Manure Tankers: Tires and Toolbars
(2006 Wellington County SCIA Major Grant Project)

Purpose: To examine the impact of tire types and application systems on manure tanker efficiencies.

Manure Tanker Tires: Radial tires have proven to highly effective in distributing weight, lowering soil contact pressures and improving traction on farm tractors. Over the last few years radial tires have become available for towed vehicles such as manure tankers and grain carts. On a fully loaded manure tanker a radial tire inflated to its lowest warranted pressure exhibits a significant sidewall bulge. This bulge has left some producers with the concern that they might be harder to the same tanker equipped with bias ply tires and higher inflation pressures. This project set-out to compare the draft requirements for two identical manure tankers equipped with comparable size tires in either bias or radial formats.

Figure 1. shows the two tankers, the tire weights, inflation pressures, and footprint size. An experiment was designed were each tanker was pulled through 8 replicated plots. Four of the plots were undisturbed wheat stubble; four were chisel plowed to a depth of 8 inches (20 cm). An instrumented tractor courtesy of Dr. N. McLaughlin, AAFC, Ottawa was used to pull the tankers through each plot while recording draft forces. Table 1 highlights the draft results and points to the fact that the tanker with radial tires was easier to pull than the bias tire equipped tanker in both the firm, untilled ground and in the worked ground. The myth is busted. Radial tires reduce soil contact pressure and although they may give the appearance of being similar to pushing a wheel barrow with a flat tire - the draft requirements were actually lower than traditional bias ply tires.

Figure 1. Bias ply and radial tire configurations

Bias ply tire.
Front axle weight 10,400 lbs, 23 PSI
Rear axle weight 12,200 lbs, 27 PSI
Tire footprint:393 sq. in.

Radial tire.
Front axle weight 10,400 lbs, 15 PSI
Rear axle weight 12,200 lbs, 20 PSI
Tire footprint: 611 sq. in.

Table 1. Impact of tire design and inflation pressure on draft.

Soil Surface Conditions	Bias Front 23 psi Rear 27 psi	Radial Front 15 psi Rear 20 psi
	------ draft (lbs) -------	
Tilled (chisel plow 8" deep)	2500	2100
No-Till (short wheat stubble)	1700	1300

Manure Application Systems: Various liquid manure application systems were also compared for draft, fuel use, and ammonia losses. Application systems included: 1) broadcast, incorporate with tillage after 6 hours, 2) broadcast, incorporate with tillage after 24 hours, 3) rotary spike (aerate the soil) immediately ahead of broadcast manure with no further incorporation (see Figure 2), 4) vertical tillage using Great Plains – Turbo-till to loosen soil ahead rotary spike application system, and 5) s-tine injection of manure (see Figure 2).

Figure 2. Application system comparisons at Wellington County Manure Day

Nuhn S-tine injector.

Nuhn Rotary spike

The ammonia losses were examined by placing ammonia "traps" over portions of the plot area immediately after manure application. Ammonia losses were measured for one week following application. The results from the ammonia loss measurements are illustrated in Table 2. It was apparent that shallow pre-tillage at this study did not reduce ammonia losses from the manure compared to broadcast and incorporation at either the 6 or 24 hour post-application mark. The s-tine injection system did however show significantly lower ammonia losses than any of the other approaches.

Table 2. Ammonia Loss Measurements		
Manure Application System	**Ammonia Gas Release (accumulated PPM)**	**Nitrogen Equivalent (approximate kg N/ha lost)**
Broadcast - 6 hour incorporation	47	14
Broadcast - 24 hour incorporation	75	22
Applied behind Rotary Spike	108	31
Pre-tillage with Turbo-till, then applied with Rotary Spike	92	27
Injected with S-tine	2	0.6

Conclusions and Next Steps: Producers considering the purchase of a manure tanker or grain buggy should weigh the potential advantages of radial tires (which include both lower soil compaction risk as well as lower draft requirements) against the additional costs. Those producers on soils with higher clay contents, who need to spread manure and/or harvest at points in the season when soil moistures are often high, and/or those trying to reduce tillage intensity stand to see the greatest benefit.

It appears that relatively rapid incorporation of manure with a tillage pass (within 6-24 hours), or light pre-tillage ahead of a broadcast liquid manure application are not as efficient in reducing nitrogen loss as a direct injection system.

Further data from this project including fuel consumption, other pre-tillage impacts and the draft requirements for a range of tillage and injection system will be available in a subsequent report.

Acknowledgements: Support for this project by the following is gratefully acknowledged.

Wellington SCIA	Husky Farm Equipment
Ontario SCIA	DeBoer's Equipment
Dr. Neil McLaughlin, AAFC, Ottawa	EMS Farm Equipment
Soil Conservation Council of Canada	Great Plains Manufacturing
Brian Dunk Farms	Sunflower Manufacturing
University of Guelph	Salford Farm Machinery
Michelin Tire	Swanston Farm Equipment
Nuhn Industries	Canadian Agricultural Producers Addressing Environmental Issues Program

Project Contact:
Greg Stewart, OMAFRA Corn Specialist. Email: greg.stewart1@ontario.ca