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A TRACTOR MOUNTED MULTI-BOOM SYSTEM FOR SPRAY APPLICATION TO SMALL PLOT TRIALS

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Summary

The development and design of a multi-boom system for spraying both tree fruit and ground crop, small plot, field trials is discussed. Results of one years use in the field have shown that the use of vertical boom systems for spray application to tree fruit and vines can increase efficiency and accuracy over and above traditional methods of small plot application techniques.

INTRODUCTION

The application of chemicals to small plot trials on fruit trees and vines has traditionally been done with hand spraying equipment. This method is not only tedious, hard on the operator and time consuming but also tends to inaccurate and uneven application, nor is it remotely similar to commercial application. For these reasons new methods were sought for small plot, single tree trials, and as a result the vertical boom system was chosen. After one seasons use the vertical boom system has proven its worth with both accuracy and speed of application as well as being easy on the operator.

BASIC DESIGN

The unit is constructed around an International Harvester Farmall Cub tractor. This tractor was selected due to its light weight, high ground clearance and availability of space for tanks etc. A tray was attached to the rear of the tractor to carry the pump and motor. To this tray mountings for both the vertical and horizontal boom settings were attached. The vertical boom mounting is designed to fold down alongside the tractor for transport.

Along each side of the engine/transmission casing panniers were mounted to carry seven 25 litre tanks. A removable, flexible, inlet/by-pass system was designed to couple into the 25 litre tanks as required.

At present a single boom is used for both the 'tree' (vertical) and 'crop' (horizontal) positions. It consists of a two metre length of 2 x 2 cm stainless steel box section onto which are attached 11 diaphragm check valves, at 18 cm spacing, each with its own separate shut off. On each end of the boom the nozzle bodies are equipped with swivel nozzles for added cover in the vertical position. For insecticide and fungicide applications for both tree and ground crops a D4/45 nozzle configuration is used. For herbicide application TJ 730308 nozzles are used. Quick action clamps and couplings are used to mount the boom in either of the two positions.

For added accuracy of application a ground driven speedometer was attached to the unit.

The total cost of the unit was \$2 255 plus a trailer, \$510. The accompanying diagram shows the details of the unit.

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OPERATION

With the boom in the horizontal position standard operation procedures are undertaken.

In the vertical position trees or vines are sprayed from both sides and speed is regulated to give the required accuracy. For early season treatments over blossom a speed of 4 km/h is opted for, reducing to 3 km/h when trees etc. are in full foliage. Speed is adjusted to give maximum cover at the run-off point. Pressures used vary with the density of the foliage. 550 kPa is sufficient over the blossom period, but an increase in pressure to 750 kPa for apples and 1 000 kPa for stonefruit is required during the full foliage period.

The tanks are filled with water (22 in all) prior to spraying, to which chemicals are added at the start of the application. Sufficient agitation is given by the by-pass during spraying but as an added precaution drums of spray mix are shaken by hand before being coupled up. At the end of each treatment drums are discarded. These are cleaned out at the end of the days spraying which allows maximum use of the available spraying time. Between treatments a full drum of water (25 litres) is pumped through the boom for cleaning purposes.

EFFICIENCIES AND RESULTS

For optimum efficiency trial design must be adjusted to both the crop and the machine. Where trials are conducted in crops with narrow in-row spacings and long rows replicates end on end along the row give optimum efficiency. On conventional tree fruit spacings square block trials are equally efficient. Although criticism can be offered against long row trial designs it does not appear that this type of design in any way affects the results.

Turn round time per treatment for a single tree plot fruit trial of five replicates is approximately 10 minutes. This allows maximum use of the available spraying time with even conditions over all treatments. When compared with hand-lance spraying a saving of 66% can be achieved in spraying time. Table 1 gives details of this as it applies to grapes.

TABLE 1: Comparative time factors of operation.

Crop; grapes	Hand lance application	Vertical boom application
No. treatments	4	4
No. replicates	5	5
No. vines/plot	3	3
No. operators	2	1
Man hours/application,		
bud burst	2.0	1.0
mid season	4.0	1.25
pre-harvest	5.0	1.5
Total man hours/season (10 applications)	38.0	12.5

Results recorded from various trials using the vertical boom system are given in Table 2. These show that differences between treatments are real and significantly different, and, coefficients of variation are as good as those from conventional methods of application. At times coefficients of variation have been as low as 7%.

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TABLE 2: Some results recorded from experimental areas using the vertical boom spraying method.

Crop; apples		
Fungicide	Interval (days)	Powdery mildew (% leaf surface infected)
Untreated control		35.4 aA
A @ 1.0	14	4.8 cC
A @ 1.3	14	4.0 cC
A @ 1.0	21	14.8 bB
B	14	9.0 bcBC
C	14	10.0 bcBC
D	14	10.2 bcBC
CV%		39.1
Crop; apples		
Insecticide	Interval (days)	Leaf roller (No. infestation points/tree)
Untreated control		4.2 aA
A @ 1.0	14	0.5 bB
A @ 1.6	14	0.3 bB
B	14	0.7 bB
C	14	0.3 bB
CV%		33.2
Crop; peaches		
Fungicide	Interval (days)	Brown rot (% infected blossom)
Untreated control		28.6 aA
A @ 1.0	7	17.6 bcAB
A @ 1.25	7	13.6 bcB
B @ 1.0	7	10.8 cB
A @ 0.5, B @ 0.5	7	12.2 bcB
C	7	19.9 abAB
CV%		40.7
Crop; grapes		
Fungicide	Interval (days)	Powdery mildew (% bunch infection)
Untreated control		26.8 aA
A @ 1.0	14	1.2 bB
B	14	0.4 bB
CV%		36.0

ADVANTAGES AND DISADVANTAGES

The advantages of the vertical boom system of spraying are:

- Evenness of application from tree to tree,
- Speed, volume per tree etc. can be kept constant,
- Added safety to the operator,
- Easy on operator, no working with heavy hoses,
- Increased speed of application,
- Atmospheric conditions are more even over all treatments,
- Negligible drift under calm conditions,
- Overspraying of some areas of the trees is eliminated,
- Closer to commercial methods than other methods,
- Water per plot can be accurately regulated with speed,
- One man operation.

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The limitations of the vertical boom system of spraying are:

Air conditions must be calm, a maximum of 1.5 - 2.0 km/h of air movement to avoid drift,

Crop height can not exceed 0.15 m over boom height for adequate coverage,

Turning areas must be available at the end of the trial rows,

In-row spacing must be sufficient to avoid overlap of treatments.

CONCLUSION

One seasons use of the vertical boom system has shown efficiencies in time, application and general trial accuracy. This coupled with ease of operation, greater safety to the operator and the system being more typical of commercial application gives real advantages for this type of application to small plot trials of tree fruit and vines.

SCHEMATIC DIAGRAM OF SMALL PLOT SPRAYER