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Dust elimination from outdoor feedlots for sheep

By D. J. Carter, Research Officer, Soil Conservation Service Branch

The humble woodchip, widely used as a soil mulch in Western Australian gardens, is set to take on a new role as a dust inhibitor in assembly yards used to hold live sheep for export.

Research by the Department of Agriculture’s Soil Conservation Service Branch has shown that, of the materials tested, woodchips were the most effective in preventing dust being generated. Wind speeds had to approach a “near gale” before dust developed from the protected soil.

The use of woodchips, therefore, provides a practical alternative to stabilising the soil and preventing an environmental problem associated with one of the State’s valuable export industries.

Assembly feedlots

Western Australia exports almost three million sheep overseas in any one year. Before shipment the sheep are assembled in large numbers in export feedlots for a pre-shipping adaptation period. As many as 100 000 sheep can be assembled at any time.

In an open feedlot the soil becomes highly degraded under the commercial stocking rate of about 1 000 sheep per hectare. When this degradation is coupled with the strong winds common in the south-west of the State, wind erosion occurs and the production of dust becomes a major environmental problem.

Most of the State’s live sheep assembly feedlots are located in the Baldivis and Mundijong areas south of the shipping port of Fremantle. Numerous complaints by neighbours have been made to the operators concerning dust, particularly during summer when the winds are more persistent and the soils drier and dustier than at other times. As a result of complaints, a research programme was started to overcome the dust problem from open feedlots.

Two soil stabilizing methods, oil (background) and woodchips under test. Below: Profile of the woodchips layer and soil. Woodchips acted as a mulch, absorbing the large quantities of dung produced by sheep.
Two strategies were adopted in consultation with the operators.

• A soil stabilisation process had to be implemented, and

• the area of the feedlot had to be reduced to lower the costs of soil stabilisation. However, the same numbers of sheep had to be assembled.

**Feedlot area**

By reducing the feedlot area, however, it was suspected that the subsequent increase in stocking rate could increase the number of "shy feeders" and lead to more deaths of sheep at sea. This had to be avoided. Experiments were set up in conjunction with the Department's Sheep and Wool Branch to test whether an increase in stocking rate during the assembly phase would increase the number of "shy feeders".

The average stocking rate for outdoor feedlots is about 1 000 sheep per hectare. The tested stocking rate was 5 000 sheep per hectare, or one sheep per two square metres. Although this reduced the feedlot area to a fifth of what it was, there was no significant increase in the number of "shy feeders" in the two experiments (Table 1). In the experiments, sheep were classified as "shy feeders" when they did not feed on both the fourth and fifth day of lot-feeding. Feeding behaviour was monitored by using a technique whereby animals which fed from troughs were marked by paint-soaked marker sponges fitted to bars on the troughs. To feed, sheep had to reach either above or below the bars, thus marking themselves.

The next step was to test several soil stabilisation methods with stocking rates of 5 000 sheep per hectare.

**Soil stabilisation**

Soil stabilisation experiments were conducted within the feedlot assembly over the summer of 1986. Small plots of 100 square metres, each containing 50 sheep, were treated with different materials likely to reduce dust. The materials tested were cement incorporated into the soil, Aqua Soil Wetter® Weslig 120® (an adhesive polymer product derived from pulping of wood), oil and woodchips.

Table 2 shows the rates of application, how the materials were applied and relative effectiveness. The "dustiness" of the treatments was determined by using a portable wind tunnel to simulate the wind speed of either the strong easterly winds or the south-westerly sea breeze.

### Table 1. Effect of stocking rate of sheep in export feedlots on incidence (%) animals classified as 'shy feeders'. (Data from C. L. McDonald.)

<table>
<thead>
<tr>
<th></th>
<th>1 000 sheep per hectare</th>
<th>5 000 sheep per hectare</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feedlot A</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Feedlot B</td>
<td>5</td>
<td>4</td>
</tr>
</tbody>
</table>

### Table 2. Soil stabilisation materials, application rates, methods of application and effectiveness in preventing dust

<table>
<thead>
<tr>
<th>Technique</th>
<th>Rate of application (per square metre)</th>
<th>Method of application</th>
<th>Effectiveness (the more stars the better)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aqua Soil Wetter®</td>
<td>5 ml</td>
<td>Spray on soil surface, 200 L water with 50 L product</td>
<td>*</td>
</tr>
<tr>
<td>Oil</td>
<td>2 L</td>
<td>Surface spray, 1:3 diesel: oil v/v</td>
<td>**</td>
</tr>
<tr>
<td>Cement</td>
<td>25 kg</td>
<td>Rotary hoe plus compaction into top 100 mm of soil</td>
<td>***</td>
</tr>
<tr>
<td>Weslig 120®</td>
<td>2 kg</td>
<td>Rotary hoe plus compaction into top 100 mm of soil</td>
<td>***</td>
</tr>
<tr>
<td>Woodchips</td>
<td>0.1 cubic metre</td>
<td>Surface application, 100 mm thick</td>
<td>****</td>
</tr>
<tr>
<td>Untreated</td>
<td></td>
<td></td>
<td>*</td>
</tr>
</tbody>
</table>

A combination of wind and mobs of sheep on bare areas can cause dust.
All materials tested under the higher stocking rate reduced the amount of dust produced compared to that generated from untreated plots stocked at 1,000 sheep per hectare. The surfaces of untreated plots stocked at 5,000 sheep per hectare were strongly compacted when compared to the commercial stocking rate. This compaction reduced dust levels even in the untreated soil, but plots were still dusty enough to cause off-site problems.

When no materials were applied to plots stocked at 1,000 sheep per hectare, wind speeds as low as 28 km/hour (a gentle to moderate breeze) stirred up enough dust to cause a nuisance. The use of Aqua Soil Wetter® or oil, both sprayed on to the soil surface, controlled dust at similar levels for wind speeds of up to 45 km/hour, but the oil spray proved slightly more effective than the Aqua Soil Wetter® under stronger winds. Wind speeds were almost doubled, therefore, before dust became a problem from these treated surfaces.

The cement and Weslig 120® treatments were both very successful at stabilising the soil surface and preventing dust movement. However, dung quickly buried the treated soil surface, thus eliminating its effectiveness. The dung was then compacted onto the surface, becoming a source of dust itself. For this reason, these treatments were not considered successful in overcoming the dust problem.

Woodchips proved the best material for reducing the amount of dust, with no dust developing from the woodchip layer until wind speeds reached 65 km/hour, equivalent to a 'near gale'. They acted as a mulch, absorbing the large quantities of dung produced by sheep at the high stocking rate, and were highly successful in eliminating the dust problem.

However, the use of woodchips involves different management techniques. The build-up of dung over a prolonged period (e.g. 12 weeks of continuous use for a 100 mm thick layer or one year normal intermittent use) eventually swamps the capacity of the woodchips to absorb moisture, and the surface again becomes a source of dust. There is thus a need to regularly replace the woodchips with a fresh layer.

For example, the spent dung-woodchip layer could be scraped off the soil surface with a front-end loader and processed by sieving to remove the dung, which could then be used in compost or soil mixtures as a high quality soil improver free of weed seeds. (These seeds are destroyed during processing of feed pellets.) The separated woodchips could then be re-applied, thus avoiding the costs of buying additional material.

The use of woodchips as a soil stabilisation system for outdoor feedlots may involve more management than present systems, but this system would greatly reduce or even eliminate dust problems from open feedlots.

Wind breaks of trees planted around assembly paddocks to reduce wind speeds across previously open soil surfaces would also reduce erosion and enhance the effectiveness of the woodchips. They would also provide shelter for sheep during the cold, wet, winter weather.

**Costs**

The only alternative to the recommended system of using woodchips would be complete shedding of sheep on raised floors. This system has proved successful, but it is expensive. It would cost about $5 million to house 100,000 sheep in sheds. Removal of dung must also be considered.

Woodchips cost about $1.50 per square metre to a depth of 100 mm. It would cost about $300,000 to cover an open feedlot for 100,000 sheep, excluding application costs. However, sheep are not continually on the feedlot during the year. A single application could last at least a year without replacement, depending on the number of sheep shipments through the feedlot.

The disadvantages of using woodchips are the labour and equipment required to spread and maintain an adequate layer of woodchips, and the high turn-around costs. The large expenditure associated with building sheds is a once-off cost. Where sheep cannot be housed in sheds, particularly when their numbers exceed the available shed space, and have to be run in the open, woodchips are recommended.