SOME CHARACTERISTICS OF LOW VOLUME NOZZLES

C. J. CROSBIE, *Department of Agriculture, Christchurch.*

From a visual examination with the naked eye, it was evident that some low volume nozzles were spraying heavier amounts of liquid on the outer edges of their fans than was being sprayed in the centre of the fans. Some doubt was felt of the ability of these nozzles to spray evenly across their width and their ability to lay a given amount of weedicide evenly over a given area. This latter aspect was especially important in trial work on semi-susceptible crops such as peas when different rates of application varying by small amounts were under investigation. Accordingly, it was decided that there be carried out an investigation of the characteristics of the low volume nozzles being used to apply weedicides. The investigation was carried out with machinery built along the lines of that developed by Shanks and Pattersen, of the University of Manitoba.

The machine for obtaining delivery rates and spray patterns was built according to the above workers' recommendations and consists essentially of two gear pumps supplying liquid at the desired pressure to one or more nozzles mounted above a set of rails on which a trolley mounted on wheels could be caused to pass under the nozzles when they were spraying. A set of tanks under the pumps enabled water to be used for delivery tests and ink to be used for the spray patterns which were collected on sheets of paper placed on top of the trolley.

After some experimental work, it was found that a solution of 1lb. of M.C.P. in 10 gallons of water could be coloured with a concentrate of carbon black and a wetting agent ground into suspension in water. The specific gravity of the resulting black spray solution did not differ greatly from that of the original solution of weedicide.

The machine for determining the variations in delivery rate across the width of one or more nozzles followed the recommendations of Borger and others at the Iowa State Agricultural Engineering Department, except that instead of using corrugated aluminium to form channels on the bed of the machine, vertical lead fences with knife edge tops were erected at 2in. centres across the bed of the unit and in this way a spray droplet fell directly into one or other of the channels. The run off of each channel was collected in measuring cylinders.

A stroboscope was used to obtain photos of the different nozzles when they were spraying and in the resulting photos the individual spray particles could be clearly seen in the fan or cone of the nozzle.

Variations Due to Pressure

Work by overseas workers indicated that with increase in pressure the delivery rate of a nozzle increased and that the included angle of the fan of spray particles increased. It has also been noted that with increase in pressure, there is an increase in the number of small spray particles so that there is increased risk of wind drift and damage to nearby susceptible crops.

To overcome these variations all the following work was done at a pressure of 30 p.s.i.

Nozzle Delivery Rates

Sixty-four fan type nozzles of one make were tested for delivery rate. Batches of 12 to 15 of the sizes 25, 32, 39, 46 and 59 were tested and with the exception of 4 which differed too widely from the mean, all conformed to the limits of plus or minus 5 per cent. of the mean for the batch. Batch means however, differed by as much as 15 per cent. from their rated

deliveries as published by the manufacturers illustrating that at the best, the published delivery rate for this make of nozzle serves only as a guide to the nozzle's output. All nozzles should be checked for delivery rate before calibrating a low volume sprayer.

Twelve fan type nozzles of another make were tested for delivery rate and when 2 widely varying nozzles were removed, the remainder conformed to plus 11.3 per cent. or minus 8.1 per cent. from the batch mean. When the limits of plus or minus 5 per cent. were imposed, only 2 nozzles remained within the limits. The test indicated that nozzles of this make were extremely variable within the batch. Spray patterns of these nozzles supported this view.

—Standish & Preece Ltd.

The top half of the illustration shows a typical distribution graph of a fan nozzle. The bottom half illustrates the spray pattern. Note the greater nozzle delivery in the two outer edges and in the central zone.

—Standish & Preece Ltd.

The top half of the illustration is a distribution graph of a typical solid cone nozzle. The bottom half is the spray pattern. Such nozzles are characterised by a high central delivery.

Spray Patterns

Spray patterns were made of fan type nozzles of 3 different makes and of hollow cone and solid cone type nozzles. Visual examination of the charts of the fan type nozzles showed that they varied first in width and secondly in evenness of spray across their width. Most fan patterns were characterised by 1, 2 or 3 heavy bands across the width of the fan.

The patterns of the hollow cone nozzles were very even across their width when examined visually and were superior to the others examined.

The solid cone patterns were characterised by a heavy build up of spray material in the centre of pattern.

Distribution Graphs

When a nozzle was tested on the second machine, a measurement could be made of the evenness of delivery across the width of the nozzle. When these measurements were plotted across the width of the nozzle, a graph was obtained that was characteristic of the nozzle and the graph could be correlated with the spray pattern of the nozzle.

The distribution graphs of the fan type nozzles fell into one of 3 main types depending on whether it had 2, 1 and a portion or only 1 apex and

—Standish & Preece Ltd.

The distribution graph (top half of illustration) and spray pattern (bottom half) of a hollow cone nozzle. These nozzles give a more even distribution than either solid cone or fan type nozzle.

a raised centre portion. The raised centre portion could be missing in some of the graphs. There were corresponding low spots between the raised portions.

Measurement of a graph showing 2 apices, 2 low spots and a raised centre showed that at the apices the spraying rate was 39 per cent. above the mean for the nozzle.

Measurement of another showing only 1 apex and a raised centre showed the apex to be 86 per cent. above the mean and the raised centre 29 per cent. above the mean. In a graph showing 1 and a portion apices, the corresponding figures were 66 per cent. and 44 per cent. with the smaller apex almost on the mean.

Distribution graphs of hollow cone nozzles were wider and flatter than the fan nozzle graphs. In one, the 2 broad apices were 21 per cent. above the mean spraying rate for the nozzle.

The distribution graph of a solid cone nozzle showed one central high apex that was 170 per cent. above the mean.

Nozzle Wear

A batch of nozzles from a low volume sprayer that had sprayed approximately 1000 acres of pasture and crop last season was tested for delivery, spray pattern and distribution across the width.

The mean delivery rate for 6 of the worn nozzles was 25 per cent. above the mean of 3 new nozzles of the same size and 16.2 per cent. above their original output as published by their manufacturers.

The spray patterns of the worn nozzles showed the heavy bands—(one or more)—characteristic of a fan nozzle. Their distribution charts when compared with similarly shaped graphs from new nozzles revealed that the included angle of the fans had increased so that they were now spraying wider than before. The graph had “flattened out” so that the apices were broader and lower and the irregularities between the apices had flattened out.

However, in that the original data for these particular nozzles was unknown, three new nozzles were tested and then mounted on a boom and run continuously for 20 hours a day and tested each day. After nine days—or the equivalent of approximately 1000 acres sprayed at 4 m.p.h.—one nozzle had decreased in output by 1 per cent., another had increased by 3 per cent. and the other had not altered. The spray patterns for each nozzle remained substantially the same, but the distribution graphs had tended to flatten out. Thus very little wear was experienced after 1000 acres of spraying with water even though it contained at times a high contamination of brass filings from a worn pump—so much so that the water was changed 3 times during the test.

It is known that the sprayer mounting the original worn nozzles was filled with water from drains, water races, etc., and in spite of careful filtering, it is felt that their excessive wear was due in part at least to fine silt in suspension in the water.

All operators of field sprayers should check the nozzles for delivery rate after each 200 acres sprayed and make the necessary adjustments to the formulation of the spraying mix if wear has occurred.

Summary

1. The published data for low volume nozzle discharge should serve as a guide only, and all nozzles should be checked before a sprayer is calibrated.
2. Fan type low volume nozzles are variable in discharge, so that all should be checked and those over plus or minus 5 per cent. from the mean should be replaced.
3. Fan nozzles are very variable in distribution across their width.
4. Hollow cone nozzles appear to be more even across their width than other types of nozzles tested and may have a place for boom work with field sprayers.
5. Solid cone nozzles are too uneven for boom spraying.
6. Unless absolutely clean water is used, nozzles will wear with use and this should be checked regularly.
7. Increase in pressure results in increased discharge, increased included angle of fan and a decrease in droplet size.

DISCUSSION

Q. What is effected most in nozzle wear—the distortion of the spray pattern or increase in nozzle discharge?

A. The bulk of the nozzle wear undoubtedly comes in nozzle discharge. Check for wear should be done regularly.

Q. Do specific nozzles have working pressures which suit their pattern best?

A. All my patterns run to one pressure of 30lb. p.s.i., and I have not considered patterns at different pressures.

Q. I would like to see the incorporation of a better type of metal—better than brass from the point of view of wear.

A. There are nozzles available with stainless steel insets. I do not know how readily available they are.

Q. Would jets set at 14in. spacing instead of 18in. spacing, so as to give complete double overlap of spray, help to even out highs and lows in the patterns?

A. Yes. Undoubtedly double application or double overlap does tend to even out variations by action of the spray coming in from adjoining nozzle. There is some hesitation to double overlap because to obtain that your boom is higher than for a single application, and thus more subject to wind drift.

Q. Have you any information on the following points? (a) Does the quality of the water affect corrosion of the apparatus. (b) Does the quality of the water, whether hard or soft, affect the result of the spraying?

A. That question is outside my range. It could be better answered by some of the chemists in the audience.

Q. There is some variation in the new nozzles. Would it not be desirable that all nozzles be tested by manufacturers before they are sold?

A. I understand that one of the manufacturers in New Zealand does test all his nozzles before they go out for field use. They are tested for output.

Q. Do firms use sequestering agents?

A. Mr. Baigent: To put out a complete range of weed killer with sequestering agent would increase the overall cost. We advise certain districts that sequestering agents are likely to be needed in that area and hormones can be supplied with such sequestering agents included at slight additional cost.

Q. Do you tend to find any difference between the effect of water on an oil base chemical as distinct from a water base?

A. Mr. Baigent: Amine salts of 2,4-D can be precipitated by extremely hard water and in such areas it is recommended that sequestering agents be used with amine formulations. A wetting agent can be used to overcome the difficulty.