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Productivity and Economics of Nurse Trucks for Manure Transport

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The profitability of livestock operations depends upon the ability to efficiently recycle manure nutrients and reduce commercial fertilizer use. Record high fertilizer prices have created an incentive for crop producers to use manure as a crop nutrient source, thereby expanding the land base available for manure application. A larger land base provides flexibility in timing manure applications and reduces the tendency to over-apply on a limited amount of land. Recent technological improvements have increased manure handling efficiency. Large spreader tanks and transport vehicles have been developed, and in-field relay tanks and nurse trucks with boom extensions have improved the effectiveness of over-the-road hauling.

New Study

Farm managers need information about equipment capacity and cost to select machinery to complete field operations within the time available. We recently completed a study of the productivity of 13 manure hauling systems used by custom applicators in 10 farms in Michigan, Ohio and Ontario. Custom applicators used tractors designed for rapid (25 mph and greater) over-the-road transport, or nurse trucks ranging in size from 6,000 to 9,000 gal for over-the-road transport to tank spreaders in the field.

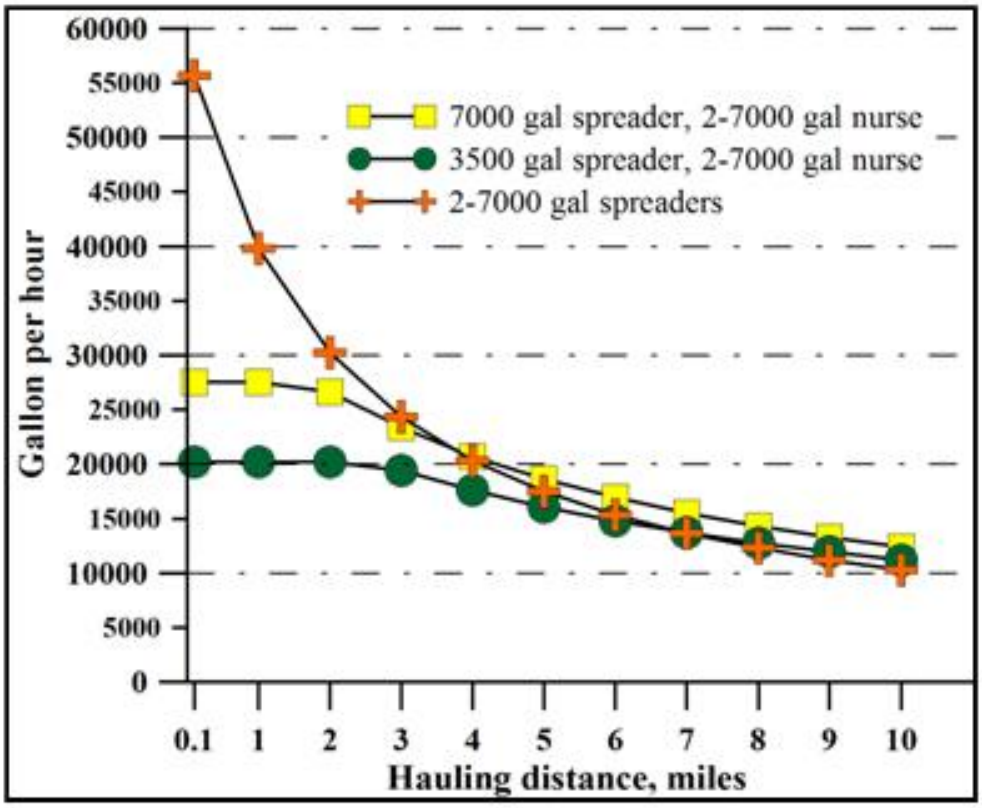
Compared with tank spreader/nurse truck systems, tractor-drawn tank spreaders alone are more productive when fields are close to storage because there is no in-field nurse tank-to-spreader transfer, but the hauling rate of tank spreaders declines rapidly as the hauling distance increases. Tank spreader productivity drops by 50% with a 3-mile haul (Figure 1). Nurse trucks have an advantage with longer hauls because of faster travel speed. Nurse trucks over-the-road typically average about 10 mph faster than high-speed tractors.

What We Found

When hauling from nearby storage, two 7,000 gal tank spreaders were twice as productive as one 7,000 gal tank spreader working with two 7,000 gal nurse trucks. When the hauling distance was three miles or more the productivity of each system was nearly equal (Figure 1). When the nurse trucks and spreader tank were the same size the spreader worked at full capacity and had no idle time within 1.7 miles of the pit. The hauling capacity was about 27,600 gal/hr. Beyond 1.7 miles the productivity dropped because the tractor-spreader applied manure faster than the nurse trucks delivered it. Additional nurse trucks, about one per mile of distance hauled in this case, were needed to keep the tank spreader working near full capacity as the hauling distance increased.

Tank spreaders with one-half the volume of the nurse trucks were used to reduce the potential for soil compaction and improve in-field maneuverability. When one 3,500 gal spreader was used with two 7,000 gal nurse trucks the tank spreader had no idle time within 2.6 miles of the pit and the hauling capacity was about 20,200 gal/hour. Compared with a 7,000 gal spreader, the 3,500 gal spreader reduced the hauling capacity by 17% with a 3-mile haul.

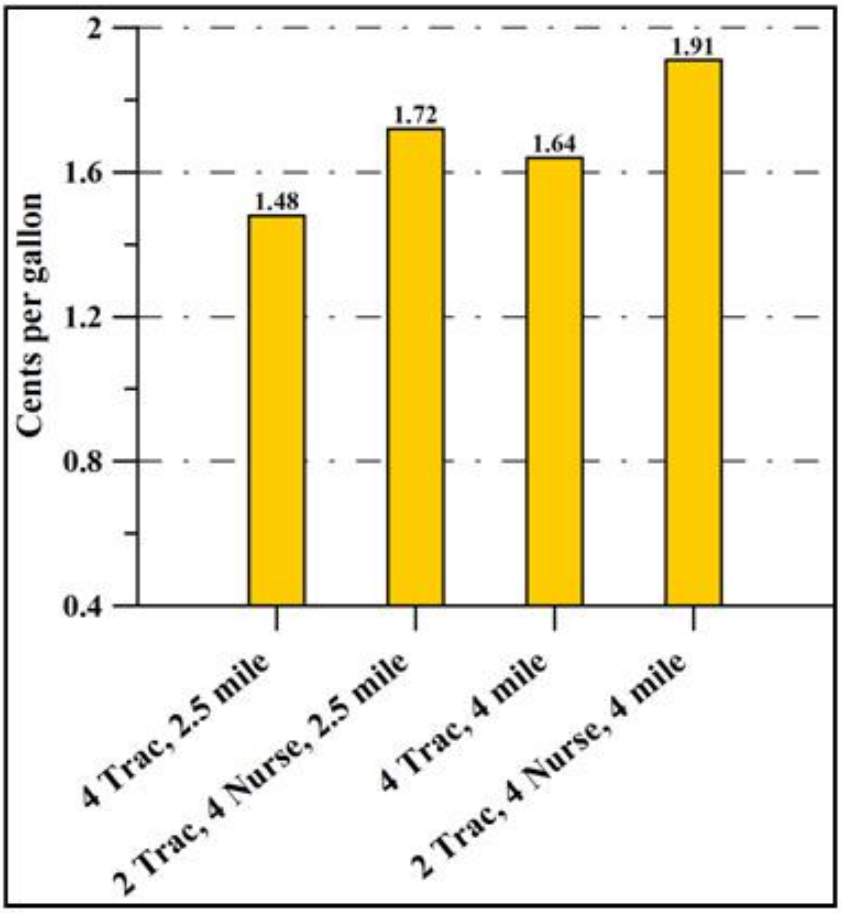
Figure 1: Hauling rate of two 7000-gal tank spreaders compared with one tank spreader with two nurse trucks.



Economics of Manure Transport with Nurse Trucks

We evaluated the costs for manure pumping and agitation, transport and application for a 1,400-cow dairy using either surface broadcast with tillage incorporation or subsurface injection with a 6-point injector. The dairy applied 12.2 million gal/yr on fields from 1 to 4 miles from the pit. The average hauling distance was 2.5 miles. Two hauling systems were evaluated. One system used four 9,000 gal tank spreaders with 6-pt injectors and 240 hp tractors. Two large lagoon pumps were used for pit pumping and agitation. The farms average hauling rate was 58,600 gal/hr but field-average rate ranged from 71,000 gal/hr within 1 mile of the pit to 42,800 gal/hr with a 4-mile haul. Twenty-six 10-hr days were needed for transport and injection with the 4 tank spreaders.

Figure 2: Manure pumping, agitation and injection costs for a 1,400-cow dairy with four 9,000 gal tank spreaders or 2 tank spreaders with 4 nurse trucks with an average hauling distance of 2.5 or 4 miles.



An alternative hauling system used two 9,000 gal tank spreaders with four 9,000 gal nurse trucks. The tank spreaders were used for hauling to fields less than 3 miles from the pit and the nurse trucks were used with the tank spreaders when hauling to fields 3 or more miles from storage. When hauling to fields near the pit this system cut productivity by one-half, but it improved productivity when hauling to fields 3 to 4 miles away. Compared with four tank spreaders the farm-average hauling rate with the nurse trucks decreased 26% to 43,100 gal/hr. Thirty-one 10-hour days were needed for transport and injection compared with 26, 10-hour days for four tank spreaders.

The cost for pumping and agitation was 0.17 cents/gal for each system. Transport and injection was 1.31 cents/gal with four tank spreaders and 1.55 cents/gal with two tank spreaders and four nurse trucks. The total cost for injection with the four tank spreaders was 1.48 cents/gal, $129/cow/yr. The total cost with four nurse trucks was 1.72 cents/gal, $152/cow/yr. Transport and land application accounted for about 90% of the total cost. The cost of injection was about 10% greater than surface broadcast with tillage incorporation.

We evaluated the effect of distance on labor and hauling cost by increasing the farm-average hauling distance by 50% to 4 miles with fields ranging from 1.5 to 6 miles from storage. The longer hauling distance reduced the productivity of four tank spreaders by 13% and reduced the productivity of two tank spreaders with four nurse trucks by 11%. The labor requirement

increased from 26 to 31 days with four tractor-drawn spreaders, and from 31 to 37 days for the spreaders with nurse trucks. The total cost for pumping, agitation, transport and injection for four tank spreaders with the extended hauling distance was 1.64 cents/gal ($143/cow/yr) and 1.91 cents/gal ($169/cow/yr) for the spreader/nurse truck system.

Summary

Manure generally is applied to cropland either in the spring before planting or in the fall after harvest. Manure hauling operations must align with other field work to make efficient use of equipment and labor and prevent delays in field operations.

Semi-tractor-drawn nurse tanks for over-the-road transport can provide flexibility in scheduling field operations and increase the productivity of tractor-drawn tank spreaders when applying manure to fields more than three miles from storage. Nurse tanks are less costly than tank spreaders. A large nurse tank with hydraulics and a boom extension costs about $25,000 compared with $90,000 for a large tank spreader with an injection unit. Custom applicators have access to the large and specialized equipment needed for timely and cost-effective manure application. A typical hourly charge for custom hire of a large nurse truck is about $100/hr. Custom hire of manure hauling services may be a good business decision for livestock producers.

For more information about the on-farm study and economic evaluation involving custom manure applicators please refer to: Tim Harrigan, Biosystems and Agricultural Engineering, E-mail: harriga1@msu.edu or Phone: 517-353-0767.