. Box 82409
Lincoln, NE 68501

Circle No. 111 on Reader Inquiry Card

CUT2-5780

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SPRAYER WAS JOHN DEERE'S FIRST LANDSCAPE PRODUCT

Two generations *of John Deere lawn and garden tractors, the 1964 model of the 8-hp 110 Tractor (right) and the 1981 model of the 14-hp 214 Tractor.*

John Deere entered the landscape business in 1962, the same year that *Weeds, Trees & Turf* began publishing. The first John Deere landscape product was the No. 5 Lawn and Garden Sprayer. In 1963, John Deere built its first lawn and garden tractor, a 7 hp model 110 with such attachments as a center-mounted mower, snow thrower and front blade. The 110 provided a three speed trans-axle with a special feature: variable speed drive varied ratios on a belt and pulley system to allow the operator to slow down or speed up any gear without clutching and shifting. The tractor was available only through John Deere agricultural equipment dealers in the eastern part of the United States in 1963. An 8-hp 4-speed version of the tractor was sold through most John Deere agricultural dealers in the United States and Canada in 1964. The tractor was manufactured at the John Deere Horicon Works in Horicon, Wisconsin.

During the early 1960's, the Horicon Works became the world's largest producer of agricultural grain drills (mechanical seeders). But, because grain drill sales were subject to seasonal fluctuations, the John Deere organization sought a product line that would help the factory use its facilities more uniformly.

Gary Lindquist, division manager, grounds care at the Horicon works, explained why John Deere entered the outdoor power equipment business. "We had several research studies done for us on the lawn care business in the early 1960's. At that time, there appeared to be good potential for growth in this market. The research also determined that lawn care products would provide additional sales for John Deere agricultural equipment dealers. We found that the John Deere reputation for building high quality farm tractors and implements would help our CP (consumer products) business in rural areas, providing a strong springboard to sales in suburban areas. One of our early goals was to develop independent CP dealerships to help us penetrate the suburban, nonfarm market. It remains an important objective for our organization."

In 1966 John Deere added a 6-hp 60 Lawn Tractor and a 10-hp 112 Lawn and Garden Tractor. John Deere produced a 14-hp 140 Hydrostatic Tractor in 1967.

John Deere introduced a new utility tractor in 1968. The 820 Tractor was powered by a 3-cylinder diesel engine producing 31 hp at the PTO. It was manufactured at a John Deere factory in Mannheim, West Germany, and marketed in North America through the John Deere Tractor Works in Waterloo, IA.

During 1969, John Deere's Horicon Works experimented with custom colors, providing some lawn and garden tractors with seats and hoods of orange, red, yellow and blue—instead of the traditional green hood with yellow seat and wheels. It was soon found that customers preferred the green and yellow combination. "Once you establish a good reputation, your colors come to represent that reputation," said Lindquist.

Another significant event occurred in 1969. The Horicon lawn care equipment business had grown to such an extent that the production of grain drills was transferred to a John Deere factory in Iowa. The Horicon Works began devoting all its time and energy to the development of consumer products.

In 1970 John Deere replaced its 60 Lawn Tractor with a 7-hp 70 Lawn Tractor, and expanded the lawn care line to include six models of walk-behind rotary mowers, two riding mowers, lawn sweepers and a 12-hp 120 Hydrostatic Tractor. Walk-behind tillers and snow blowers joined the line in 1971. From 1972 to 1974, John Deere added an electric-powered riding mower, dumpcarts, and gasoline-powered edger-trimmers.

The 820 Utility Tractor was replaced in 1973 by a more powerful Mannheim-built tractor—the 830 developed 35 hp at the PTO. It was powered by a 3-cylinder diesel engine and featured an 8-speed transmission with 2-lever control and built-in shuttle shift.

1974 was a pivotal year for John Deere. The company introduced what it termed the "second generation" of lawn and garden tractors, lawn tractors and riding mowers for sale in 1975. "We put side panels on the tractors and enclosed the engines for quiet operation," according to Lindquist. "We styled the tractors so they would have a family resemblance to John Deere farm tractors, a feature that we thought would appeal to both rural and suburban customers. We were the first manufacturer to offer a complete line of quiet lawn and garden tractors and riding mowers."

On January 12, 1977, the Horicon Works celebrated a milestone by manufacturing its half-millionth tractor. The event pointed up the dramatic progress the factory had made in only 15 years. Factory plant area had increased by 81 percent, and average yearly employment had more than doubled.

John Deere added compact utility diesel tractors to its grounds care line in 1978. The 22-PTO-hp 850 and the 27-PTO-hp 950 are marketed through the John Deere Tractor Works in Waterloo. Both tractors are powered by 3-cylinder diesel engines. A 33-PTO-hp 1050 Tractor joined the line in 1979. The 1050 is powered by a turbocharged 3-cylinder diesel engine. An MFWD (mechanical front wheel drive) option gives the 1050 positive traction in mud, slush and snow. The MFWD option was extended to the 950 as well.

In 1981 John Deere added two more compact utility diesel tractors: the 14.5-PTO-hp 650 with a 2-cylinder diesel engine, and the 18-PTO-hp 750 with a 3-cylinder diesel engine. Johnny A. Dickinson, division manager, utility tractors at the Waterloo factory, said, "These new diesel tractors are designed to fill the gap between John Deere gasoline-powered lawn and garden tractors and our higher-horsepower diesel tractors. Our research shows that prospects require a greater range of forward speeds than is now available in many competitive tractors. They want ample ground clearance, a compact size for storage in a utility shed, a more convenient implement attaching system, and the availability of a full line of implements. Our compact utility diesel tractors meet these objectives."

The lawn tractor business has been a significant growth area for the John Deere consumer products organization. From 1977 to 1981, the annual production at the Horicon Works has increased by 1041 percent.

The most recent addition to the John Deere compact utility tractor line is the 1250—a 40-PTO-hp diesel tractor.

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full model line.

The 1967 models were dedicated designs for turf care. There was an 18-hp Turf-Truckster vehicle having a pickup-style bed, an 8-hp unit with the same feature and one having a stripped chassis. A unit oddly enough named the Lobster had an 8-hp engine, along with a sister unit powered by a 5-hp engine to provide personnel transports.

Always sensitive to the user, OMC Lincoln entered the 1968 season with a 12-hp Turf-Truckster and beefed up the 5-hp Minute-Miser vehicle with a 6-hp engine. A new sprayer having rear boom delivery operated by the vehicle PTO emerged as another innovation.

The 1969 season evolved into Truckster vehicles powered by 18-hp, air-cooled engines equipped with pickup beds, wide-box dumpbeds and a 12-hp pickup and dumpbed were other options.

McDonald notes with pride the 18-hp OMC engine's legacy of durability and performance. While major automakers were constantly building bigger blocks, OMC Lincoln decided to make its engine simply better with ongoing refinements of the same standard design.

The '60s rolled out and the '70s in with the unveiling of a 4-wheeled truckster. The Lobster lost its niche in the product line, however, just as the Cushman Eagle motorscooter did in 1965. The demand simply wasn't there, so OMC Lincoln focused its product emphasis elsewhere.

The year 1973 reflects that fact. OMC Lincoln was heralded then for introducing its quick-change, pin-disconnect system on Turf-care units. The ability to promptly swap utility beds and accessories saved manhours and lended new flexibility in a vehicle having consolidated roles. That year the firm also introduced its Runabout vehicle which has become a mainstay in its turf industry marketing.

"That one feature placed us so far ahead of the competition that we didn't undertake another major refinement until 1978," McDonald notes. "That year, however, we introduced our radial frame on the Runabout and added a Greensaver aerator attachment to those accessories already established. The Turf Minute-Miser went the way of the Lobster. In 1979, we began marketing a 2-seat Runabout and the following year a power converter to accommodate the growing number of electric tools used out on the course."

The Turfcart model followed a year later, providing the industry with a low-cost transport for minor chores. Cushman begins 1982 with a totally redesigned model line.

"The industry is unique so we will continue listening to what it needs and reacting accordingly," McDonald predicts. "We intend to maintain our role as a bellwether."

STATUS REPORT:

HORTICULTURAL SPRAY OILS FOR TREE PEST CONTROL

By WARREN T. JOHNSON

Figure 1. *The dark spots on the undersides of Amur maple illustrate an injury symptom caused by a spray containing excessive oil.*

Figure 2. *The tiny purplish spots with yellow halos illustrate injury symptoms on Redbud from spray containing excessive amounts of oil.*

Dr. Warren T. Johnson is professor of entomology for Cornell University, Ithaca, NY. He is the national expert on oil sprays for tree and shrub pest control, doing most of the research on the subject.

Why should we expand the use of oil for pest control at a time in history when this would further deplete a non-renewable resource? If we reflect for a moment that the pesticide industry is mostly a petrochemical industry, the question becomes no more pertinent to horticultural spray oil than it is to synthetic pesticides.

Then why do we pick a 100-year old commercial product and reinstate it into a pest control program when the claim for modern chemicals is that they do a more efficient job? This is an appropriate question, but to respond requires an analysis of the situation and a bit of historical reminiscence. First, the history.

Oil is one of the oldest *natural* pesticides. In the first century A.D., the Roman scholar Pliny wrote that mineral oil would control certain plant pests. It was also known at that time that the oil was liable to injure plants. Jumping ahead several centuries and to the United States, oils were used to control insects before the Civil War, and by 1865, kerosene (then known as coal oil, because it was derived principally from oil-bearing bituminous shales) was recommended for the control of scale insects on Florida citrus. By World War I, U.S. Department of Agriculture entomologists were recommending an oil emulsion that was later dubbed "United States Government boiled emulsion" for the control of San Jose scale on apples.

Between 1942 and 1970, teams of petroleum chemists and entomologists made great strides in spray oil science and technology. Now, there is a good understanding about the components of oil that cause phytotoxicity and the oil fraction needed to kill insects and mites.

During the three decades prior to 1970, every major oil company had its favorite horticultural oils and much marketing competition. Most of these were sold for dormant use with a viscosity range from ca. 100 to 220. None were exactly alike in terms of physical properties (see Table 1). There were four state agri-

cultural experiment stations—Florida, Texas, California, and New York—that had scientists studying the various oil properties. These scientists established specifications for the oils to be used in the control of fruit insects and mites in their respective states, based upon the needs of their fruit growers.

Arborists and nurserymen benefited from the work on fruit trees because many of the pests controlled by oil were the same pests that injured shade trees and shrubs. Remembering that spray oils were developed for fruit trees, it is easier to understand why some of these oils when applied to certain shade trees and shrubs, not only killed arthropods, they occasionally injured the plants that the applicator was trying to protect. The development of so-called 60- and 70-second viscosity superior spray oils added to our confidence in the phytosafety considerations of ornamental plants because they evaporated more rapidly from treated plants.

Table I.
Specifications for Superior Spray Oil

Properties	Standard
Saybolt Universal Viscosity at 100° F, seconds maximum	*
Gravity, ° API (minimum)	30°
Unsulfonated residue (UR) (minimum) (%)	92%
Pour point, °F (maximum)	20°
Distillation at 10 mm Hg, °F	
50% point	420 ± 8°F
10-90% range (maximum)	80°F

*For technical reason, a specific viscosity standard has not been made a part of these specifications. Oils otherwise defined here may fall within the 68-74 second visocity range.

The 1982 Spray Oil

Today, superior horticultural oils are being produced by four oil companies. Chevron refines horticultural oil primarily for use in California. They have withdrawn their product, Ortho Volck spray oil, effective in 1982 because they can make a greater profit from other kinds of petroleum products. Exxon and Gulf have a 70 second viscosity superior oil in tank car and barge shipment quantities for use on citrus in Florida and the Rio Grande Valley. This oil is refined to meet the Florida-Texas citrus spray oil specifications. The Sun Refining and Marketing Company supplies spray oil to a wide range of markets throughout the United States with sales largely to agricultural chemical companies for repackaging and marketing. The Ag chemical companies prepare their own labels and sell in small quantities (1 pint to 55 gallons) to home gardeners, arborists and other spray contractors. The oil you use in 1982 will have the typical properties shown in Table I, some of which will be stated on the label.

Spray oil specifications are couched in the jargon of petroleum chemistry but this important information should not be difficult to understand. *Viscosity* is a measurement of oil heaviness; the time it takes for a given amount of oil to flow through a hole of precise size and measured in seconds. The *gravity* test is another technique to weigh oil. When related to viscosity and unsulfonated residue (UR) it provides an index to the oil paraffinicity; spray oils must be largely paraffinic to be safe for plants. The gravity specification is measured in terms of degrees; the higher the number, the more paraffinic the oil. Thirty (30°) degrees is the minimum standard. The *unsulfonated residue*, expressed in percent, is a measure of purity or degree of refinement. The process involves the chemical reaction of oil with concentrated sulfuric acid. That part of the oil that reacts with the acid (aromatic portions) can be separated, leaving the unsulfonated residue or paraffinic oil. White mineral oil is a paraffinic oil that goes through the sulfonization process several times and is used for pharmaceutical purposes, e.g. lotions, cosmetics and laxatives. It has a UR of about 99.5%. *Distillation* temperature range is a measure of the volatility of an oil and is the most valuable criterion for determining the pesticidal activity and paraffinicity of an oil. Volatility is monitored by controlling the 50% point of the distillation range to a narrow specified range and the 10%-90% range to a maximum of 80°F. The distillation profile and the unsulfonated residue are the two most important tests assuring an acceptable spray oil. Without the above specifications, there is no scientifically acceptable way to compare pest control or phytotoxicity results with other oils.

Mode of Insecticidal Action

Modern spray oil can kill arthropods in two ways: (1) by penetrating the egg and interfering with the vital metabolic processes or (2) by preventing respiration through egg shells or respiratory passages (tracheae) of both immature and mature insects. In the egg, a growing embryo must have a constant exchange of gases. Interrupting this gas exchange, even for a few hours, may bring about its death. A dormant egg in autumn or winter has a minimal need for gas exchange. An oil film around a dormant egg may evaporate before vital processes are seriously affected. If an oil-sprayed, dormant, overwintering immature or adult insect can "hold its breath" for a week or more, it may overcome the presence of oil. One may extend the oil residual period by increasing the dose. The key feature in oil efficacy is the arthropod's oxygen requirement. During the dormant season, the dosage may range from three to five percent. During the summer, or verdant season, most insects require an uninterrupted source of oxygen. If impeded for a few hours in the case of eggs, the arthropod will not be able to survive. Normal dose for summer treatment varies from 1 to 3%.

Oil Phytotoxicity - Its Mode of Action

"Do not spray on oil sensitive plants!" This admonition is often found on old superior oil labels, but who knows what it means? Some very delicate annual flowering plants such as Impatiens will show

TABLE 2

An abbreviated sample of a proposed label as submitted to the Environmental Protection Agency.

SUNSPRAY 6E

A SUPERIOR HORTICULTURAL SPRAY OIL

CAUTION: KEEP OUT OF REACH OF CHILDREN
HARMFUL IF SWALLOWED. IF SWALLOWED, DO NOT INDUCE VOMITING.
AVOID BREATHING OF VAPORS AND SPRAY MISTS. DO NOT POLLUTE FISH AND WILDLIFE WATERS BY RINSING OR DRAINING OF EQUIPMENT. SEE OTHER CAUTIONS

55 GALLONS NET • U.S. STANDARD

EPA REG. 862-11

ACTIVE INGREDIENT:	BY WEIGHT
PARAFFINIC OIL*	98.8%
INERT INGREDIENTS	1.2%
	100%

Sun Oil Company, 1608 Walnut St., Philadelphia, Pa. 19103

*Unsulfonated Residue ..... 92% min.
Grade of Oil Superior/FC-412-66/Unclassified
Weight per Gallon ..... 7.1 lbs.

CAUTION

General—All horticultural oils interfere with or slow plant transpiration and respiration during the period of evaporation. **Do not apply during periods of drought or when plants exhibit moisture stress.** Never apply concentrated spray oil to any part of a plant. Do not use 6E in combination with or immediately preceding or following applications of dinitro compounds, sulfurs, captan, folpet, Dyrene, Karathane, Morestan, or Sevin. Check tank mixtures for chemical and physical compatability.

Ornamental Plants—Oil will remove the glaucus (blue) bloom from such evergreens as Colorado blue spruce and Koster spruce. Use with caution and reduce dosage for summer applications to Japanese red maple, Amur maple and black walnut.

Timing of Treatment—You must determine the precise timing to fit local growth and climatic conditions.

MIXING DIRECTIONS

1. Add sufficient water to the mixing tank to allow proper agitation by pump or paddles.
2. Add other desired pesticides as listed on left panel mixing thoroughly prior to the addition of oil.
3. Add oil under agitation when ¾ full topping off with water to form milky solution.
4. Maintain agitation until solution is used.
5. In small equipment lacking agitators—stir or shake diluted spray frequently during application.

DIRECTIONS FOR USE

CROP	INSECTS AND MITES	Application Rate 6E Gallons per 100 Gallons of Dilute Spray	Time of Application (Stage of Development)
APPLES	Apple Red Bug	2	Dormant
	European Fruit Lecanium Scale	2	Dormant
	Fruit Tree Leaf Roller	3	Dormant
	European Red Mite	2	Green Tip to Delayed Dormant ½" Green
	San Jose Scale	2	Delayed Dormant ½" Green
	Scurfy Scale	3	Delayed Dormant ½" Green
PEARS	Fruit Tree Leaf Roller	3	Dormant
	Pear Leaf Blister Mite	3	Dormant
	Pear Psylla	2	Late Dormant
PECANS	Obscure Scale	3	Dormant
PEACHES	Cottony Peach Scale	3	Dormant
PLUMS & PRUNES	Eurpean Red Mite	2	Dormant to Delayed Dormant ½" Green
	European Fruit Lecanium Scale	2	
TREES & SHRUBS	Spider Mites	3-4	Dormant
		2-3	Verdant
	Eriophyid Mites	3-4	Dormant
		1-3	Verdant
	Scales & Mealybugs	3-4	Dormant
		2-3	Verdant
	Psyllids & Whiteflies	2-3	Verdant
	Aphids & Adelgids	3-4	Dormant
		2-3	Verdant
	Plant Bugs, Treehoppers	3-4	Dormant
	Leafhoppers	2-3	Verdant
	Leafrollers, Leaf Tyers Webworms	3-4	Dormant
	Cankerworms	2-3	Verdant

SEE MIXING DIRECTIONS ON OPPOSITE PANEL

no adverse reaction to oil used at summer dosage. What, then, are the oil sensitive plants? First, lets deal with some basics. Concentrated oil is a herbicide. As a concentrate it penetrates both bark and leaf tissues wreaking havoc with living cells. Oil painted in narrow bands on the bark of certain young trees such as red maple or sumac will kill them.

When diluted oil is sprayed on foliage, twigs, and small branches, the stomates of the leaves and the lenticles of the bark get covered with a thin deposit of oil that interferes with the exchange of gases. This becomes the basis for phytotoxicity. There are other factors too, that may cause plants to react adversely. Usually, it's the state of growth that makes the difference. A dormant plant can tolerate a heavier deposit of oil than a plant growing actively. Some of the hundreds of leaf stomates may be closed by a film of oil but whether symptoms of injury will appear depends upon the number of stomates that are closed, the amount of oil that is deposited, how fast the oil is evaporating and the clearing capacity of the stoma guard cells. Some plants, such as Scots pine, can tolerate a tremendous dose of oil on new and old needles (33% oil) even in early July with the temperature exceeding 90° F. Other plants, such as the Japanese maple, can tolerate no more than 3% oil under the best of growing conditions. Other trees and shrubs sensitive to oil are Amur maple, black walnut and Aucuba. This is not to say that oil should never be used on them for insecticidal purposes, but other factors need to be considered.

Environmental conditions such as soil moisture, relative humidity and wind speed are of major importance. Any plant suffering from moisture stress is a candidate for severe foliage injury if it is sprayed with oil. I am of the opinion that any common woody ornamental plant can tolerate 2% of oil in the verdant condition if it is healthy, the soil moisture is adequate, and

the relative humidity creates conditions for fairly rapid evaporation of the oil. Under normal application temperatures, (35° - 100°F), it appears that temperature alone is not a factor.

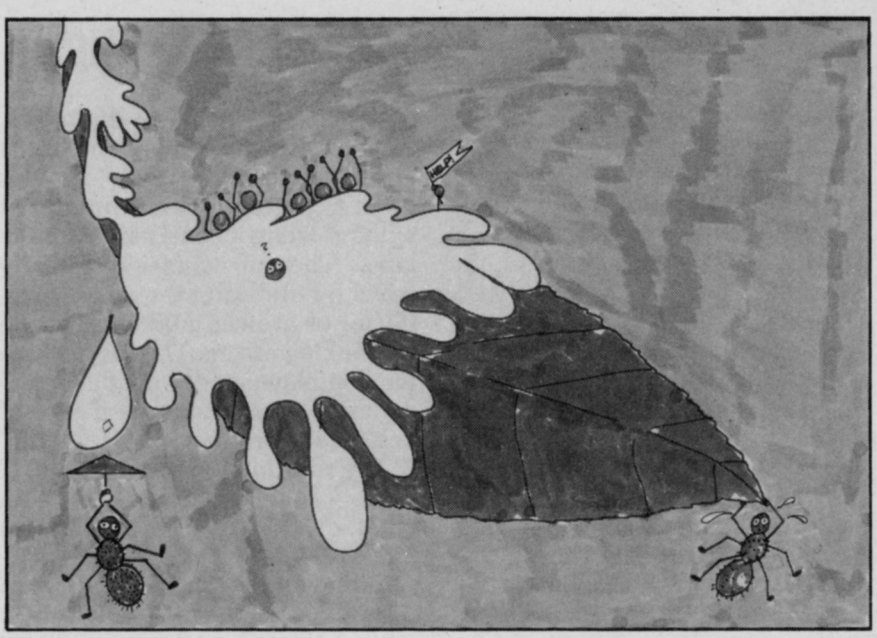
Oil Persistence on Foliage

Immediately following a spray treatment, the foliage will have a pleasing, shiny luster, the result of a thin film of glistening oil. The actual amount of oil that will remain on a leaf will depend largely upon the pubescence and other physical characteristics of the leaf. Honeylocust leaves, for example, sprayed with 4% oil will have a shiny appearance, particularly on the upper surface, for more than eight days. Plants with abundant leaf hairs (trichomes) on the undersurface will have an altogether different appearance when oil is on them. They will feel oily but will not glisten. Some leaves with large numbers of leaf hairs will appear to be soaked with oil.

Plant leaves with a vast number of trichomes hold a larger volume of the spray solution and thus receive a higher concentration of oil after the water evaporates. Because the concentration of oil is higher, the oil remains on the plant longer and takes longer to evaporate. Leaf hairs may be both beneficial and deleterious. On the one hand, they retain the oil on the insect for a longer period, but on the other, they block the stomates for a longer period, also. In general, leaves with dense pubescence should be considered oil-sensitive and should receive a lower rate of oil.

Symptoms of Phytoxicity

When leaves are deprived of stomatal functions for any reason, the foliage becomes slightly yellow. This symptom occurs when an excessive amount of oil is uniformly distributed over the leaves. More often than not, there will be a larger deposit of oil at the leaf tip or margins. If the oil on the margins remain too long, the margins become yellow; later they darken appearing water soaked, not unlike some stages of edema, and later they become dark purple. The ultimate symptom is brown, necrotic tissue. The injury is not always marginal but may occur as small spots following the same symptom sequence (Figure 2). If the symptoms do not progress beyond the water soaked stage (Figure 1) the leaf recovers or at least can function with a fair degree of efficiency.



Efficacy

Since much of the oil used ten or even five years ago was not the same as that used today, efficacy comparisons may seem inappropriate. Fortunately, data taken from plants treated with 60 and 70 second oils compare favorably with the oil that is currently available. With the distillation, UR, and gravity properties of older oils for comparison, one can interpolate the probable efficacy of the new oil. From interpolated data we can assume that the currently refined spray oil (Table 1) will kill the eggs of any of the following arthropod groups: spider and eriophyid mites, armored and soft scales, mealybugs, psyllids, asphids, adelgids, whiteflies, plant bugs, leafhoppers, treehoppers, leafrollers, leaftyers, webworms and cankerworms. We can also assume that the new oil will control a wide range of arthropods in stages other than the egg. Some of the recommendations found on the new label is based on such interpolated data.

A film of oil interferes with the feeding capabilities of viruliferous sucking insects, but except for this spray oil (Stylet Oil*) seems to have little if any tactile effect on crawling insects, or flying insects migrating to oil treated surfaces.

Labels and Brand Names

Because of the inherent safety to humans and mammals of purified paraffinic oils, the Environmental Protection Agency has exempted these products from many of the regulations imposed upon the promoter's of synthetic organic pesticides, namely residue requirements. There has also been a relaxed attitude regarding the way oils are described on their labels. Some labels' ingredient statements were so vague (before EPA) that the product described would have also been a good description for a machinery-lubricating oil.

Since superior horticultural spray oil has no precise formula, it is impossible to provide a precise ingredient statement. The source of the crude oil makes a major difference in the product that comes from the distillary's pipes. Likewise, a few degrees of difference in the distillation temperature can make a difference in the potential for phytotoxicity and pesticidal activity. Nonetheless, today's product must have a better identity via the ingredient statement. Green Industry users of horticultural spray oils have been without a property description largely because it was not on the label and further, few knew that it existed. It was assumed, erroneously, that an oil label was as complete and as explicit as the label for a synthetic organic insecticide.

We are closer now to a standard

*trade name registered in Florida

product than ever before, in part because there are fewer refineries in the business of making horticultural oil, and in part because only one oil refining company actively promotes its product beyond the citrus industry.

In March 1982 the Sun Refining and Marketing Company presented EPA officials with a change in their horticultural oil label which may prove to be the best thing that has happened to promote spray oil in the past thirty years. In terms of its physical properties, Sun's oil comes fairly close to the specifications developed by the several agricultural experiment stations, but it does represent a compromise. The abbreviated label (Table 2) shows some of the major changes and additions under consideration.

For the first time there is an attempt to provide an acceptable common name—*Superior Horticultural Spray Oil.* The use recommendations and directions are greatly expanded with some specific and some general directions. General directions allow the user a greater degree of freedom to use his own experience and judgment without being inconsistent with the label. This, of course, works two ways by allowing the spray contractor or grower a greater chance for making errors. The former distinction between dormant and verdant oils now becomes a matter of dosage; the product is the same.

The caution statement gives a short, condensed sentence about what oils do to plants; "(They) interfere with our slow plant transpiration and respiration while the oil remains on the plant." The most critical point about the potential for phytotoxicity is in the admonition "Do not apply during periods of drought or when plants exhibit moisture stress." Specific precautions are limited to conifers with a glaucus bloom; reduced dosage is suggested when oil is used on Japanese red maple, Amur maple and black walnut.

There will continue to be brand names, but if a standard label is developed the only difference will be in the art work and the visual appeal of the label.

Summary

With one major producer of superior horticultural oil and one basic label there should be one set of recommendations. The user can expect control over a wide range of species and if the applicator maintains proper "quality control" over mixing and spraying there should be no problem with phytotoxicity. With phytotoxicity based upon excessive dose, and tree and shrub turgor, oil will take its rightful place in the arsenal of weapons for use in integrated pest management. If the new proposed label is approved, the arborist and spray contractor will legally be able to use oil on hundreds of woody ornamental plants, and, if his judgments are just and reasonable, he will be able to do a better job at less cost to the consumer while properly using one of our safest insecticides. **WTT**