

AGRICULTURE

D-D Saves Crops From Foes

New soil fumigant routs root-ruining nematode worms from fields producing everything from potatoes to pineapples; yield increases up to 200% reported.

By **BLAKE CLARK**

(For earlier reports on use of D-D, see SNL, April 22, 1943, and Nov. 10, 1945.)

► "THE NEW SOIL fumigants bid fair to become one of the greatest boons to agriculture since the development of fertilizer," announces Dr. Robert M. Salter, Chief of the Bureau of Plant Industry, which is a hard-headed division of the United States Department of Agriculture, not given to wild or loose talk. "The proper use of these new chemicals will bring increased crop yields all over the world."

Two million acres of land lying idle in the southern United States can now be brought back to profitable cultivation. Certain highly profitable crops which at present must be rotated every two or three years can be planted year after year on the same land. Truck farmers in various regions can reasonably expect from 20 to 200 percent larger crops, and thousands of home gardeners will discover that after all they, too, have green thumbs.

Scientific Protection

The scientific farmer learned long ago how to protect vines and fruit from insects and pests attacking above the soil, but he carried on a losing fight with the teeming trillions of pests lurking underground. The most virulent of these are nematodes—burrowing, eel-like worms 1/64 to 1/25 of an inch long—one of the farmer's worst enemies. He knows them as wire worms, round worms, eel worms, but has never known how to fight them effectively. One species causes root-knot, gnarling and stunting the roots of plants until they cannot absorb nourishment from the soil. It is known to attack 1500 plant species including tomatoes and the cabbage family. Another, the citrus nematode, causes a slow decline of orange, lemon and grapefruit yields and necessitates uprooting and replanting groves after 14 or 15 years. The meadow nematodes feast upon the farmer's corn, peanuts and tobacco. With a keen sense for

the best food values and vitamins, they burrow just under the skin of potatoes and ruin them. Species of this group are the worst pests of the nurseryman, attacking some of his most valuable ornamental plants, particularly boxwood. The florist curses them. The amateur flower gardener mourns his blasted China asters and snapdragons.

Nematodes are the common bane of the Asiatic rice farmer, the European sugar beet grower, the Java rubber producer, the India tea planter and the English, Danish and Irish potato farmer. They have been found in ocean depths, on mountain peaks, inside the Arctic Circle.

So serious had nematode infestation become by 1940 that it threatened to destroy the Hawaiian pineapple industry, which would spell ruin to the islands. Planters called upon a stocky, carrot-topped entomologist named Dr. Walter Carter to help them in their plight.

Carter once before had almost single-handedly saved the pineapple industry from extinction, by discovering the cause

of a devastating wilt and the remedy for it.

"It isn't a 'bug-sleuthing' job this time," he said. "At least we know and can see the villain. Nematodes are least damaging in virgin soil. Evidently we must do the impossible—restore virginity."

In early experiments, chloropicrin—tear gas—was shot into the soil. It killed the noxious organisms but it was tricky to handle and expensive.

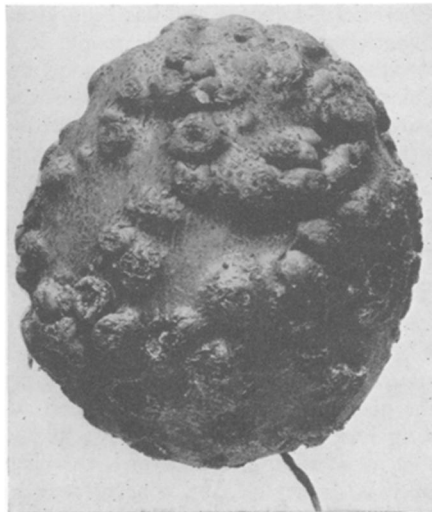
Dr. Carter began a search for an inexpensive soil fumigant that would do the job. He asked a number of chemical companies for samples of by-product waste materials. Scores of bottles, drums, cans and steel cylinders piled in from the synthetic rubber, petroleum, coal tar and gasoline industries. Carter and his assistants took them to the fields at Wahiawa and measured them out on 20 different plots. Each chemical was tested from four to six times. Not one gave encouraging results.

D-D Development

Then came one from the Shell Chemical Corporation in California. A by-product of allyl-chloride, used in making plastics, it showed up well in the preliminary trials. Dr. Carter tried it out on a larger plot. Every 15 inches he punched a hole in the ground and poured in a fraction of an ounce of the dark-colored liquid. It spread through the soil like coffee through a lump of sugar. Fumes shot out in a circle, killing every worm they reached. Grimly pleased, Carter dubbed it D-D, because its chief components are dichloropropane and dichloropropene.

Dr. Carter tested D-D on 840 plots on 14 different plantations throughout the islands over the next two years. Treated and untreated plots, side by side, would look just alike for months. But by harvest time untreated squares of the checkerboard had blotchy, stunted plants. Treated plots were covered with healthy plants of towering broad, live-green leaves from the center of which grew giant-sized, golden yellow pineapples. Equally important, Carter found that the land could be replanted that same season.

The pineapple company ordered all the D-D it could get—125 tons—and shot it into 1250 acres. These fields, which had yielded from 12 to 30 tons of fruit



ROOT-KNOTS—This potato is diseased with the root knot nematode. Courtesy of the Division of Nematology, Bureau of Plant Industry, Soil, Agricultural Engineering.



INJECTOR—Applicator of Shell Chemical Corp. used for treating land at Weatherford Farms, Linn, Texas. Photo by R. A. Biron, Dow Chemical Co.

per acre, now yielded on the average 40 tons increasing cash yield, growers estimated, by \$250 an acre. On 50,000 acres that adds up. If scientists worked on commission, Walter Carter would be one of the world's wealthiest men.

The news was hailed with great excitement by truck farmers in California, where nematodes seriously damage the crops on 65 percent of the arable land. Field tests were conducted in the sandy soil at Atwater, in Merced County, badly infested. Untreated plots of snap beans died, yielding nothing. Plots treated with D-D bore a heavy crop. Tomato vines in unfumigated areas yielded five or six prune-sized fruit and then died; in D-D dosed plots each plant bore a bushel of tomatoes.

Other Effective Fumigation

In Los Angeles county, where root-knot usually malformed and stunted carrots until more than half were unmarketable, fumigation was so effective that 95 percent of the carrots were perfect. A rancher in Ventura used to grow 816 pounds of sweet potatoes per acre. Fumigation boosted his yield to 13,860 pounds. In another county, where 75,000 to 85,000 acres of the best land crawls with the worms, D-D multiplied yields of lettuce eight times. All over the state, growers of lima beans, squash, Irish potatoes and beets obtained similarly astounding increases in yield and quality.

Sugar beet growers' fields are infested with nematodes. They force expensive rotation; replanting is unprofitable for three years. At Midvale, Utah, the Amalgamated Sugar Company planted soil that it would normally have left idle. The company found to its gratification that on this sick land, D-D increased

beet yields from 3.71 to 17.7 tons per acre.

Certain nematodes relish tobacco. Shade-grown tobacco is the most expensive in the world—partly because the tiny worms make it necessary to put up cheesecloth shade over fresh land every year. This spring, growers at Quincy, Florida, treated the fields with D-D and replanted. To their surprise, yields greatly surpassed those on virgin fields.

Peaches will not grow profitably on thousands of nematode-infested land in the South. Dr. Gotthold Steiner, principal nematologist of the Bureau of Plant Industry, had an experimental orchard planted at Tifton, Ga. At the first fruiting, from the trees in one area, he picked ten times as many peaches as from the unfumigated trees.

One of the worst potato pests in the world is the golden nematode, an especially tough species which for more than 20 years has plagued the farmers of Ireland, England, Scotland, Denmark, Sweden and Germany. In some areas only one profitable potato crop can be grown every five or six years. In Sweden and northern Ireland the government took infested lands out of production to prevent spread of contamination. In Germany, rotation was prescribed by law and controlled by police. Imports of potatoes from diseased regions were prohibited.

In 1941 Charles Gellweiler, of Hicksville, Long Island, complained to his county agricultural agent of decreasing potato yields. Tests proved the dreaded golden nematode had arrived. Thoroughly alarmed, the Department of Agriculture surveyed the potato growing regions of 19 northern states. It was discovered that the infestation was restricted to some 1500 acres near Hicksville. These are now quarantined while an intensive program of complete nematode

eradication is carried out.

Results already obtained offer tremendous hope to European potato farmers. D-D has proven up to 99.9 percent effective. Yields in treated areas have risen more than 75 percent.

Preliminary surveys indicate that about 80 percent of the arable land in Florida, Mississippi, Louisiana, Texas, New Mexico and Arizona is nematode infested, and more than 60 percent of that in Washington, Oregon and Idaho. Half the counties of the mid-western states show some infestation. The worms do not multiply so rapidly in the cooler areas, but they are quite capable of doing serious damage as far north as New York, as the Long Island experience shows.

The home gardener can fumigate a 2000-square-foot plot for \$5.64. The only equipment he needs is a sharp stick and a teaspoon. He prepares the soil to good tilth and pours in the D-D, taking care as with any chemical not to spill it upon his hands or clothes. Since it is toxic to living plants, he waits two weeks before putting in his crop so that all fumes can escape from the soil. The farmer who has too much acreage to fumigate by hand uses a portable applicator or a small machine. Big operators have their own specially built tractor-drawn machines



CHECKERBOARD—Plot marked for treatment by spot injections with hand applicator. Stakes mark the spot where injections are made. Photo by A. L. Taylor, Division of Nematology, Bureau of Plant Industry, Soil, Agricultural Engineering.

Do You Know?

The human body contains enough *phosphorus* to make 2,200 matches.

Cases of *mastitis*, costly disease of dairy cows, can be checked effectively with penicillin.

Schoolrooms can be made considerably lighter by using, instead of blackboards, white glass *chalkboards*, on which blue chalk is used.

Tungsten for use in high-grade light bulbs must be 99.99% pure; refined from ore, it is pressed into bars, and drawn into strands one-fifth the diameter of human hair.

Despite restrictions on use of grains, this year's production of American *beer* has been running at an annual rate of about 70,000,000 barrels, as contrasted with prewar production of about 55,000,000 barrels.

which feed a thin stream of the liquid through small pipes running down behind narrow plow points.

Two firms in California are doing a land-office business fumigating by contract. Starting in the south, they go straight up-state, spreading D-D at \$40 an acre, doing sometimes 20 acres a day. Still the market in the United States had hardly been tapped.

Soil fumigant already is being shipped to Puerto Rico, South Africa, New Zealand and England. Dow Chemical Company and Innis, Speiden Company have brands on the market competing with D-D. As present prices continue to drop with increased production, fumigants can be used profitably by growers of virtually every crop—even cotton, corn and wheat—raised in affected areas. Manufacture is a simple process, and present production of some 10,000 tons a year can be expanded almost overnight.

Gardeners in Florida and California obtain the liquid chemical from their local seed stores. Manufacturers promise

that by spring it will be packaged and on the shelves of dealers in all areas where it is needed. The man who is already enjoying good crops or whose land is unfertile may not find fumigation profitable, although over and above pest control it has given definite evidence of plant stimulation similar to a shot of nitrogen in the soil. Certainly if he has poor crops he will do well to uproot samples and take them to his county agent for inspection. "I thought I'd been planting when the moon was too full," one Florida farmer said, "but it was the ground that was too full—of that dratted worm."

It is imperative that we produce large quantities of food for years to come despite limited farm labor and equipment. It is essential that the most efficient use be made of all arable land. General use of the new soil fumigants should more than double our present production of most vegetables and some fruits on land now infested with nematodes, and thus help fill the horn of plenty for ourselves and for our world neighbors.

Science News Letter, October 12, 1946

ENGINEERING

Waste Products Find Use

➤ MOLDED BOARDS of softwood shavings from a planing mill can be produced at a price which can compete with plywood or lumber in certain instances, the American Society of Mechanical Engineers was told by Robert A. Caughey of the Souhegan Mills, Wilton, N. H. These shavings are now largely a waste product.

By the use of the proper amount and type of resin as a binder, and by curing under proper conditions of temperature and pressure, he said, it is possible to obtain a molded product which has very high resistance to water, very high strength and hardness, and which is eminently suitable for a wide variety of applications. Sawdust and other wood wastes can also be used to make lumber substitutes.

Mr. Caughey reviewed many of the new processes for using wood wastes in making plastics, or fillers in plastics. He called attention to the present tremendous wastage in connection with lumbering and woodworking industries. The wood wastes in terms of pounds of material, he declared, amount to at least 80% of the salable material produced, and this does not include the logging waste left in the woods.

The industry to which the waste wood

situation presents the greatest challenge, he asserted, is the plastics industry. The wood in the form of waste is still sound material with its original basic properties of strength and chemical resistance. The only disadvantage lies in its form, it being generally in such small pieces that it cannot be worked up into any usable product. It therefore remains to convert these particles into large pieces of some practical value.

Science News Letter, October 12, 1946

INVENTION

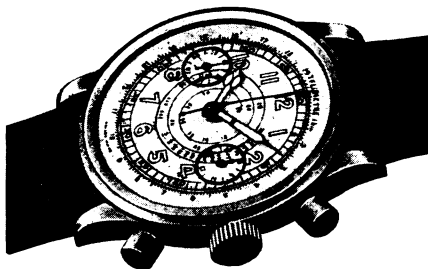
Plastic Coating Makes Better Work Gloves

➤ WORK GLOVES, made of plastic-coated fabrics, are promised for the near future. Much of the glove is Canton flannel, but the thumb, index finger and palm-surface are covered with vinyl butyral, a tough, flexible plastic made by the Monsanto Chemical Company, that gives protection similar to leather.

The plastic coating is washable. Grease, oil and grime can be removed with a solvent. The gloves will be made by regular glove manufacturers, Monsanto furnishing the plastic. This coating material has good wearing qualities.

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