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The Advantage of Ultra-Low Volume Spraying-Some Data from Malawi and West Africa

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In Malawi farmers growing cotton were encouraged to spray their crop using a knapsack sprayer after trials were completed c 1962, but in 1969 a farmer complained that it was difficult to get the water needed to spray their cotton, so a new trial was carried out using a hand carried ULVA sprayer apply the same insecticide but as a formulation with oil and applied 2 litres of spray per hectare

Table 1: Data from Albar Cotton Variety Sprayed with ULV SPRAYS Compared with a Knapsack Sprayer Fitted with a "Tail Boom" to Enable Spray to be Directed at different Heights as the Plants Increased in Height

Year	Yield 1969-1970	Kg/ha 1970-1971	% Bolls Damaged 1969- 1970	By Bollworm 1970-1971
ULV Single row swath	2255	1848	22.2	24.8
ULV Five row Swath	1595	1754	39.2	31.6
Control sprayed with knapsack with Tail boom	2259	2151	11.8	10.6
Control -unsprayed	457	798	61.6	38.5

Although the yields from ULV spraying each row were equivalent to the knapsack sprayer, the system was not adopted there. In Contrast in 1975, ULV spraying was tried on a small scale in 1975 and rapidly expanded to practically all the cotton fields.

Figure 1: Using a Hand Carried ULVA Sprayer with a Rotary Atomiser to Spray along each Row of Cotton in Malawi.

Figure 2: Knapsack Sprayer with Nozzles Positioned to Spray at an Angle to Direct Up between Branches and for some of the Droplets to be Deposited on the Underside of Leaves

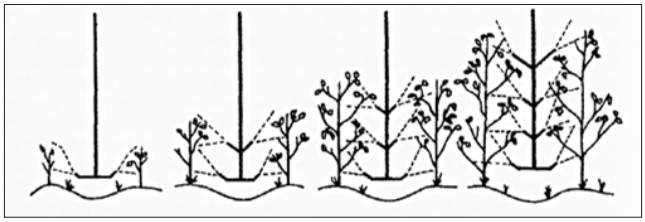

Figure 3: Increase in Number of Nozzles in Relation to Height of Plants

Table 2: Data on Seed Cotton Production in West Africa 1975-1984 [1]

Year	1975	1984
Area (ha)	815500	785000
Production of seed cotton (tonnes)	548500	872000
Yield of seed cotton (kg/ha)	673	1111
Area protected (% of total)	47	80
ULV as %	3	97

Although the area of cotton in 1984 was less than in 1975, the overall production of cotton increased as the ULV spray deposit was not removed by rainfall. Also, the knapsack sprayer used a ULY sprayer was introduced was only fitted with a lance with a nozzle, so distribution of the spay depended on how the operator used the lance.

Later in 1995, the use of ULV spraying was stopped as it was claimed it cost more than when a knapsack sprayer was used, despite the fact that yields had been increased by using the oil-based formulation. In 1996 the crop was still sprayed using a rotary atomiser using 10-11 litres of water per hectare. In retrospect, this was not a wise decision, as in general the amount of rain has increased due to Climate Change rainfall, so any water-based spray deposited on the cotton plants is now very likely to be removed, whenever it rained (Figure 4). Droplets on the upper surface of leaves are most exposed to the rain, but when more rain occurs over a longer period of time droplets on the lower surfaces will also be moved down into the soil by the plants. While the roots of some plants might absorb some of the pesticide, much of pesticide can move and eventually can reach a stream or river. By returning to use of water-based sprays was no doubt aimed at selling more pesticide without considering the environmental impact of spray being moved into the soil.

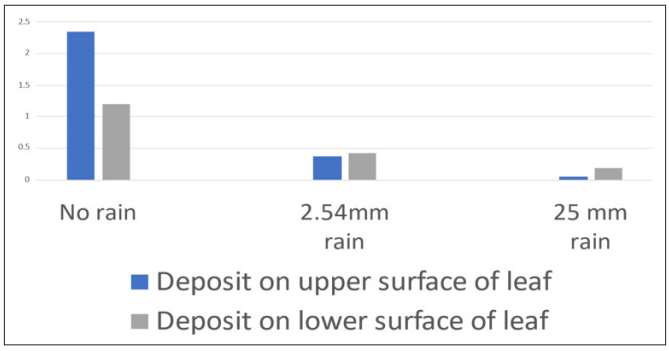

Figure 4: Impact of Rain on Spray Deposits on Leaves

There is now concern that certain crops have absorbed toxic pesticides from the soil under plants.

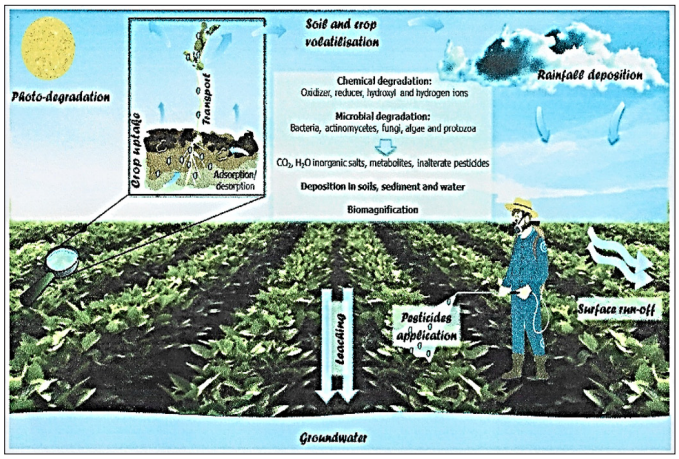

Figure 5: Behaviour and Fate of Pesticides into the Environment [2].

Table 3: Extracted from an Email Received from Pan UK

Produce found to contain PFAS pesticides	Total number of samples tested by UK government	Percentage of samples containing PFAS pesticides *(all rounded down)*
Strawberries	120	95%
Grapes	109	61%
Cherries	121	56%
Spinach	96	42%
Tomatoes	96	38%
Peaches/nectarines	97	38%
Cucumber	96	22%
Apricots	97	20%
Beans	96	15%
Spices	72	8%
Cabbage	96	7%
Lettuce	97	7%
Potatoes	145	2%
Apples	96	2%

In February 2024 the European Environment Agency reported that pesticides were assessed against effect or quality thresholds between 2013 and 2021. One or more pesticides were detected above their effect threshold at 10% to 25% of all surface water monitoring sites. Exceedances were often caused by the insecticide imidacloprid, and the herbicide metolachlor. Exceedances of one or more pesticides were detected at between 4% and 11% of groundwater monitoring sites, mainly by atrazine and its metabolites and bentazone. Differences in weather, crop type and

reporting mean that changes between years may not be significant.

The number of pesticides reported in surface waters ranged from fewer than ten substances (Austria, Iceland, Romania, Switzerland) to more than 100 substances (Belgium, Czechia, Finland, France, Germany, Italy, Netherlands, Spain). For groundwater, the lowest number of pesticides monitored was reported from Austria (6) and the highest number from France (242). Back in 1890's when Bordeaux mixture was sprayed on vines, it was reported that if it rained the farmer needed to spray again [3].

Exceedance rates of more than 30% were reported in 8 out of 30 countries for surface waters and in none of the 21 countries for groundwater.

Instead of applying pesticides formulated in water, with the changes in Climate resulting in more rainfall it is suggested that when a pesticide is to be applied, it should be formulated mixed in oil. The spray should be applied at Ultra-low Volume e.g. 1 litre per hectare, or less than 5l/ha A book specifically about ULV spraying was published by a company in Holland [4].

A ULV spray can be applied using a drone, fitted with a rotary atomiser to select a droplet size the avoids drift by avoiding very small droplets, that can by carried by air movement away from the crop and wastage if droplets are too large and are more likely to be deposited on the ground.

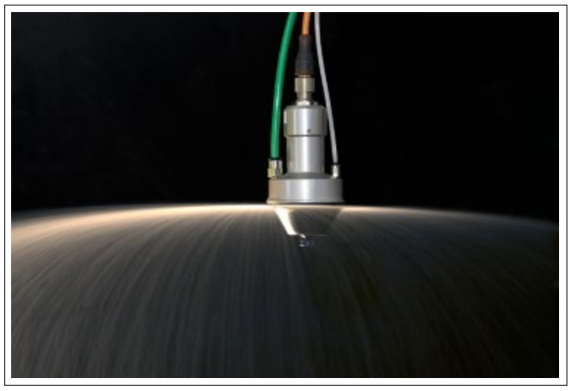

Figure 6: Rotary Atomiser for ULV Sprays

The size of droplets can be determined by using the appropriate speed of rotation of the nozzle and flow rate of the spray liquid.

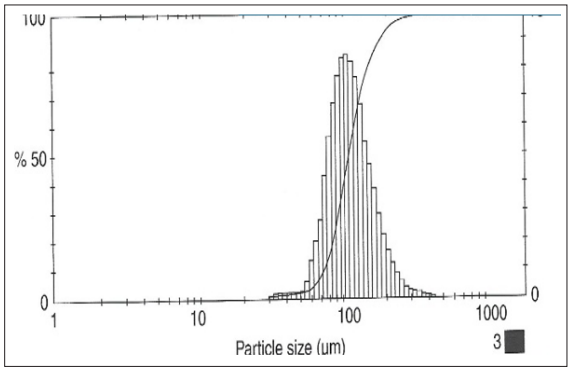

Figure 7: Range of Droplet Sizes using a Rotary Atomiser

There has also been the development of Electrostatic sprayers which improves the deposition of the charged droplets on foliage [5-8].

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