

PERSPECTIVES IN THE APPLICATION OF PESTICIDES TO COTTON

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The successful application of Agrochemicals involves an understanding of the:- target, product, equipment, droplet behaviour, and the environment.

The Target

The major targets in cotton production are weeds and insects.

The application of herbicides pre- or post-emergent requires that product (droplets) be placed on the soil or weed surface. This can be achieved by using relatively large droplets greater than 150 μm which fall under gravity. There is little change in the target over time.

The application of insecticides, however, requires that product is distributed throughout the crop canopy. This can best be achieved by small droplets less than 100 μm moving in air currents through the crop and not sedimenting readily under gravity. Because of crop growth the target for insecticides changes rapidly over time.

Understanding the Target is critical to the successful application of Agrochemicals.

The Product

Agrochemicals vary widely in their mode of activity and are available in a variety of oil and water based formulations.

The product formulation affects the formation and behaviour of droplets.

Understanding the Product is important in successful application.

Equipment

The two most widely used methods of droplet formation are hydraulic pressure and centrifugal energy.

Hydraulic pressure is used to force the spray liquid through an orifice (nozzle). A sheet is formed which becomes unstable resulting in droplet formation. There are several nozzle types producing different droplet sizes and patterns, however, hydraulic nozzles all produce a wide range of droplet sizes.

Spinning discs or cages are used to form droplets by centrifugal energy and, if properly used, can produce a narrow range of droplet sizes.

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Droplet Behaviour

Capture - Droplets less than 100 μm move slowly under the influence of gravity and are most influenced by the movement of the surrounding air. In contrast droplets greater than 150 μm , move predominantly under the influence of gravity, sedimenting onto upper leaf surfaces or the soil.

Number - Halving the droplet size results in eight times the number of droplets, e.g. the volume of one 200 μm droplet yields eight 100 μm droplets. The smaller the droplet size the greater the number available per spray volume.

The Environment

The meteorological conditions at the time of spraying have a considerable influence on the fate of droplets.

Evaporation - Small water based droplets, less than 100 μm , evaporate more rapidly than large 250 μm droplets. This can be an important factor in the selection of droplet sizes when using water based sprays. Evaporation of droplets of oil based or ULV formulations may be minimal.

Air Movement - The movement of air is important in the distribution and capture of small droplets less than 100 μm . Without definite natural or mechanically generated air movement small droplets are unmanageable.

HYDRAULIC GROUND BASED EQUIPMENT - OPERATIONAL FACTORS

The boom sprayer is not a magic wand and it must be set up and used in relation to the product/pest and environmental conditions.

Ground Application of Herbicides - Operating Parameters

Nozzle - Flat Fan (Broad Acre) or Even Spray (Band).

Spray Angle - 65-110°, 110° preferable as boom can be positioned closer to the target.

Pressure - 1-3 Bar (100-300 kpa), the higher the pressure the smaller the droplets.

Orifice Size - (medium). The smaller the orifice the smaller the droplets.

Boom Nozzle Spacing and Height 50 cm and 35cm respectively for 110° flat fans.

Speed of Travel - to suit the nozzles, pressure and field conditions.

Active Ingredient per Area - calibration using the output of individual nozzles, speed of travel and number of nozzles.

Nozzle Charts - should be used to select the equipment and operational parameters and the equipment must be calibrated frequently.

Applications Fail to Control Weeds Because of:-

Wrong nozzles - for product/target/environment.

Worn nozzles - replace when output has increased by 20%, they wear according to the material of manufacture and products used.

Timing of application and calibration - worn nozzles and/or calibration errors are the most frequent reasons for failure.

Ground Application of Insecticides - Operating Parameters

Nozzle - hollow cone - to produce small droplets.

Pressure - 4-8 Bar (400-800 kpa) depending on manufacturers recommendations.

Orifice Size - (small to medium). The smaller the orifice the smaller the droplets.

Boom Nozzle Spacing and Height 50 cm and 60 cm respectively.

Speed of Travel - 6-12 k/hr.

Carrier per Area - 100-400 l/ha depending on nozzle, pressure and speed of travel related to target complexity.

Applications Fail to Control Insects Because of:-

Wrong nozzles - small hollow cones required to produce small droplets. If more droplets are required more small nozzles should be fitted not larger nozzles giving fewer larger droplets.

Worn nozzles - they produce larger droplets.

Calibration - essential for use of correct product rate per area and also indicates worn or malfunctioning equipment.

Timing - is critical for the effective use of insecticides. The crop area to be treated can preclude the use of ground operated boom sprays at the optimum times for insect control throughout the crop.

Environmental Conditions - small water based droplets evaporate and air movement is important for the movement and capture throughout the crop profile.

N.B. - The successful use of boom sprays for the application of pesticides requires a detailed knowledge of the equipment and its operation. It has to be properly adjusted for each application.

AGRICULTURAL AIRCRAFT - OPERATING FACTORS

Aircraft operating in cotton are normally fitted with centrifugal energy droplet generating equipment. The spinning cage Micronair AU5000 nozzle is the most common. The rotational speed is controlled by changing the blade angle, finer angles rotate the cages faster and smaller droplets are generated. The equipment generally produces a narrower droplet spectrum than hydraulic equipment, and therefore smaller volumes of total liquid can successfully be applied per target area.

Equipment

The equipment is used by licensed operators. On-board sensors are able to monitor chemical flow rate, cage rotational speed and speed of travel.

Product Application using Agricultural Aircraft

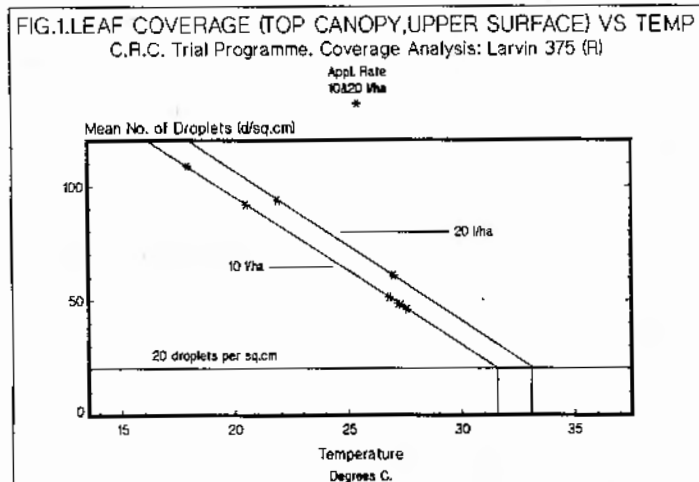
In cotton, two principle methods are used to apply pesticides using agricultural aircraft. If spraying is undertaken in such a way that large droplets are produced, with the aim of laying down a uniform deposit over the surface of a crop or ground under the influence of gravity, the system is known as placement spraying. Features of placement spraying include the need to use large droplets (typically blade angle settings of 50-75°), the use of swath widths selected to give an even distribution across a paddock (typically 16-24 metres) and the need to have cool temperatures and low uniform windspeeds. The application of herbicides is normally undertaken using such techniques.

Alternatively, pesticide sprays can be deposited utilising the natural turbulence present above a crop canopy to transport and distribute small droplets onto the target. Termed wide swath spraying, the technique requires the production of small uniform droplets (typically blade angle settings of 35-55°), the use of special low evaporative ULV formulations and strong crosswinds. Wide swath spraying is being used increasingly in the cotton industry especially to apply insecticides to simple crop canopies up to 4-5 weeks old.

The principles of placement and wide swath spraying can be combined in the application of insecticides to complex crop canopies.

Cotton Research Council Supported Field Trial Programme 1986/87

The influence of Micronair blade angle, temperature, humidity, wind-speed and flowrate on the application of Larvin 375 (R) (Flowable) to mature cotton canopies was investigated. Of the parameters

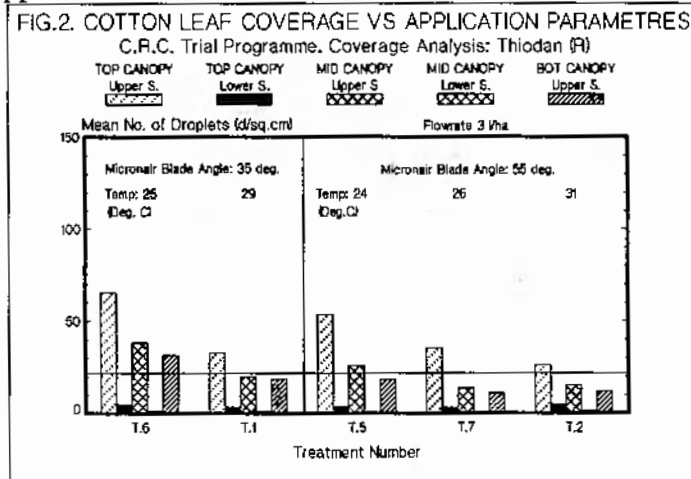


investigated, temperature was found to have the most influence on the number of droplets deposited on the canopy. A representation of temperature against top canopy coverage is shown in Figure 1. The straight lines, drawn

with the aid of a computer model show clearly that as temperature increased, the number of droplets found on the upper leaf surfaces decreased. Assuming that 20 droplets per sq cm are required for insect control, the model suggests that the application of 10 l/ha would fail at about 32°C. It should be noted that doubling the application rate did not double the deposit on the canopy. Other relationships affecting product efficacy and canopy deposit, including the use of spray oils will be presented at the completion of the project.

Field Trial Programme 1987/88

The reasons for the variable results obtained following the aerial application of ULV formulations to mature crop canopies in Queensland



were investigated in the 1987/88 season. As part of a large scale programme using Thiodan ULV (R), the influence of blade angle, temperature, windspeed and atmospheric stability was investigated. The results expressed as

droplet numbers recovered throughout the crop canopy against blade angle and temperature are presented in Figure 2. The data shows clearly the rapid decline in deposit down the crop profile and the considerably lower numbers of droplets deposited on the lower leaf surfaces. The data suggests that the finer blade angle of 35° resulted in greater canopy coverage and that an increase in temperature tended to decrease deposits throughout the canopy profile. The data is currently being fully analysed to determine the significance of these factors.

Unfortunately, despite repeated attempts, the influence of temperature above about 32°C was not able to be investigated at Emerald during the 1987/88 season. It is anticipated that this section of the programme will be completed in the 1988/89 season.

Defining "Windows" for Aerial Application

The data generated to date clearly shows that "spray windows" for aerial application can be better defined. It is hoped that further investigations along with the detailed analysis of results obtained from both CRC and industry sponsored work will allow for the better definition of spray windows for the application of insecticides to the simple and complex canopy stages of cotton crops.

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