LOW - VOLUME NOZZLES.

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Were it not for the development of delicately-precise low-volume nozzles, hormone type weedkillers would have doubtful virtue over older chemical treatment methods. There are still a few "doubting Thomases" who deny anyway that there is any particular virtue in these new chemicals. However, a few facts from North America will suffice to convince all but the most incorrigible, or the fanatic disbelievers. Quoting from the 1948 Proceedings of the North Central Weed Control Conference and referring to North Dakota alone:

"Of the 1½ million acres treated with 2,4-D in 1948, ground spray accounted for 66%, ground dusting 7%, airplane spray 21%, and airplane dusting 5%. In equipment for applying 2,4-D the big increase this season was privately-owned ground spray rigs, with over 8,000 privately-owned ground sprayers in operation in 1948, as compared with 240 in 1947. Other equipment used this season, privately-owned, included 69 ground dusters, 45 airplane sprayers and 4 airplane dusters. Custom rigs in operation in the State this year included 168 ground sprayers, 21 ground dusters, 86 airplane sprayers and 17 airplane dusters."

The primary function of a nozzle is to deliver a uniform coverage with minimum fogging on a plane area when working at a constant pressure and travelling at a constant speed. To this end, where multiple nozzles are used, each nozzle of a specified size or output must rate exactly as the others over the whole range of working pressures. This is where some years of painstaking research and the evolution of expensive machinery have at last attained a measure of perfection.

The first efforts were directed at the solid and the hollow cone. It is obvious that in translatory motion neither of these jet shapes can give uniform coverage. The solid cone, in travelling, concentrates too much spray-mix in the central area, the hollow cone too much towards the outer edges. This led naturally to the more difficult manufacturing proposition, viz., the fan-shaped jet.

Three methods are adopted in the production of the fan type jet.

1. Two impinging circular jets as in the fish-tail gas burners.
2. A circular jet deflected from a dead-smooth inclined surface.
3. Partial penetration into a V-cut by a conical hole into the sharp angle of the V from the rear.

No. 1 is the principle of the Bray gas jet. The fine orifices are too easily blocked and difficult to clean. The "spread" is too uneven.

No. 2 is adopted by the Kromer Co. in U.S.A. and is not unsatisfactory.

No. 3 is the method most favoured by the bigger nozzle manufacturers in the U.S.A. Earlier efforts were partially frustrated by a thick edge to the jet from the lemniscate orifice, but the bigger firms have now overcome this problem to a greater or lesser extent. The disadvantages of some of the products are:

(a) the feather edge of the orifice. This results in wear and alteration of capacity after a period of use.

(b) a multiplicity of parts to the nozzle, leading to possible losses in the field when clearing blockages, etc.

The Monarch Engineering Co., claim that their orifice is a thickened-edge product 12 times that of the edges of other brands. They have evolved a large capacity cage-type strainer and a patent insert that eliminates the thickened edge of the jets. There is one feature invaluable and unique, viz., the one nozzle housing (body and cap) will accommodate any one of a whole range of interchangeable tips (low-volume fan, hollow cone, solid cone, high-volume fan). It is this nozzle that finds widespread use in New Zealand, as tips alone may be imported and the housings manufactured locally, thereby eking out dollars.

For those interested, we can supply a list of the range of these Monarch interchangeable tips, which run from as low as 0.84 gallons per hour output up to as high as 300 gallons per hour. To relate nozzle size, speed of travel and coverage in gallons per acre, we have devised a simple handy graph.

We have spent several hundreds of pounds trying to duplicate in New Zealand some of the U.S.A. tips, but without coming within sight of success. A pointer to the difficulty of the task is a report that some of the biggest U.S.A. manufacturers reject over 80% of these low-volume tips and one firm scrapped three month's output, i.e. 100,000 tips on one occasion, rather than market less than the best. Even so, tests show that absolute perfection of jets is yet some little distance away.

One may well ask why perfection is required. The reason is that margins of safety are small. A crop or pasture may be just tolerant of a certain limited strength of a weedkiller. To ensure control of a variety of weeds, it is necessary to apply as high a concentration of weedkiller as the crop or pasture will stand. A 10% variation up or down in the rate of coverage can skirt too closely to crop damage or to reduced weed control.

Any jet irregularities can be partially ironed out by spacing the nozzles or adjusting boom height so that double coverage is obtained. In passing, it should be noted that a spray machine using a diaphragm pump or a reciprocating pump, even if fitted with a cushioning air chamber, can, by its pulsations, induce irregularities comparable with the above.

Nozzle Testing. Two systems are used:

- (a) Qualitative (b) Quantitative

In (a) the nozzle is mounted, say, 3' above the bench. A flat-top trolley carrying a large sheet of white poster paper is drawn below the jet at a controlled speed and the spray pattern pictured on the paper by dyed fluid emitted by the nozzle. Varying density of the spray pattern indicated the relative variations in coverage by the nozzle. Alternatively, the nozzle can travel over the stationary paper.

In (b) a droplet count can be made from the spray pattern, but a better method is to mount two 4' lengths of corrugated aluminium lapped below the nozzle and set on a slight incline. A collecting or measuring vessel traps the flow from each valley in the sheets. By plotting the flows from each corrugation, a graph of the variation of density of coverage along the axis of the jet is

obtainable.

The effect of height can, incidentally, be obtained by operating fan nozzles horizontally instead of vertically. In fact, Spray Engineering Co. offer a fan-type nozzle that in this fashion reaches a spread of 10' when operating only 20" above ground level.

There are three methods of mounting nozzles on the spray boom so as to reduce loss of spray mixture after shutting off. (N.B. It is not wise to attempt to screw a nozzle directly into a boom. The wall thickness of tubing is not sufficient to give enough threads to prevent leakage).

- (1) Insert the nozzle holder well up into the boom tube.
- (2) Use an inverted U to draw off from the top of the boom.

These two methods trap any loose scale or grit in the boom but limit drip only partially. They are of little effect on sloping ground.

- (3) The best safeguard is to use a ball check valve in combination with (1).

This useful adjunct will shortly be produced in New Zealand. It is inserted above the nozzle and comprises a spring-loaded valve that automatically closes when the fluid pressure drops to 10 p.s.i. Its use is essential for airplane spraying to prevent spray falling on sensitive crops, etc., when the plane is manoeuvring between working runs.

GENERAL

THE LOW-VOLUME FAN TIP is generally to be preferred for weed control.

THE LOW-VOLUME HOLLOW CONE TIP is preferred on hand wands by many users. These tips are best for insecticidal and fungicidal spraying as, for the same rate of output, greater atomisation is gained than with the fan.

THE SOLID CONE TIP is useful for spot spraying, applying blossom-thinning, fruit-setting or pre-harvest drop hormone sprays to fruit trees, for insecticidal spraying, and for applying oil sprays.

THE HIGH GALLONAGE TIP is useful for all purposes requiring the application of larger volumes of liquid.

The first three groups will serve for colloidal applications of sulphur and DDT if the nozzle strainer is removed, but are not recommended where gritty matter is in suspension. The High Gallonage Tips will serve all normal requirements.

Always check nozzle output with the pressure-gauge readings on your machine and do not rely on makers' rated capacities. Rated capacities are based on water spraying. The output with oils, for instance, will be different. Again, all pressure gauges are not always accurate. Re-check output occasionally, according to severity of use. In time, wear on nozzle tips will increase output.

The orifice of these tips has a delicate edge, so do not use a needle to free blockages. A toothpick or toothbrush is suggested.

Before operating a new machine in the field with hormone sprays, run the liquid through the system for, say, half an hour, collecting the spray in containers under each nozzle. This will free any dirt, grit, filings, etc., that may be in the system, and eliminate stoppages in the field itself.

Clean tips after each day's use by boiling for half an hour in "Basol 88", obtainable from most dairy supply companies. Dust and oil can build up around the orifice and deform the shape of the jet.

Never lay the boom on the ground. Store in a clean place.

Remove the cap tip and strainer from the nozzles in the spray boom if travelling far (in case they work loose), and cover the nozzle body to prevent entry of dust into the boom.

For those few who may be interested, it is worth noting that the Monarch Special Non-Clog Cone Nozzle is stocked in New Zealand now. It is so called because any impurities small enough to pass the orifice of this nozzle will never clog back or foul the hole. It is ideal with the ball check valve for aeroplane work.

Another item now made in New Zealand is a swivel adapter nozzle for spraying row crops with DDT, etc., under and over the foliage at the same time.

For users having a "Holland" or "Dragon" knapsack there are available special nozzle housings with all the interchangeable tip features, and designed for direct fitment to the wands of these sprayers.

It has been found that humidity and plant and ground moisture, as well as plant physiology, play a part in determining the effectiveness of hormone sprays. This accounts for a large proportion of the failures on some occasions when applying spray mix at 2½ to 5 gallons per acre. The other prime factor is time of day. A.M. operations will generally be good, P.M. less so, particularly towards evening. Hence, the recommendation for the general user now is to spray at not less than 8 gallons per acre.

Some recommended tip sizes for various purposes are given below. Expert operators know under what conditions the following liquid rates can safely be reduced:

<u>Crop and Pasture Weeds:</u>	spray at 8 gals. per acre, with Monarch No. 32 fan tip.
<u>Ragwort:</u>	not less than 20 gals. per acre with Monarch No. 46 fan tip.
<u>Dimitro Products:</u>	not less than 30 gals. per acre with Monarch No. 59 fan tip.
<u>Gorse:</u>	with water 80 gals. per acre with Monarch No. 67 fan tip.
<u>Gorse:</u>	with dieselene 30 gals. per acre with Monarch No. 59 fan tip.
<u>Blackberry:</u>	diesel- with ene 30 gals. per acre. with Monarch No. 59 fan tip.
<u>Blackberry:</u>	with water 80 gals. per acre. with Monarch No. 67 fan tip.

Trace element (e.g., cobalt) as low as 1 gal. per acre.
with Monarch 2.0 Cone tip.

Liquid insecticides and fungicides:

at or above 3 gal. per acre,
with Monarch 6.4 Cone Tip.

For blackberry work it is more important to spray all the stems rather than the leaves. To facilitate this a special blackberry spear has been developed. A triple nozzle head sprays a 180° fan highly atomised and of 3' radius. It is hoped that working at 60 or more pounds per sq. in. pressure, less liquid and less concentrate will give equally good control.

GENERAL DISCUSSION.

Q. - On most days there is some sort of wind blowing. If the boom is high, the right amounts might not reach the ground?

Mr. Brodie - Mr. Williams has a twelve-foot straight boom which does not allow latitude in height of the tips of the boom. One contractor uses cords to regulate the rise and fall of the tips of the boom, and so keeps the tips to eighteen inches above the ground. Where the ground is trouble-some, one can have a long boom in front of the tractor. A height of three feet three inches is a great deal. Mr. Williams picked favourable times to work. In windy weather one could undertake only less-delicate operations, and it would not be safe to operate on maize, which is touchy. To aim at a perfect nozzle one would have to work under favourable conditions. If a farmer is interested in pasture work and there is no red clover, he can have some tolerance.

Mr. J. W. Woodcock - Are all nozzles standardised?

A. - Each manufacturer has his own system, with the majority stocking the thousandth-of-an-inch measurement.

Mr. C. J. Crosbie - It is the rear wheels of a tractor, and not the width of the front wheels, which influences the whip of the boom. If the front wheels are close together, rough country gives a lowering of the boom and no whip. When the boom is in the front the rear wheels, if dry, tend to pick up the spray from the front. If the rear wheels are wet they drop as much spray as they pick up.