

Direct application is a popular method of applying anhydrous ammonia fertilizer before planting. Seedlings seem to thrive on ammonia nitrogen, mature plants on nitrate nitrogen. By the time plants have matured, soil bacteria have changed injected ammonia to nitrate nitrogen to give steady fertilization for the growing crop

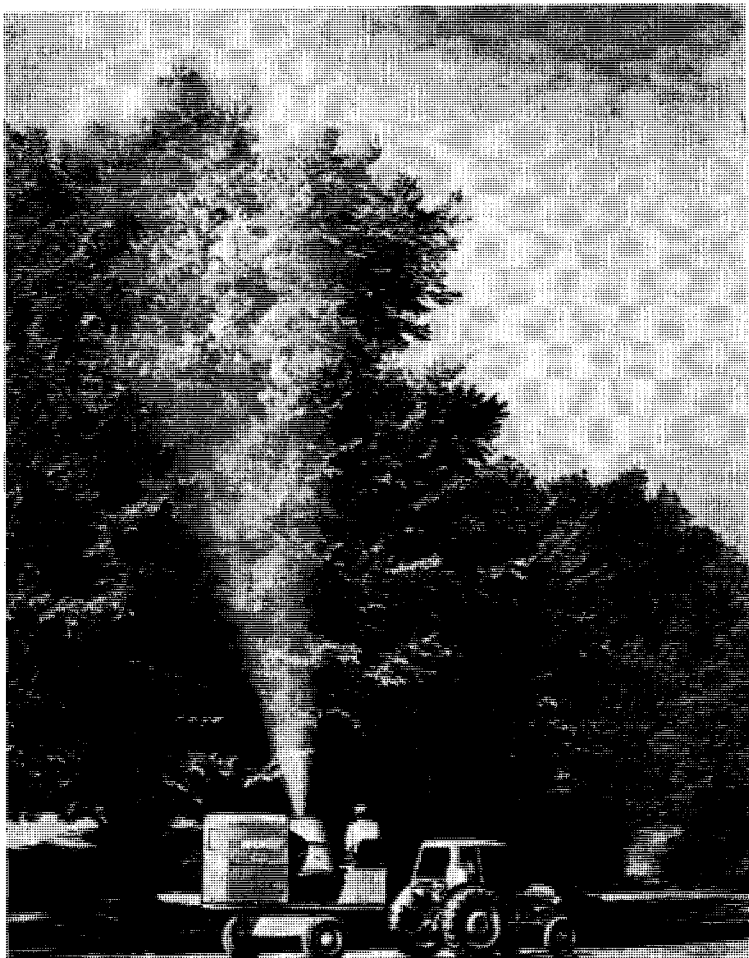
Putting Research to Work

Application Equipment

- adapted to agricultural chemicals and fertilizers

Developments in agricultural chemicals and fertilizers in the past decade show striking progress. Chemical research has been a major factor. But directly related engineering work has been quick to develop new machinery for most effective application of new materials. The combination of chemical and mechanical development is putting research findings to work on the farm.

Air-type mist sprayers are in wide use for protecting shade trees and controlling mosquitoes. 1954 John Bean Rotomist, seen in action, can be mounted on a truck or hauled by a light tractor. Spray material is discharged in a concentrated form for labor and material savings and for better coverage without runoff



THE INDUSTRIAL REVOLUTION had its effect on agriculture through such labor-saving machines as McCormick's reaper. The inventions of that period began a change in farming which has continued at an accelerating rate. The tractor, for example, has freed for human food production thousands of acres once needed to grow feed for farm work animals.

Shortly before and during World War II, the basis was laid for another type of change in mechanical equipment for the farm. That basis was chemical. Organic chemical insecticides, led by DDT, weed killers such as 2,4-D, and new fertilizers and new fertilization practices made evident the need for new equipment to apply to the farm some of the benefits of chemical research and technology.

What has happened as the result of the rise of new agricultural chemicals and fertilizer is an interesting example of the effects of technical research progress in one area on progress in a related area. More powerful, and often more expensive, materials became available and new techniques and equipment were needed for most efficient and effective application. The specialized, precision equipment offered today by agricultural machinery companies shows that research and development are meeting the opportunities presented by the rapid progress of fertilizers and agricultural chemicals.

Fertilizers

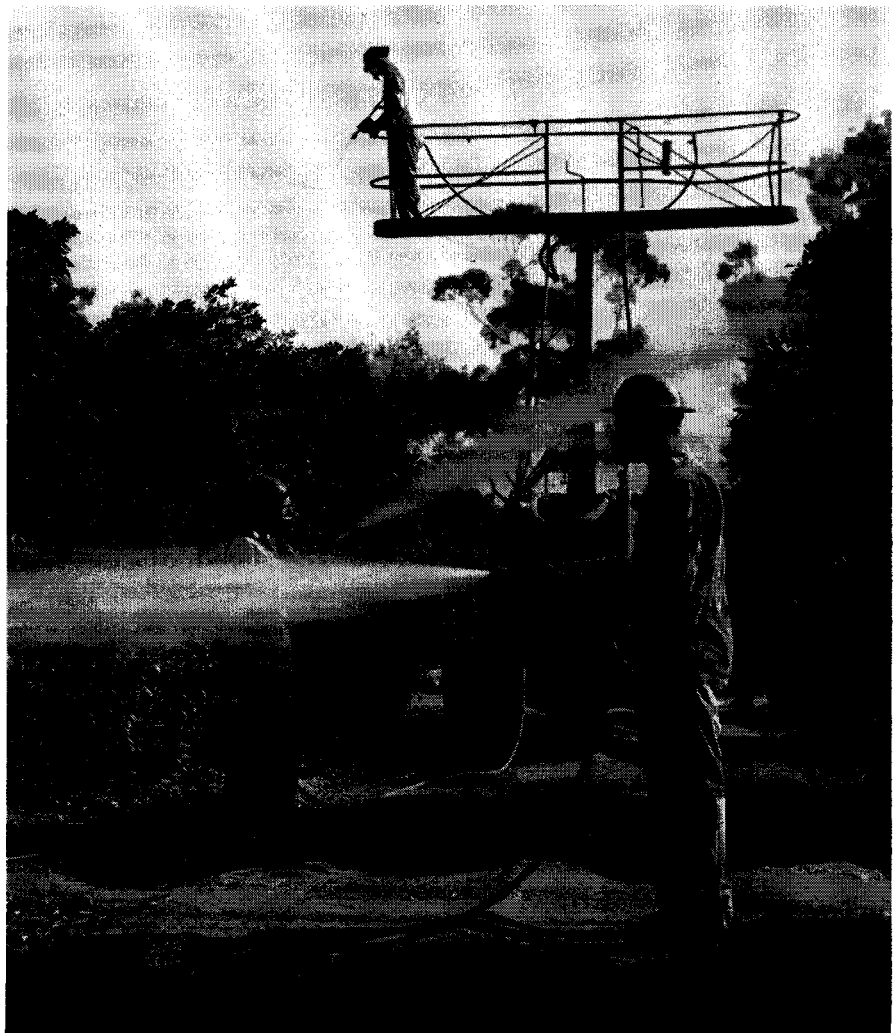
Farmers still in business can remember that a common method of application of fertilizer was to dip a pinch from a bucket and drop it with the seed. Today not only is the fertilizer measured more accurately before being placed with the seed, but study has shown the value of placing most of the material well below the seed, as a source of food for the roots which soon begin to grow.

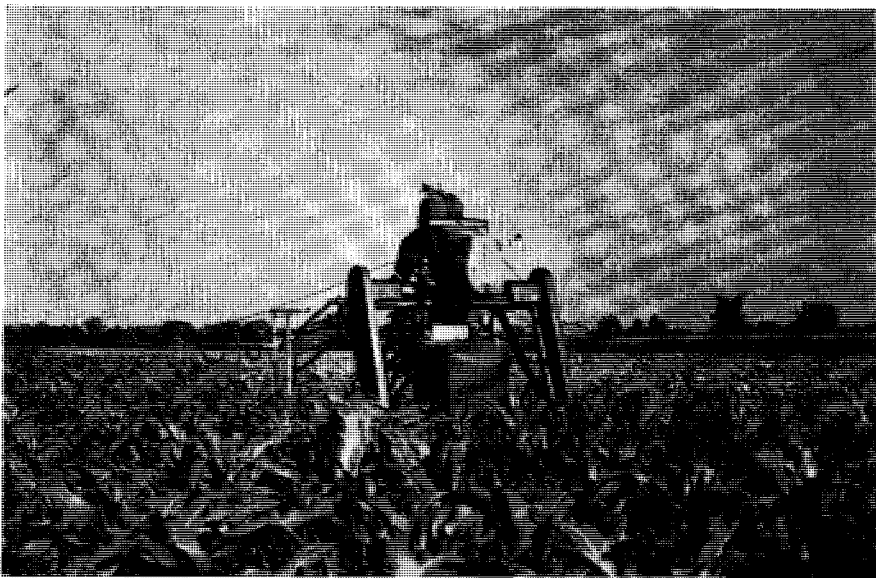
Data on the fertilizer industry show that each year there is further movement toward the use of high analysis fertilizers. These more concentrated materials require higher precision application use to avoid waste. Agricultural engineers in universities, federal and state experiment stations, and equipment manufacturing companies have studied this problem and are stimulating production of equipment designed to place fertilizer where it can be used most efficiently. The band application which places a small amount of fertilizer around the seed with most of it a few inches below makes possible the use of most of the fertilizer by the developing roots as they extend downward from the seed. Waste in areas untouched by the roots is reduced to a



This stationary boom, made by Hardie, Food Machinery and Chemical, and others, delivers large volume of spray. The unit shown requires 150- to 200-gallon-per-minute pumps having high pressure

Manually directed spraying is often used to apply insecticides on citrus trees. Protective clothing has been developed for use when toxic materials are applied

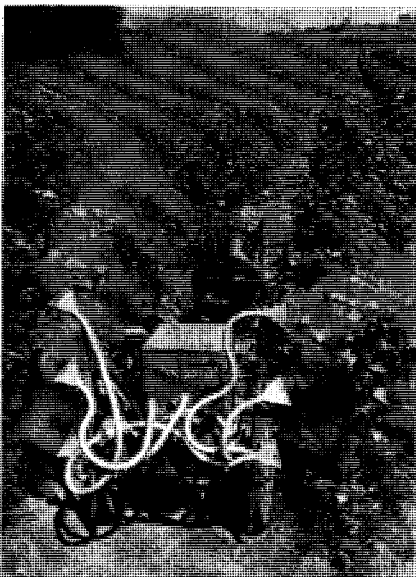




minimum. The amount applied is carefully controlled.

With the increasing realization that fertilizing of pasture land is profitable, machinery has been developed for the placement of fertilizer without plowing up the pasture crop. This equipment is now on the market.

A revolutionary step in the use of ammonia as fertilizer has been the direct application of liquid ammonia or its aqueous solutions. (*AG AND FOOD*, Nov. 11 and Dec. 23, 1953). The experimental proof that liquid or aqueous ammonia could be injected directly into the soil as a very effective fertilizer has led to the development of accurately controlled equipment including injectors, pumps, and meters. Similarly, aqueous solutions of urea and ammonium salts are now coming into widespread use. Specialized spray equipment for most effective application is being developed.



Modern equipment for use in applying insecticides after crop has attained height. Crop getting insecticide here is corn, which is attacked by corn earworm, corn borer, army worms, and other serious insect pests

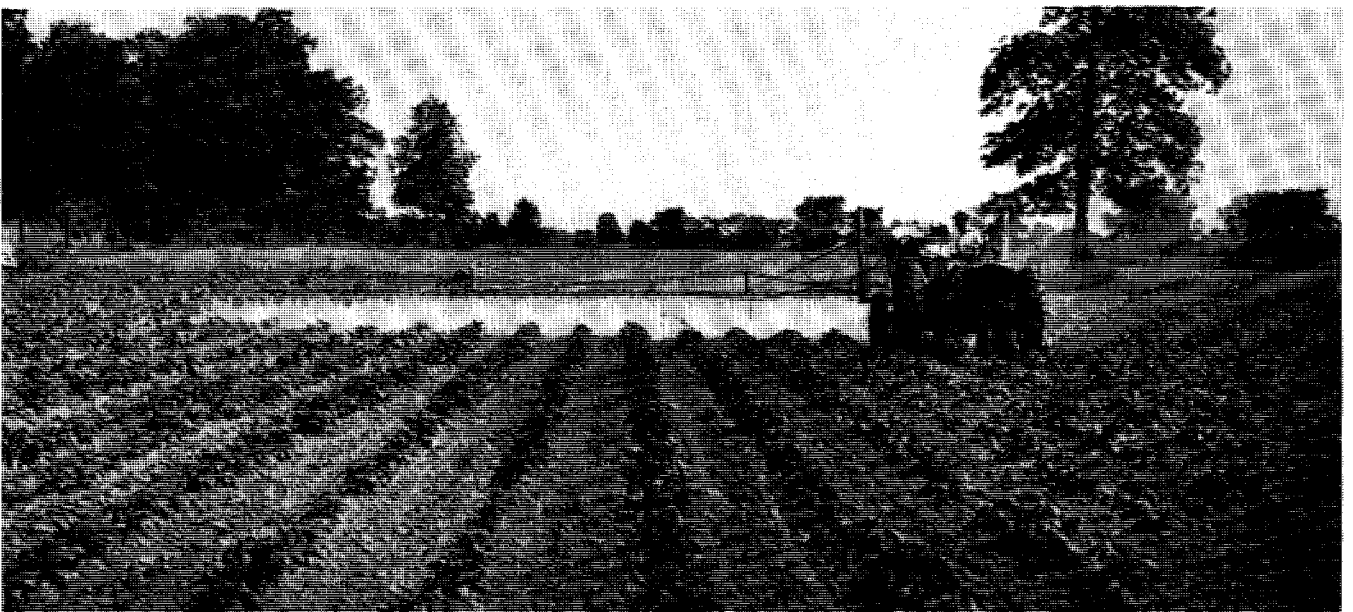
Insecticides and Fungicides

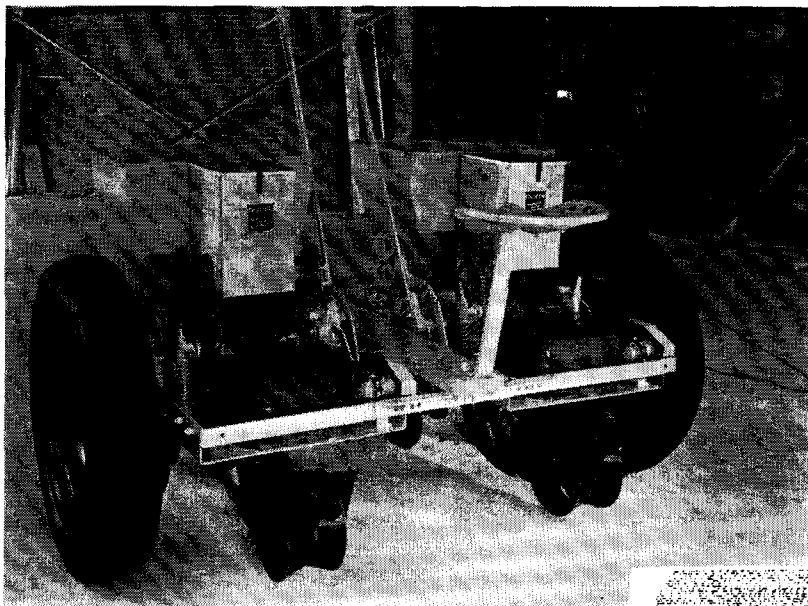
With the advent of DDT, a new type of insecticide arrived and it called for a specially designed type of application equipment. DDT was followed by a great variety of organic chemicals which were formulated in a great variety of ways. Aerosols entered the picture as vehicles for the new insecticides and further developments were needed for proper application. The newest major step is the systemic insecticide for which development of application techniques is well started.

Crop-wise, there are special problems. Citrus fruits and nuts are sprayed with units designed to reach most effectively, and with minimum labor, all parts of

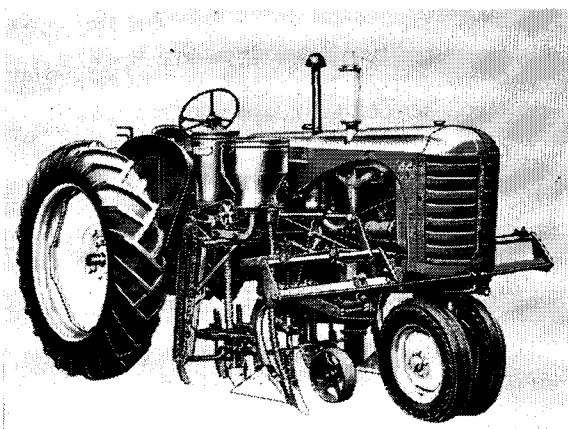
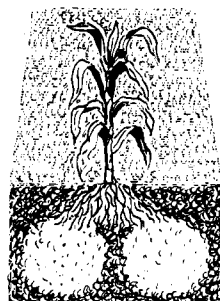
Vertical distribution of dusts from top to bottom of growing bushy plants is a problem which has been solved by a variety of machine designs. This engine-driven duster is especially designed for vineyards and high-bush blueberry plantings by Niagara Chemical Division of Food Machinery & Chemical

Spray booms vary and are adaptable, and light weight is desirable. This 40-foot unit, developed by Hardie Mfg. Co., sprays tomatoes, potatoes, row and field crops. Nozzles can be added for between-wheel spraying. Boom folds back when it hits an obstacle





A recent development by Oliver Corp. is a corn planter that places fertilizer during planting operation. In each row, two deep disks open trench into which is dropped controlled amount of fertilizer in two bands four inches below seed level. Shallower disks cover deep bands and open a seed trench at a higher level. Tubes place smaller amount of starter fertilizer in two bands at seed level. See diagram below



A Massey-Harris side-dressing unit applies fertilizer during cultivation or planting. During cultivation, fertilizer is fed down on each side of the row. During planting, fertilizer is placed at same depth as seed

John Deere and International Harvester recently have introduced new type units for fertilizing and reseeding pastures which can also be used for fertilizing alone. Colter slices into soil, pointed applicator opens slice, which is held open by a boot while fertilizer drops into it from a tube. Seed can be dropped in behind fertilizer



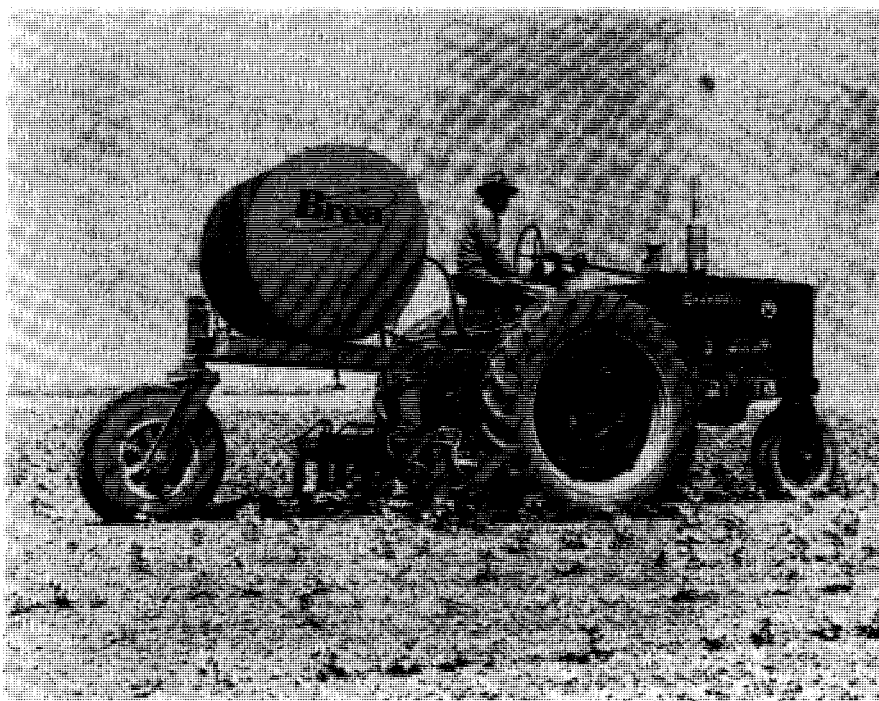
the trees. Corn needs insecticide application after it has reached a height greater than that of most of the annual crops; as a result, all machinery must be used with spray nozzles to reach down between the corn rows. Potatoes and tomatoes call for low-level boom sprayers. On large truck farms, multirow equipment must be used for efficiency. Soil fumigants against nematodes need to be injected beneath the soil; attachments have been developed for liquid ammonia injection units to apply the soil fumigants at the same time.

In application of solid materials to plants, the loss through failure to stick to the leaves and stems is an important part of the expense. Electrostatic dusting is being developed: solids are applied in dust form as charged particles. As a result the dust particles cling to the plants. It is directed toward reducing dust losses, frequently estimated near 80% to a much lower figure.

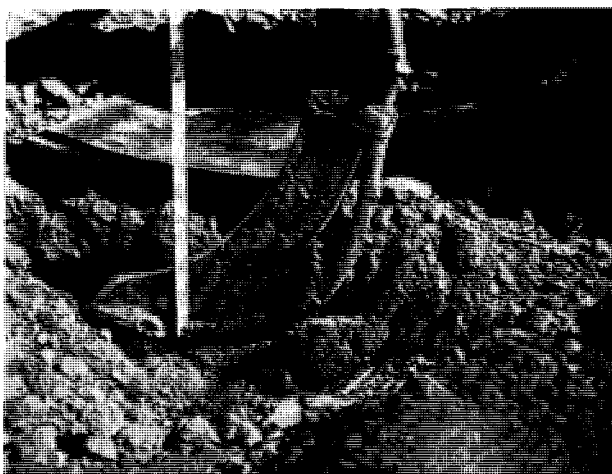
Herbicides and Defoliants

We have at our disposal powerful and effective herbicides, and the number is increasing. Herbicides must be applied in such a way as to avoid contact with vulnerable parts of crop plants. Accurate directional sprays are necessary. Defoliants, in wide use on cotton, require specially designed spraying units for greatest efficacy and least waste.

There is a full story in airplane application alone, not touched here, but advances in surface equipment during the past few years have been such that combined with the progress



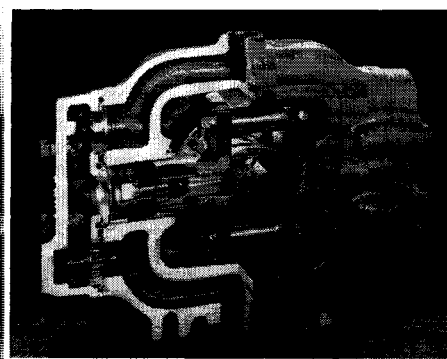
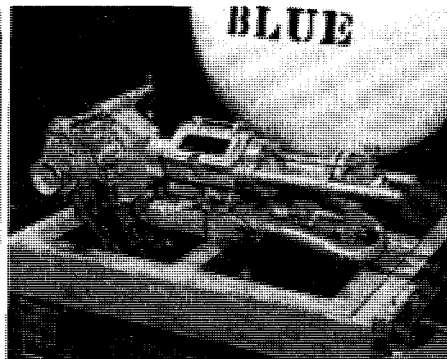
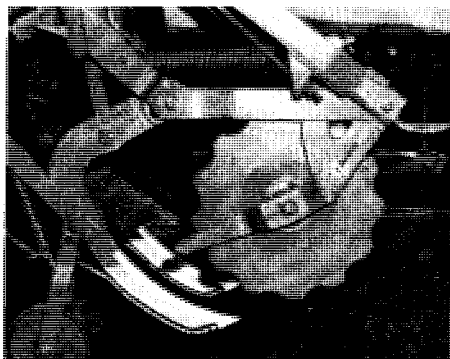
Rig used in San Joaquin Valley for applying ammonia solution to young cotton. Solution is placed six inches deep in bands on each side of plant



Shell's NH_3 injection shank, for use by applicators in its dealer distribution system, is pictured in the ground to show depth and position during action

Left. Anhydrous ammonia metering pump, developed by John Blue Co., mounted on company's Universal ammonia applicator. Applicator is designed for using anhydrous NH_3 as side-dressing, preplanting, or pasture application. Metering pump uses a heat exchanger which dissipates heat of compression of ammonia within the pump to ammonia leaving pump. Center. Spring loaded applicator blades of the Universal applicator. Ammonia enters soil through

tubes behind applicator blades. Spring-loaded rollers behind blades seal applicator. Disk-shaped colters cut sod to depth of three to four inches, while applicator blades run behind colters and inject NH_3 at depth of six to eight inches. Right. Cutaway view of a high-pressure, twin-piston power take-off pump for agricultural chemicals. This pump, developed by John Blue Co., will handle both corrosive and abrasive fluids at high pressures.



through chemical and agronomical research, the efficacy of protecting and feeding farm crops is beyond comparison with that of 50 years ago. The results of research have been brought to the farm through the interrelated interests of technical groups once hardly acquainted with each other.

Special Problems

In addition to physical design there are other problems now getting close attention. Corrosion is a primary consideration. An industry cooperative program is being directed toward this matter by a subcommittee on fertilizer application of the Farm Equipment Institute. Recently, in a report before the American Society of Agricultural Engineers, C. E. Guelle, International Harvester Company, chairman of the subcommittee, reported that while results are not yet conclusive, progress has been made. Gray iron still is the best compromise between cost and corrosion resistance, but stainless steel is going into certain portions of the equipment. Fiberglass and plastic coatings are also under study as well as metallic plating.

In summary, Mr. Guelle pointed up as the leading trends in improvement of application machinery: (1) better metering, (2) bigger capacity, and (3) more accurate placement. Some of the accompanying illustrations show how these improvements are being made.

Other associations taking an active interest in the development of better equipment include Allied Farm Equipment Manufacturers Association, Southern Farm Equipment Manufacturers, Inc., and the National Sprayer and Duster Association.