COMPARISON OF PUMPS FOR WEED SPRAYING

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SUMMARY

THIS paper compares the various types of pumps commercially available at present in New Zealand suitable for weed spraying. Emphasis is laid on the fact that as most users drive their pumps directly from the power take-off shafts of tractors the pumps therefore require to be compact, light in weight, and relatively slow in their speed of rotation. The increased use of wettable powder weedicides has its problems when a suitable pump is being selected and some thought should be given to the choice of type. Rotary gear pumps, centrifugal pumps, roller pumps, and piston or plunger pumps are compared, the various attributes of each type being shown.

To be successful and economical the application of weed control chemicals depends on a number of factors. Efficient and reliable methods of spray application are of the utmost importance. In the past it was thought sufficient to squirt or pour the weedicides on to the pasture, crop, or scrub weeds to be controlled. Modern weedicides require to be applied accurately, and the results obtained depend very largely on the spray machinery used and the care and attention of the operator.

The advent of low volume nozzles has greatly increased the scope of weed control and has made possible the use of power-driven spray equipment. It is readily acknowledged that the pump is the most important part of a weed spraying unit, not only because it supplies the spray boom or spray gun with the required quantity of liquid at the desired pressure, but also because it is usually the most expensive component in the spray outfit.

Because of these factors careful thought should be given to the choice of a suitable pump. In New Zealand most pumps are driven from the power take-off shafts of tractors and therefore require to be compact, reasonably light in weight, and, above all, to be relatively slow in their speed of rotation, usually expressed in revolutions per minute. This speed may range from 200 to 600 r.p.m.

A pump for weedicide spraying must be capable of delivering the recommended quantity of spray at the required pressure, be reasonably simple in construction, must be as trouble-free as possible, and, above all, have a long service life.

Although most pumps will satisfactorily handle emulsions and solutions, they may not be suitable for suspensions of abrasive wettable powders or for working at higher pressures. If the pump is to be used solely for emulsions and solutions at low pressure, then the choice of type is relatively simple. On the other hand, however, if wettable powders are to be used or higher pressures employed, then the choice of a suitable pump is somewhat more complex. The question of wettable powder weedicides is growing more important than ever with the increased use of these and the possibility of the same pump being used for the application of insecticides and fungicides. It is advisable when buying a pump to consult the stockist, especially if it is to be used for such mixtures. The ultimate selection of a suitable pump therefore, will depend on several factors including the following:

Size of area to be treated.

Type of spraying; for example, low pressure, high pressure, wettable powder spraying, or a combination of all of these.

Size of spray boom to be used and the quantity of spray required per acre.

Number of spray guns to be employed, if any.

Price and ease of maintenance.

Type of user; for example, farmer, contractor, etc.

The different types of pumps commercially available at present, having some or all of the above desirable qualifications, are:

1. Rotary gear pumps.
2. Centrifugal pumps.
3. Roller pumps.
4. Piston or plunger pumps.

1. *ROTARY GEAR PUMPS*

The most popular types of pumps employed in the past have, without a doubt, been gear pumps. These are relatively low in price, require little maintenance, and are fairly simple in construction.

By definition a gear pump is a positive displacement pump with a circular motion, and can be divided into two categories, although the pumping action is similar.

Internal spur gear pumps: This type has four basic parts—internal gear or rotor, idler, crescent seal, and casing. While this type does not enjoy great popularity here, it is worthy of mention. Materials used in its construction are more often of cast iron with steel gears. The pumping action is brought about when liquid fills the space between the gear teeth as they unmesh on one side. This liquid is carried round in the tooth space to the opposite side and displaced as the teeth again mesh.

An internal spur gear type gives better pressure characteristics (up to 300 lb. p.s.i.) than the external gear, although it is somewhat more expensive. It is suitable for mounting on a tractor power take-off shaft, although its direction of rotation can be reversed only if provision is made for swinging the crescent through 180 degrees. With proper maintenance, such a pump should give 200 or more hours of service before replacement is necessary. The repair of a gear type is not really practical, as it is probably better and cheaper to replace it.

External spur gear pumps: In this type there are only three parts, two external gears and a casing. This is by far the most popular type of gear pump used in this country and is the simplest in operation. Materials used in the manufacture of these pumps vary somewhat, although probably the best for all-round service is phosphor bronze for the casing and gears, with stainless steel shafts.

The direction of rotation in the external spur gear pump is important; the side where the gears unmesh is the suction or intake side and the outlet or discharge side, on the other hand, is where the gears come together. In other words the rotation of these pumps is fully reversible. They are suitable for working pressures up to approximately 100 lb. p.s.i., and have a discharge capacity of from 4 to 8 gallons per minute. It is wise to provide such a pump with a surplus capacity of some 30 to 50 per cent. to compensate for a gradual falling off in operating efficiency.

Both types have good priming characteristics, as on a dry lift (unprimed) they will prime themselves up to approximately 10 ft. above the spray mixture. On a wet lift (primed) they will lift 20 to 30 ft. above the spray mixture. The life of this type of pump is largely determined by the intelligent greasing of it. It should be borne in mind that ordinary grease

is not satisfactory, as it is quickly removed by emulsifiable solutions. Special solvent greases are available and these are the only types that should be employed. To obtain the maximum life from the pump it is advisable to grease it at least every 2 hours of operation at the lower pressures and more often at higher pressures.

These pumps are ideal for emulsions and solutions when used for pasture or crop spraying where pressures of from 30 to 50 lb. p.s.i. are required. For the user with a small area of gorse or blackberry to control, using a spray gun or hand wand, they are quite satisfactory, provided pressures are kept below 100 lb. p.s.i. For the pumping of wettable powder slurries they are not really satisfactory and when used with such mixtures early replacement of the pump can be expected. Their main weakness is wear due to abrasion.

Abrasion or wear usually occurs in the gears, causing an over-all reduction of their diameter, and consequently increasing the tolerances between the gears and the housing.

A most essential accessory which must be used in conjunction with a gear pump or, in fact, any type of pressure pump is a suitable method of straining the spray mixture before it enters the pump. The importance of a good strainer cannot be over-emphasised, especially with gear pumps, as the failure to provide this will give similar results to those obtained when using wettable powder slurries through the pump. Either a line strainer or foot strainer can be used, and this should be fitted with 50 or 60 mesh gauze for best results. A point to check on carefully while spraying is the cleanliness of the strainer. If it is blocked, or partially blocked, it may cause collapse of the suction hose thereby starving the pump. It is as well to remember that if the pump is starved on the suction side, it cannot be expected to give sufficient discharge volume or pressure.

At this point the question of pressure control should be considered. With any type of weed spraying pump a method of pressure control must be provided for the following purposes:

- Relieving excess pressure.

- As a safety valve when the outlet is closed off.

- Providing liquid for by-pass back to the spray mix tank for agitation purposes.

A point to watch is that the pressure control is never screwed in to its full extent and also that the spring loading is always relieved before starting the pump. Few pumps will prime themselves if this simple rule is not followed.

2. CENTRIFUGAL PUMPS

These are not positive displacement pumps. Instead, they develop pressure from high liquid velocity imparted by the rapidly rotating impeller. They are not satisfactory for operation direct from power take-off shafts, as they require relatively high speeds (2,000 to 3,000 r.p.m.) in order to provide sufficient pressure for spraying. It is necessary to increase the pump's speed if it is desired to operate it from the p.t.o shaft and this can be satisfactorily accomplished by using belt or chain drive.

Ordinary centrifugal pumps have poor pressure characteristics unless they are of a special type or multi-stage design. They are not self priming and need to be provided with a foot valve to hold their suction, unless provision is made for a special priming device or priming tank to keep the suction line full. They do, however, have a place where large quantities of water are required, especially as a contractor's unit for quick filling of spray tanks.

Their greatest attribute, however, is for the pumping of wettable

powders. A single stage centrifugal pump giving pressures up to about 50 lb. p.s.i. is perhaps the most trouble-free pump available for this purpose, as clearances within the pump are large and suspended solids such as wettable powders can be used with them. Abrasion is therefore not a problem. A pump of this type can be used without the risk of undue wear taking place. If higher pressures are required, however, then this advantage is lost, as the internal clearances must be considerably reduced or multi stages used, which is more expensive.

There is a special design of self priming centrifugal pump available for the boom spraying of gorse, for which purpose it is ideal. This requires fairly high pressures (150 to 200 lb. p.s.i.) and a large volume of spray mixture per acre, usually from 200 to 300 gallons. With the increasing popularity of boom spraying of gorse, this pump will become even more widely used. The pressure of a centrifugal pump is sometimes given in head in feet. To convert this to pressure expressed in lb. p.s.i., multiply by $\cdot 434$, or to convert pressure in lb. p.s.i. to head in feet multiply by $2\cdot3$.

3. ROLLER PUMPS

These pumps are designed specially to fit directly on the tractor p.t.o shaft. The basic parts are body, rotor, end plate, and rollers. Nylon roller and rubber roller types are available, although nylon rollers are more commonly used and have greater non-wearing properties than rubber rollers. Both rollers are tough, water lubricated, and will withstand, with certain restrictions, some abrasive solids. The body, rotor, and end plate are usually made of Ni-Resist, a nickel-copper-chromium ferrous alloy cast iron, sometimes referred to as Austenitic stainless iron. Pumps in this class require no greasing or oiling of any kind, as they are equipped with permanently greased, shielded or sealed ball bearings, together with two spring loaded neoprene seals to prevent leakage of the liquid into the bearings. Maintenance is therefore reduced to a minimum. While Ni-Resist will not pit through corrosion as cast iron does, it may, however, rust. Flushing of the pump after use with a rust inhibitor is therefore necessary.

The pumping action of the roller type is brought about by the eccentricity of rotor and casing or body. As the rotor revolves the roller vanes follow the casing bore and displace liquid with every revolution. They are self-priming to 5 ft. and will hold their prime up to 25 ft. when primed. For the pumping of emulsions and solutions these pumps are very satisfactory at low boom spraying pressures on pastures or crops (30 to 60 lb. p.s.i.). On the other hand, they are well suited for gun spraying of scrub weeds such as gorse and blackberry at pressures up to 250 lb. p.s.i. Under these conditions they have a long service life, provided some attention is paid to straining of the spray mixture. A suitable strainer for a pump of this type should have 60-mesh gauze fitted for best results. To use a finer mesh strainer than this may cause unnecessary restriction on the suction side of the pump, resulting in reduced flow, pressure, and capacity. One of the characteristics of the roller pump is that at a given speed it will, at higher pressures, deliver considerably less water than at the lower pressures; although this applies to any pump of the rotary type to which both the gear and roller pumps belong. As to their suitability for the pumping of abrasive wettable powders, they are not satisfactory for this purpose at high pressures, but can be used at the lower pressures (below 80 lb. p.s.i.) when fitted preferably with rubber rollers.

For boom spraying, where pressures are low, these pumps have a distinct advantage, as they will handle a large boom for pasture or crop spraying and still by-pass adequate quantities of spray mixture back to the supply tank for agitation purposes.

4. PISTON OR PLUNGER PUMPS

There are a number of pumps in this category now available commercially which are designed for p.t.o. operation. One, two, and four piston types are available, and while this has a bearing on the discharge capacity of the pump, it is of little consequence with regard to its pressure range. They are true positive displacement pumps, as at a given speed pressure has little influence on their output. For example, if the rating of such a pump is given at 5 Imperial gallons per minute, the output at 30 lb. p.s.i. and 300 lb. p.s.i. will be practically identical. The output is in direct proportion to their driven speed. As in the above case where the pump has an output of 5 Imperial gallons per minute at, say, 500 r.p.m., then the output at 250 r.p.m. will be exactly half, in other words, $2\frac{1}{2}$ Imperial gallons per minute.

A piston or plunger pump is defined as having a to and fro motion; moving backward or forward or up and down, as distinguished from a circular motion. Before proceeding further we should know the difference between a piston and a plunger, as the word plunger is frequently used erroneously for piston. A piston is shorter than the stroke, whereas a plunger is longer.

While usually being more expensive than others, pumps of this type have a longer service life. They are equally satisfactory at either low or high pressures provided pulsation is kept to a minimum, especially in low pressure boom spraying, when these may be fairly critical. For wettable powder spraying they are also very satisfactory, as the majority of them are designed with this particular application in mind. Most have replaceable liners and these are sometimes made of stainless steel, which is an advantage especially if wettable powders are to be used extensively. Their main attribute is the ability to work at high pressure for long periods at slow speeds. They require greasing at regular intervals to be kept at their best, and the regularity of this will depend on the maker's recommendation. Straining of the spray mixture, while necessary, is not as important as in other pumps, as they can tolerate suspended solids very well. Failure to provide a strainer may, however, cause the valves to stick through some foreign body lodging under them.

CONCLUSION

In a short paper such as this it is not possible to deal with every type of pump, but I have endeavoured to cover the more commonly used pumps at present available in New Zealand. A separate paper could be given on contractors' pumps, for example, and this could include such additional types as turbine vane pumps, diaphragm pumps, and many others.

It can be seen that there are many available types from which to choose, and given reasonable care a good pump will last for many seasons of work, provided that the manufacturers' maintenance is carried out. It could also be said that a pump is only as good as the treatment it receives, so that if a pump of the positive displacement type is purchased, then the operator should make sure that its treatment will not make it a positive **replacement** pump.

DISCUSSION

Q.—Does dinoseb damage nylon pump rollers?

A.—Dinoseb was thought to affect rollers, but our experience is that although the rollers became harder no damage resulted.

Q.—Under what conditions of operation would a roller pump be suitable for use with wettable powders?

A.—A pump with rubber rollers operating at less than 80 lb. p.s.i. pressure.

Comment: The life of a pump is related to the particle size of the powder.

Q.—Are rubber pump rollers synthetic?

A.—Yes.