WEED CONTROL IN PUERTO RICO

Kobe Shoji

Research Director, C. Brewer Puerto Rico Inc., Fajardo, Puerto Rico

INTRODUCTION

Sugar cane growers in Puerto Rico are faced with problems of weed control as any other farmer in the world. He is faced with increased cost of production of cane, through higher labor and material costs. When labor costs were low, much of the weed control was done by many men using machetes and other implements.

As every farmer knows—"weeds are plants out of place." Since beginning of farming, man has been confronted with undesirable species of plants, obnoxious and persistent. Puerto Rican cane fields are no different. The weeds are obnoxious and certainly very persistent due to good conditions for plant growth. One only has to observe an abandoned sugar cane field to realize how rapidly the weeds in Puerto Rico can completely overshadow the sugar cane plant. Every farmer knows he must combat these undesirable plants if he is to grow sugar cane.

It is impossible to estimate how much weeds are reducing to full productivity of our sugar cane crop. Studies at University of Illinois has shown that one grass like weed per seven square feet caused a reduction over three bushels of corn per acre. Poor weed control practices undoubtedly are causing reduced tons cane and sugar per acre in Puerto Rico.

Sugar cane field are infested with both grasses and broad leaf of many species such as Digitaria, Eleusine, Chloris, Cynodon, Panicum, Paspalum, Cyperus, Portulaca, Crotalaria, Euphorbia, Amaranthus, Impomoea, and many others.

In the past two decades many new types chemicals were developed through chemistry to provide farmers with added tools for the combating weeds. Chemicals names, such as, 2,4-D, Kuron, Silvex, Telvar, Atrazine, Karmex, and simazine are familiar all through the industry. At one time or another most farmers have used these new chemicals with good success, and sometimes with disappointing results.

GENERAL PRACTICES IN PUERTO RICO

Reviewing the weed control practices of Puerto Rico; in general the use of chemicals are universal and at practically the same rates of applications regardless of the locations. Puerto Rico has many different soil types, many different climatic areas, and yet the weed control practices remains similar throughout the island.

Table 1 summarized the weed control practices in Puerto Rico for plant and ratoon crop.

There is a wide range of effective control with materials such as Karmex and Atrazine when used as pre-emergence herbicide in Puerto Rico. It has been observed
by many growers, that different length of control is noted within fields. There is more or less a standard recommendations made by the manufacturer for the use of herbicide, regardless of locale. These recommendations are based for the most part, from field testing of preemergence herbicides in sugar cane, on the evaluation of the length of time different herbicide gave effective control. Conclusions that, the material or materials which gave the longest control would be best to apply in practice. In many cases a single application of pre-emergence herbicide has been all that is needed, however, many as 4 to 5 applications is not uncommon, including spot spraying.

**HERBICIDE AND SURFACTANTS**

In the past 4 to 5 years tremendous strides have been made in the study of herbicide and their action upon plants. Majorities of herbicides of today are considered as systemic herbicides, that is, it must enter the plant through the roots or the stomata and cuticle of the leaf. Once having entered the plant, most of these herbicides effect the photosynthetic mechanism of the plant, thus causing the plants to die for lack of proper carbohydrates.

Herbicides used today are more selective towards one type of plant than others. The classical example is 2,4-D, bring selective primarily toward broad leaf plants. The so-called pre-emergence are also selective. Harada has shown that Karmex is better than Telvar, Atrazine or Simazine on certain species of *Digitaria*. Atrazine is better than Karmex, Telvar or simazine on certain *Euphorbia* here in Puerto Rico.

In the past 3 years the role of surfactant became very important in use of herbicides. The use of surfactant were associated with insect control long before it became important in herbicide work.

There are many aspects to the field of surfactant and its relations to herbicide action. There are many hundreds of surfactants available on the market, each manufactured for some finite purpose. In the early work of surfactant-herbicide combination, it was found that certain surfactant had remarkable enhancement of herbicide activity on plants, and other surfactants had marked suppression of activity of the herbicide.

Not all is clearly understood as to relationship between any individual surfactant and herbicides. The threshold for surfactant enhancement generally is found within the range of 0.01 to 1.0% concentration of surfactant. The greatest amount of
Sund in his experiments in Hawaii show a very good correlation between the enhancement occurring between 0.5 to 1.0%. It has been found that, an individual surfactant does not necessarily behave the same in combination with all herbicide on all species of plants.

Information of this sort is lacking here in Puerto Rico concerning the effectiveness of various surfactant and herbicides. C. Brewer P. R. Inc. and others sugar firms has and are using several surfactant in combination with herbicide, with little or no knowledge as to their relative merits of enhancement or suppression effect of the herbicide. It has been noted that on the second application of Karmex or Atrazine, very effective control has been obtained with weeds that are beyond the 4 or 5th leaf stage, and at other times no control is obtained. This may be a factor of surfactant-herbicide combinations.

The solubility of Karmex is increased from 40 ppm in water to 145 ppm in a solution containing 0.5 percent Tergitol NPX. Even with this increase in solubility of Karmex with Tergitol NPX, does not necessarily mean that effective herbicide control will take place in all cases.

SOIL ADSORPTION OF HERBICIDES

Knowledge of the fixation capacity of the soil is extremely important since with the advent of substituted ureas and triazines, in as much we are dealing primarily with herbicides that are not contact and absorbing little through the leaf surface. The weeds are controlled primarily after the root uptake of the herbicide applied. Yet any material sprayed on the soil for action on plants is confronted with two factors of great magnitude. First if we assume that 6 inches depth of soil weighs $1 \times 10^4$ pounds per acre, then 4 pounds of active herbicide mixed in the top surface, is present only at a concentration of 4 ppm. The second factor is the fixation of the herbicide by the soil. Let as again assume that 70% of the herbicide is adsorbed by the soil, this leaves only 1.2 ppm of the herbicide for weed control. Tests have shown in laboratories that 0.01 ppm of Karmex in solution will cause severe inhibition of growth of certain plants.

A survey of soil on C. Brewer P. R. Inc. fields show that Karmex fixations ranges from 55 to 95% and Telvar from 35 to 97%. This means 1.8 and 0.2 ppm of Karmex and 2.6 and 0.12 ppm of Telvar is available for weed control. In soil of 90% adsorption very little weed control can be expected with Karmex or Telvar alone. Some success has been obtained by using a combination of Karmex and Atrazine at 3 pounds of each per acre. Using the soil data on adsorption, some fields were closed in with Telvar at 2 pounds per acre plus one spot spray.

As was discussed above, surfactant have marked effect on herbicide actions. Not only does surfactant effect the foliar systemic herbicide, but have marked effect on fixation of herbicide in the soil.

Harada has shown the effect of several surfactant on the fixation of Karmex on Hawaiian soils. The following Table 2 taken from Harada's experiments.

This experiment clearly show that all surfactant do not have the same effects, when applied with herbicide to the soil. Sterox SK and Tergitol NPK are used in Puerto Rico, however, Sterox actually enhances the fixation of Karmex to soil while Tergitol decrease effectiveness of to fix Karmex some 32%.
TABLE 2
EFFECT OF SURFACTANT ON SOIL FIXATION OF KARMEX

<table>
<thead>
<tr>
<th>Surfactant</th>
<th>Concentration</th>
<th>Fixation, %</th>
<th>+ OR %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check</td>
<td></td>
<td>77.2</td>
<td></td>
</tr>
<tr>
<td>Osamul 0.5%</td>
<td></td>
<td>85.6</td>
<td>+10.9</td>
</tr>
<tr>
<td>Vatsol 0.5%</td>
<td></td>
<td>84.8</td>
<td>+9.8</td>
</tr>
<tr>
<td>Sterox SK 0.5%</td>
<td></td>
<td>81.6</td>
<td>+4.4</td>
</tr>
<tr>
<td>Tergitol NPX 0.5%</td>
<td></td>
<td>52.4</td>
<td>-32.1</td>
</tr>
<tr>
<td>Check</td>
<td>0.5%</td>
<td>88.8</td>
<td>-35.4</td>
</tr>
</tbody>
</table>

Fig. 1. The relationship of soil adsorption to net days of weed control for Karmex and Atrazine.
Fig. 2. The relationship of Rainfall to Total days of weed control for Karmex and Atrazine.

length of weed control in relation to adsorption of Karmex and Atrazine in soils. Fig. 1, taken from Sund's experiment, show the relationship of soil adsorption and net day of weed control for Karmex and Atrazine.

EFFECT OF RAINFALL ON HERBICIDE

Weed control in fields harvested in January, February and March are difficult for many reasons. The lack of sufficient moisture inhibits the normal growth of cane, however enough moisture is available for weed seed germination. Lack of sufficient moisture also markedly effects the uptake of herbicide into the roots. Sund has shown that, rainfall definitely effects the herbicides action of weeds, as shown in fig. 2, from Sund's experiment.

GENERAL COMMENTS

Fields have closed in with one application, while others have taken 4 to 5 applications. From this type of performance, we need to know much more about the chemi-
cals we are using, and how one chemical behaves upon certain soil. We in Puerto Rico
lack the fundamental knowledge, and this knowledge will only come about through
research. As it was pointed out by Harada, both Sterox and Tergitol NPX are nonion-
 nic type of surfactant, however it is a mistake to use one because it really hinders the
effect of the herbicide. By using 4 pounds of Karmex on soil where only 2 pounds are
necessary, not only wastes money but chances are, damage to cane will occur.

Let us remember that these chemicals we are using are lethal to plants in very
low concentrations, cane is a plant, therefore, it takes our every know-how to use these
highly toxic chemicals without damage to cane. However, if used properly, our pro-
duction can be increased without added increased in cost.

REFERENCES