

than it would be if it were maintained as a lawn. It can be concluded that the more the roadside vegetation is like the natural vegetation of the region, the less energy is required to maintain it.

The main objective of roadside vegetation management should be to keep the highway a safe and pleasurable place to drive. What is growing along the roadside should not imperil nor distract the driver, yet it should provide a series of restful glances for the experienced driver and a certain flow of countryside scenes for the passengers. For ecological and economical reasons, the composition of roadside vegetation should depend on the locally adapted native species and a selected number of introduced species that are dependable. Due to the variability of most roadside conditions, a mixture of species has to be used since no single species has the adaptive scope to cover it all.

This program should promote beauty, prevent erosion, and reduce the spread of noxious plants. Mowing is an important maintenance procedure that has been designed for average vegetation of the region. Mowing height, interval, and placement, particularly on slopes, are very important to the roadside program. In the Iowa model, they found that by raising the mowing height 3 in, more vigorous birdsfoot trefoil could be retained in the Interstate medians on a less frequent mowing schedule. In the same model, the backslashes were not mowed and a vigorous stand of smooth brome, switchgrass, and other taller species was developed. This had a desirable result and proved to be a good natural habitat for certain nesting birds.

The use of herbicides has traditionally been associated with the control of noxious species adjacent to crops and pastures into which they could readily spread. Often, it is the other way around. In Texas, glyphosate and velpar are currently approved for sterilization around signposts, guardrails, culverts, bridges, and warning posts to make the mowing effort less restrictive and more efficient. Sterilants should be applied no closer than three times the distance between the dripline of the tree and the trunk of the tree. Roadside vegetation management is too important to be left to the field operators. It must be closely supervised by ecologically trained personnel who recognize the limitations of mowing and spraying. The design of roadside facilities, placement of signs, construction of slopes, and other land-mowing operations should be done with maintenance in mind.

#### INFLUENCE OF RESEARCH AND DEVELOPMENT ON ROADSIDE MANAGEMENT

D. James Morre

Research is an important source of new developments in roadside management. However, for research to impact practice, it must be implemented. Sight distances must be maintained, signs not obscured, erosion prevented, and a healthy weed-free turf maintained. Research should include a planning phase that involves an analysis of the problem, outlines objectives and procedures, and assembles the required personnel and resources. This is followed by the actual conduct of the research, which may require several years.

Testing under field conditions is especially slow because weeds germinate and grass seedheads form only at a particular time each year. One must usually wait a year to repeat or confirm an observation although some additional information can come from

the laboratory. After analysis, recommendations are formulated and, if appropriate, implementation is performed. Implementation is aided if the major findings are evaluated under actual-use conditions as part of the research project. All should be aware of advantages, benefits, and projected or actual cost savings as well as any disadvantages or undesirable features. An individual should be prepared to modify recommendations to accommodate local needs.

In Indiana, the present program of research was initiated in 1966. Between 1966 and 1970, surveys were made to determine weed and brush species and densities and to further identify the problem. Work also included the evaluation of various herbicides. In the first period, only environmentally safe amine forms of 2,4-D were used as a fall-spring rotation. In the fall, hard-to-kill perennial and biennial weeds, such as thistle, milkweed, wild carrot, and curled dock, are actively moving nutrients from the foliage to the underground roots in preparation for the winter. Herbicides likewise moved to the roots. In the spring, plants are at a most susceptible stage--either just at the beginning of growth or just on germination. Most annual and winter annual weeds have been eliminated from Indiana roadsides by this treatment. Annual grasses including crabgrasses and the foxtails were reduced by about 90 percent. At least 3 years are required for a sufficient weed population to become reestablished and to justify another spray application.

A major advantage of the fall-spring rotation is environmental safety due to the fact that the crops are dormant. Through improved weed control, we were able to reduce from five-cycle mowing to three-cycle mowing with a net cost saving of \$300 000/year.

Banvel plus 2,4-D was used to reduce mowing or even eliminate mowing altogether. Two-cycle mowing was possible through careful timing where it was required for safety or appearance. Mowing was delayed until the grass reached a height of 18 in, when fescue was starting to form seedheads. The only problem encountered was encroachment of brush. Either spraying for brush control once every 3 years or late one-cycle mowing was recommended. This research resulted in a first year saving of nearly \$1 000 000.

We are now in phase 4 of the program--chemical mowing. The objective is to develop and test materials or mixture materials that will eliminate the need for mechanical mowing.

Research has a continuing and important role in roadside vegetation management. A few examples from the Indiana program illustrate how research, once implemented, can lead to new maintenance practices with substantial cost savings. Many research and implementation activities would be facilitated by more information on what are the desirable or necessary ingredients of a well-maintained roadside and of special problems where solutions are currently unavailable. Research, and especially the implementation of research, ultimately involves not only the researcher but the user as well. An important ingredient of research implementation is good planning that begins even before the research is initiated.

#### APPLICATION OF WEED CONTROL MATERIALS WITH NEW SPRAYING SYSTEMS

Ray Dickens

(Dickens' presentation was not available for publication.)