DEPOSITION ADJUVANTS IN LOW VOLUME INSECTICIDAL APPLICATIONS

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Abstract

The aspects of insecticide deposition and retention contribute greatly to an acceptable level of insect control. The use of adjuvant products has been found to both enhance initial deposition and to aid in the retention of the deposit. These actions can provide for higher levels of insect control.

Discussion

The topic of this presentation will be slightly altered to include an additional attribute important to insecticidal application. While it is generally conceded that the initial deposition of insecticide is of utmost importance, it is likewise agreed that subsequent retention of the deposit is essential for sustained insect control. Therefore, both the deposition and retention aspect will be considered in the topic.

In production agriculture, the decision to make an insecticidal application can be based on a wide variety of factors. Whatever the rationale, once the decision has been made, all efforts from that point forward should focus on the achievement of the following goal: that is, to provide to the target an insecticidal deposit of such quantity, nature, and time of retention as to afford an acceptable level of insect control. In that context, the remainder of the presentation will involve an examination and review of how adjuvant products may influence the attainment of the stated goal.

Some of the factors that govern insecticide deposition are as follows: Application equipment and its parameters of operation, environmental conditions, pesticide formulation type, the target surface and adjuvants if included. The issue of operating parameters, especially the total volume applied, can be very influential on deposition. Trends toward lower total volume application be either air or ground have made deposition enhancement a much more difficult task.

All of the preceding factors, with the exception of the target surface, will determine the overall physical attributes of the "spray". The following list represents most of the properties that will determine initial deposition:

1. The size of individual droplets.
2. Droplet size distribution.
3. Physical properties of individual droplets.
   a. viscosity
   b. surface tension
   c. elasticity
   d. adhesion

Results

Several years ago, while investigating the issue of the initial deposit of insecticides, someone finally asked enough of the right questions which led to a better understanding of what adjuvants were actually doing. As indicated in the following table, the use of the adjuvant sticker "Bond" improved day zero deposits.

One of the first questions to arise was, "why are there differences between insecticides?". It became apparent that the answer lay in the concentration level and the formulation type of the insecticide. The next question was, "what exactly does the adjuvant do to cause this specific effect?". It was suggested that perhaps it increases the average droplet size. Subsequent, investigation showed that the presence of the adjuvant did not significantly alter droplet size. What then is the explanation for this increase? It finally became apparent that specific properties imported to the spray droplet by the adjuvant were mitigating impact behavior that resulted in diminished deposition. The droplet behavior in question was; bounce or reflection, shatter or rupturing to smaller fragments, and drainage or run-off from the leaf surface. As indicated in Table 1, the improvement due to the use of the adjuvant ranged from approximately 25 to 55%. It is felt that the specific properties of elasticity and adhesiveness imparted by the adjuvant are responsible for the reduction of bounce, shatter and run-off following impact. Several studies since that time have verified the ability of specific adjuvants to increase the initial deposition of insecticides.

As previously indicated, retention of pesticide residue is also an important aspect of efficacy. The largest environmental factor responsible for reducing residues is water. This can be either rainfall or overhead sprinkler irrigation. There have been many wash-off trials conducted, and for the most part they indicate that the right type and dose of an adjuvant can enhance the ability of the deposit to be retained. Several of these same trials illustrate the fact that improved retention also improves levels of insect control. The results of one such study that illustrates both rainfast and control enhancement is are shown in Table 2.

A point that should be made and understood is that not all adjuvants possess or confer the appropriate properties that will improve deposition and retention of insecticides. In fact, utilization of the wrong type or even the wrong dose of the right type may either fail to perform at all or actually exacerbate removal by rainfall. In support of this premise, trials at the U.S.D.A. Stoneville, Mississippi revealed that the use of conventional wetter-spreaders, organosilicones,

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and oil-surfactant types of adjuvants actually increased pesticide removal under wash-off conditions. Under one-half inch of simulated rainfall, more insecticide was removed when mixed with an adjuvant than when applied with water alone. Nine products caused approximately 5 to 20% more bifenthrin insecticide to be removed when simulated rainfall was applied 15 minutes post application. The products Bond and Plyac, however, allowed 25 and 15% less insecticide to be removed under the same conditions.

Conclusions

The issues of deposition and retention are certainly ones that are critical to the concept of optimization of insecticide performance. Success in this area will depend on a multitude of factors, but in the simplest terms, will hinge upon two broad aspects: (1) the base of available knowledge, and (2) the ability to utilize "state of the art" technology. These two areas will increasingly include adjuvant products. Currently there is a fairly widespread recognition and acceptance of the utility of this group of products. The expectation is that the trend will continue to increase largely due to efforts by pesticide and adjuvant manufacturers as well as other researchers. As a result, the base of this technology will broaden and will increase:

(1) The knowledge of the specific properties of spray solutions that can enhance pesticide performance or mitigate constraints to performance.
(2) The understanding of the properties of adjuvants and the conditions under which they can be expressed.

Table 1 - Average day zero insecticide deposition

Insecticide	Without Adjuvant	With Adjuvant
Parathion 8E	15.7 ppm	22.6 ppm
Carbaryl 80S	10.7 ppm	13.6 ppm
Permethrin 25W	3.4 ppm	5.3 ppm

Field & Lab., Fort Collins, Colorado (Adjuvant - Bond)

Table 2 - Percent mortality - corn earworm with permethrin

Rainfall	Without Adjuvant	With Adjuvant
0 cm	77	83.0
2.5 cm	53.5	82.5
5.0 cm	47.5	83.0
Percent mortality - Residual efficacy		
1	39	48
7	13.5	18.5
14	3.8	7.0

Heim 1990 (Adjuvant - Bond)