but in the field they all show little or no control. With these sulfurs we may be like two of the experiment stations were years ago. The one reported excellent control of a certain disease by dusting with sulfur; the other, inquiringly, informed the first that they were not securing such results. It is reported that the reply came back, "Perhaps you don't know how to dust with sulfur." So here, the sulfurs seem toxic, only we do not know how to use them at present. This season, we are trying more sulfurs in more combinations and with more applications of these mixtures than heretofore.

STEM-END ROTs

The stem-end rots of citrus are caused by two fungi, Diplodia natelensis Evans, and Diaporthe citri (Faw.) Wolf. This latter is the same fungus that causes melanose. Our interests have been primarily centered on it. Both of these fungi are very common in older citrus groves. They may be considered as sporulating most abundantly on dead wood; the Diplodia on large limbs and branches, the Diaporthe on the smaller citrus twigs. As considered in the fruits, these two rots are undistinguishable except by laboratory methods. The characters of stem-end rot are a soft, very pliable rot originating at the stem-end of the fruits.

There are increasing numbers of rules and suggestions for the control of these rots. The past publications of Stevens, Winston, Fulton and Wolf, as reported in the Proceedings of that Society, may be consulted for these more complete recommendations. At this time, we wish only to point out the fact that a certain amount of infection with the melanose fungus, resulting in stem-end rot, takes place in the groves as the fruits are developing. This early or grove infection seems to be present largely in a quiescent stage in the citrus buttons. Any practice for melanose control, as pruning and spraying, has materially lowered the percentage of stem-end rots of fruits in storage and transit. Spraying with Bordeaux this past season for melanose, showed a stem-end rot control varying between 0.0 and 60 per cent over the unsprayed checks. These grove practices are to be recommended as auxiliary measures to be used for the control of this type of rot.

HIGH PRESSURE SPRAYING IN THE CITRUS GROVE

Chas. D. Kime, Orlando

Spraying is again becoming a popular grove procedure, for which fact we can thank the Automotive industry. Yet with all of our progress the really difficult grove locations, where spraying is being done, are still in the test stage. The cost of the work as compared with the price of the resulting fruit crop will decide if our present equipment is good enough or too expensive to operate, and if it needs further development.

A good many of us remember the wheezy, vibrating noisy outfits of 1912 which we called spray outfits. Surprising to say, due to the effectiveness of the spray materials available even then, the old bamboo rod did effective work but it was slow, terribly slow, and impossible to use because spraying only five acres was quite a lengthy chore.

Since 1912 we have seen intensely interesting mechanical developments. And while there is still much to be desired, machinery adaptable to grove work is vastly better suited to our needs today than even so short a time as three years ago. Although its use seems to be well within the range of allowable grove cost, we will have to admit that cost figures are not very plentiful. With increased production and only the better grades of fruit bringing a good profit spraying is no longer a luxury but a necessity. As one grower very emphatically told me, "It makes no difference
what the cost is we have got to spray or quit growing fruit."

The hardest job of spraying in existence is right here in Florida. There are hundred of acres, yes even thousands of acres of grove now in heavy bearing lying on steep, sandy, curving hillside in Orange, Polk, Lake and other citrus growing sections, that must be sprayed, two, three, and occasionally even four times per year. At least one of these applications is likely to be needed when the sand is dry and bottomless. Yet due to the extent of the acreage these hillsides must be negotiated by power-driven equipment or left unsprayed. The bulk of our groves are only somewhat less difficult to spray than the above. All at some time are sandy and can be traversed by a tractor or truck only because we have paid special attention to tractive effort.

The development of better methods of securing traction in sandy going has made revival of spraying possible and as the most important factor in its revival, it seems pertinent to see what has been accomplished along this line. To this day rubber tires are still special equipment in tractor catalogues or else are not offered at all, and trucks as an aid to grove work are an unknown quantity. I am still amazed at the lack of information on securing better traction in sandy soils.

**Traction Tractors**

The use of discarded truck casings, such as the large 40x8 sizes, for securing greater pulling power apparently originated in Florida. The first of such assemblies of which I have any knowledge were built by Hoyle Pounds, of Winter Garden. Their great utility caused metal lugs to be entirely displaced so that today we see Fordson, Harts-Parrs, Internationals, Case, John Deere and all other tractors equipped with either dual or triple casings per side. Metal wheels for driving work are practically unknown and even the front steering wheels, with their knife-like metal rims are being displaced by rubber-tired equipment.

This past year two new types of driving casings have been tried extensively. They are "zero-pressure" casings with a metal ring at the tire beading vulcanized to the casing wall, and a low pressure balloon of large diameter running about 11.25"x24", and twelve pounds air pressure. This huge casing with its doughnut resemblance is a familiar sight to most of us.

The greater pulling power of this last addition to tractor equipment arises from the type of ground contact it secures in extremely sandy soils. It does have a large area in contact with the ground, about 115 square inches and because of the low pressure it tends to level out bumps and small ridges without having to lift the weight of the tractor in getting over them. With this tire, weights are added to the wheels, running in many cases three to four hundred pounds per wheel or six hundred pounds total so as to give it better pulling power, when operating under maximum loads and in extremely hard going such as dry sandy hill-sides. In other words even the doughnut tire does not solve the problem but is made extremely efficient (better than the discarded casing equipment, or smaller wheel equipment), by the addition of weights to the wheels.

Such equipment would undoubtedly last a long time and may compare favorably with any other type when sufficient comparative cost figures are available but whatever the cost, it offers a chance to operate spray rigs of large capacity in groves that have heretofore been sprayed only with much trouble and expense. The super balloon or mounted air pressure casings cannot be expected to displace the use we are now making of discarded truck tires of the larger sizes as this source of equipment is low in cost, in maintenance and what is of more importance, furnishes effective power for extremely difficult grove work. But the super balloon will outpull all other types.

**Grove Traction, Trucks**

Trucks of the latest dual or single wheel design are still "boggling" down in our groves; under load or empty they cannot negotiate difficult going with ease. If this is the case, we can hardly expect to load them with a 4 or 500 gallon tank, a spray pump of 25 gallons capacity and expect to operate the pump from power take-off and at the same time travel the grove row by row, turning at the end of each row. This very set-up is being tried this year. It is the very last and hardest test for endurance and ability, and frankly such loads seem to be beyond the ability of this type of truck. The power is there, possibly, but traction is likely
to prove insufficient as is the case occasionally in fruit hauling. In groves where traction is good or for lighter loads the dual wheels are fine but they have a definite limitation.

A newer development in truck hauling is represented by the dual drive, six-wheel outfits. Effective tractive effort in loose sandy soils is stepped up enormously. These outfits offer a distinct possibility as grove trucks for handling heavy, large capacity spray equipment row by row or any other way. They are giving an excellent account of themselves in taking fruit directly from the grove without any intermediate handling, and also in fertilizer deliveries to the grove direct.

Weight and power we have had for several years, in both trucks and tractor units but until recently the method of applying this power has received little consideration. The actual results already secured in field operation indicates that in the method of applying lies the solution.

Spray Pump

Since we have assurance of being able to get through the grove with High Pressure Sprayers of large capacity we are fully justified in considering the types available and the best method of operating.

The Pump

Increased capacity and reserve pressure are demanded of present spray machines. If we contrast the best of the outfits available today with those of a few years ago we find the following points incorporated:

<table>
<thead>
<tr>
<th>Cylinder size</th>
<th>Pump No. 1 Quadruplex</th>
<th>No. 2</th>
<th>No. 3</th>
<th>No. 4</th>
<th>No. 5</th>
<th>No. 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-cylinder</td>
<td>2½x2½</td>
<td>3-cyl.</td>
<td>3-cyl.</td>
<td>3-cyl.</td>
<td>3-cyl.</td>
<td>3-cyl.</td>
</tr>
<tr>
<td>Gallons per min.</td>
<td>20</td>
<td>45</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>34</td>
</tr>
<tr>
<td>Power needed</td>
<td>12</td>
<td>20</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Speed of pump</td>
<td>60-120</td>
<td>100</td>
<td>75</td>
<td>120</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>Pressures</td>
<td>400</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>400</td>
</tr>
<tr>
<td>Bearings</td>
<td>Plain</td>
<td>Timken</td>
<td>Ball &amp; roller</td>
<td>Timken</td>
<td>Plain</td>
<td>Timken</td>
</tr>
<tr>
<td>Weight</td>
<td>680</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>800</td>
</tr>
</tbody>
</table>

Pressures have increased from 300 pounds to 700 or even better.

Pump capacity has been stepped up from 10 to 12 gallons per minute to 30 gallons and even better.

The pumps speed have tended to increase from an average of about 50-60 to as high as 180 rpm or better.

With the increase in pump speed, bearings have been changed at vital points from plain to roller and ball bearings.

The cylinder size has remained about the same with a tendency to smaller cylinders rather then larger, 3½"x4" being the largest.

The number of cylinders have remained the same, three or four being used in all makes.

Porcelin lining is used in all types, though brass lining is supplied as regular equipment in some makes.

A careful comparison shows that some of the manufacturers have devoted much thought and care to their latest models, with the idea of producing a machine of ample reserve capacity, free from upkeep expense, of long and effective life and as light as experience and use of stronger metal alloys such as chrome-nickel iron would permit. These pumps are really precision built machines and largely eliminate the usual tinkering job of replacing plunger cups, valve gaskets, valve seats, etc.

The outstanding features of our spray pumps are reliability and consistent performance. It is a pleasure to use them.
The value of high pressure, large capacity outfits lies altogether in the speed of application and acreage covered. They have got to move. The old bamboo rods did and still do splendid work but they are slow. The one or two nozzle guns stepped up the time but coincident with their development injury to foliage became common.

In spite of the danger of injury from the force of application of the spray material the gun has developed into an efficient tool.

Its success depends in the user being able to spray fast, and consequently nozzle clogging was more serious than had previously been the case. To avoid this, larger disc openings were often substituted and this without any increase in pressure aggravated the foliage injury. The spread of spray material secured with the gun is determined by the whirlplate holes first, and second by the pressure. The number of holes in the whirlplate influences the drive of the spray and its spread. The angle on which they are bored, and the taper of the holes and their size will also influence the speed, drive and quantity of material delivered. The hand adjustment gives a long reaching type of spray that is sometimes necessary in spraying the tops of very tall trees. The spray gun is a better tool, under pressures that cause a fine, atomized spray than under lower pressures permitting a driving type of spray that will injure foliage and fruit.

With better pressures the atomizing nozzle has been grouped into the broom type of rod, as high as six being sometimes used to advantage on a single rod. With plenty of pressure and a small disc opening, such a collection of spray nozzles will cover a tree quickly and thoroughly with a fog of finely atomized spray material. The broom type of spray rod is not adjustable. It atomizes the spray when operating under suitable pressure, and practically eliminates application injury.

The “broom” is so efficient that many groves can be sprayed by sitting on the spray outfit and sweeping the trees as they are passed. When properly grouped they will actually reach to the tops of 30-foot trees. They will not always displace the gun for this work, as, if windy, the drift is difficult to control, hence the time spent in talk on discussing injury from “gun” spraying. If guns must occasionally be used their adjustment should be watched more closely.

The ideal combination from the growers standpoint is a 25-30 gallon pump that will safely reach a maximum pressure of at least 700 pounds, operating two spray rods of four nozzles each. Such an outfit would have to have a 400 gallon tank and ample power to operate at full pressure.

**POWER SOURCE**

Hauling a heavy load in soft going such as is found in many groves as previously pointed out takes plenty of power and exceptional tire equipment. If we add to this a power take-off for operating the spray pump, the load is enormously increased. Yet, because of their great utility and ease of handling, the power take-off is here to stay. It is true that spray rigs with their own separate engine are just as efficient and in the one point of steady power flow are superior to any

---

**Nozzle Discharge—Gallons Per Minute**

<table>
<thead>
<tr>
<th>Disc openings and size No.</th>
<th>.0465</th>
<th>.0635</th>
<th>.0781</th>
<th>.0635</th>
<th>.078</th>
<th>.0635</th>
<th>.078</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 56 No. 52 5/64</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pressures</td>
<td>GPM</td>
<td>GPM</td>
<td>GPM</td>
<td>GPM</td>
<td>GPM</td>
<td>GPM</td>
<td>GPM</td>
</tr>
<tr>
<td>300 lbs.</td>
<td>.90</td>
<td>1.37</td>
<td>1.80</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>350 lbs.</td>
<td>.96</td>
<td>1.48</td>
<td>1.93</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>400 lbs.</td>
<td>1.03</td>
<td>1.58</td>
<td>2.05</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>500 lbs.</td>
<td>1.15</td>
<td>1.78</td>
<td>2.27</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 nozzle broom @ 500 lbs.</td>
<td>4.60</td>
<td>7.12</td>
<td>9.08</td>
<td>5.72</td>
<td>7.28</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5/32 3/16 7/32</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.0 13.7 18.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.3 16.2 20.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.0 18.2 21.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>48.0 72.0 84.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
form of power take-off but it is much less con-
venient to keep up a separate engine for spray
work and haul around the added weight. In any
case we must have a hauling unit that with a small
amount of additional expense is capable of fur-
nishing the power to operate the sprayer as well
as for hauling it through the grove.

An inquiry among the users of high-powered
large capacity outfits lines up for us the following
ideas involving changes or adjustments the users
felt were advisable or necessary.

The power take-off for spray-pump operation
is giving wonderfully efficient service. It is
more satisfactory when located at the center than
when offset as is the case in some tractors. With
truck operation the offset on the take-off is less
important as the drive does not have to allow for
any free movement in getting to the pump.

Traction in the very heaviest of sandy soils
needs further improvement as the trouble most
frequently met with is lack of ability to pull the
spray outfit through the sand.

Higher pump pressures needed for increasing
reserve power.

Hauling units develop insufficient power to
operate pump and haul spray outfit at the same
time. (Tractor or truck.)

Height and width of entire unit needs designing
to suit the kind of grove where it will be used.
(Close headed trees, seedlings etc.)

Fuel cost needs reducing. (Use of distillate
where possible.)

In case of separate truck for the spray tank the
type of wheel mounting is very important.

Time can be saved by using a separate mixing
supply tank to keep sprayer supplied with material.

A gear-set on the pump is of advantage in groves
is necessary. This gives a two speed gear for the
pump alone and is set at the pump so as to operate
from the driver’s seat.

The larger pumps require 16 horse power to
operate at the required level. If a separate engine
is mounted a four cylinder is always better than
two or less.

Trucks secure their power output through engine
speed rather than through large cylinder displac-
ment. This is referred to as torque and secures
a most amazing amount of power from a com-
paratively small engine. There seems to be no
reason why in Florida soils at least the same pro-
cedure could not be applied to tractors as well.
The biggest objection to present tractor outfits is
lack of mobility and the addition of too much
permanent weight. In many cases models suitable
for all other grove jobs lack power output and
traction when it comes to hauling and operating
the spray outfit at one and the same time.

Variation in pump speed as operated from the
power take-off has not proven as serious as one
would expect in the larger outfits, but in the
smaller pump sizes the loss of time when changing
gears as reflected in spray passing through the
spray nozzle is serious. A greater air pressure
reserve tank would aid in overcoming this lag in
pressure and give also a more even flow of liquid
through the hose line with less vibration.

Road Speed. We are constantly demanding
more and more of grove machinery—and getting
it. Road speed or ability to travel quickly from
one grove to another is an ever present consider-
tion. After having attempted at one time to work
a number of small groves located at some dis-
tance from each other I am very firmly of the
opinion that only a few of the outfits of today
had better ever be taken from the grove at all. A
good roadspeed greater than fifteen miles per hour
is a necessity if an outfit is to be taken from one
grove to another.

Exchange houses are today taking the lead in
cooperative grove work. They are planning the
extended use of the spray outfits described here
for their members. There is great danger that
due allowance will not be made for the extremes
of conditions under which such outfits would
operate.