The Wurster Process for Controlling Pesticides

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My purpose in this paper is to discuss several different approaches for putting controlled release of pesticides to use. All of the techniques I will discuss have been developed using Wurster coating technology but, conceptually, lend themselves to a variety of techniques.

The encapsulated warfarin, Tox-Hid®, was developed to mask taste and odor which make it possible for rates to avoid toxic baits. Several factors were critical to the development of a successful product which became commercial in June 1974. The key factors are:

1. The encapsulating film must be a taste and odor barrier
2. The capsules must be small enough to prevent rupture in the mouth or segregation in meal type baits
3. The capsules must withstand the temperature and pressure used in preparing Pelleted baits
4. The capsules must release the toxin in the stomach of the target animal.

A summary of the test results in developing this product can be found in "Pest Control" magazine, the May 1974 issue, and a brief history of the development of this product was presented at the San Francisco ACS meeting symposium on controlled release products for which a pre-print was published (August 1976).

A systemic insecticide, Di-Syston, was used in preparing a polymer matrix which is placed in contact with seeds in the field and slowly releases the active into the soil at the base of the plant. White several techniques are available for the preparation of sustained release matrixes; the concept developed for this product involves distributing that matrix uniformly among the plants. This was readily accomplished by utilizing the Wurster technique to apply the polymer/Di-Syston combination as a coating around the seed. In addition to providing sustained protection for the seedling, other advantages include:

1. Treated seeds are more free flowing and therefore easier to plant uniformly than seeds without this treatment
2. The Di-Syston has no phytotoxic effect on the seed
3. There is reduced hazard in handling the seeds treated with the polymer/Di-Syston combination, compared to seeds treated with Di-Syston only
4. Since the insecticide is released at a controlled rate, loss of insecticide to weathering is minimized.

Much of this work was reported in the proceedings of the International Controlled Release Pesticide Conference in 1974.

Several controlled release coatings of pesticide granules have been developed in the Coating Department of WARF Institute. In separate programs, coatings were selected and developed to provide the desired release in a particular environment. These have ranged from creating a shell of hydrocolloid gum around the granules, which becomes a gel when put into a wet environment, to sealing the granules in a film, which is relatively unaffected by moisture and only slightly permeable to the active. The hydrocolloid system wets forming a gel through which the active ingredient must diffuse in a rate-limiting step. The water resistant film provides extended low-level protection, which is only slightly affected by the presence of water. While detailed information concerning these formations is proprietary, they do typify the range of properties that can be achieved through materials selection.

Fintrol®, is a controlled release fish toxicant, which is designed to release the active ingredient uniformly into a predetermined depth of water. This unique form of controlled release is necessary to give uniform distribution of the toxin antimycin with depth. The Fintrol product consists of a high-density inert core, which is coated with a water-soluble resin containing the toxin. The resin begins to dissolve immediately on contact with water. Because of the high-density core, the particles sink. The soluble coating dissolves at a uniform rate releasing the antimycin as the particle settles into the bottom. Several formulations are available to give uniform controlled release over several depths. Additional information on this product can be found in "Investigations In Fish Control, No. 25-28," published in 1969 by the U.S. Department of the Interior Fish and Wildlife Service. These products are now available through Aqua Biotics.

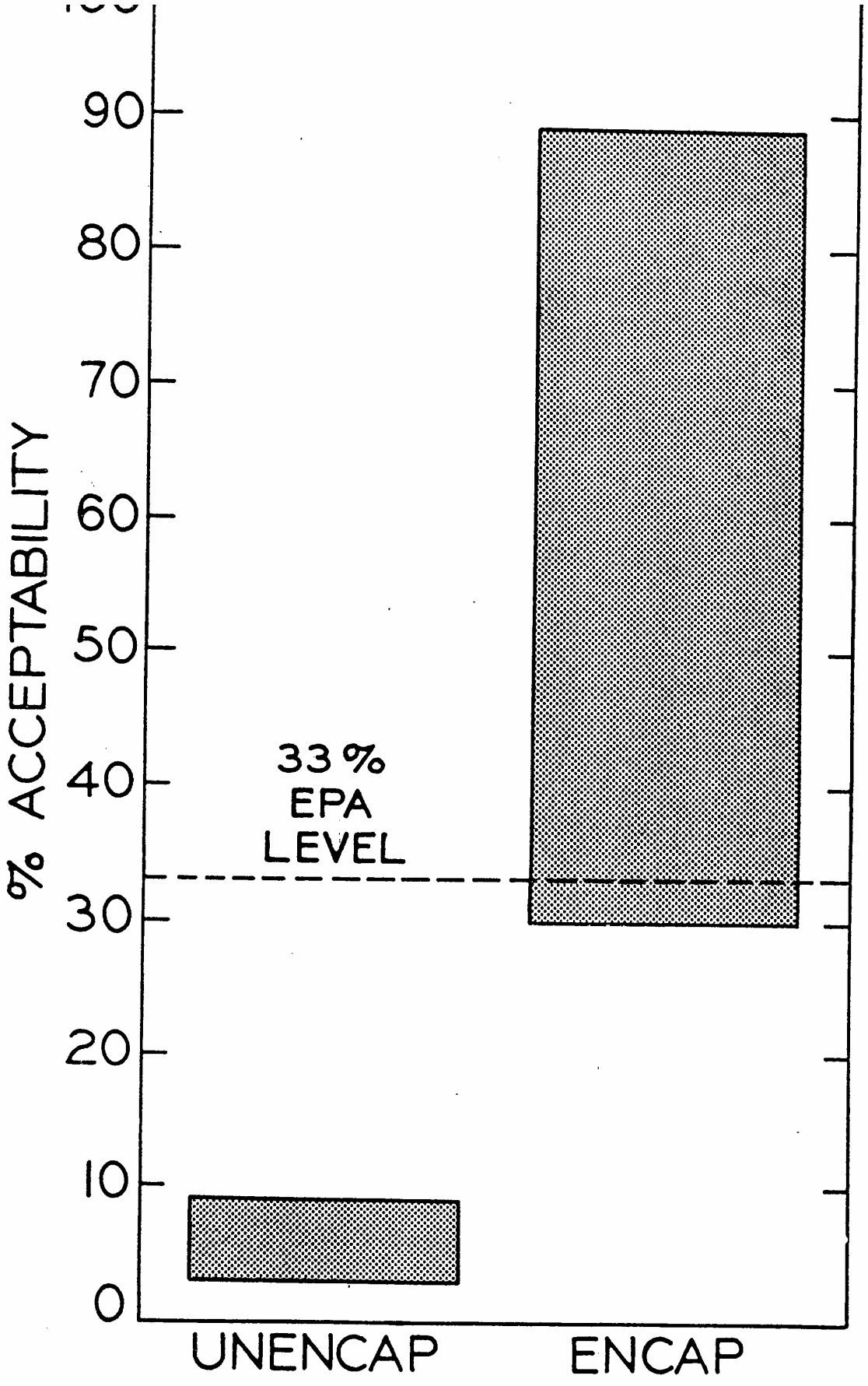
An area of concern to growers of onions is the fungus disease known as white rot. This disease, which is an infestation of Sclerotium cepivorum, can quickly destroy an entire crop. Several fungicides are fairly effective against this organism but only at relatively high concentrations. The Coating Department is participating in a series of trials in which the onion seed is coated with the fungicide. Coating the seed has two advantages over simply mixing the seed and the fungicide together. 1) The fungicide is uniformly distributed from seed to see. 2) The fungicide coating palletizes the seed permitting precision planting.

Onion seedlings emerging from the coated seed are growing in a microenvironment containing high concentrations of fungicide. Using precision planting techniques, 22,000 seeds are planted per acre, which is approximately 0.2 pounds of seed. Present coating levels of 2-4 pounds of fungicide per pound of seed means that only 0.4 to 0.8 pounds of fungicide are used per acre, compared to 10-15 pounds normally used. Although the total fungicide used is reduced, the local concentration is equivalent to 15 tons per acre. More detailed information can be found in the proceedings of the 1975 Controlled Release Pesticide Conference.

Hopefully, these examples will be helpful to the reader, typifying a variety of concepts covered by the term "controlled release."

Pesticide Performance from Encapsulated Cotton Seeds

	Age of Plants				
Treatment	2 Weeks	3 Weeks	4 Weeks	5 Weeks	5 Weeks, 3 Days
Resin A	100%	100%	100%	87%	77%
Resin B	100%	100%	100%	95%	77%
Resin C	100%	100%	100%	100%	77%
Control Unencap	100%	100%	100%	37%	0%


90
80
70
60
50
40
30
20
10
0
% ACCEPTABILITY
33 %
EPA
LEVEL
UNENCAP
ENCAP