290 as the 3,6-dichloropicolinic acid is very slightly irritating to the skin on repeated or prolonged contact. It may be injurious to eyes, and some impairment of vision may occur if not flushed from the eyes promptly. These effects on skin and eyes are reduced by formulating DOWCO 290 into Lontrel 205 or M-3972. DOWCO has very low toxicity to fish, bobwhite quail, and mallard ducks. Garlon and DOWCO will effectively supplement the biological activity of Dow's existing herbicides such as 2,4-D and Tordon.

DEVELOPMENTS IN THE ELI-LILLY COMPANY
A.T. Perkins

Perkins presented the new developments that are occurring in the Eli-Lilly Company. However, he requested that no information be published at this time in accordance with company policy.

FUTURE IN CHEMICAL ROADSIDE VEGETATION MANAGEMENT
Roy R. Johnson

Union Carbide Agricultural Products Company has developed and is marketing many herbicides for the management of grasses, broadleaf weeds, and brush that grow on highway rights-of-way. Along with these herbicides and plant growth regulators, Union Carbide has developed application equipment to apply herbicides uniformly and with a minimum of drift. The Directa-Spra is widely used by municipal, county, and state highway departments. Where aerial application is feasible, the Microfoil boom provides accurate application with little drift potential. Two new devices, the Spirometer and the Mini-Wobbler, are currently being commercially developed. These devices can apply herbicides and plant growth regulators to highway vegetation in a swath of up to 50 ft from the spray vehicle without using a boom and at forward speeds of 10-15 mph. Typical spray volumes are 25-50 gal/acre. These application devices were used to treat several thousand acres in 1980. Use on typical highway sites will be investigated in 1981.

FLEXIBILITY IN ROADSIDE VEGETATION MANAGEMENT PROGRAM
C.W. Middleton

Major challenges concerning inflation and energy use that we all talk about are opening the door to a number of significant changes. Many of these challenges are related to the optimum use of a changing budget and are concerned with such areas as holding mowing cost down and vegetation problems that occur with reduced mowing.

Today's planning of highway chemical prescription programs has changed radically in just 2 years. The flexibility and ingenuity of tank mixes are also becoming more essential for a successful program.

Two years ago, the industry had three flexible materials that were either premixed or tank mixed and were used with other industrial products such as Hyvar, Spike, Krenite, Embark, and MSMA. These last three were used in every season of the year. Now 2,4,5-T is no longer available from Velsicol or other suppliers for right-of-way use. Two broad spectrum chemical tools are left for selective weed and brush control: 2,4-D and Banvel (Dicamba). These two materials are flexible in many common use situations: highway (including ditch bank labeling), utilities, home lawns, corn, pastures, rangeland, railroads, forestry, aquatic, watersheds, soil sterilant, and grass inhabitation areas.

Three new product lines are in various stages of development from Velsicol:

1. Vegatrol DPA (available as an ester or amine) was introduced this year; this product should complement our Vegatrol A4D and LV4D;
2. We will also introduce Banvel C.S.T. (cut-surface treatment) for selective brush control; this material is applied as a ready-to-use concentrate; it contains no 2,4-D and should be used on a freshly cut surface such as tree trunk frill or a freshly cut stump and should be ideal for brush cutting crews; this product will increase our present product line of Banvel XP pellets, 4WS, 720 and Banvel 520 (oil and low oil mixes); and
3. Ravage (Test Code VEL. 5026) is our new total vegetation control product, which has been submitted for approval by the Environmental Protection Agency.

FUTURE IN CHEMICAL ROADSIDE VEGETATION MANAGEMENT
Anthony Stacha

Ciba-Geigy markets a number of products that are used in roadside vegetation management programs in the United States. These product formulations are Pramitol 25E, Primitol 5PS, Atratol 80W, Atratol 8P, Aatrix 80W, Aatrix 4L, Aatrix Nine 0, Princep 4L, Princep 80W, and Princep Caliber 90. Due to the diversity of weed problems and rainfall in the United States, the uses of these products vary from complete bare ground control chemicals in some areas to selective control of undesirable species depending on rates used.

Princep has been used for a number of years in the western United States for selective control on highway rights-of-way. Recently, Aatrix has obtained a state label in Oklahoma for a different type of selective control, that is, broadleaf weed control in bermuda grass along the roadsides.

My experience in Texas has been centered around the application of Pramitol 25E under asphalt shoulders to prevent weed and grass encroachment. This use of Pramitol 25E considerably extends the life of these shoulders. Pramitol 25E (under shoulders) can be applied on the ground before laying asphalt by mixing 20-30 gal of Primitol in a minimum of 100 gal of water and uniformly spraying on a well-prepared surface. Pramitol 25E may also be applied at the same rate and may be mixed directly with the cutback asphalts such as RC, MC, and SC. This later program can be applied by the contractor and requires no special equipment and labor. The only additional cost is the cost of the chemical. Tests have shown that the long control of Pramitol 25E under highway shoulders to prevent weed encroachment, thus extending the life of the shoulder, is a very economical program and in some cases appears to double shoulder life.

Currently, registration is pending with the Environmental Protection Agency on Dual 8E alone and as a tank mix with Princep for weed control in field and liner grown woody ornamentals. The granting of this registration offers potential for Dual and

Dual/Princep where various ornamentals represent the roadside landscaping.

Also, Ciba-Geigy is testing a new compound identified as CGA-82725, which is a postemergence grass control herbicide. The complete activity of this compound has not been reported to date.

A registration for a Tandex/Princep mixture is currently being planned. This combination will offer a potential for either selective control of annual weeds, or complete vegetation control, depending on rates applied. Ciba-Geigy is striving to find new and better compounds for use as well as to determine new uses for old compounds to better service the roadside vegetation management programs in the United States.

FUTURE IN CHEMICAL ROADSIDE VEGETATION MANAGEMENT

Stephen R. Muench

(Muench's presentation was not available for publication.)

FUTURE IN CHEMICAL ROADSIDE VEGETATION MANAGEMENT

M.R. Jones

Chevron Chemical Company has two herbicides that can be used for right-of-way maintenance--Ortho Paraquat CL and Ortho Diquat 2 spray. Ortho Paraquat CL is a restricted herbicide; it can be applied only by licensed applicators. It is a contact herbicide with a quick burndown or disiccation on grasses and weeds. Sometime ago we made available a reference book on Paraquat Toxicology and Poisoning. This listed treatment procedures, methodology, and information on Paraquat.

Ortho Diquat 2 spray has been labeled for right-of-way, highway, and other areas that have unwanted weeds and grasses. It is also a contact herbicide and it is a nonrestricted product. It is compatible with many residual herbicides to help develop a complete maintenance program. Both terrestrial and aquatic species are listed on the label that makes the product a dual-purpose contact herbicide. Diquat 2 spray has an LD 50 of 440. It carries a warning statement on the label.

Ortho X-77 spreader is a non-lonic surfactant that is recommended for use with both Ortho Paraquat CL and Ortho Diquat 2 spray. It is necessary to add a non-lonic surfactant to obtain the best results with either of these products. This aids in wetting both weed and grass species and helps inhibit foaming.

FUTURE IN CHEMICAL ROADSIDE VEGETATION MANAGEMENT

John W. Matteson

Embark^{R} 2-S Plant Growth Regulator (PGR) is a versatile, newly developed product from 3M designed to reduce the cost of grass maintenance in locations such as highway rights-of-way, airports, golf courses, and cemeteries. Embark 2-S PGR is formulated as a diethanolamine salt solution containing the equivalent of 2 lb active ingredient/gal. Toxicological studies show that, when used according to label recommendations, Embark PGR presents no hazard to the user or the environment.

Embark PGR may be tank mixed with 2,4-D for total vegetation management. Research has shown that no incompatibility exists when Embark PGR is tank mixed with Dicamba, MCPP, and other broadleaf weed control herbicides. Embark PGR will reduce or eliminate mowing requirements for a minimum of 5 weeks on Bermuda grass and a minimum of 8 weeks on cool-season grasses such as Kentucky bluegrass, tall fescue, chewings fescue, red fescue, and several other species. Year-long seedhead suppression can be attained on cool-season species by making spring applications before the seedhead develops. Fall applications give spring vegetative growth suppression and seedhead control on many cool-season species. Mowing may be made before or after application or not at all. The important thing to remember is that the grass must be actively growing and healthy and not cut too short to get sufficient absorption of the chemical.

Any spray equipment that will apply 15-150 gal/acre of spray solution and give uniform coverage can be used for Embark PGR application. The quality of application is more dependent of the equipment operators than of the equipment itself. During its 2 years on the market, Embark has shown many states and municipalities that its use will reduce the labor assigned to mowing, thus allowing more flexible use of manpower and equipment, will reduce mowing risks, and fits in well with total vegetation management.

3M is continuing its research with Embark PGR to increase its utility in vegetation management. Other chemicals from the 3M research laboratories, such as MBR 18337, are showing promise as turf management tools of the future.

HERBICIDE SPRAY EQUIPMENT

J.M. Custer

(Custer's presentation was not available for publication.)

HYDRO-SEEDING AND MULCHING MACHINERY

Bob Jones

Establishment of vegetation of roadsides falls into two basic categories: the planting of living plants and the planting of seeds. One of the critical factors of successful planting is that of providing adequate moisture. The cost of irrigation made it necessary to seek ways to take better advantage of rainfall. Man learned centuries ago that a covering, such as rocks, leaves, or twigs, would help protect the new vegetation. Moisture was better retained in the soil, soil temperatures were moderated, and the plants were protected from erosion. In some cases a planting has been successful when under normal conditions it might not have been. In some cases, the reverse is true. The agricultural community has dealt with this less than 100 percent probability of success from the beginning of time.

Straw or hay mulching (high-profile mulch) has proved to be the most successful technique in the arid climates of the West. The process involves the planting of seed and fertilizer in the soil with one piece of machinery, then mulching with a layer of