APPLICATION PROBLEMS

Chairman: Mr. N. F. Pine

DEVELOPMENTS IN THE DESIGN OF GROUND CROP SPRAYING EQUIPMENT DURING THE LAST TWO YEARS.

H. R. Herridge, E. Allman & Co. Ltd.

Greater efficiency with economy is, and always has been, the demand of the agricultural and horticultural grower throughout the world. The introduction of low volume spraying was a step towards meeting this demand but the early low volume sprayers left much to be desired.

During the previous Weed Control Conferences papers have been read by a number of eminent speakers on the subject of ground crop spraying machines. If you were in attendance, or if you have since read these papers, you will realise that this subject covers a very wide field and that improvements are continually being made to the sprayer tanks - either in their shape or in the materials from which they are made or coated with, control systems, spray booms, spray nozzles, pumps, methods of attaching the machines to the tractor, types of hose and other fittings, all of which together make up the spraying machine. It is not my intention, therefore, in the limited time available to attempt to cover the whole field of development which has taken place during the last two years on ground crop spraying equipment and I propose to deal only with the development of the vane type sprayer pump which is now being fitted to many low or low/medium tractor mounted ground crop sprayers or by one or two manufacturers to high volume machines.

At the 1954 Weed Control Conference, Mr. C. Culpin of the National Agricultural Advisory Service, said this of the vane pump - "A type of pump called the Rollervane has recently been introduced in fairly cheap machines by two well known manufacturers. There has so far been too little field experience in farmers hands to be sure how these compare with gear pumps but they have many attractive features. Like gear pumps they can be damaged by pumping water that contains particles of sand or similar materials. There is reason to believe, however, that the Rollervane type will usually outlive gear pumps working in similar conditions in spraying machines."

Three years have now passed since the Rollervane pump was first fitted to spraying machines and sold to users in this country and the information now available has proved that the vane type pump offers many advantages over the gear type pump which has been in common use since the introduction of the low volume tractor mounted sprayer. The small gear pump was first fitted to this type of machine because it was readily available and had been in use for years on machines tools at chemical plants and petrol refineries for pumping many types of liquid. In fact, it was used almost universally as a transfer pump, and, although accurate machining is required in this design of pump, the performance does depend on small clearance tolerances. Because of the high production figures it was a reasonably priced unit. However, after it had been in use on spraying machines for a while, faults soon became apparent. If the pump is run dry for only a short period of time, or if there is abrasive material in the liquid, or misalignment of the pump with the driving shaft of the power unit, wear soon takes place on the gears, body, front and back plates and bearings, with the result that pressure and output drops considerably.

Also because spraying units are being used by individuals who are not engineers and who, in the main, do not follow operating instructions too carefully, it became quite apparent that another type of pump was required if a reasonable working life was to be obtained from it.

Approximately six years ago one manufacturer introduced a flat carbon vane pump with a cast iron body, phosphur bronze liner and rotor, stainless steel driving shaft and carbon bearings to their spraying machines in this country and the pump showed very good promise. The company, however, went out of production and the vane pump development was temporarily suspended.

Rollervane pumps had been in use on spraying machines in America for some considerable time before they were eventually introduced into this country. During its development over here, various metals were tried for the pump body, rotor and driving shaft. A number of materials for the rollers and several types of bearings and seals were tested. Finally, for the Rollervane Pump which has been fitted by one manufacturer of spraying machines for three years to their machines, a Ni-resist casting was used in the pump body and rotor, stainless steel for the driving shaft and an ebonite composition moulded into a stainless steel insert for the rollers. Ball bearings which are packed with lubricant and sealed, thus eliminating the need for continual greasing, are fitted. The bearings are protected from the spray chemical by two seals which are under pressure whilst the pump is working and two shear pins are located in the driving coupler and one in the rotor so that should the pump seize, or foreign matter get into the pump causing the rotor to jam, the pins will shear and no serious damage would be caused to the crucial parts of the pump, i.e. body, rotor or rollers.

In another Rollervane pump which has been in use for about three years, the body and rotor are of a rust resisting material, stainless steel driving shaft, ball bearings are packed with lubricant and sealed, rollers are of nylon and the pump has a built in pressure by-pass system.

Other vane pumps are now available and most have the body and rotor cast from hard wearing non-corrosive materials, the driving shaft of stainless steel, flat vanes and bearings of ferrobestos. When bearings made from this material are used it is necessary for them to be regularly greased. Because the vane pump is centrifugal in action and generally smooth running and comparatively light in weight, manufacturers have been able to dispense with pump mounting brackets which are necessary with a gear pump if a reasonable working life is to be obtained from it. To hold the small vane pumps to the power take off shaft of a tractor and to stop the pump from turning, all that is required is a reasonably strong anchor chain, one end permanently fitted to the pump and the other easily attached to the tractor. This feature alone is simplified and shortens the length of time required for fitting or dismantling the machine from the tractor.

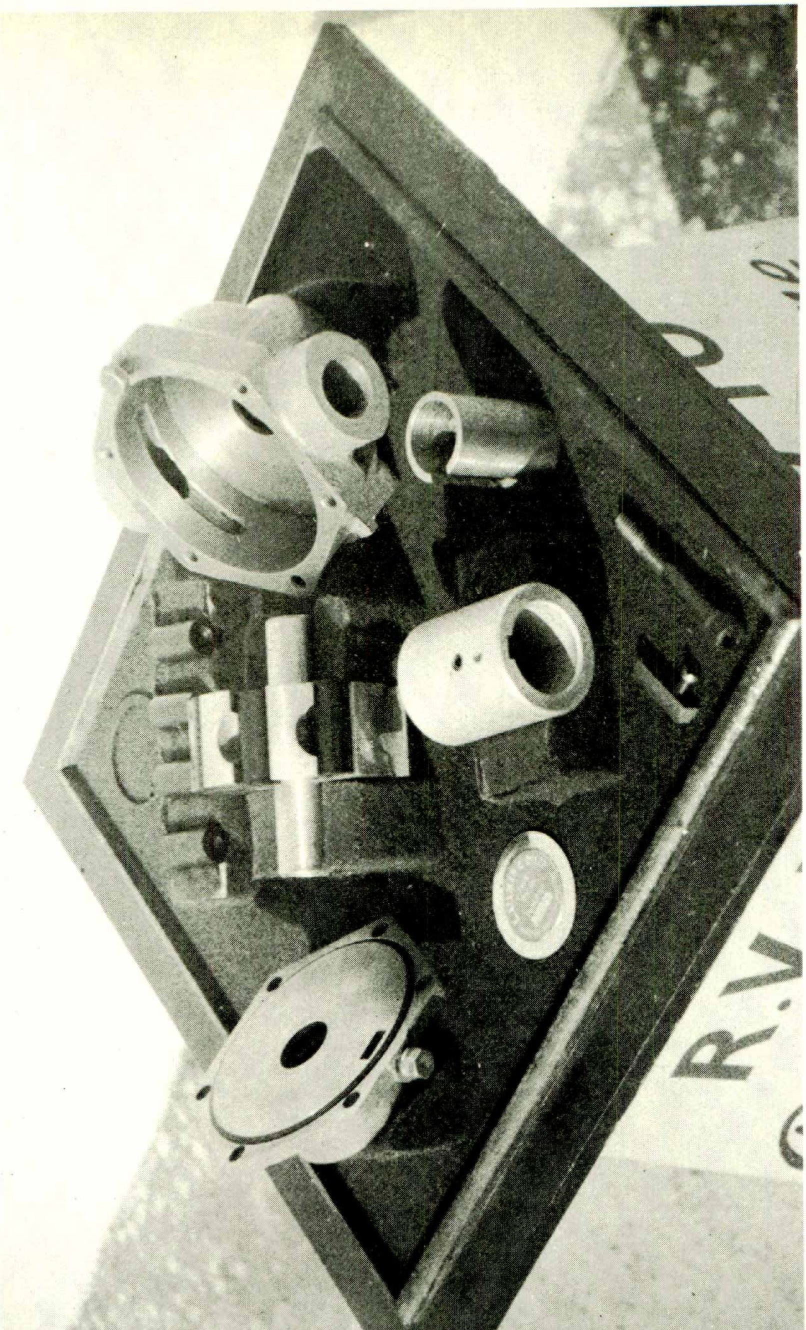
The working principles of the vane pump being fitted to spraying machines, briefly for the benefit of those who may not be familiar with them, is this:-

> When the rotor is turned at speed within the body of the pump, centrifugal force throws the vanes, which are loose in the rotor, against the body, and, because the bearings carrying the rotor shaft are positioned off centre to the body of the pump, liquid is sucked into the pump as the vanes passing the inlet port are thrown out from the rotor. The liquid is then carried round in the chamber which is formed by the rotor being

off centre, and, as the vanes when passing the outlet port are forced back into the rotor, liquid is forced from the outlet port under pressure.

Although the working principle is the same, vane pumps do vary in output and pressure due to their size or the components used. They differ in that some have less vanes than others, the vanes may be round or flat, they may also be positioned in the rotor at different angles and, quite obviously, due to the materials used in construction, some have a longer working life than others. Although sand or similar materials will cause wear within the pump, bearing surfaces being reduced to a minimum, and because the vanes are made from softer materials than the body and rotor, performance does not drop so quickly as with the gear pump. Also, due to its simple construction, the vane pump can be easily serviced by a semi-skilled mechanic either on the farm or at the local dealer's workshop thus eliminating the need for the pump to be returned to the manufacturer for service. Thus not only time is saved, and this is very important in itself, but money also. Indication that either the Rollervane type pump is giving much better service or that more are being serviced by the farmer and dealer, is the fact that one manufacturer, who has in the region of 3,000 Rollervane pumps in use on spraying machines in this country, had during the last twelve months a reduction of two-thirds in the number of pumps returned to them for service as compared with an equivalent period of time when gear pumps were fitted. Reports from several manufacturers all indicate that the vane pump is giving the user far less trouble and a longer overall working life.

Vane pumps in operation today have proved to be a step forward in giving the user greater efficiency at a reduced cost, but spraying machine manufacturers, like the chemist and others connected with the agricultural and horticultural industry, are not resting on their laurels. Development is continually taking place to improve on the performance of the vane pump. New materials are being continually tested for the pump body and other component parts and, although I cannot disclose at this Conference details of other designs, pumps are being tested where the liquid is not in contact with any moving component part which through contact with the chemical would cause wear or corrosion to take place and the pump could be serviced by the operator of the machine in a very short space of time. There is every reason to believe that within the next two years ground crop spraying machines as we know them today will have taken on a completely new appearance and will be extremely simple in design and construction.



HYDRAULIC SPRAY NOZZLES

A. Westerman

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Introduction

The technique of low volume spraying has been well established during the last ten years, and has been so simplified that in many cases it has become a routine farming operation.

At the same time development of new herbicides has progressed rapidly and of course the main factor in weed control is the nature of the herbicide. This in itself however would not be sufficient to guarantee successful results. It is important that the correct dose of active ingredient be distributed as evenly as possible over the target. Among many factors involved in achieving this, the spray nozzle is by no means the least important.

It is essential, therefore, that the scientist responsible for the development of the herbicide and the establishment of the theoretically ideal method of its application must have a knowledge of spray nozzles, their performance and their limitations, so that the practical possibilities may be taken into account when translating the ideal into the form of practical instructions for the application of the herbicide in the field.

It is of equal importance that the nozzle designer has a precise knowledge of the processes involved in spray formation so that the performance of nozzles may be predicted, and a guide given to the scientist in the choice of nozzle most suited to his needs.

The purpose of this short paper is to review the types of nozzle at present available, and to discuss briefly the effect of nozzle design upon the spray criteria governing nozzle choice.

Choice of nozzle

Nozzle choice is obviously governed by several factors among which cost and end use are of obvious importance. The main characteristics which must be known, however, by the intending user are:-

1. Rate of discharge.
2. Spray angle.
3. Distribution.

These three factors are inter-related and are of equal importance when it is desired to place the spray on the crop in a prescribed manner.

These spray characteristics are controlled by nozzle design and have been considered in detail by the Technical Committee which in the last year or so has been preparing a British Standard Specification for hydraulic spray nozzles.

A draft specification has now been produced and is to be circulated for comment in the near future.

The main purpose has been to provide for both physical and functional interchangeability of nozzles of like size and type.

It is proposed that functional interchangeability shall be based on rate of discharge and uniformity of distribution. To this end it has been proposed that fan and cone nozzles shall be made with six different flow rates, two

spray angles and two types of distribution curve at a pressure of 40 p.s.i. for fan nozzles and 100 p.s.i. for cone nozzles.

Droplet size is also of importance in some cases, but is not easy to control although the mechanism of atomisation is now fairly well known having been studied in great detail by Fraser (1). In general it may be said that mean droplet size increases with orifice size but decreases with increase in pressure.

Nozzle design and spray characteristics

For low volume spraying the hydraulic spray nozzles used fall into three main types:

1. Cone nozzles.
2. Indirect nozzles.
3. Fan nozzles.

1. Cone nozzles

Such nozzles usually have two functional components, the nozzle tip which contains the final orifice, and a swirl plate having tangential or helical passages. A swirl chamber is formed in one or the other of these two components and is positioned between the two. A typical nozzle is shown in Figure 1.

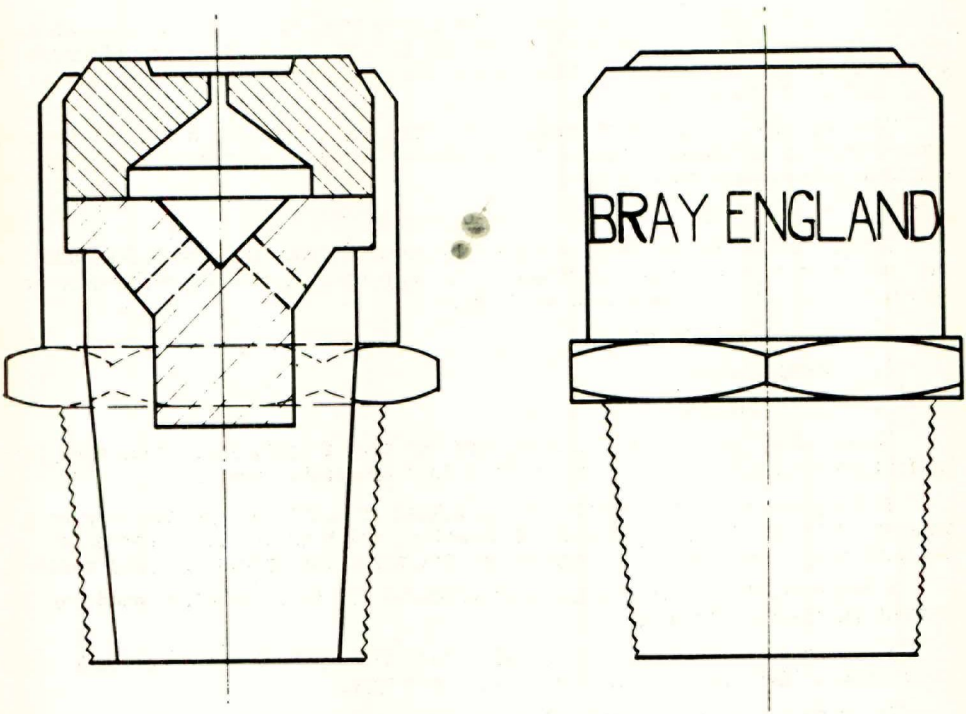

Figure 1. Cone Nozzle

The liquid issuing from the passages in the swirl plate enters the swirl chamber tangentially and therefore rotates as it moves towards the final orifice. The centrifugal force due to rotation causes the liquid to pass through the orifice in the form of a thin film at the walls only, there being an air core at the centre of the vortex.

Thus a hollow cylinder of liquid leaves the orifice with both axial and tangential velocities, the latter causing the cylinder to open up as it progresses into the form of a hollow cone. The spray angle is determined by the ratio of the two velocities, and the flow rate by the diameter and wall thickness of the cylindrical column and the speed with which it moves towards the orifice.

The theory of the liquid flow in cone nozzles has been studied by a number of workers (2,3), but is a strict mathematical treatment which is a little difficult to apply in practice.

It is well known, however, that the flow through these nozzles is dependent upon the applied pressure, the diameter of the exit orifice d, the swirl port diameter p and the diameter of the swirl chamber s. Figure 2 shows the effect of variation in orifice diameter on flow rate with the swirl port and swirl chamber diameters held constant and similarly the effect of variation in swirl port diameter. In both cases increase in diameter results in an increased flow rate.

The variation of spray angle with change in orifice and swirl port diameters under the same conditions is shown in Figure 3. The spray angle increases with orifice diameter but decreases as the port diameter increases.

From these and similar curves a series of empirical relationships may be obtained which show that the flow rate and spray angle are functions of $d^x p^y s^z$.

It is possible, therefore, for any particular nozzle to obtain a relationship which enables its behaviour to be predicted.

It is emphasised that such a relationship applies accurately over a limited range only and is modified by change in the length of exit orifice and shape of the swirl chamber.

It is essential in cone nozzles that all surfaces should have a good surface finish and that the orifice, swirl chamber and swirl ports should be co-axial as it is very easy for the smallest defect to throw the spray out of balance.

In this respect it is important to note that if a cone nozzle may be disassembled for cleaning purposes, it must be re-assembled correctly and nozzles and swirl plates should not be interchanged. If a sealing washer between nozzle tip and swirl plate is provided by the manufacturer, a washer of the original thickness must be used as a replacement otherwise change in spray characteristics will result due to change in the dimensions of the swirl chamber.

Pressure also plays an important part in the design of cone nozzles as at low pressures the liquid first forms a bubble due to surface tension forces.

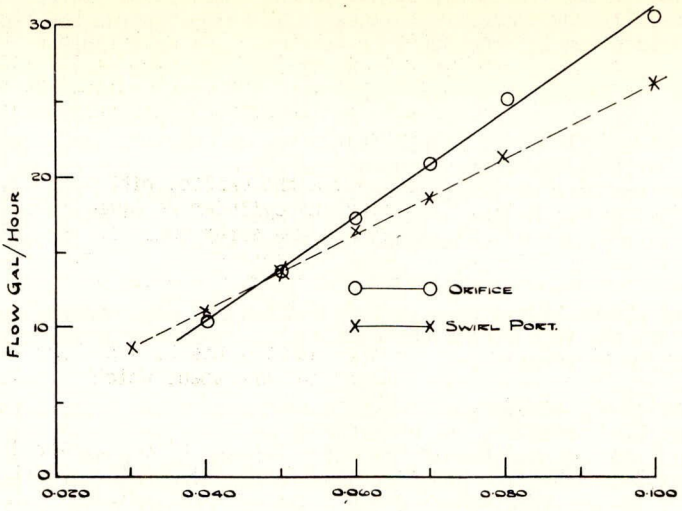

Figure 2. Variation of Flow Rate of Cone Nozzles with change in Orifice and Swirl Port diameters.

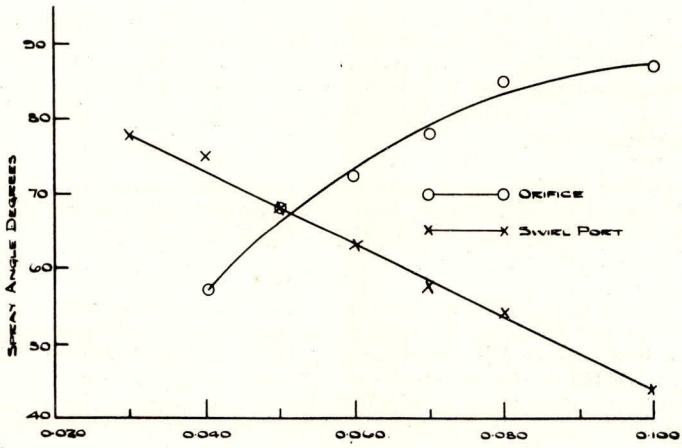

Figure 3. Variation of Spray Angle of Cone with change in Orifice and Swirl Port diameters.

The pressure at which the bubble opens depends upon the design of the nozzle and the physical properties of the liquid. The spray angle increases with pressure to a maximum but then decreases due to air entrainment.

Nozzles with small flow rates tend to give more solid distributions than larger nozzles due to the droplets of the former possessing less mementum and therefore being directed towards the centre of the cone by the higher air pressure on the outside of the cone.

2. Indirect nozzles

These nozzles, also known as Anvil or Target Impingement nozzles produce a flat sheet of spray similar to that given by fan nozzles but are not in such general use as the latter. However in order to understand the principle of operation of fan nozzles it is better to consider first the indirect nozzle.

A solid jet of liquid usually of cylindrical form is directed against a flat surface called the anvil which causes the jet to spread into a diverging sheet of liquid. In the case of direct impingement a circular sheet of liquid is formed.

When the jet is inclined at an angle to the anvil the component of velocity parallel to the surface is unaltered, but the normal component is cnanged into velocity parallel to the surface. The combination of these two velocities leads to the formation of a flat fan shaped sheet of liquid.

As circular orifices are usually employed in these nozzles the flow rate can be predicted fairly accurately from the expression:

$$Q = c. A. v.$$

where Q is the flow rate
c is the discharge coefficient (usually 0.85 to 0.90)
A is the cross-sectional area of the orifice
and v is the velocity of the liquid.

The spray angle is a little more difficult to predict and the assumptions must be made that momentum is conserved in the collision of the liquid with the anvil and that the liquid velocity parallel to the axis of the jet is constant.

3. Fan nozzles

There are many types of fan nozzle, but in principle they are the same as the indirect nozzle with the anvil being replaced by a second liquid stream. The impact of the two streams at the point of convergence forms the required collision.

For reasons of simplicity of design the two streams of liquid are caused to be formed in a nozzle having a single orifice, the approach channels being such that the streams emerge from opposite sides of the orifice and impinge just above and within the orifice.

The two most common types of nozzle are shown in Figures 4 and 5.

The approach channel within the tip shown in Figure 4 is cylindrical with a dome-shaped end. A V-shaped slot runs across the face of the tip and breaks into the hemispherical cavity. The orifice is formed at the point of inter-penetration and is elliptical in shape.

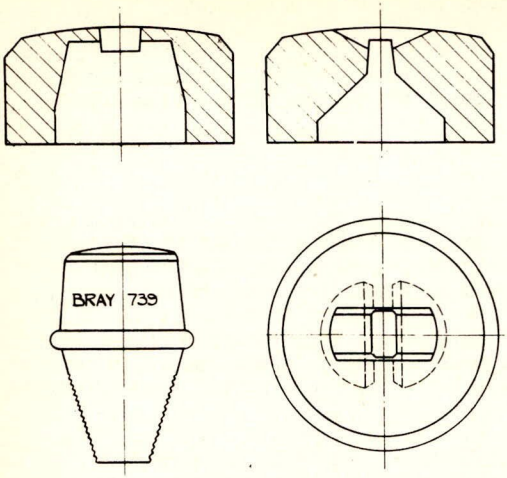

Figure 4. Fan Nozzle.

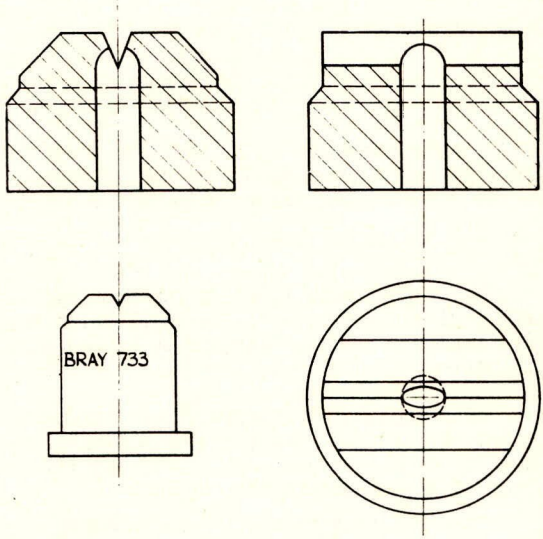

Figure 5. Fan Nozzle.

Figure 5 illustrates a tip which has a rectangular slot at the top of the approach channel. A further rectangular slot is formed in the face of the tip at right angles to the first. Both slots are wedge-shaped so that inter-penetration occurs at the point of which is formed a rectangular orifice.

As in the indirect nozzle, the angle of approach of the two streams determines the effective angle of the spray and distribution of liquid across the spray sheet.

However the approach channels are usually too short in length to allow the approach angle to be assessed with any degree of accuracy.

In particular in the two nozzles shown in Figure 4 and 5 there are lips on each side of the orifice at the end of the approach channel and these lips cause a sharp final convergence resulting in pressure at the axis being increased and the spray sheet being formed at right angles to the direction of convergence.

If in the nozzle shown in Figure 4 the orifice is formed by a narrow parallel sided slot instead of a V-slot, the two streams are in almost direct opposition and a flat sheet of large angle is formed.

As the angle of the V-slot of this type of nozzle is increased the spray angle becomes smaller and the distribution becomes more uniform due to the different inclination of the converging streams. This effect is shown in Figure 6. The diameter of the approach channel and the depth of the slot must also be taken into consideration and affect not only the spray angle, but of course the flow rate. If the approach channel is large in diameter the lips on each side of the orifice will be longer, and the final convergence of the two streams of liquid more direct, resulting in a fan of wider angle. As the lips are made shorter either by reducing the diameter of the approach channel or increasing the angle of the V-slot, the final convergence is less direct and a smaller angle results.

The spray characteristics may also be changed by altering the curvature or shape of the dome shaped end of the approach channel. Thus if the end is square instead of rounded, with a V-slot of 60 angle, the distribution curve, instead of being substantially triangular with a major peak in the centre, is wider and has an additional peak on each side of the major one.

The spray angle and distribution given by the nozzle shown in Figure 5 is also affected by the length of the lips at the side of the orifice and by the small trapezoidal shaped side ports at each end of the long dimension of the orifice. If these side ports are shallow the distribution curve has a large central peak and the angle is small. As the depth of the side port is increased the peak disappears and a plateau is formed giving a substantially rectangular pattern. Further increase in depth results in a depression appearing in the centre of the plateau, the distribution curve having a double peak and the spray angle being increased.

It is difficult to predict the flow rates of nozzles of this type as the flow from the nozzle is not wholly axial and the component of axial velocity varies dependent upon the angle of convergence and the shape of the approach channels. It is impossible, therefore, to apply the formula used for circular orifices. It is possible, however, from a knowledge of orifice areas to predict the flow rates of a series of nozzles once one size of that type of nozzle has been established.

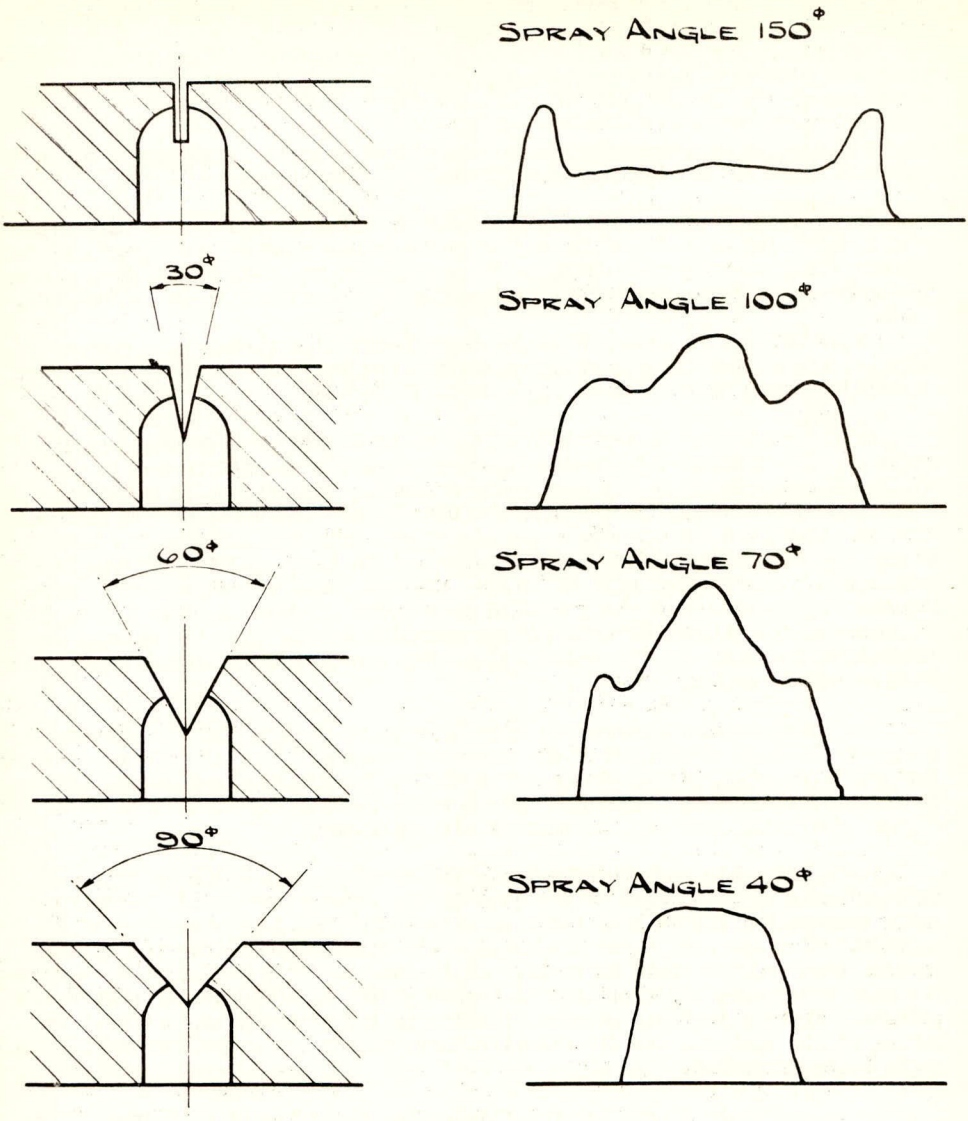

Figure 6. Effect of Slot on Spray Angle and Distribution of Fan Nozzle.

The flow rate is essentially a function of pressure and over the range of pressures used in low volume spraying the flow rate is found to be directly proportional to the square root of the pressure.

Increase in pressure has no appreciable effect on the spray angle but does alter the distribution curve as shown in Figure 7. The amount of liquid deposited at the edges of the spray is increased and the pattern is a little more uniform at high pressure.

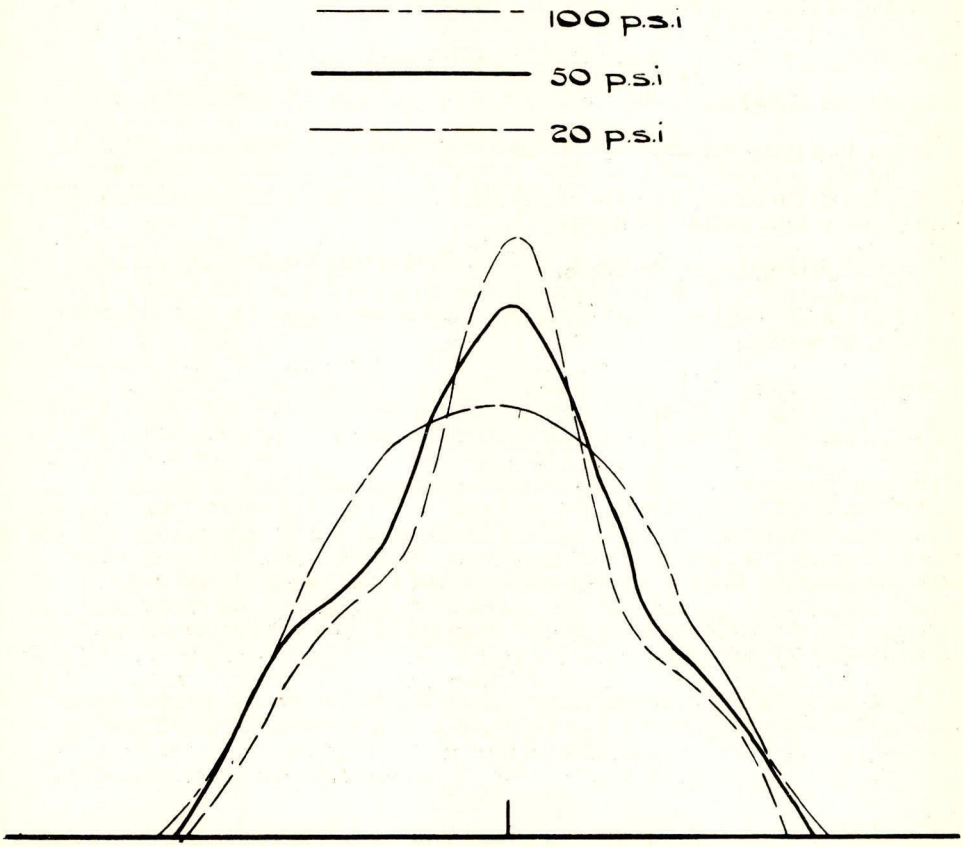

Figure 7. Effect of Pressure on Distribution of Fan Nozzle.

Relative merits of cone and fan nozzles

Low volume spraying, as its name implies, entails the use of nozzles having small flow rates and hence small orifices which are liable to blockage. In this respect the cone nozzle is better than the fan nozzle in that small flow rates can be obtained from relatively large orifices in the centre of which is a large air core. The judicious use of filters can, of course, largely obviate this blockage.

Fan nozzles give a flat spray which has a higher momentum than cone sprays and this is especially important when it is necessary for the liquid to penetrate heavy foliage or weed growth.

The question of whether a hollow cone or a flat sheet is more suitable for producing greater uniformity of coverage is debatable and essentially the suitability of a nozzle depends upon its end use.

Materials of construction

Brass and ceramic materials are used most commonly for spray nozzles.

Brass is easily machined but it has the disadvantage that small burrs may be left in the orifices and these have a marked effect on the flow rate and distribution given by the nozzle. Steel suffers from the same disadvantage and is, of course, less easily machined.

Ceramic materials are difficult to machine but are readily moulded by quantity production methods in precision made dies, and thus lend themselves to the production of orifice shapes which are either impossible or very difficult to produce in metals.

Ceramic materials have the advantage also that they are extremely resistant to attack by acids and alkalis and are consequently unaffected by any of the liquids normally used for weed control.

Ceramic materials are very resistant to erosion and Figure 8 shows the result of an erosion test using 2% suspension of copper oxychloride in water on nozzles made from brass, Monel and ceramic material. It is appreciated that the effects of erosion will differ dependent upon the conditions but in this particular case the increase in flow rate of the brass nozzle is markedly greater than that of the others. The rapid erosion of brass has been noted also by Caussin (4) who observed a 40 to 50% increase in flow rate after the passage of 8 to 10000 l of solution.

Steel is similar to ceramic materials in its resistance to erosion but it is difficult to be specific as so much depends upon the type of steel and its hardness.

Discussion

An attempt has been made to review the different types of nozzles at present available and to discuss the complexity of some of the factors which determine their performance. In the last respect it should be noted that the question of nozzle design only has been considered and the important effects of the physical properties of the liquid had to be left for consideration at a later date.

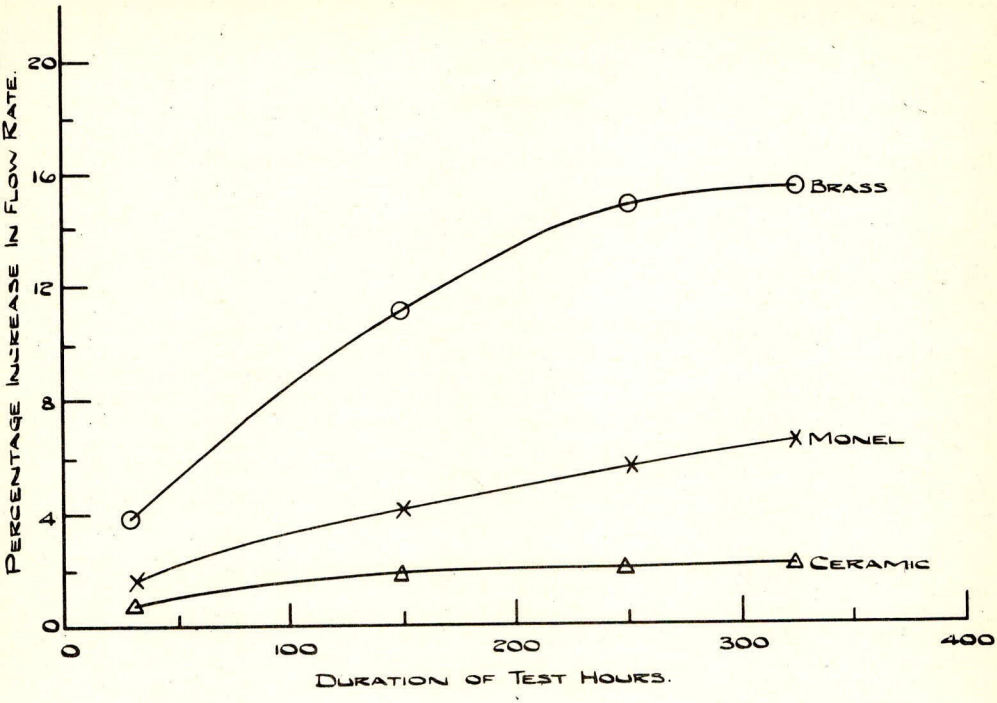

Figure 8. Erosion of Fan Nozzle.

The small size and apparent simplicity of nozzles, particularly of the fan type, has lead to the belief that their design is a simple matter. This is not so for although it must be admitted that in the past nozzle design was largely empirical, in recent years much fundamental data has been compiled and is being used to predict the performance of nozzles.

These predictions have to be based on the assumption that the nozzle will be used at a certain pressure and once that is established it is important that the nozzles are used at that pressure in practice.

Standardisation should help in this respect in that the important spray characteristics will be precisely defined at a fixed pressure dependent upon the type of nozzle.

These facts should be borne in mind by the manufacturers of herbicides and due allowance made in assessing their requirements.

It is evident from this that close co-operation between manufacturers of herbicides and nozzles is necessary for the continued successful development of low volume spraying.

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(4) CAUSSIN, R. (1955) VII Symposium Annuel de Phytopharmacie.

DISCUSSION ON THE PREVIOUS TWO PAPERS

Mr. M. S. Bradford

The world of crop production machinery is constantly changing and both the farmer and the contractor are often bewildered by events. The fashion swings from high volume to low and then from low to medium. New chemicals appear which render machines obsolescent. One is reminded of the aborigine who went to great trouble to make a new boomerang with which he was very pleased until he ran into a very big snag. This appeared when he tried to throw the old one away. In spite of hearing this morning that in some parts they are now using them for stopping gaps in hedges, my company still employs with considerable efficiency of effect, one of the old-fashioned atomiser sprayers.

It was heartening to hear of the very necessary advances being made in the design of spray machine pump units. I feel myself that better attention by the farmer as regards maintenance could achieve almost comparable results in prolonging the life of pump units. How many times have we seen the sorry spectacle of the start of a machine after a winter of so-called storage. It is often found that residues of last year's chemicals are still there, largely because little or no attempt had been made to clean the machine properly before putting it away.

Although not covered in the papers presented this morning, I would like to ask also if any research is being made on the subject of agitation within the machine. The human element being what it is, bad pre-mixing where such is necessary, is often the cause of trouble. After all, it is of little practical use if pressure, speed and jet performance are correct when the chemical issuing forth is incorrectly mixed. I hope also that there is investigation being carried out further to assist "the inert masses" of the South-West efficiently to operate on fields of awkward shape and gradient, necessitating many gear changes and much short-work.

And now about nozzle markings for the user. A more complicated arrangement than the existing one is difficult to conceive. Your user usually knows the standard speeds and pressures and it will be a welcome change if visible marking can be standardised to tell him what volume of application will result from his using the jet concerned. No doubt the standardisation will have to include some standard jet spacing on the machine. The operator is just an ordinary mortal whose understanding of complicated formulae is likely to be nil. May I offer up a plea therefore, for as simple a nozzle marking as possible compatible with efficiency?

There are many factors which contribute to a satisfactory result from the application of a herbicide. I wonder to what extent slight variation in nozzle

efficiency and therefore slight variation in coverage are likely to affect the final answer in terms of increased yield to the farmer? Can some efficiency in this field be sacrificed for simplicity.

Mr. H. R. Herridge

On the question of the efficiency of the pump, one cause of trouble is that so many farmers allow them to run dry. Agitation is caused by using the by-pass system and there must always be a certain amount of liquid in the tank so that the pump can retain its pressure. Although the spraying machine may be spraying from the nozzle and although it originally had enough output to feed the nozzle and the agitator, after it has been in use for some time it will not have sufficient for full operation. The only real answer is a mechanical means of agitation, which would put up the price of the machine, so once more it is a question of economics and the amount of money that the farmer is prepared to invest.

With regard to visible markings of the pumps, this question has been gone into thoroughly by many manufacturers. As far as we know there is no efficient means of telling when one has overlapped or missed part of a field and guess work is still necessary.

The problem of uneven ground could be dealt with by the use of wide angle spray nozzles eliminating the need of a boom provided the application is correct. There should be a heavier application of chemical but not such a large droplet size.

Dr. A. Westerman

Both marking and chemical coverage or distribution are to be covered by the B.S. Specification. I dealt with this subject only briefly as, when the paper was prepared, it was still confidential. However, I read yesterday in the B.S. Information News that the draft specification had been circulated for comment and may now be discussed so long as it is remembered that at the moment it is no more than a draft.

The rate of discharge, spray angle and distribution are all specified and these three characteristics define the chemical coverage which will be obtained from a nozzle or any combination of nozzles.

The system of marking is also to be standardised and B.S. 7 T 80 will mean that the nozzle is made to the B.S. Specification, that it has a flow rate of 7 gallons per hour with a triangular distribution and spray angle of 80°. This may appear to be a little complicated at first sight but does at least mean something.

It is hoped that as many people as possible will comment on the draft so that when the final specification is published it will be generally acceptable.

Mr. J. D. Fryer

With regard to British Standards Specification - what is the capacity tolerance of through-put laid down by the new specification.

Dr. A. Westerman

It is proposed that the tolerance on flow rate shall be $\pm$ 10 per cent.

CHAIRMAN'S INTRODUCTION

We have heard this morning of the striking progress in the development of chemicals for weed control and the rapid spread of their use on the farms. I am glad to say that the agricultural merchants realised early the great potential value of these techniques to agriculture, and in order to help its members to keep in touch with developments the National Association of Corn and Agricultural Merchants formed a specialist committee in 1951 of which the next speaker, Col. Cramphorn, is the present Chairman.

This conference, is, I know, mainly technical, but the enormous amout of research and development would be largely wasted if it were not quickly translated into practical action on the farm, and the widespread adoption of new materials and techniques is often hastened by advisory activities of merchants and their representatives - activities which are now regarded as an essential part of selling. In fact agricultural merchants have a very close interest in farming and are naturally anxious to further full production in the industry to the best of their ability and I am sure our trade would be happy to co-operate in any research which might be undertaken on the lines suggested by Mr. Hirsch into the matters of spreading new knowledge.

Corn and agricultural merchants often have strong family connections with local farming, going back for generations and our speaker has an outstanding record in this respect. He tells me that his forebear, Thomas Cramphorn was a miller as far back as 1677. Col. Cramphorn's firm now has 43 branches in Essex and neighbouring counties. He himself has been a director since 1934 and with the background experience and knowledge which I have outlined, I am sure he will command your interest in the subject of the "Merchant's Place in Handling Weedkillers".

THE MERCHANTS PLACE IN HANDLING WEEDKILLERS

J. F. Cramphorn, National Association of Corn and Agricultural Merchants

As a preliminary to speaking in detail of the merchants place in the handling of weedkillers, it will I think be of interest, to enlarge for a moment or two on the merchants' place in agriculture as a whole.

Many years ago, certainly when my ancestors had a mill in the seventeenth century at Bow, then still a village outside London, merchants and millers were interested only in the grain which farmers brought to them and which they ground into flour or sold for feeding livestock. When research into plant breeding necessitated large scale multiplication of improved strains of cereals, they quickly entered this field and by trying these new strains and growing them on, both in their own fields and by contract, soon established themselves as seed growers. This has been a continuous and expanding process during the last hundred years, so much so that now virtually all commercial cereal seed (and free from wild oats at that!) is grown and supplied by the agricultural merchant. During the last century, when artificial fertilizers were introduced, realising that these had an enormous potential part to play in improving quality and yield of agricultural crops, merchants were not slow in associating themselves with this new development in both manufacturing and distribution, and here again, nearly the whole of the fertilizers now used in the country are handled by merchants. The manufacturer has faith in this channel of supply and the farmer has confidence in the service he obtains, so, over the years, a two way traffic was built up - the merchants growing or having grown for him, the seed which he sells with the necessary fertilizer, to the farmer and the farmer in turn, selling the crop back to the merchant. It was natural, therefore, that the tremendous developments in crop protection of recent years, brought with them added scope for the merchants' energy. The impact on agriculture of these aids to crop protection was such, that no merchant could ignore them, even if he would. Almost overnight, the merchant was involved in holding stocks of products, of which at the onset - let me be frank - he had very little knowledge, (and I will speak more of this later) and of supplying his farmer friends with herbicides whose effectiveness he had to take on trust, from his manufacturing friends. What interested the merchant, (and here he was in exactly the same position as his grandfather, or greatgrandfather a hundred years ago with the introduction of superphosphate) was, that here was something to improve the quality and yield of corn - here was something to increase the amount of grain he bought and sold or manufactured into feeding stuffs - as well as enabling him to give just one other service to the farmer. The supply of weedkillers has become just one more link in the chain which binds the corn merchants' activities to the farmers and one more spoke in the cycle of events from seed to crop. It has been estimated, by competent authority, that the loss in this country due to weeds, is still of the order of seventy million pounds a year, or something like 20% of the agricultural production handled by corn merchants. So that quite apart from what profit there may be in the actual handling and sale of weedkillers, (and if I may say so with all due respect to our manufacturers, they see it is not too large,) the increase in turnover and cleanliness of grain samples which can be expected from the increased use of weedkillers, holds many attractions for the merchant, and the fact remains that the greatest proportion of weedkillers reach the farm through the agricultural merchant. It may sound simple to refer to the merchant as a mere supplier of manufacturers products, but like many quick dismissals of problems it is an over simplification. The merchant must first satisfy himself that the product he will offer

to his farmer friends is one which will do the job claimed for it, and in these days of rapid development, and of new products being put on the market at an early stage, this is a vital consideration. The merchant then has the normal staff work that is undertaken in any distribution problem, namely, to ensure that the right product reaches the right farm at the right time - and even this is not always as easy as it sounds - as farmers may telephone, as they often do, at 10 p.m. one evening, just as one is going to bed and want 40 gallons of MCPA delivered 30 miles away by 8 o'clock the following morning, when all lorries have been briefed the night before for different jobs. But perhaps the most important job the merchant has to do is to ensure that he and his representatives have a high enough standard of technical knowledge, to be able to recommend the appropriate product for the task required and to keep pace with the new developments and products as they appear on the market. The trend is for chemicals to become more and more selective and for specific herbicides to be recommended for specific weeds. The farmer, therefore, must rely more and more on his merchant for advice. Mr. Hirsch has referred to the factors affecting the use which is made by farmers of available information and the personality which is required to put it over. The merchant is in almost daily touch with a wide circle of his farmer friends and as he only lives by his ability to put over to them things which are of ultimate advantage, he is well qualified, in this respect, but realising the necessity for up-to-date knowledge of commercial herbicides and treatments, the corn merchants, through their Institute of Corn and Agricultural Merchants, have, for some years past, arranged courses of instructions for their members on these subjects (amongst others). Last year, for instance, a course was held at Reading University which was attended by 85 corn merchants and their representatives. This winter a course is being held for the same purpose at Cirencester and it may be of interest for you to know, that at the course organised last September, by the British Weed Control Council, corn merchants provided the biggest single block of students, in fact a quarter of the total. I think it will be realised from what I have just said, that corn merchants are very conscious of the integral part they have to play in agriculture, and are emphatic in their desire to maintain this position by (amongst other ways) keeping themselves abreast of technical developments. The merchant, his father and his grandfather before him have traded in his locality for years. He is in business for profit, just as the manufacturer and the farmer, but he knows that he will not remain in existence long if his profit is exorbitant, or if he takes unfair advantage of his customers. The competition between merchant and merchant is as fierce as in any trade in the country. The prosperity of agriculture and the prosperity of individual farmers he serves, is inextricably tied up with his own well-being. In selling the farmer weedkillers, he is serving his own interests and he is serving the farmer. I think I have made it clear that the merchant as well as the farmer is vitally interested in the effect on yield of weedkillers and economic angle of their use. Although the estimate of crop loss due to weeds of £70 million per year has not yet been refuted, there are at present absolutely no facts or figures to say how much this figure is, in fact, being reduced by the greater use of weedkillers. The sceptical farmer, the farmer who is not yet convinced that weedkillers will save him money, wants facts and figures to prove that he will gain by their use. We, as merchants, want this information to pass on to him and to help persuade him that what we know to be true on other farms, can apply to his as well. We have approached various bodies with regard to this; we have offered to provide plots and facilities for the conduct of trials as to yield and profitability, and we hope most sincerely that the Weed Control Council's latest approach to the Agricultural Research Council on this subject will bear fruit. The research report on "Phenoxybutyrics"

to be presented tomorrow afternoon by Mr. Breese on "The Early Spraying on Spring Cereals with MCPA and MCPB" gives just the kind of ammunition we want and I hope most sincerely that larger and more extensive trials of this nature may be organised. I hope, too, that the Rothamsted trials may be continued as the information from them is undoubtedly of enormous value. After all, the important thing in farming today is the cost of the operation and the return which is obtained from it.

And there is another practical question which is often raised and to which reference has already been made by Mr. Rhys Thomas and Mr. Cannon, the question of active ingredients.

I cannot emphasise too strongly the value we put on the declaration of active ingredients of, at any rate the more common, weedkillers. We want some kind of yardstick to compare the rate of application necessary, the effectiveness anticipated, and the cost per acre. We do not ask for more legislation, but even something on the lines of fertilizers and feeding stuffs analysis would suffice and, although discrepancies occasionally occur, it would be of tremendous practical value. In spite of a reluctance in some quarters to make use of new developments, farmers are becoming more technically minded and quite rightly want to know what they are getting for their money and what effect on their land they are likely to achieve, both during the year of application and in subsequent years. Now, although I have said that by far the greatest proportion of weedkillers reach the farm through agricultural merchants, the merchants and contractors interests are by no means always at variance, and although two years ago, at the last conference, when we listened to a most admirable and interesting paper on the contractors' place in handling weedkillers, we were asked to believe it was not economical, for farmers to buy anything other than a high volume sprayer, the fact remains that something like 35,000 low volume sprayers are in use on farms throughout the country. It has been estimated that a low volume sprayer is an economical proposition for a farm with as little as 30 acres of cereals and it is to those farmers, who can, by using them, spray their MCPA or 2,4-D at the right time - and I emphasize at the right time - that we address ourselves. The merchant welcomes the contractor and admires his invaluable work for, he knows that the resulting crop will be a better one and will be cleaner, and therefore not only more profitable, for the farmer, but easier for the merchant to handle. I have spoken briefly of corn merchants' work in the handling of weedkillers, and posed two problems with which we are faced. I have purposely avoided anything in the nature of the physical handling of awkwardly shaped drums of considerable weight and of the necessity of tying up large sums of money, sometimes for many months.

I have also avoided any reference to the fact that the 'credit squeeze' adds to our difficulties after a harvest such as we have just experienced, as much as anybody's, but I cannot close without some reference to the invaluable help given to us by our manufacturer friends. We are indebted to them for the greater part of the technical knowledge we have absorbed; we are indebted to them for the splendid service they give to us and we are indebted to them for the generous way in which most of them back us up when something goes wrong in the field. In spite of an awkward little bone of contention in some cases in the shape of a Non-Warranty clause, the support which they give us, and through us, the farmer, is of the utmost value.

In conclusion, may I forestall a question that is almost bound to be asked:- "Why are so few merchants here when we have the handling of

weedkillers so much at heart?" The reason is that although weedkillers, like seeds and fertilizers are a vital part of our trade, at this particular time of year, we are far too concerned with moving from the farms the results of the worst harvesting conditions in living memory.

DISCUSSION ON THE PREVIOUS PAPER

Mr. P. R. Hayward (Introduction to discussion)

Being employed entirely on the technical side of an agricultural merchants' business, I cannot really call myself a merchant, but I do stand somewhere between the farmer and the merchant, and I could not help feeling the slight suggestion this morning that the agricultural merchant was hardly the right person to put over the knowledge of herbicides to the practical farmer.

Being employed by a firm of agricultural merchants, I may be accused of being biassed, but I have never sold a gallon of a herbicide in my life and in my very favourable position of being able to watch the agricultural merchant and his staff at work, I cannot, frankly, think of anybody better to put over the knowledge and the new techniques of herbicides to the farmer. The agricultural merchant is contacting the farmer both in selling and buying, and a very large proportion of the farmers turn to the merchant for advice, quite without being forced to do so. In the Eastern Counties I cannot praise too highly the work of the agricultural merchant in this respect, they are backed up by the manufacturers and by their staff in the field, and when the agricultural merchant is stuck for the answer to a farmer's problem there is always somebody to whom he can turn.

To the contractor, and here I speak as a farmer, I would say that yours is the work of pioneering and demonstrating weed control. You will always be called in to do the difficult work, but the farmers' own sprayer has come to stay, and if the chemical is not toxic and it can be sprayed under medium or low volume, the farmer is going to do the job for himself. What is more natural than that he should find out about the herbicides and how to apply it from the person who supplied the chemical, i.e. the agricultural merchant.

There is no question of the agricultural merchant being biassed to sell one firm's products because in the main he is selling more than one brand. There have been suggestions at times that the agricultural merchant can never be unbiassed, but frankly if he is so biassed he will soon find himself with no customers to be biassed with. It is the merchant who will be buying the final crop and it is in his interest to see that the crop is sprayed with the right chemical at the right time and in the right strength.

Seed growing farmers welcome research work in the approach to wild oat control. The main seed growing areas are the main corn growing areas and there the wild oat problem is at its most serious.

In reply to comments made this morning, I would emphasize that there is an adequate supply of seed corn in this country free from wild oats. I say this in case the representatives from Sweden consider that they have a monopoly in this direction. The problem is really to find sufficient

fields in the country on which to grow the seed crop. We know that suitable cleaning is important for wild oat control and this in the main means adequate rotation and good cultivations.

Should chemical weed control become general practice in the eastern counties for wild oat control, you can rely upon the agricultural merchant to put over this new technique with the same high degree of fidelity and skill in interpretation as he has done with fertilizers, feeding stuffs and seed during the last century.

Mr. C. V. Dadd

Mr. Hayward said there should be enough seed about, that is free of wild oats. The calculation is not difficult to make: 10% of the total cereal acragge of the country, making allowance for the north and west. But nonetheless, though it is preaching to the converted, there is a great need for all of us to urge farmers to buy seed of this quality when they go outside their own farms for seed. There is a long way to go before we achieve both the quantity, and the willingness on the part of the farmers to buy really good quality seed for this particular purpose.

Mr. N. F. Pine

I understood that at the moment the trade is meeting the demand.

Mr. H. G. Huckle

I suggest that it is rather undesirable for there to be further regulations in connection with product specification. There is at the moment a very admirable set-up known as the "Crop Protection Products Approval Scheme" to which users can easily refer if there is any doubt at all in their minds about the materials they wish to use.

Dr. E. Holmes

I do not agree with Mr. Huckle. We, the technical people in industry, have been helping the Recommendations Committee ever since it started. It seems absurd of us to agree to certain recommendations in terms of pounds or ounces of active agent per acre and then refuse to specify the ingredients in our products. I have been able to convince most of my technical colleagues that it would be very desirable to put the name of the active agent on the tin in pounds per gallon, but so far have failed to convince my commercial colleagues.

Mr. H. G. Huckle

I am sorry to hear that Dr. Holmes has not been able to persuade his commerical colleagues, and I am aware of the fact that he and I differ on this matter. The point I would like to make, however, is not that I disagree with the idea of stating active content on labels for MCPA and 2,4-D because we in fact already so do, but I am most anxious that this should not become a recognised practice for all agricultural chemicals. In fact, of course, a simple statement on active content is not always sufficient to indicate what the efficiency of the particular product is going to be. There is a great deal in formulation technique and if it became a recognised practice always to judge a chemical by the active content, then formulation technique is at a discount.

Mr. B. C. Williams

I would like to endorse Col. Cramphorn's view that it is very important that we clearly mark on drums and literature what is the ingredient of the chemical sold. In the long run this will come about. It would be foolish to imagine selling fertilisers by name only. I can remember a farmer asking for so many tons of No. 1. When asked why he wanted that variety, he replied that it was most important for him to have the best! At present we are at a stage where a trade name is easier for the farmer to understand than chemical names, but the day will come when he will understand the chemicals. He is even now beginning to ask for the chemical names, contents etc. Further thought should be given to the chemical containers and their clear marking. Labels usually fall off after exposure to the weather, and it would therefore be very easy to pick up one drum with DDT and one with MCPA and spray them at the same time, unless more attention is paid to this matter.

Mr. A. J. Cannon

When I spoke this morning I was not really criticising the merchants. We have found in our district that the merchant has benefitted from the contractor and the contractor has benefitted from the recommendations of the merchant. The spraying contractor can supply the material or put it on. He is valued by the merchant selling the material.

The interests are all the same - the farmer, contractor, merchant and the manufacturer.

Dr. E. Åberg

In Sweden farmers are given a small handbook showing the concentration of active ingredients of commercial herbicides. This handbook also contains recommendations for usage based on the strength of the product. By comparing the data in the handbook with the declaration of the ingredients on the tins or the drums the farmer will be able to find out how he can best use the product he has available.

Col. J. F. Cramphorn

I have little further to add to what I have already said. I am very glad if I have created some active interest in the necessity for declaration of active ingredients in weedkillers so that users have a yardstick by which to compare the relative value of different products. I am glad Mr. Cannon confirms that the merchants and the contractors are not at variance but are, in fact, complementary. We do have the same interests at heart. I will close in mentioning the value of the British Weed Control Handbook. In distributing more copies of it than any other body except the manufacturers, who support it so actively, I believe we have been of service to the farming population and we want to see a greatly increased circulation of the next issue.