NEW CONCEPTS OF SPRAY MACHINERY

By P. M. BEDDEK, Frank M. Winstone (Merchants) Ltd.,
Auckland

SUMMARY

SOME more recent introductions and developments in the spray machinery field are outlined. The author has touched briefly on a new type of automatic spot spraying boom which relies on mechanical selectivity rather than chemical selectivity together with some details of motorised knapsack sprayers and invert emulsion application equipment and problems faced with this new form of herbicide.

A report is also given of wear tests comparing nylon spray nozzles with brass and aluminium, showing the superiority of nylon, especially where erosive chemicals such as wettable powders are used.

The word concept has several meanings. One dictionary quotes "A general notion or idea comprising all the attributes common to a class", while according to another it is "Idea of the attributes common to a class of things".

After studying both sources I am not much wiser as to the exact meaning, but as I intended it to mean "Newer Types of Spray Machinery", then that is my concept of it.

It is an acknowledged fact that in most cases where poor weed control is reported we have been inclined to blame the chemical, inferring that it was a faulty formulation, the wrong choice of type, or the incorrect timing of application.

We are fortunate in being able to take the chemical for granted in most cases. It can be relied on to do the job for which the manufacturer intended it, provided certain basic principles are followed and that it is applied according to directions. Where poor results are obtained invariably poor application techniques have been followed.

AUTOMATIC SPOT SPRAYING BOOM

Up to now weed control chemicals have been taken for granted to give us selectivity whether it be spraying crop or pasture. We have relied on a minimum dosage rate to give us good weed control on the one hand and crop or pasture protection on the other. The latter consideration of crop or pasture protection has mostly been the main theme because, with wrong choice of weedkiller or incorrect application, good weed control has resulted, but also a good kill of valuable clovers or damage to crops can result.

The mechanically selective boom rig has merit in a number of applications. It makes possible the control of weeds growing in a pasture that would not otherwise have been possible; for example, a weed that can be controlled with only high rates of 2,4-D, these rates being sufficient to kill or severely damage valuable pasture species.

Its object is to achieve greater selectivity of weed control in pastures and some crops and to make use in some cases of non-selective weedkillers in a selective manner. Some examples of weed growth best suited for its application are rushes (*Juncus* spp.), thistles, docks (*Rumex* sp.), ragwort (*Senecio jacobaea*), and seedling gorse (*Ulex europaeus*), etc., though there are many others.

Basically it consists of a straight boom section of any reasonable length, though usually shorter than a conventional straight boom. The most popular size is of 7 ft 6 in. in length. On the boom itself are 6 spray heads with fan type nozzles spaced 14 in. apart. Each head has as well as the nozzle a feeler or trip spring, a pressure adjusting screw with two valve springs—one heavy gauge and one light gauge—giving a range of pressure,

that is spring pressures from 1½ oz to 14 lb variable adjustment according to the type of weed growth to be sprayed.

The distance from the nozzle orifice to the end of the trip or feeler spring is 16½ in., this distance being suitable for most weed growth likely to be encountered. A boom mounting is provided to give variable height adjustments for different size of weed growth so that the boom can be raised or lowered, depending on the individual application. The rake of the boom and the individual feeler springs can be altered also. The further forward the angle the sooner the nozzle sprays and conversely the sooner it stops spraying.

In operation as the tractor is driven over the pasture the feeler spring contacts the undesirable weed growth and this contact pushes back the spring opening up a valve and thereby spraying. As soon as the weed is passed the feeler wire springs back into place and the nozzle outlet is closed off. One, some, or all of the feeler wires can contact weed growth and work independently of each other.

Various sizes and types of spray nozzles have been employed experimentally with the boom until the fan type nozzle was adopted as standard. Cone types, both hollow and solid, were satisfactory, though the fan type proved slightly superior in that it sprayed less pasture.

Nozzles used and their nearest equivalents are:

Delavan 9.5, spray angle 73 degrees, output .633 Imperial gallons per minute.

Monarch .67, spray angle 70 degrees, output .66 Imperial gallons per minute.

Spraying Systems Teejet 730616, spray angle 73 degrees, output .625 Imperial gallons per minute.

Much developmental work has been carried out on this device from its invention to perfection and already it is being adopted by many overseas countries. Results to date have been most encouraging and it gives food for thought as a new approach to pasture spraying in particular. It is not claimed to be the complete answer nor is it claimed to take the place of the conventional boom but rather is complementary to it.

We are all aware that pasture weeds should be sprayed when young seedlings and this is undoubtedly the best time of application. Often however the farmer, for a variety of reasons, does not get round to spraying until the weeds are semi-mature or mature in which case this device definitely has a place.

Application Equipment for Invert Emulsion Forms of Weedkillers

The drift problem of weedkillers has been a perennial one for many years both from ground spray rigs and also by aircraft application. Much has been written on this drift problem and many suggestions given for an overall reduction. Invert emulsions may be a possible answer to this drift problem.

Some advantages claimed for invert emulsions are:

1. Low evaporation of the oil covered spray.
2. Good spreading and contact between oil and plant surface.
3. Leaves coarser atomisation of the spray material with relatively few numbers of small spray particles.
4. The thick white emulsion is an excellent marker.

Uses for Invert Emulsion of Herbicides

Aerial spraying of pastures and scrub weeds is probably one of the main uses for these inverts.

Numerous trials have taken place both in this country and mostly in the U.S.A. on types of equipment suitable for the application of invert forms of herbicides.

In tests conducted at a pressure of 100 lb p.s.i. with a nylon roller pump through a ¾ in. spray line it was determined that the maximum hose or pipe length through which it can be satisfactorily pumped was 50 ft.

It is an advantage to use a spray gun with a large orifice disc; size No. 10 to No. 12 spray tips would be suitable. The pressure indicated of 100 lb is

not necessarily the maximum that can be employed, but 200 lb would seem to be about the upper limit. Gear and roller pumps were more satisfactory than centrifugal types.

At this stage, however, the use of inverts would seem to be by aerial application rather than ground application. Many trials have been carried out overseas from aeroplane and helicopter rigs and invert emulsions are used commercially.

Recently a new type of spray nozzle for the application of these materials has been designed and tested and is proving most satisfactory. At this stage patent application and other considerations do not allow a full description of this nozzle, but a description of the principle of application is given.

Instead of mixing the invert emulsion, the oil, and the water before application the technique adopted with this new nozzle is that the oil and the invert are pre-mixed, but the water is not added at the spray tank but at the point of delivery; that is, at the nozzle itself. In operation, whether by helicopter, aeroplane, or tractor, the spray rig carries two tanks each with a feed line to the nozzle where the components are intimately mixed and an invert emulsion formed. The nozzle ejects the emulsion in uniform 80 micron droplets. For the purpose of comparison this is about double the size of droplets formed in the usual herbicide spray from a helicopter. The big factor of these large droplet sizes is that it adds materially to the drift resistance and is therefore safer to use than standard emulsions.

WEAR TESTS ON SPRAY NOZZLES

There is a large range of spray nozzles available: flat fan, hollow cone, solid cone, even spray, boom extension, broadcast spray, and others. Most of these types are available in various capacities, spray angles, etc., and each is designed with a special purpose in mind.

Brass has been the most commonly used material and has performed satisfactorily. Brass nozzles are not very satisfactory for use with wettable powders, particularly when sprayed at higher pressures. Tips made of materials other than brass, such as aluminium, stainless steel, hardened stainless steel, tungsten carbide, and others may be preferable. While some of these materials will undoubtedly give longer life, they are more expensive and in some cases the cost is economically not warranted.

For these reasons the spray equipment manufacturer has looked for other materials such as Delrin, Nylon, Zytel, and other synthetics. Nylon particularly has given good results. This material has proved most satisfactory for the application of all types of herbicides, whether they be emulsions, solutions, or wettable powders. Compared with brass or aluminium, nylon definitely gives better wear characteristics and the following are results obtained comparing these three materials at recently run tests.

Originally erosion tests were conducted using JD4 fuel containing 0.72 grams of 20 to 40 micron silica sand per gallon. These data were taken from tests conducted at a constant pressure of 160 lb p.s.i. and at a constant flow rate. Nozzle wear expressed as "Percent Flow Increase" in relation to brass, was reported for a four-hour operating period. The flow increase for each material was expressed as a percentage of that which occurred for brass. The average results indicate that nylon was more durable than brass or aluminium.

Further evaluation of these materials was recently made in tests with an abrasive Kaolin clay. Fifteen per cent of clay in water was sprayed through fan type tips at an operating pressure of 160 lb p.s.i. These tests are summarised and abbreviated to give comparisons. There is some inconsistency; however after many tests the average result may be summarised as follows:

Nozzle material	Flow increase per centage of brass
Nylon	86
Aluminium	94

Nylon appears slightly superior to any other materials. As might be expected the flow increase is somewhat smaller for the high capacity tips.

The data accumulated and summarised are abbreviated and condensed, but it does, however, substantiate the claim that nylon is superior to either brass or aluminium.

WEAR DATA FOR AGRICULTURAL FAN TYPE NOZZLES
(15 per cent kaolin clay in water)

Nozzle type	Flow rate at 40 lb p.s.i.	Condition	Time	Flow increase at 40 lb p.s.i.	Per centage flow increase compared to brass
Fan 65 degree					
Spray angle	.057				
Brass		160 lb p.s.i.	1 hr.	13.7 per cent	100 per cent
Alum.		160	1	16.2	118
Nylon		160	1	6.2	45
Fan 80 degree					
Spray angle	.057				
Brass		160	1	13.0	100
Alum.		160	1	13.0	100
Nylon		160	1	11.7	90
Fan 73 degree					
Spray angle	.066				
Brass		160	1	14.7	100
Alum.		160	1	14.8	101
Nylon		160	1	13.8	94
Fan 73 degree					
Spray angle	.135				
Brass		160	1	12.1	100
Alum.		160	1	5.8	48
Nylon		160	1	1.9	16

MOTORISED KNAPSACK SPRAYERS

While these machines are not exactly new to the New Zealand market, they are relatively new for the purpose of weed control.

The term "Motorised Knapsack Sprayer" is used generally in discussing portable misting machines, shoulder mounted power sprayers, and duster mist blowers. There are at least 12 different brands available and basically these machines consist of a 2-stroke motor, ranging from 1.8 to 5 h.p., depending on the make of sprayer, either direct coupled to a blower or fan or in some cases by belt drive. The liquid supply tank in most machines has a capacity of 2 to 2½ gallons. They are light in weight, ranging from 27 to 38 lb.

They are described as concentrate sprayers. Concentrate application has the following necessary characteristics:

1. Low volume under 12 gallons per acre or per unit area.
2. Chemical concentrations many times that of any conventional spray mixtures of the same basic chemical.
3. Much finer atomisation or droplet size compared with ordinary or conventional sprays.

The size of droplets is usually referred to in microns, a micron being 1000th of a millimetre or 1/25,000th of an inch. These sprayers deliver droplets of from 20 to 160 microns with an average of 50 to 60 microns. The term "mass median diameter" is frequently used when referring to droplet sizes and it means that it is the droplet diameter with half the spray volume of drops larger and half of drops smaller.

A droplet with a radius of 50 microns is 8 times larger in volume than one with a diameter of 50 microns. A misting machine giving droplets of

50 microns in size would deposit 9,224 to a square inch whereas a droplet of 300 microns would deposit only 43 droplets to a square inch.

Air is used as the principal carrier of the spray, hydraulic pressure not being an important factor. The air output of these machines varies from 140 cubic feet to 430 cubic feet per minute and the speed of the air at the output nozzle from 140 to 287 miles per hour.

They are equipped with interchangeable nozzles, giving outputs ranging from $\frac{1}{4}$ to 6 pints per minute merely by changing the jet size or by selecting a certain position of the output control tap. Most types available can also be used for dusting merely by changing to a special dust tank or hopper.

These machines have been successfully used for work in areas not accessible by vehicles such as weed control in drains, forest breaks, hilly country, waste areas, patches of gorse, blackberry (*Rubus* spp.), thistles, etc., and for any other application where drift problems are not likely.

Work is also proceeding on adaptations to these machines for the application of inverts.

CONCLUSION

This paper is not technical, but gives an insight into some more recent developments in application equipment. Spray pumps, nozzles, boom rigs, and other equipment all continually being improved and new types introduced, and the spray equipment manufacturer is endeavouring to match the chemical manufacturer in producing new and better equipment.