SELECTIVITY OF HERBICIDES

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Selectivity is a very ambigous word used frequently but meaning different actions to different people. Our concern here is to discuss obstacles in the path of herbicidal actions which produce or prevent selectivity.

Selectivity for our purpose can be defined as the safe selective removal of a weed plant species from an environment established for the production of a desirable plant specie.

Some of the statements I will make are from a paper presented at a herbicide symposium conducted at Corvallis, Oregon. The writer discussed selectivity in the concept of differential specie response to specific herbicides. With 2,4-D we can select dandelions from a turfgrass sod--we can with other herbicides remove some weeds safely from pine seedling--but we do not have a broad spectrum herbicide which is safe on all pine species.

For the commercial nurseryman there is always a question in his mind when a failure occurs as to why the same selectivity which apparently succeeded for others did not work for him. This is an extremely difficult question to answer since there are many variables over which we have no control. Perhaps a more realistic concept for the user is one of plant tolerance. In the field, growers should be concerned with practical weed control. A limited amount of crop injury may have to be tolerated. Many growers have learned to live with a certain percentage of weeds. This may not be true in your particular nursery, but I think you will admit that it is possible. You don't have to have an absolutely clean and perfect nursery bed. As for actual production, there are many factors that come in and determine how many plants you produce.

Physiologists spend a lot of time looking into weed control and have come up with some of the reasons why we do or don't get weed control. Obviously, the morphological characteristics of the plants definitely influence the action of the herbicide. Certainly, you've got to consider that first you have to get the material to a site of action. The first doorway is through the plant itself. In a foliar spray, you've got to consider the shape of the plant. Actually, the leaf shape itself is very critical; plants having leaves that are flat or somewhat cupped will hold more. Plants that are extremely dense, such as the pines, will absorb and hold more. You probably know that waxy leaves will shed a water solution very readily; the reverse will be true of many hairy leaves. Plants that have a considerable amount of hair on the leaves will actually resist the movement of the solution into the plant simply because the hairs hold the solution off the leaf surface.

Here is where we have to consider the formulation. This is where the additive (things that we add to formulations, such as surfactants) will spread and reduce surface tension and it will penetrate the leaf. These are some of the ways that we can overcome resistance on the part of the weeds to the chemical that we apply. Certainly, if we happen to have crop plants that are able to resist the movement of the formulation (a water solution with an added surfactant) we are going to decrease some of the penetration into the plant. But, if the weeds themselves are such that they readily absorb the water solution while the crop plant does not, we have a built-in selectivity.

Now, we have problems after the chemicals get onto the plant. Many herbicides must move to the roots to give good control, so differences in movement within the plant can result in selectivity.

Basically, this slide shows the overall objective of herbicidal activity. Note on the slide that there's a theoretical site of action. To kill the plant you have to get the herbicide in a form that is still active to the particular site where it can produce its effect. The importance of these obstacles vary between plants as we've just discussed in the morphological characteristics.

The chemical itself is subject to many problems. In the soil, there may be problems of decomposition. With some of the herbicides, volatility is also a problem that must be considered. There's the actual absorption by the plant and the micro-organism breakdown. Inside the plant itself there are transportation obstacles which will stop it, or interfere with its movement toward the site of action. Actually, when you get within the plant, you have enzyme actions that will detoxify, degrade, and in some cases, activate the herbicide. Although you can apply the material to the plant itself, the question is--What happens inside? This is one of the factors that determines selectivity.

A few years back, one of the newer concepts of weed control was the beta oxidation process. That was simply a matter of certain plants having the ability to convert a material, such as 2,4-D butyric acid, into the simpler 2,4-D acetic acid while other plants did not. This slide shows the case where some of the legumes could not do this.

If you apply 2,4-D butyric to alfalfa, it would absorb it and hold it and then pass it out whereas some of the weeds in there would take it and immediately start breaking it down and converting it into 2,4-D acid. As soon as that action takes place, the plants begin to show the normal 2,4-D responses.

The most startling thing happened in weed control in corn using Simazine, another herbicide with which you are familiar. We could see fields of nothing but corn. When the physiologist began to dig into this, they found out that actually here was a case where the corn was capable of converting the Simazine into a non-toxic material while the weeds were not.

One of the oldest forms of degradation, or conversion, that we know about is sesone, which is still used with peanuts. In the early days, this was quite interesting because soil micro-organisms could take this compound and convert it into 2,4-D and you got the same response as a 2,4-D treatment.

So, going back over the whole thing, I think we have to think in terms of tolerance rather than selectivity. When we have accepted that fact we can begin to think in terms of how to achieve this tolerance. Certainly, the rate of application will sometimes be critical, because we find tolerance of the plant may be 2 to 3 pounds, where 4 pounds would be marginal and 5 pounds would be excessive. We can actually consider physical placement of the herbicide. Many of you know this from the use of Simazine. You know that it's not a too lethal material if you can place it so that the roots of the crop plant are below a particular zone. You can apply it and still catch the germinating weeds within the top 1/2-inch of soil and still have an inch of buffering from the soil material. This is a tolerance built on actual physical placement.

There has been much work done in the last years using activated charcoal as a buffering agent. Even as a corrector of an overdose of material as well as a buffer because of its absorbing characteristics. It can absorb a lot of the toxic material and as long as the roots are below it, it will keep the toxic material in a narrow belt. You can get the germinating weeds and still get the protection of the plants that you are trying to grow. Other organic matter could also serve as a buffer.

To summarize this whole business: think in terms of tolerance. Develop a slightly different concept than the elimination of weeds completely, and learn to tolerate practical applied weed control. Consider the fact that your market, from a purely industrial standpoint, is not a major market. With all the research needed on the introduction of new compounds, we, in industry, have to work cooperatively with you. Compounds have to have many uses before we can begin to move it into the field. But, people like Mason and Gale are certainly the ones that will be working with and trying to resolve your problems.

In conclusion, learn to consider selectivity in terms of tolerance rather than pure safe removal of weed species. Answers will be available through coordinated research among growers, extension service, and research personnel.

COMMENT (Carter): I want to stress that when we are talking about tolerance, we don't mean total selectivity. Rarely do we have pure resistance. So if somebody recommends that 2 pounds of a given herbicide be used with pine seedlings--just because 2 pounds is good, that doesn't mean that 4 pounds is better. Using 2 pounds, you might get good tree growth and good weed control while using 1 pound you might not get any weed control, and using 4 pounds, you might not have any trees. It's going to be extremely important that you do a good, accurate job of calibration and application of your material. You must also remember that tolerance and selectivity can vary with climate and soil. Hence, you must be careful in making use of practices recommended in other regions before you have tested them on a small scale in your own.