# Improving the performance of automatic jetting races (AJRs) for the protection of sheep from flystrike

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## Summary

*Considerable evidence indicated that Automatic Jetting Races (AJRs) were not being as effective as they should be at protecting sheep from flystrike. Ineffective wetting was believed to be a major contributory factor. To examine this issue and to endeavour to make appropriate modifications to improve AJR performance, a series of experiments were undertaken to investigate the mechanical performance of the equipment to improve their efficiency and efficacy in controlling the sheep blowfly, L. cuprina. Results indicated that significant improvements can be made.*

*Following the release of the improved AJR design, concerns were held that the improved performance of the equipment may result in excessive pesticide residues in raw the wool. A further experiment was conducted indicating that the concentrations were no more excessive than good hand jetting when using either diazinon or cyromazine.*

**Keywords**
Jetting, automatic jetting race, sheep blowfly, pesticide residues, wool.

## Introduction

Effective jetting is only achieved by wetting the sheep to skin level in those areas most likely to be affected by flystrike *i.e* from the poll, over the shoulders, down the backline, over the rump and crutch areas and around the pizzle. Wetting to skin level maximises the efficacy of the pesticide, giving maximum length of protection. Automatic jetting races (AJRs) aim to achieve this and are an alternative to the much slower practice of hand held treatments. AJRs do however tend to use more chemical than hand jetting. Jetting through AJRs also has the potential to offer a much safer, quick and timely operation. AJRs are not recommended for lice treatments.

Work at Trangie in 1988 (Herdegen *et al.*, 1989) and by the Kondinin Group in 1991 (Hamilton, 1992) demonstrated that AJRs were less effective than hand jetting. Anecdotal field evidence from farmers and advisers also suggested that AJRs could be made more effective and labour efficient. As well, observation of working AJRs suggests that operators may be exposed to excessive pesticide spray drift. It was also noted at the time that a number of farmers had modified existing AJRs to improve their performance.

To minimise the amount of insecticide which remains in the wool at shearing, woolgrowers should minimise insecticide treatment whenever possible and aim to optimise the effectiveness of the necessary applications. One way to achieve this is to improve the machinery used to apply insecticide into the fleece.

As a result, NSW Agriculture, with funding from Australian woolgrowers through the International Wool Secretariat (IWS), conducted research to investigate ways to improve the performance of AJRs for the control of fly strike (Lund *et al.*, undated).

The principal aims of the project were to:

- Establish the required plumbing design, flow characteristics, droplet form, nozzle type, size and location for both intermittent and continuous flow AJRs to achieve maximum protection against flystrike.

- Make freely available the results to manufacturers to up-grade their product, to farmers to modify existing machines and to farmers to make an informed assessment of AJRs when purchasing a new machine.

To achieve this the work concentrated on (i) improving the plumbing design and components of intermittent jetting systems (those that are actuated by the sheep passing through the race) and (ii) on the wetting of the sheep.

## Results summary

The work indicates there are a number of principles that need to be followed when selecting and operating an AJR to achieve effective jetting of sheep for protection from flystrike. The results showed that each of the components tested:

- Plumbing size,
- Valve type,
- Accumulator (pressure cylinder),
- Nozzles,
- Spray bar arrangements,
- Spray bar height,
- Pump flow rates,
- Spray pressure,
- Sheep speed, and
- Volume applied,

had an effect on the operation of the system and had a significant effect on wetting sheep to skin level along the backline, crutch area and under the belly. The preferred design features are:

| | |
|---|---|
| Number of top spray bars | 2 |
| Number of nozzles per top bar | 3 or 5 |
| Top bar orientation | Longitudinal, 100 mm apart. |
| Top nozzle size | Solid stream (4.8 mm dia). |
| Top nozzle direction | Straight down, angled in. |
| Top bar height above sheep | 150 mm. |
| Number of bottom bars | 1 |
| Number of nozzles per bottom bar | 3 |
| Bottom nozzle size | Solid stream (4.0 mm dia). |
| Bottom bar arrangement | Across. |
| Bottom bar angle | $30^{o}$ forward. |
| Sheep speed | Less than 1 per second. |
| Manifold & Valve size | 40 mm dia. |
| Hoses and spray bars | 25 mm dia. |
| Accumulator (pressure cylinder) volume | Less than 2.5 litre |
| Valve type (for intermittent machines) | Quick acting gate or butterfly valve. |
| Operating pressure at nozzles | Greater than 450 kPa. |
| Pump specification | 6 l/s at 550 kPa. (6 kW: A little larger than the common "5 hp fire fighter"). |

## General discussion

A number of manufacturers have taken up the above recommendations and have in some cases, through their experience, made minor alterations to the spray bar configurations with good success. *e.g.* two longitudinal and one across top spray bar arrangement with nine nozzles. Two bottom spray bars, one to target the pizzle and the other to target the crutch, also appears to work well. A further modification could be the addition of a number of shut-off valves on the various spray bars such that jetting can be targeted onto a specific fly susceptible area of the sheep rather than all areas. This change would reduce

the volume of jetting fluid used and could possibly have a significant effect in reducing pesticide residue levels.

With respect to the jetting race construction, sides should be solid to direct the sheep's view of where to go. It should not look like a narrow tunnel nor should it appear cluttered. Although the parallel sided race appears to be the tried and proven design, the 'V' configuration may reduce any tunnel effect. Top spray bars may add to the creation of the 'tunnel' effect.

The floor of the race might also cause problems. A metal floor may make enough noise to cause the sheep to baulk. Wood or even polyurethane might be a preferred material (maybe for the complete AJR).

Intermittent machines tend to clutter the race with triggering mechanisms causing a visual blockage. If the actuating device could be less conspicuous then this might clear the sheep's view and reduce baulking.

Constant flow machines, incorporate the same spray-bar configuration, are less cluttered but, without some form of sump, may waste jetting fluid. The inclusion of an additional re-circulation pump and filtering are an additional complication, cost and add to the risk of infection.

With respect to the lead-in and lead-out race, the interfaces of the lead-in and lead-out races with the AJR are vital. They should be the same colour, shape, material etc. to maintain continuity. The use of flaps or hock bars is thought to be unnecessary and constitute ‘junk’ in the race. The race should have a north/south orientation to throw constant shadows.

## On-farm operation

First and foremost, the AJR should conform to the design criteria outlined above. The next issue is the pump.

***Pump selection***

Pump size is specified by its pressure/volume characteristics. The pumps' operating pressure point is determined by the nozzle requirements and pressure losses in the piping. The flow rate is determined by the number and size of nozzles and sheep speed. To minimise pump power requirements the recommendations on volume applied, sheep speed, pipe and valve size and system arrangements need to be followed.

Our work suggests that five to six litres of jetting fluid may need to be applied to sheep in full wool at a pressure > 450 kPa; 1/2 litre per month of wool growth. This suggests that a pump slightly bigger than the conventional "5 hp fire fighter" is required. Sheep in shorter wool require less fluid in which case the smaller pump may suffice in the short term (Check pump specifications: For jetting, volume is more important than high pressure).

***Sheep behaviour***

Because sheep speed was such an important factor in jetting performance and that sheep behaviour through jetting races was known to be an issue, an extensive review of the literature on sheep yard design was undertaken. In addition direct discussions were held with a number of recognised authorities on the subject of animal/sheep behaviour. This review and discussions suggested that the performance of the entrance and exit races adjacent to the AJR are particularly important components in controlling sheep flow, spacing and speed. A number of general recommendations with respect to the design and operation of AJR's and the immediate entrance and exit races are made. They are:

- At the entrance race, move sheep around a corner to achieve separation ie; around a bugle race;
- Remove as much 'clutter' from the AJR as possible;
- The AJR should have solid sides;
- Reduce the 'tunnel' effect;

- An exit race will both assist in encouraging sheep to run through the AJR and can be adjusted to control the speed of the sheep. A floor will also overcome any problems of excess water baulking the sheep;
- The AJR and the adjacent entrance and exit races to be the same material and colour.

***Operating costs***
Because the "improved AJR" is more effective than existing machines it is capable of providing longer protection from flystrike. Longer protection offers fewer repeat treatments. By reducing the number of machine treatments from three to two, savings are made in operator labour and mustering time.

The "improved AJR", whilst it may not quite match best hand jetting in terms of efficacy, will provide adequate protection from flystrike such that the frequency of jetting is the same as for hand jetting. There will also be the usual benefits AJR's offer such as a reduction in operator labour and improved timeliness of the operation. However, because the "improved AJR" uses more chemical, the direct costs per week of protection is slightly higher than that of hand jetting.

***Operator safety***
It has also been noted that the larger solid stream spray nozzles operating at lower pressures reduced spray drift. This has two effects. Firstly it significantly reduces the risk to the operators of pesticide exposure and secondly, in reducing the spray curtain effect, sheep movement through AJRs', particularly the continuous flow machines, is improved.

Operators should however still take reasonable precautions against pesticide exposure. A recent OH&S study of shower dip workers showed that full length cotton overalls, gumboots and a washable hat significantly reduced operator pesticide exposure.

***Sheep wetting***
When using the improved AJR, there are a number of adjustments and checks that need to be made as the first few sheep are jetted:
- On an intermittent machine, adjust the triggering arms such that the sheep fully open the on/off valve yet not so tight as to ‘jam’ the animal. If the adjustment is too loose jetting may be less than optimal.
- Adjust the longitudinal spray bars as close as practical to the sheep’s back and such that the sprays are hitting evenly each side of the midline of the sheep’s back.
- Jetting fluid dripping from the rib-line of the sheep is an indication of good jetting.
- After the first few sheep are jetted, check that the areas targeted for treatment are wet using an indelible pencil. Alternatively, a scourable coloured dye could be added to the jetting fluid. If there are still dry areas (i) the triggering mechanism may be too loose, or (ii) the pump pressure may need to be increased.
- If there is excessive wetting of the sheep and/or excessive wastage of jetting fluid the pump pressure may need to be reduced *i.e.* throttle the pump back.

## Pesticide residue ramifications

The improved AJR, by increasing the output of the pump unit in terms of volume, increased the amount of pesticide retained in the wool and increased the amount of pesticide placed at skin level in flystrike susceptible locations on the sheep. With the greater emphasis now on producing low residue wool, it was important to ensure that adoption of these modifications to AJR’s did not lead to a greater residue problem.

Further research (Levot, undated) compared the residue burden in fleece shorn from sheep treated four months previously by a) hand jetting, b) a standard AJR, and c) an AJR modified in accordance with the findings outlined above.

Results showed that on average, hand jetting applied 3.1 L of fluid per sheep. The standard AJR delivered 1.7 L/sheep and the modified AJR 4.5 L/sheep. Hand jetting also left significantly higher

diazinon residues than the modified AJR, which, in turn, left more than the standard AJR. Hand jetting and the modified AJR showed no significant difference in residue levels when using cyromazine. The standard machine was significantly lower.

Results also showed that the modified AJR, although more efficient than the standard AJR, was less efficient in delivering pesticide to the preferred sites on the sheep and significantly less insecticide was retained compared with hand jetting. The results with diazinon indicated that hand jetting sheep with 8 months wool would leave residues at shearing in the bale wool well in excess of proposed industry standards, as did the modified AJR. The result with cyromazine showed all treatments were within the proposed acceptable limits.

## Acknowledgments

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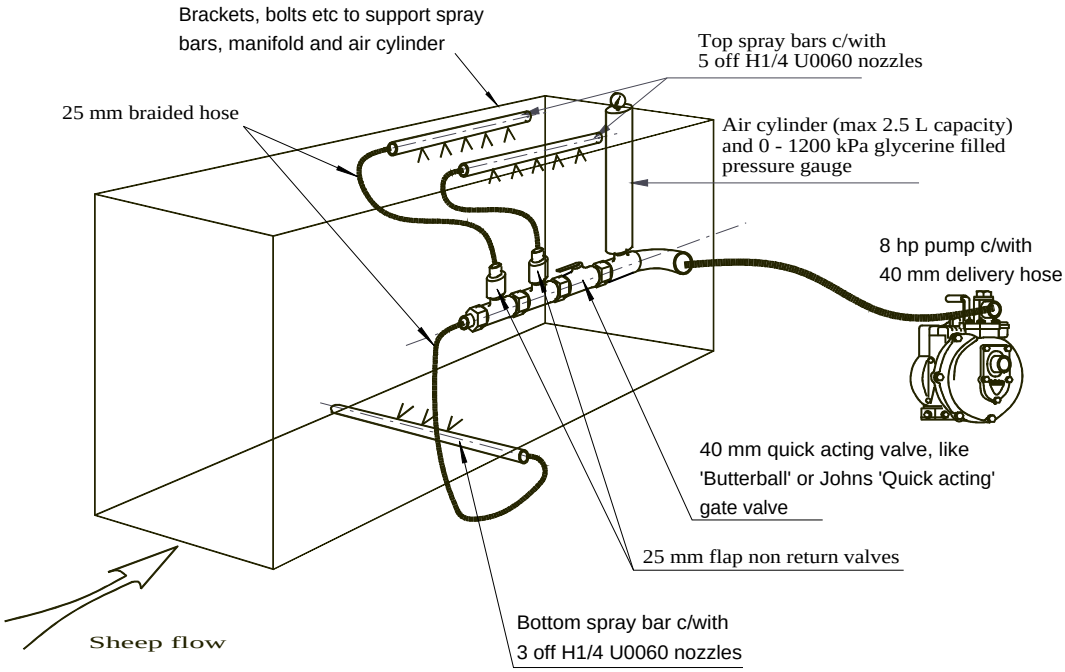
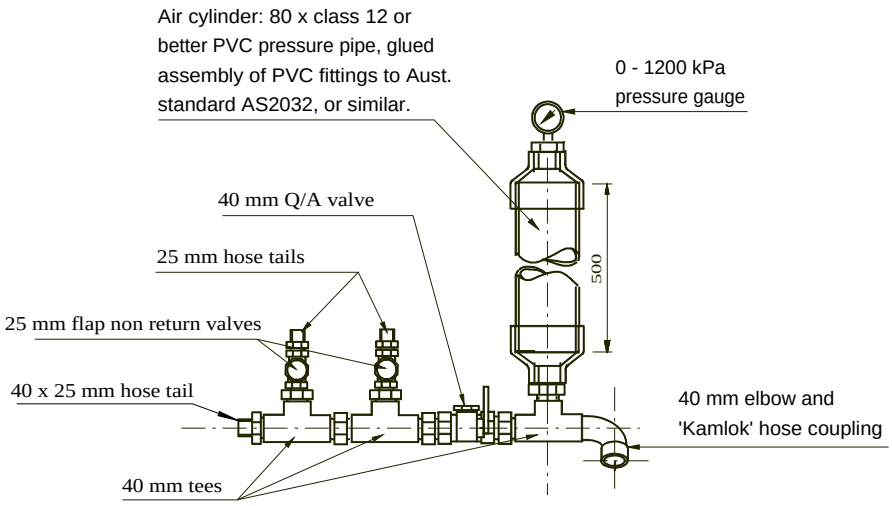
# Appendix 1.

## GENERAL ARRANGEMENT




## FITTINGS




Hint: Use rigid PVC/Polythene/Brass fittings where possible to avaoid corrosion problems.