PESTICIDE APPLICATION TIPS AND TECHNOLOGIES

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Abstract: New developments in sprayer tip materials and sprayer accessories offer improved sprayer performance and easier calibration to growers. Ceramic tips offer much longer life than other materials and, thus, maintain accurate calibration for a longer period. A sprayer calibration kit includes a dedicated electronic calculator which greatly simplifies sprayer calibration calculations. A flow meter is now available which makes it easier to check sprayer tips for uniformity and wear.

Keywords: Pesticide application, sprayer tips, electronic calculator.

Pesticides are an important tool for California alfalfa producers. As the general public becomes more concerned about pesticides, growers face increased regulation of pesticide use and the possible loss of some pesticides. Applying a pesticide at the correct rate is extremely important to obtain proper control of target pests. Underapplication can lead to poor pest control while overapplication costs money in wasted materials and can lead to residues which might exceed legal tolerances and could have adverse environment consequences.

A study done in the late 1970's by University of Nebraska agricultural engineers (Reschenberger, 1980[2]) indicated that 2 of every 3 pesticide applicators were making significant application errors. These errors were due to a number of factors including inaccurate calibration, incorrect mixing, worn equipment and failure to read the product label. They found many problems with worn, mismatched and damaged spray tips. They made numerous suggestions based on what they observed during the study including suggesting daily recalibration. Although I do not believe that the problem is nearly as bad in California still some of the situations observed in the Nebraska study do occur here.

Recently there have been some new products introduced that can reduce the potential for some of the problems noted in the Nebraska study to occur and also to make sprayer calibration much simpler.

Sprayer tips are the part of the sprayer that have the most significant effect on the spray application rate and the spray pattern. Tips must be carefully selected in order that the proper spray application be obtained. There are a number of factors to be considered when selecting tips, including the pattern produced. This discussion will be confined to the selection of tip materials and the checking of tips to insure they are still operating at the desired flow rate.

There are a number of materials used for spray tips. The most common material is brass because of its ease of machining and resulting low tip costs. The disadvantage of this material is its high wear rate when used with abrasive materials such as wettable powders. Stainless steel and hardened stainless steel have been recommended because of their improved wear resistance when used with abrasive spray solutions. More recently various materials such as polypropylene, other plastics, and ceramic materials have been used for tips. These newer materials offer a variety of advantages such as reduced cost, increased chemical resistance, or longer life.

However, the availability of these tips has been limited in the United States because most of them have been developed in Europe. For example, I saw ceramic tips being used in Europe in 1981 but they have only been introduced into the California market in the past year by two manufacturers.

Despite the differences in wear rates of the different tip materials there is only a limited amount of published data available comparing different types of tip materials. Charts from two different studies are shown here. Wear rates of a variety of tip

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[2]Reschenberger, L 1980, The Billion Dollar Blunder, SUCCESSFUL FARMING, Apri 78 (6):23-27.

materials are shown in Figure 1. It should be pointed out that in this test wear rates were quite rapid which was due to the high pressure used and the extreme abrasiveness of the particular wettable powder. This chart should be used as an indicator of the relative life of different tip materials rather than as an indicator of life based on hours of use.

Figure 2 more accurately represents tip life in hours. Using a 10% increase in flow rate as the point at which tips are worn out and should be replaced we can see that the brass tip lasted approximately 90 hours, the stainless steel tip 345 hours, the Kematal[R] tip over 440 hours and at 500 hours the ceramic tip was still at the design flow rate. This chart also indicates that the flowrate for all the tips except the brass tip declined initially and then began to increase. This same phenomena was noted in work conducted at Oregon State University but has not yet been fully explained.

Although resistance to tip wear is important, economics must be considered. Generally, brass tips are considerably cheaper than tips made of other materials. The most expensive tips are stainless steel and ceramic which are in the same price range based on recent quotes in the Central Coast area of California. Other economic considerations are the labor cost of changing tips and most important, the extra chemical cost incurred when using worn tips and over-applying expensive pesticides.

For users there are several things that can be done to insure uniform spray application. Tips should be checked periodically to insure that they have not worn beyond the point of usefulness. The 10% deviation from the design flow rate is a good point to consider replacement, particularly when applying materials such as herbicides where the nozzle pattern may be critical to good application. When tips wear, the wear rate is not uniform across the oriface and most of the wear occurrs in the center. This changes the spray pattern produced by the tip at the same time the flow rate is increasing. Thus worn tips give less uniform application which can be a serious problem with certain types of applications such as broadcast herbicide work.

Tips can be checked using calibrated measuring devices to measure individual tip delivery rates and comparing the measured delivery rates with those given in the manufacturer's literatures. Major tip manufacturers such as Spraying Systems and Albuz provide technical manuals which give the design flow rates for the tips they manufacture.

A sprayer calibration kit introduced within the past year makes sprayer calibration much simpler than before. The unique feature of the kit is an electronic calculator specifically designed for sprayer calibrations. It also includes an accurately calibrated measuring container that can be used to measure tip flow rate and a simple step by step manual that describes how to operate the calculation.

The calculator is the heart of the system and has several unique features including a built-in stopwatch that can be used to calculate ground speed and nozzle flow rate. For example to measure ground speed the calculator is activated by pressing the A key. The display then shows a diagram of a stopwatch to indicate the calculator is in the stopwatch mode and three zeros. When the sprayer passes the starting point of measure the course that has been set up to measure speed the stopwatch key is pressed to activate the timer and then as the sprayer passes the end of the measured course the stopwatch key is pressed again stopping the timer. The time then appears on the display for a few seconds and then the letters FT will appear on the display. This is the prompt to enter the length of the course being used on the keyboard. After the course length is entered the OK key is pressed. The calculator will then calculate and display the travel speed as MPH (miles per hour).

To select the proper tip size once the speed is known the B key on the calculator is pressed and the speed is again displayed. The OK is then pressed if the speed is correct and the display now shows IN. This is the prompt for nozzle spacing on the boom. This figure is entered and the OK key is pressed again and the calculator now displays the letters GPA which is the prompt for the gallons per acre you wish to apply. The correct figure such as 40 gallons per acre is entered and the OK key pressed. The calculator then displays a number along with the letters GPM which represents gallons per minute. This is the gallons per minute that each tip must deliver at the calculated travel speed and tip spacing to give the desired gallons per acre application rate. Then the proper tip can be selected using a tip manufacturer's handbook.

The calculator uses the four basic factors needed for calibration which are sprayer speed, application rate in gallons per acre, tip spacing and tip flow rate. Knowing any three of these factors allows the fourth to be easily calculated. The real advantage of the calculator is that no formulas must be memorized and there is little chance for calculation errors. The calibration container when used in conjunction with the calculator makes it very easy to determine tip flow rate. The kit is reasonably priced and greatly simplifies sprayer calibration.

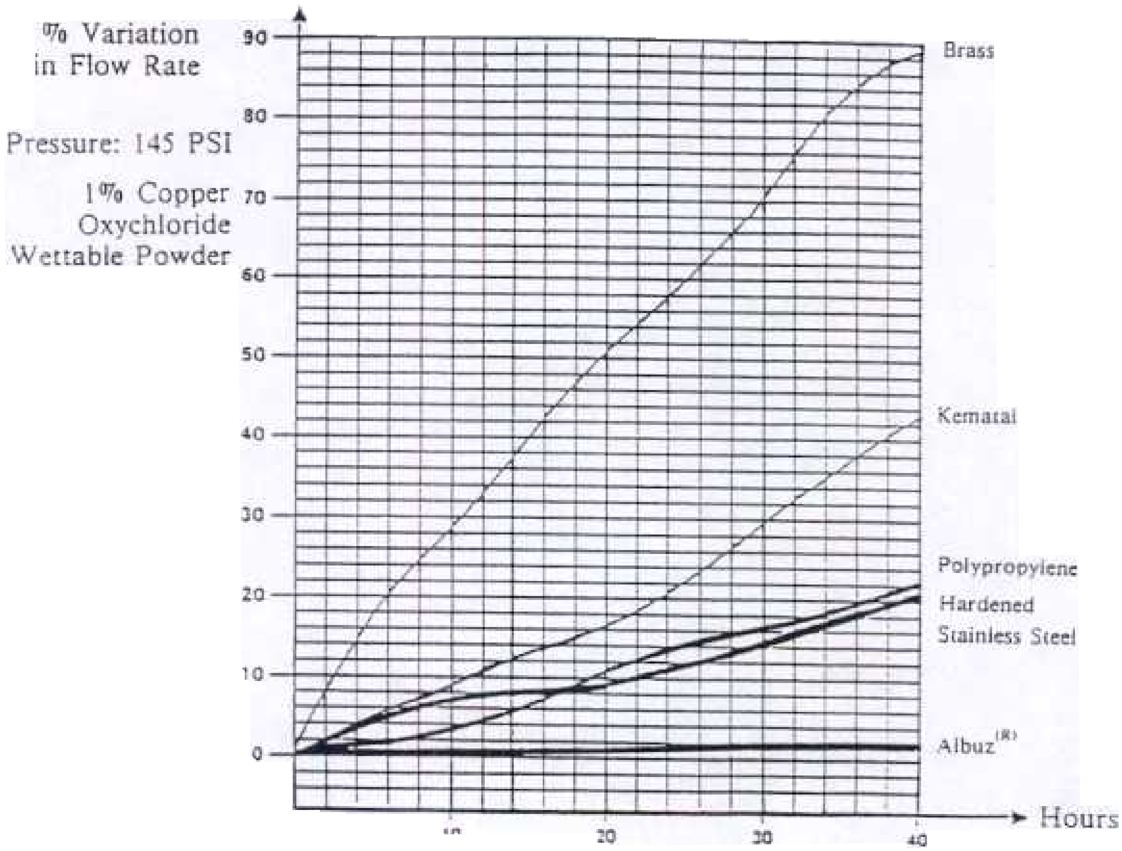
Sprayer tip manufacturers provide technical manuals that are excellent reference sources. These manuals provide valuable information on tip delivery rates at various pressures which is essential for proper calibration. Additionally they contain information on calibration techniques, droplet size and drift information and information on spray tip wear. Any grower who sprays pesticides should have at least one of these handbooks in his shop.

Another recently introduced device that is helpful to sprayer operators is a simple flow meter that can be used to measure tip flow rates. Since it is a flow meter rather than a measuring container its use does not require timing with a stopwatch. It is particularly useful for check tips on a boom for uniformity. Often tips are not all replaced at the same time or a damaged tip may be replaced with a new tip or a tip damaged when it is cleaned. The flow meter allows quick measurements of all tips on a boom so that the operator can be assured that the tips all fall within the recommended plus or minus 10% of the initial design flow rate.

Other products that are now under development will help growers do a better job of pesticide application. Direct injection sprayers which inject the pesticides into lines of the sprayer instead of being mixed in the tank will solve the problem of disposing of leftover tank mixes and reduce the amount of rinse water created when sprayers are cleaned and are available on a limited basis. Automatic rate controllers that adjust the application rate to compensate for forward speed variation are in limited use and will become more common in the future.

In conclusion a variety of new types of sprayer equipment and accessories assist growers in doing a better job of pesticide application. Ceramic sprayer tips reduce tip wear, increase the application uniformity and are cost effective. A sprayer calibration kit which includes a dedicated calculator takes the mystery out of sprayer calibration and a flow meter simplifies the task of comparing sprayer tip flow rates.

Figure 1. SPRAY TIP MATERIAL COMPARISON



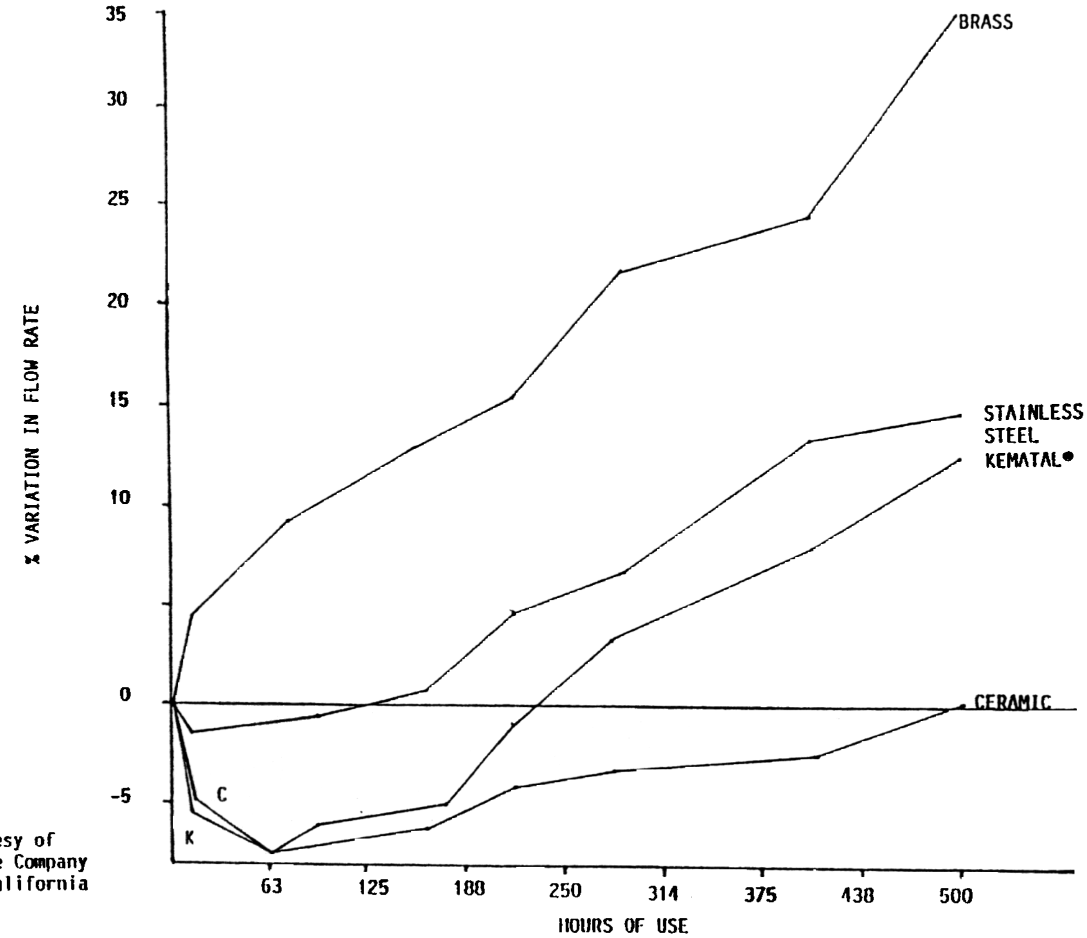
Comparative Wear Resistance
—110°—

Flat Fan Spray Tips

Source: Shell-U.K., in "PHYTOMA", 1984.

MATERIAL	Initial Flow Rate (GPM)	Flow Rate After 40H (GPM)	VARIATION (%)
Albuz Ceramic	.43	.44	+ 2.4%
Hardened S. Steel	.24	.28	+ 17.6%
Polypropylene	.17	.21	+ 20.3%
Stainless Steel	.24	.29	+ 22.2%
Kematal	.22	.32	+ 42.9%
Brass	.22	.42	+ 88.2%

FIGURE 2. VARIATION IN SPRAY TIP FLOW RATES VERSUS HOURS OF USE FOR DIFFERENT MATERIALS.



Data courtesy of
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