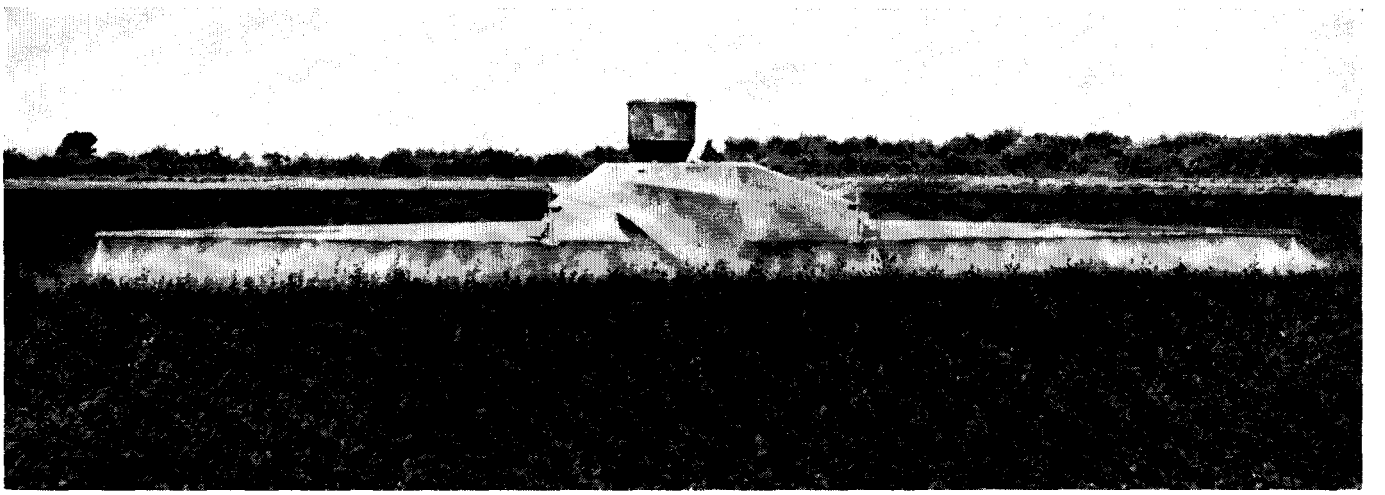

A large volume crop duster made by Hardie Manufacturing Co. with boom up to 30 ft. long can dust 20 to 30 acres per hour

provement of pesticide application by the ground duster. Studies of the dust behavior from outlet to deposit area, for instance, would help to increase dust deposit in treated areas, provide greater uniformity of deposit, and coordinate air drifts, wind, convection currents, and turbulence at the treated surface with dust behavior. Studies should also be directed toward the ratio of air velocity to air volume relative to dust deposits and toward control of direction of the dust stream after leaving the duster. Research should also look to improving the application of dust formulations of metallic chelates and minor elements as plant nutrients and hormones as weed killers or growth regulators.

In the area of development, specialists should look into the possibility of developing furrow-type dusting machines for applying seed treatments, soil fungicides, and fumigants in the seed row. They might also consider development of a better dusting machine for applying coarse or granular pesticides on or in the soil. Broadcast and drift dusting should be studied more thoroughly, and more effort should be devoted to studies on the self-propelled high clearance dusters.

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HERBICIDE APPLICATION EQUIPMENT

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Selective weed control agents call for production of special application equipment

INTRODUCTION of the selective herbicide 2,4-D made selective weed control economical on large acreages and created a demand for low cost, mass-produced sprayers. Adaptability of 2,4-D to low volume application instituted a new concept in herbicide application. Similarly, other subsequently developed herbicides have often required production of special application equipment. The nature of the chemical and its action are important factors in the design of application equipment.

Equipment Used for Weed Control in Crop Lands

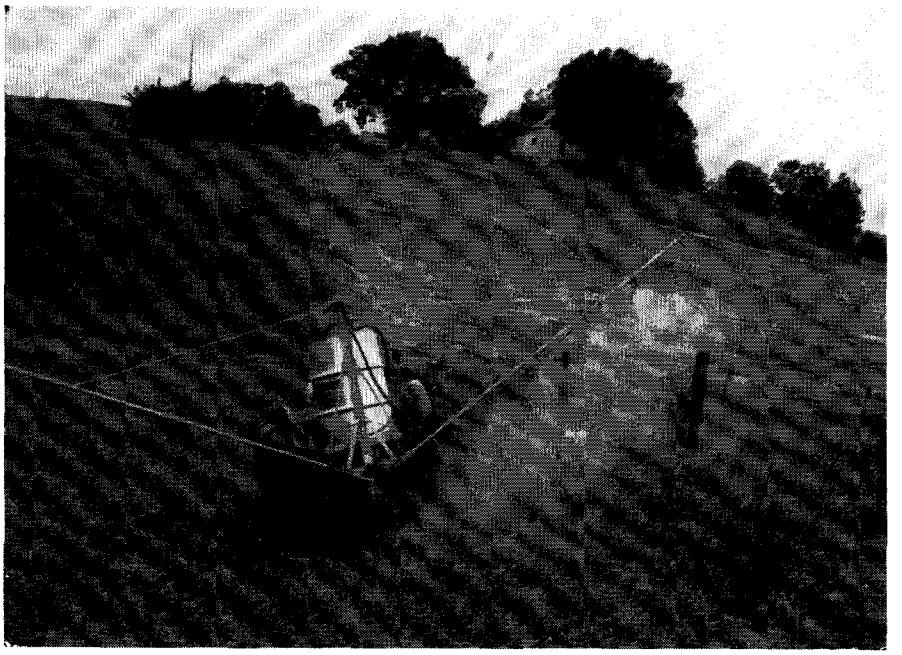
The low volume sprayer is an example of equipment designed to fill a specific use made possible by a new chemical. In 1947 use of 2,4-D was developing for weed control in grain in areas where water supplies are low. The adaptability of this chemical permitted the development of the low volume, uncomplicated, and inexpensive sprayers applying 5 to 10 gallons of spray per acre. The pump of this unit, which is usually mounted on the power take-off of the tractor, operates efficiently at 450 to 550 r.p.m., and the boom is mounted on the tractor or on a trailer pulled by the tractor. Tractor-mounted booms are commonly placed ahead of the driver so that inspection of the boom is relatively easy. Nozzles are generally designed to give a fan-type spray pattern and deliver less than 0.08 gallons per minute at 40 p.s.i. Two-hundred mesh screens used to prevent plugging of the small orifice, easily become covered with insoluble materials, and every precaution must be taken to prevent such materials from entering the spray system. Usually only water-soluble salts or emulsions are used in this equipment. Formulation chemicals must be used that will not precipitate in the spray tank even when hard water containing 400 to 800 p.p.m. calcium-magnesium is used.

A number of contact herbicides which if sprayed over cotton plants would destroy both weeds and crop can now be used for weed control in this crop, if proper equipment and application methods are used. Research has determined that sprays of these materials directed to the base of cotton plants results in weed control without injury to cotton.

Pre-emergence weed control in cotton and other crops has been made possible by the development of such herbicides as DNOSBP and CIPC. These materials persist in the surface layer of soil long enough to kill small seeded weeds which germinate after planting. The larger, more tolerant crops are able to come up through this layer of chemical without injury. These materials are usually applied with special planter-mounted equipment which applies a narrow band of chemical directly over the row at the time of planting, reducing the amount of chemical required and the risk of inclement weather preventing treatment before the crop emerges.

Vegetation Control in Nonagricultural Areas

Chemical brush control has become an important outlet for herbicides in recent



A six-row boom sprayer spraying fence rows. With this type of sprayer booms can be adjusted horizontally or one boom can be shut off as shown. A Century Engineering Corp. model

years, primarily for the esters of 2,4-D and 2,4,5-T as well as the ammonium salt of sulfamic acid. Effective brush control with these materials is dependent upon thorough wetting of the brush, which requires a larger volume of water and a pump capable of applying it at sufficient pressure to penetrate the vegetation adequately. Piston pumps with capacities in the range of 15 to 20 gallons per minute are most commonly used. Standard orchard guns with orifice sizes around $^1/_8$ inch in diameter disperse the spray. Low pressures, 150 to 200 p.s.i., are most common since higher pressures tend to break the spray into smaller droplets, thus increasing the drift hazard.

Dense brush may require as much as 300 to 400 gallons of spray per acre for adequate coverage. Liquid formulations used in low concentrations have certain features that tend to make them more desirable than dry formulations used at high concentrations. A brush spraying unit applying 1500 gallons of spray per day would use 12 to 15 gallons of a material like 2,4,5-T, while 1200 to 1500 pounds of a salt such as the ammonium salt of sulfamic acid would be used in the same gallonage. In the former instance the 3 five-gallon cans required could be carried on the spray unit and easily measured into the tank. When high concentrations of the indicated salt are used a separate unit is often required to haul and mix the chemical.

Booms used for weed control on railroad roadbed and roadside areas are necessarily much different in design than those used in crop areas. Railroads more often use spray mixtures containing contact herbicides and these materials must be applied in spray volumes sufficient to give complete coverage of vegetation since only the area of the plant actually contacted by the chemical is killed.

In contrast to the low volumes (5 to 10 gallons per acre) used in grain spraying, volumes used in railroad work often exceed 150 gallons per acre. Spraying is often done at speeds of 8 to 12 miles per hour, which is two to three times that of most agricultural units. A high volume sprayer of this type applying 150 gallons of spray per acre at 8 miles per hour would have to discharge 40 gallons per minute to spray a two-acre mile. This requires large orifice nozzles, high capacity, low pressure, centrifugal pumps, and a large supply tank, usually a tank car. The mixture is agitated by bubbling air into the spray tank or by recycling the mixture.

Brush control on railroad right-of-ways with chemicals has been made practical by the development of special application equipment, which consists of a battery of spray guns to drench right-of-way brush as far as 100 feet from the track. Such a unit may discharge as much as 350 gallons a minute spraying a 65-foot right-of-way at 8 miles per hour, large centrifugal pumps being used to obtain this volume. Low pressures of 60 to 100 pounds are commonly used to avoid fogging sprays. One contractor has developed a technique for proportioning the chemical (2,4-D and 2,4,5-T esters) directly into the spray line as the water goes through the pump. This equipment is mounted on a railroad car and becomes part of the spray train which commonly includes a locomotive, spray car, and four to six tank cars for water.

Aerial Application of Herbicides

Herbicides effective in low amounts per acre and easily mixed with water or oil lend themselves to aerial application, most of which are made with a total spray volume of 1 to 5 gallons per acre. These applications are most useful where large acreages are involved.

The aerial spray equipment consists of a boom attached to the airplane wing, a small wind-driven pump, and a tank. The pump may operate at low pressures but must be capable of volume output in the range of 20 to 30 gallons per minute. Gear pumps are the most common type. Each nozzle should have a positive shutoff so that none of the spray can escape except while spraying is in progress.

Soil Fumigants

Methyl bromide is commonly used for control of weed seeds and vegetative organisms in plant beds such as tobacco seed beds. This compound is highly volatile and must be applied under a gasproof plastic tarpaulin. The special device used to apply methyl bromide consists of a hollow punch clamped around the pressurized methyl bromide can and attached to a plastic tube in such a manner that the chemical passes through the plastic tube which is inserted under the tarpaulin. A similar fumigant, chloropicrin, is also used for this type of weed control. It is injected into the soil with a probe and the hole is then sealed over with soil.

The progress made in herbicide application during recent years is indicative of developments which may be forthcoming as a result of chemists, agricultural engineers, and plant physiologists working together in close cooperation.

(Presented before the Division of Agricultural and Food Chemistry, American Chemical Society, Kansas City, Mo., March 26, 1954).

Example of a mister, duster, sprayer. One type of unit developed as a multiple use machine. Silver Creek Precision Corp.