PRE-HARVEST DESSICATION OF SUNFLOWER WITH DIQUAT RECENT DEVELOPMENTS IN DRIFT REDUCTION

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SUMMARY:

"Pre-Harvest Desiccation of Sunflowers is an established technique in many countries. The introduction of Hybrids, which retain green foliage long after seeds have reached physiological maturity, can be assisted by the correct use of a dessicant. Development of the use of deflector (floodjet) nozzles for aerial application is showing promise as a means of reducing drift, a major constraint to the wider use of the technology.

This paper outlines work carried out on drift reduction in 1987 and briefly reviews the support that desiccation can give to plant breeders and growers."

INTRODUCTION

Dessication has become an integral part of sunflower growing in many parts of the world. Diquat was first introduced for this purpose 25 years ago to reduce seed losses at harvest. During the oil crisis of the late 1970's, the technique became more widely adopted as a means of reducing energy inputs into harvesting and seed cleaning and drying. Usage increased further as growers made use of the resulting earlier harvesting for sowing the principal following crop, winter wheat, closer to the optimum planting time.

More recently, advances in plant breeding and the increased usage of fungicides resulting from the appearance of Phomopsis helianthi MUNT-CVET ET AL have further increased interest in the technique. The vegatative parts of green-stem hybrids and fungicide-treated plants tend to remain green longer after maturity than conventionally cultivated Phomopsis sensitive plants. Desiccation can reduce the apparent consequences of this characteristic in terms of harvest timing and efficiency.

In order to obtain the full advantage of the technique however, correct treatment procedures must be followed. Sunflower desiccation is normally carried out from the air, either by fixed wing aircraft or helicopter.

Present recommendations for 'Reglone' desiccation, for example are to use either hollow cone (D8, 10 or 12 with 46 or 56 swirl plate) or flat fan nozzles (6220 or 8020) (Spraying Systems Co designations). Depending on spray parameters such as speed, pressure and swath width, these nozzle sizes give a spray volume for fixed wing aircraft of 30-75 l/ha^{-1}. Helicopters with spray speeds 80-100 km/h^{-1} are fitted with nozzles typically D8 or 10 with 45 swirl plate or 8010 flat fans.

Despite giving satisfactory service over a number of years, these types of nozzles can produce an excessive number of small driftable droplets, typically classified as those less than 130 micrometres (µm) in diameter. In extreme circumstances this can represent more than 15-20% of the total spray volume emitted. Therefore to minimise the risks of spray drift, a development programme was implemented to produce a new nozzle design based on the following criteria:-

a. Droplet size distribution to contain 10% of spray volume in droplets <130 μm. This to be irrespective of nozzle spray angle and/or liquid pressure.

b. Nozzle to be capable of large scale manufacture.

c. Throughput (fixed wing operations), nominally 6.5-7.0 $1/min^{-1}$ @ 2 bar operating pressure.

d. Minimal maintenance requirements.

MATERIALS, METHODS AND RESULTS.

Helicopter Operations

Nozzle Concept

Wind tunnel studies using a "Malvern Laser" unit showed the "Deflector" (Floodjet or Impact) nozzle type offered positive advantages in reducing the percentage of spray droplets less than 130 μm, compared to other designs. ICI Agrochemicals distribute a version of the deflector nozzle called the 'Polijet^R'. Figure 1 shows wind tunnel results from the largest 'Polijet' available (red). This is compared to a standard hollow cone D8-45. Both nozzles were tested in a 20 m/s^{-1} airstream at 3 l/ha^{-1} liquid flowrate (water).

Results clearly show the drift potential from the red 'Polijet' compared to the D8-45, is reduced nearly five fold to less than 4% ofthe emitted spray volume.

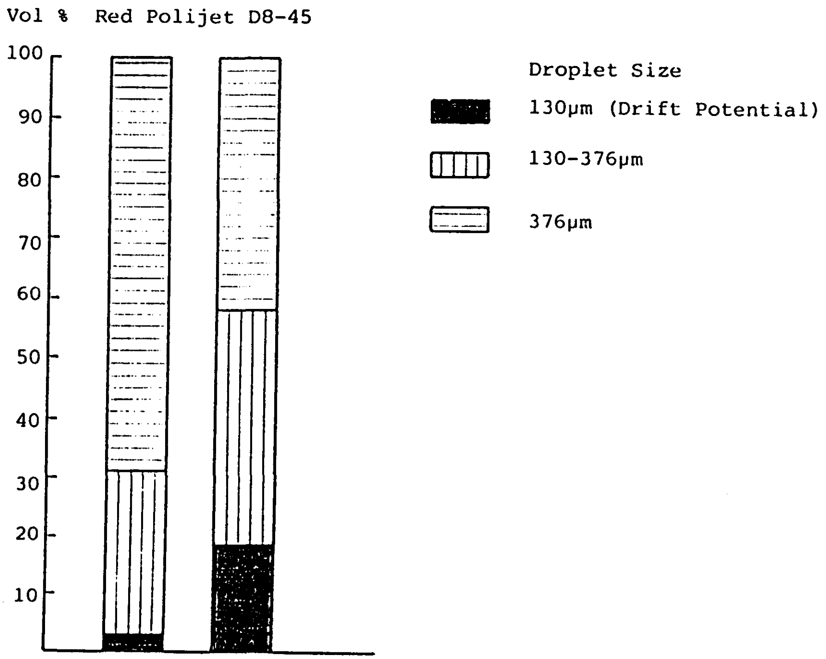

Figure 1 Droplet size distribution of Polijet compared to D8-46

Polijet is a trade name of ICI Agrochemicals, England

Field Evaluation

Tests were carried out on two types of helicopter in Hungary, the Kamov Ka-26 and MD-500 E. In Poland a Mi-2 helicopter was used.

Ground deposition studies on filter paper can be summarised as follows:

Hungary KA-26: Compared to the D8-45 nozzle the red 'Polijet' reduced the percentage of driftable droplets (<130um) from 8 to 2%, medium droplets (130-376 µm) from 33 to 20% and large droplets (˙376 µm) increased from 59-73%.

MD-300 E No significant difference in deposits could be detected between the two types of nozzles (D8-45/red 'Polijet'). The reason for this is believed to be a combination of boom position and high operating speed, but this needs to be confirmed.

A total area of 26,087 hectares was desiccated with helicopters equipped with Red 'Polijets' and no incidents of spray drift were reported.

Poland M1-2 Only a limited test was undertaken with red 'Polijets' and, although deposition studies were made, no precise droplet data is available at present. However, reports from field staff were very favourable towards 'Polijets' and further evaluation is planned in 1988.

Fixed Wing Operation

Nozzle Concept

Tests were initially carried out with increased throughput red 'Polijets' (6 l/min @ 2 bar pressure). Although the droplet size distributions were comparable to hollow cone and flat fan nozzles, because of the higher windshear 40 m/s^{-1} there was no positive reduction in driftable droplets. Therefore a new design was evaluated and the layout is shown in figure 2. This prototype nozzle is constructed from brass and consists of a spray chamber partially shrouded with a sleeve, the purpose of which is to reduce the emitted spray angle and hence the effects of high speed airshear on the production of droplets. An extended stem is used to minimise airflow disturbances on the spray.

Windtunnel data from this prototype nozzle is shown in Figure 3 and a comparison is made with D8-46 and 8020 nozzles. Measurements of droplet size distribution were taken at three discharge angles 0^o, 45^o and 90^o relative to airflow. At 0^o the percentage of spray (<130 µm) is similar, though the prototype out-performs the cone and fan. Changing the discharge angle to 45^o and 90^o gives a marked increase in driftable droplets from the D8-46 and 8020, compared to the prototype .

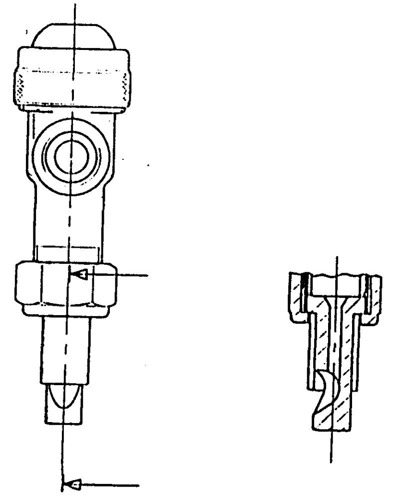

Figure 2 Prototype Nozzle Configuration

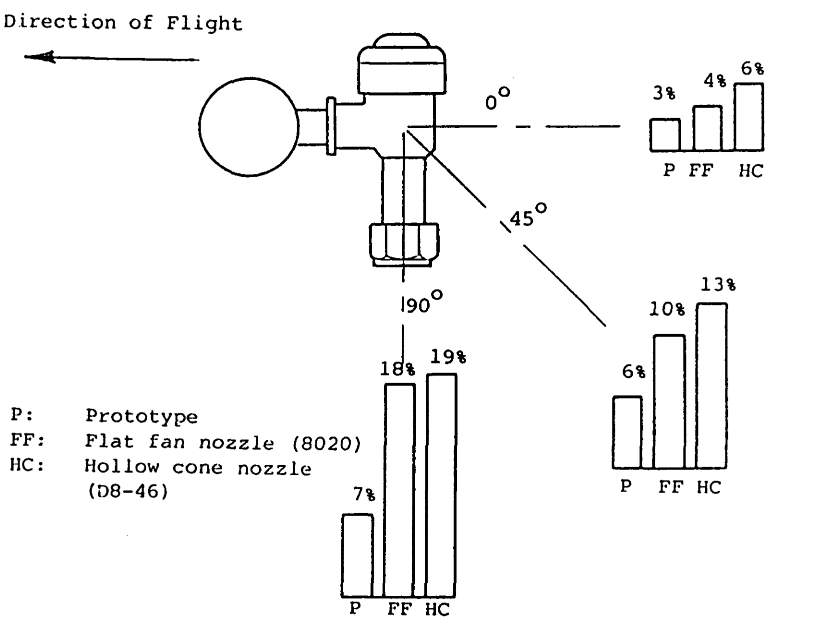

Figure 3 Percentage of spray volume in droplets 130μm for three different discharge angles.

Field Evaluation

Prototype nozzles were fitted to Antonov AN-2 aircraft in Hungary and Poland. Results from deposition measurements showed positive benefits in favour of the new design from both countries.

In Hungary tests showed a reduction in small droplets from 15-3%, medium droplet deposits 52-30% while large droplets increased from 33-78%. 3730 hectares were desiccated with prototype nozzles with no reported incidents of spray drift damage.

Polish results were equally favourable with a visible reduction in spray vortex effect from the aircraft wingtips. Spray drift measurements, with dyed water were conducted up to 50 metres either side of the spray centre, and no detectable levels of drift were seen outside these distances. 40 hectares of field beans were also desiccated with 'Reglone' and after three days the effect was assessed. Unsprayed green areas 3 to 4 metres wide were noted between adjacent spray swaths indicating clearly a sharp cut off.

DISCUSSION AND CONCLUSIONS

Both the red 'Polijet' and prototype nozzles performed as expected under field conditions and reduced the drift potential compared to those nozzles currently recommended for'Reglone' desiccation. In the case of helicopter operations only the MD-500 E responded unfavourably. Further tests are planned to establish the reasons for this. In addition a helicopter version of the fixed wing prototype nozzle is currently being evaluated and this may be more applicable to helicopters such as the MD-500 E. Recommendations for drift limitation with these nozzles will be made available when evaluations are complete.

ACKNOWLEDGEMENTS

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