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Evaluation of adjuvants to determine effect on droplet size and potential use as "anti-evaporants" as substitutes for crop oil.

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Abstract.

This presentation reports on results of the use of "Adjuvants" for improvement in the deposition of spray droplets thanks to their effect in reducing losses due to evaporation. During the tests it was observed that the products behave differently when applied through rotary atomizers than when applied using hydraulic nozzles.

Field tests conducted in Argentina have confirmed that the products have a positive effect on the number of droplets collected using water sensitive cards

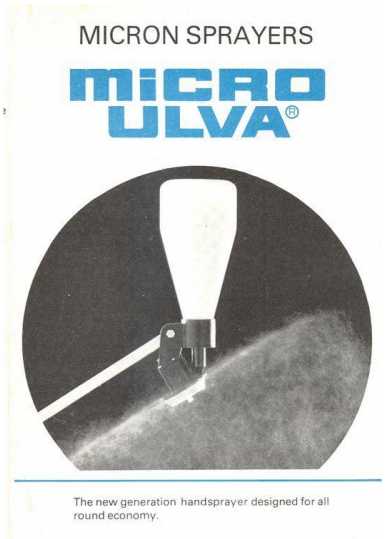
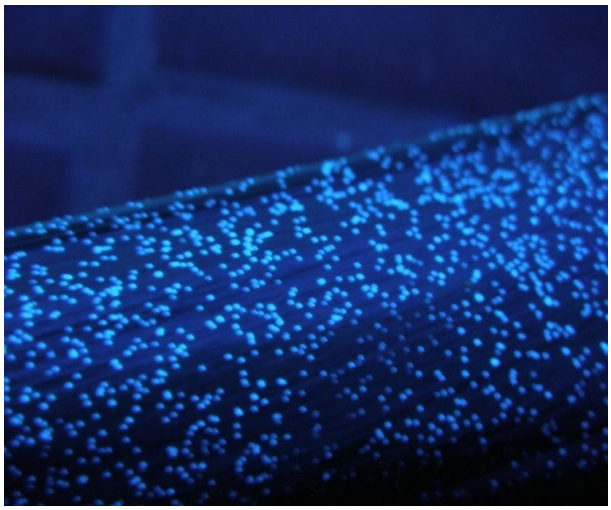
Keywords. Aerial application, low volume application, control of evaporation, drift reduction, and improved deposition of aerial sprays.

Location: The trials were conducted in various provinces throughout Argentina including La Pampa, Cordoba, Salta, Santa Fe and Entre Rios. In most cases the tests were made with collection cards placed in open fields of bare corn stubble.

Weather Conditions: Temperatures: 28-34°C [58-70°F] and relative humidity range: 22-45% with wind speeds ranging 5-11 mph, with an average of speed of 8.8 mph at 90 degrees to line of flight.

Preliminary tests using Ultra Low Volume Controlled droplet applicator CDA: 1 liter/hectare using the fluorescent tracer “Tester”.

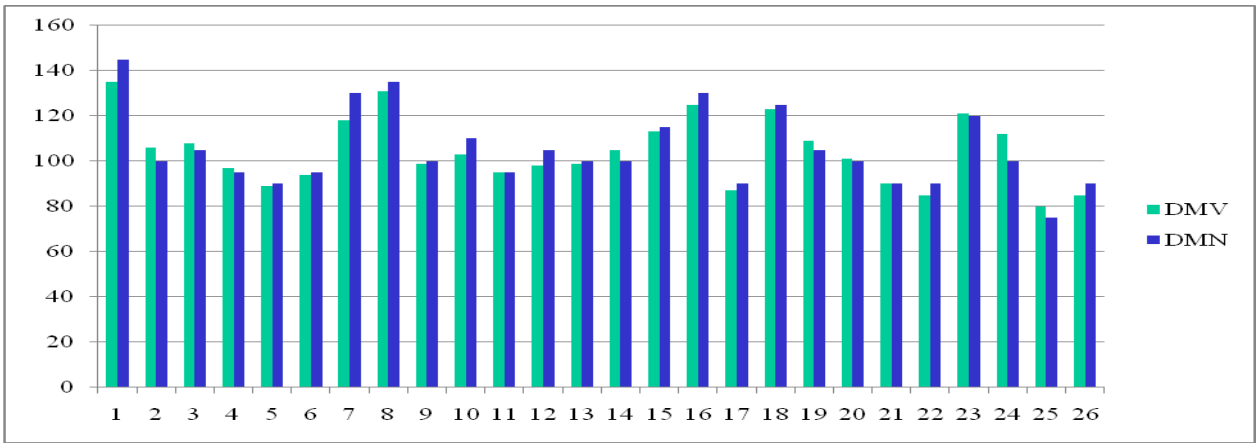
Table.1

Micro ULVA	Photo showing uniform sized droplets using the tracer
	

Observation: This device was used to check the effect of the products on surface tension and its effects on the droplet size. The addition of any adjuvant can have a dramatic effect on the droplet size as shown in the graph below.

Table.2 Effect of various adjuvants on droplet size:

Tests using a MICRON –ULVA controlled droplet applicator.



Observation:

Effect of various products on the droplet size using CDA applicator show how dramatic the effect can be when a farmer requests that several products are applied together. A mixture can often mean failure of a contact product due to too large a droplet size or excessive drift by reducing the droplet size.

Materials and Methods: A wide range of aircraft types and equipment were utilized for the tests and in each case the aircraft were operated as “found” without making any modifications.

Aircraft types:

- Ayres Turbine Thrush and a Thrush 600
- Air Tractors models 401 and 402
- Cessna 188
- KRUK-106

Spray equipment: 4 types of rotary atomizers, Micronair, Tecmoliq, Aleman, JIB

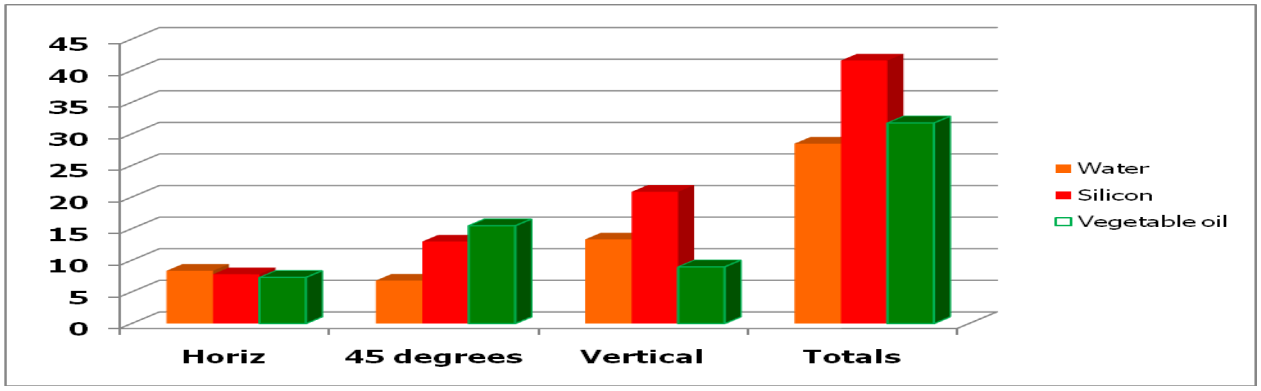
- Ceramic Hollow cone, and CP09 nozzles
- **Spray volumes:** 0.3 - 1.2 gals/acre with a **RED Dye** added to enhance droplets/visual effect

Trial Objective:

To compare efficiency of droplet collection with water sensitive cards [25 cm x 75 cm] placed at different angles relative to the wind direction at a height of 20 cm. A total of 4 consecutive swaths were made upwind with analysis made of the first swath.

Equipment: Ayres Turbo Thrush with Tecmolig rotary atomizers.

Graph.1: To evaluate the relative droplet collection efficiency of cards placed at different angles utilizing a silicon additive. Average Nos of droplets/cm² collected with 5 lts/ha



Observation: Cards inclined at 45 degrees acing the wind collected many more droplets than cards placed horizontally, in addition more droplets were collected on the vertical cards most likely due to the effect of the product in reducing the surface tension and consequently smaller droplets.

Both the visual observation and the droplet analysis confirmed the following result.

Horizontal cards best for the collection of large drops, however low efficiency in the collection of small droplets. The other extreme with vertical cards collect very few or no large droplets. This trial demonstrated clearly that for collection of a more complete droplet spectrum the cards must be placed at 45 degrees angle facing the wind direction.

Table 3: KRUK-106 Hollow cone nozzles at 90 degrees and 12 litres/ha [1.1 gpa]

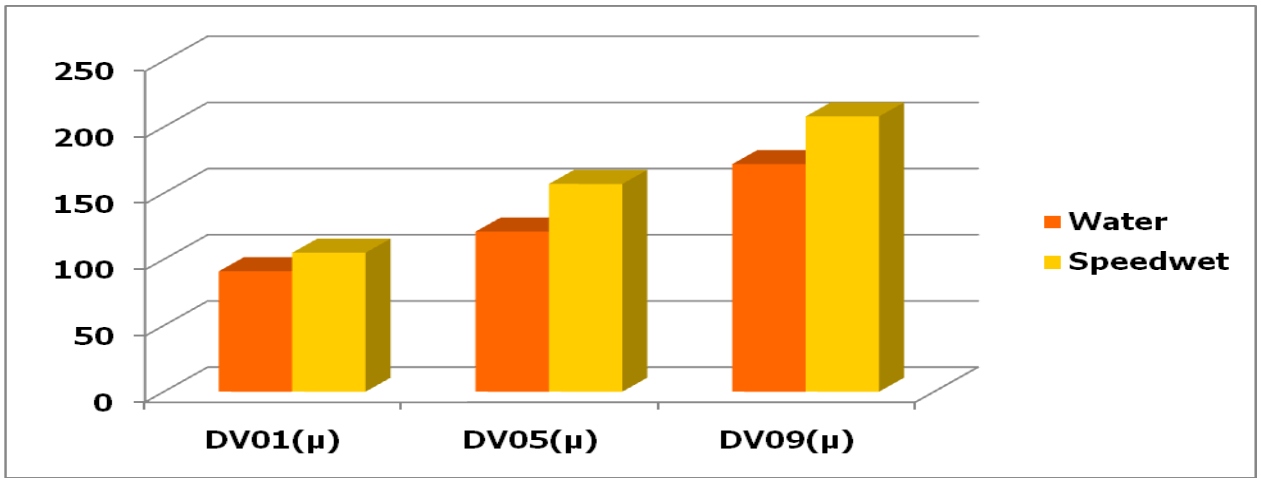
Test	No of Drops	CV%	Dvo.1	Dvo.5	Dvo.9
Water	79	90	175	305	425
Water + Speedwet	72	66	149	260	361
Water + Nimbus oil	57	106	120	190	263

Observation: The addition of the silicon adjuvant Speedwet reduced the values for Dvo.1, Dvo.5 and Dvo.9 and also the %CV confirming that had the effect in producing a more uniform droplet size. It is also apparent that the Nimbus oil had a dramatic effect in reducing the droplet size probably due to the effect on the surface tension.

Table 4: AFUCOR- AT-402 with CP09 Nozzles, 8 litres/ha [0.75gpa]

Test	No of Drops	CV%	Dvo.1	Dvo.5	Dvo.9
Water	62	65	158	278	361
Water + Speedwet	123	47	144	291	430
Water + Nimbus oil	78	47	132	210	300

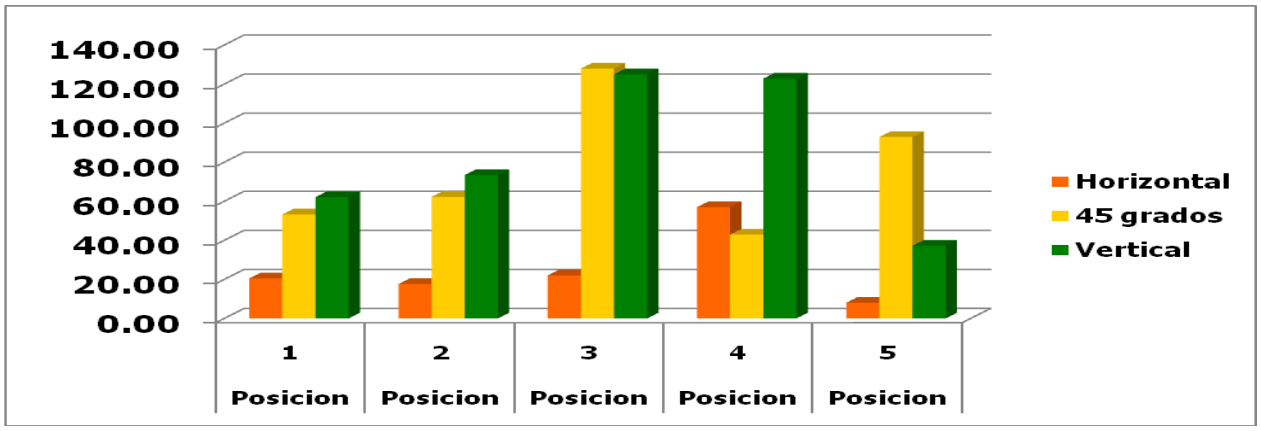
Graph-2: Rotary atomizers AU3000 Spray volume 3 liters/hectare



Observation:

The addition of Speedwet resulted in larger droplet sizes being collected on the cards. This test was under conditions of low humidity so it is probably that the effect of the Speedwet was to maintain the droplet size while the water droplets lost size due to evaporation.

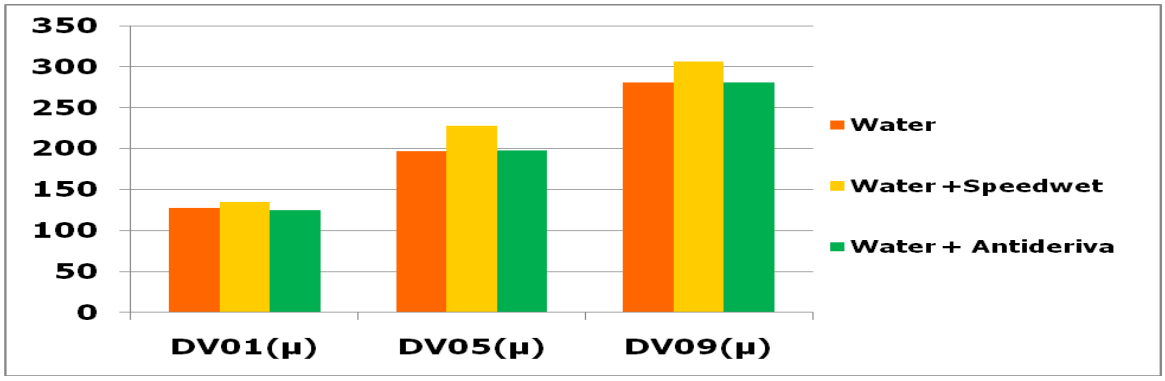
Graph 3: Air Tractor-402: CP09 Flood nozzles- 8 lts/ha- Water. In this test cards were placed horizontally, 45 degrees and vertically at 5 positions across the swath, with a crosswind.



Observation:

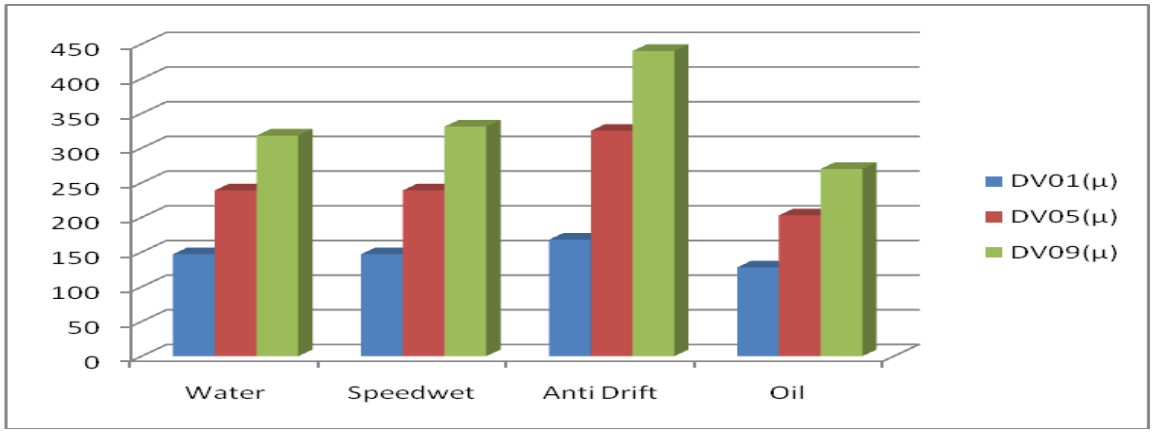
Note the very dramatic difference in the number of droplets collected between the horizontal cards and those at 45 degrees and vertically, with as many as 6 times more droplets being collected on the inclined and vertical cards when compared to the horizontal.

Graph 4: Air Tractor-401 76 Hollow cone nozzles 5 liters/ha



Observation: In this test only marginal differences between the products.

Graph 5: Cessna 188 Aleman Rotary atomizers – 5 liters/ha



Observation: The addition of the Speedwet showed no change in droplet size when compared to water, however the Antidrift product resulted in an increase in Dvo.9 values indicating the presnce of some larger droplets. On the other hand with oil there was a reduction in all values indicating a significant reduction in droplet size.

Summary of results:

- ✓ The addition of adjuvants can have a major impact on the droplet spectrum
- ✓ Collection cards at 45 degrees highest efficiency in collecting most droplets
- ✓ Color dye enhances the definition of droplets for analysis and also very effective in identifying equipment failures
- ✓ Deposition aids show promising effect in increased deposition under conditions of low humidity

Equipment type and settings are more important than the product on the droplet size/spectrum.

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