Supercow: A Liquid Manure Applicator for Small-Plot Research

Andy I. Bary,* Dan M. Sullivan, Steven C. Fransen, and Craig G. Cogger

ABSTRACT

Small-plot research in manure nutrient management requires accurate manure applicators that are easy to operate and maneuver. Our objective was to design a small-plot liquid manure applicator that could apply variable rates of dairy manure containing up to 60 g kg

-1 solids to perennial grass plots while avoiding traffic and compaction on the plots. The applicator consists of a 1000-L fiberglass agitation tank mounted on four load cells, a delivery pump and motor, and a side-mounted boom with four nozzles for manure application, all built onto a wagon and towed by a tractor. The side-mounted boom allows manure application without traffic on the plots. Manure application typically was within 7% of the target rate and had a coefficient of variation ranging from 2 to 17%, measured over a series of rates from 53 to 211 Mg ha

-1 (wet weight). The precision, accuracy, and ease of operation of the applicator met our research requirements. Efficiency of operation could be improved using a larger agitation tank.

RESULTS AND DISCUSSION

Table 1 shows the means and standard deviations of manure applications from 19 application sets done on eight dates during a season of manure application. Solids content of the manure ranged from 31 to 49 g kg

-1. Mean manure application rates were within 7% of the target rate for all but one application set (Table 1). The coefficient of variation within an application set ranged from 2 to 17% and decreased with increasing target rate. In a separate test, we measured the delivery rate of each of the four nozzles on the boom. The coefficient of variation among nozzles ranged from 2.9 to 4.7% (n = 11 trials, data not shown).

To determine the effectiveness of agitation in the supercow, we mixed high-solids slurry (53–67 g kg

-1 solids) in the tank. We collected slurry from the sampling port at three times during the application cycle:

1 Use of trade names is for informational purposes only and does not imply endorsement by Washington State University or Oregon State University.
Table 1. Means and standard deviations of supercow manure application rates.

<table>
<thead>
<tr>
<th>Target rate</th>
<th>Date</th>
<th>No. of replicates</th>
<th>Mean</th>
<th>SD</th>
<th>CV</th>
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<tr>
<td>Mg ha⁻¹</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>53</td>
<td>3 May</td>
<td>4</td>
<td>53</td>
<td>2</td>
<td>4</td>
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<tr>
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<td>3</td>
<td>51</td>
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<td>12</td>
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<td>12</td>
<td>54</td>
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<td>17</td>
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<tr>
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<td>12</td>
<td>59</td>
<td>6</td>
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<td>16 Aug.</td>
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<td>8</td>
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<tr>
<td></td>
<td>3 May</td>
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<td>108</td>
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<td>11</td>
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</table>

† Does not include one application where the tractor was run in the wrong gear.

because of water leakage. We subsequently protected the readout and junction while washing or storing the supercow.

The 1000-L tank was only large enough to cover one to four plots before refilling. Also, the manure tended to foam during agitation, reducing the effective volume of the tank. The small size of the tank combined with the large size of the pump probably increased the amount of foaming. The supercow could accommodate a larger tank, and we recommend a 2000-L tank as a future modification to increase volume and reduce the potential for foaming.

The applicator parts cost $15 900. The most expensive parts were the pump and motor ($7300) and the load cell and readout system ($5100). Both of these had more capacity than needed and could be reduced in size to reduce cost.

ACKNOWLEDGMENTS

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REFERENCES