

DRIFT & BUFFERS

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The use of aircraft in agriculture in recent years has provoked much attention. Media reports of aerial spraying often seem to be deliberately structured to feed the perception that large quantities of pesticide are being drifted across the countryside.

OFF TARGET MOVEMENT OF PESTICIDES

Drift is more accurately described as the off target movement of pesticide material. When off target losses occur it is in no ones interest. The grower, applicator, chemical company and community all suffer and there is agreement it should be avoided. Why do losses occur? Priestly (1986) suggest that it is because of two principle factors. There are over 1000 registered pesticide products which are applied by a wide range of application equipment using different technologies under an extremely wide range of environmental conditions and there is an ignorance of the factors involved in pesticide application. There are two forms in which pesticides can move out of target areas, as droplets or particles and as vapour. Droplet or particle drift is the most common and is discussed in this paper.

The cause of drift from an aircraft or ground rig is dependent on a large number of variables. Factors influencing off target

movement include product formulation, meteorological conditions, droplet size, target structure and spray release height.

Droplet size is a particularly important factor as droplets 100 μm and smaller have a significantly slower fall or sedimentation velocity than those larger than 100 μm . This prolongs the time for which they may be exposed to conditions carrying them from the target area. The information in Table 1 shows the fall speeds of droplets in still air.

TABLE 1: SEDIMENTATION RATES

Droplet Diameter (μm)	Terminal Velocity (cm/s)
500	220
200	72
100	25
50	7

(AAA Pilots & Operators Manual)

However, it has been shown that droplets less than 100 μm are the most effective and efficient for spraying into crop canopies under turbulent conditions created by wind interaction with the crop canopy. The management of these small droplets whether created intentionally for spraying efficiency, or unintentionally as a result of application activities is one of the current challenges facing cotton production.

BUFFER ZONES

Crop buffer zones were proposed by J. Watt in relation to the management of DDT in cotton production in 1976. This proposal was based on the theoretical calculations of J. Spillman

combined with the field data from Ciba Geigy. The combination of theoretical principles and actual data resulted in his conclusion that in turbulent conditions there was negligible deposit after 300 metres down wind of the release point. This led to a suggested 300 metre buffer zone on the down wind side of the crop to be sprayed with alternatives to DDT. This did not address the management of the possible down wind movement of small droplets out of the alternatively sprayed 300 m cotton buffer zone.

BIOLOGICAL BUFFER ZONES

J. Harden (1987) proposed the concept of biological buffer zones, consisting of areas of non crop vegetation at the Aerial Agricultural Aviation Convention. They would contain purposefully selected and grown vegetation to effectively capture any small droplets moving out of sprayed areas. He concluded that the suitable vegetation types for this buffer zone would be tall, rough and thin, with the rough and thin referring to the foliage types required for maximum catching efficiency. The vegetation would not be short, smooth and thick.

Cotton Research Council funding has supported the investigation of this concept of purposefully designed biological buffer zones to surround cotton cropping areas.

RESEARCH WORK

The detailed research began with the development of a theoretical mathematical model by J. Spillman. This model allows for the relationship between wind speed, the porosity of a barrier and barrier height to be calculated. This was

followed by a series of wind tunnel experiments which determined the air flows associated with a series of nylon gauzes of known porosities. Wool tufts were used to investigate the effect of both gauze porosity and number. If air carrying droplets is forced up over a barrier it will carry small droplets with it. However, at a critical porosity sufficient air will pass through the barrier and droplets will be captured.

The mathematical and experimental models tested in the wind tunnel generally agreed on the following characteristics for a spray catching barrier; porosities should be below 0.5; height to be approximately 1.5 times the height of spray release; and multiple screens are more effective than single screens.

The field trial programme which followed the laboratory work included visits to Emerald and Moree districts to inspect cotton production situations and to examine local vegetation types and possible 'natural' buffer zones. This included discussions and visits with Forestry staff at Emerald and an aerial inspection, courtesy, Aircair Aviation, of the Moree district.

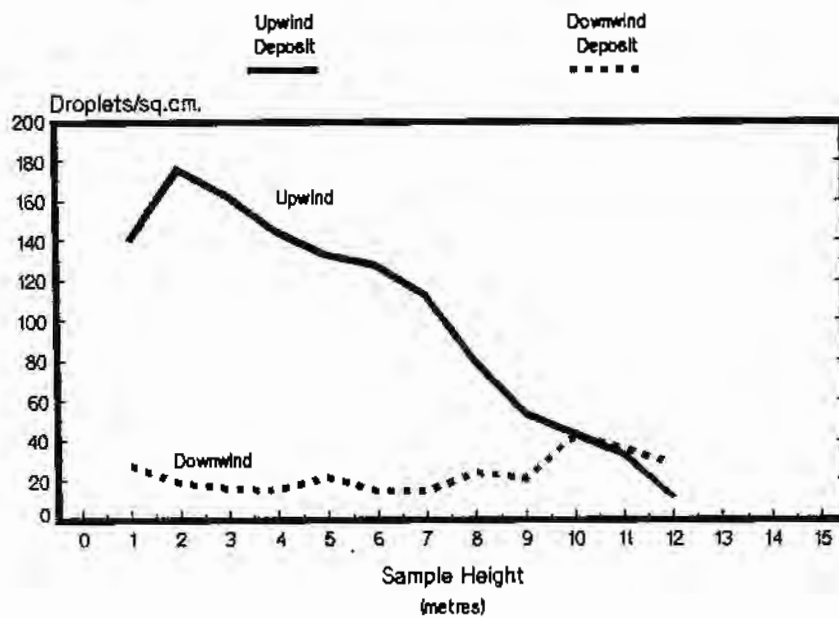
The infield investigations conducted at the College involved the establishment of experimental techniques for testing screens of natural vegetation for effectiveness in catching spray droplets under 100 μm in size. Special artificial collectors made of oil sensitive paper, mounted on 10m masts, were used to capture droplets both up wind and down wind of a screen of vegetation. A series of experiments showed that in winds up to 5 m/sec varying percentages of the droplet cloud, released at a height

of 3m, were caught. The vegetation screen tested was a single row of Cassuarina spp. up to 9m tall.

RESULTS

An example of the results is summarised in Diagram 1.

DIAGRAM 1: DROPLET REMOVAL BY BUFFER FOLIAGE
Low Windspeed: (mean of two collectors)



The data shows that different percentages of the droplet cloud moving towards this screen were caught at each of the sampling sights from 1m to 10m above the ground. At 2m approximately 90% less material was deposited on the collectors behind the barrier and at 9 m, 50% less. These preliminary results are very encouraging especially considering the screen tested consisted of a single row of plants of a single species and of higher density than may be desirable. The foliage of the Cassuarina spp. used was long, thin and rough.

FUTURE WORK

Using the techniques developed, the capture of spray droplets generated, experimentally and using commercial scale equipment, will be investigated at several locations using a number of vegetation types, heights and configurations.

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