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Staff photo.

Strategies for applying manure for the best economic return

Dragline application is the most efficient method of manure application. Optimize equipment and hose selection to create the best economic return on this method.

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Manure application is a fast-growing industry, with more farmers looking for alternatives to commercial fertilizer. Manure is proven to be a balanced nutrient product for farmers. Not only does it supply nitrogen needs for a crop, but in the same application, it supplies phosphorus and potassium needs as well.

Dragline application is the most efficient method of manure application for larger sites and high-volume jobs. Choosing a dragline operation over a manure tank and other application methods is dependent upon your unique situation at each job. The window of opportunity for application after harvest and before the ground freezes is a major variable in your decision. Alternative methods can take longer to complete with fewer gallons applied per hour compared to dragline, and that efficiency drastically decreases as the distance manure is transported increases. The application rate per acre of manure is also a variable to consider when switching to a dragline operation.

Studies have shown that dragline manure application can be three times more efficient and profitable compared to other methods, like tanker application. However, dragline systems can struggle when fields are small, long distances from the site and require less than 3,000 gallons per acre. When you've reached the point where you are applying over 20 million gallons in your operation, the efficiency of dragline outweighs the familiarity of manure tanks. Custom applicators can create a dragline operation with the greatest efficiencies and return on their investment by optimizing their engine and hose size.

Choosing a hose size for the best efficiency

The average mainline and drag hose sizes have increased in recent years as applicators are achieving higher flowrates. When choosing the hose you'll use for dragline application, the size in diameter can make a big difference. As you increase in hose diameter, pressure loss decreases. Inversely, pressure loss increases as you increase flowrate. As you increase your gallons per minute, your hose should also increase in diameter to prevent pressure loss.

The two main things to consider when looking at increasing your hose diameter are how many gallons you are intending to apply and how quickly you need to get the job done. These two considerations take into account the most expensive variables in your operation outside of equipment cost: labor and fuel consumption. A larger-diameter hose can expand your distance between booster pumps. Combining the right hose size with the proper horsepower can optimize your dragline operation's efficiencies. Getting the job done faster with larger hose may cut down on potential labor and fuel costs, and it may also provide more time to take on more jobs in a season.

If you know your flowrate, a Hazen Williams chart can help visualize the pressure loss associated with hose size. Using the chart in **Table 1**, we can find the pressure loss in an 8-inch drag hose pumping at 3,000 gallons per minute. The first step is to find your hose size at the top of the chart. Then, find your flowrate on the left or right side in gray and follow it across the row to your hose size. The number found under PSI units will be your pressure loss at that rate with that hose. In our example, we have 28 PSI of pressure loss when using an 8-inch hose. However, if you were to move up to 10-inch hose at the same rate, you would have only 9.5 PSI of pressure loss (**Table 2**).

TABLE 1 Hazen Williams chart of the pressure loss in an 8-inch drag hose pumping at 3,000 gallons per minute

Flow (GPM)	5"*			5.5"			6"			Flow (GPM)	7"			8"			10"			12"			Flow (GPM)
	HEAD LOSS		V	HEAD LOSS		V	HEAD LOSS		V		HEAD LOSS		V	HEAD LOSS		V	HEAD LOSS		V	HEAD LOSS		V	
	Feet	P.S.I.	FT/S	Feet	P.S.I.	FT/S	Feet	P.S.I.	FT/S		Feet	P.S.I.	FT/S	Feet	P.S.I.	FT/S	Feet	P.S.I.	FT/S	Feet	P.S.I.	FT/S	
800	54	82	**13**	34	15	11	22.4	10	9	800	11	4.6	7	5.5	2.4	5	2	0.8	3.3	0.77	0.3	2.3	800
1,000	82	35	16.4	52	22	**13.5**	34	15	11	1,000	16	7	8	8.4	3.6	6.4	3	1.2	4	1.2	0.5	2.8	1,000
1,250	124	54	20.4	78	34	17	51	22	**14**	1,250	24	10.5	10	13	5.5	8	4	2	5	1.8	0.8	3.6	1,250
1,500	174	75.5	24.5	109.7	48	20	72	31	17	1,500	34	15	**12.5**	18	8	9.6	6	3	6	2.5	1.1	4.3	1,500
1,750	232	101	29	146	63	24	95	41	20	1,750	45	19.5	15	23.5	10	11	8	3.5	7	3.3	1.4	5	1,750
2,000	297	129	33	187	81	27	122	53	23	2,000	58	25	16.7	30	13	**13**	10	4.5	8	4.2	1.8	5.7	2,000
2,250	369	160	37	232	100	30	152	66	25.5	2,250	72	31	19	37.5	16	14	13	5.5	9	5.2	2.3	6.4	2,250
2,500	449	195	41	282	122	34	185	80	28	2,500	87	38	21	46	20	16	15.4	7	10	6.3	2.7	7.1	2,500
2,750	536	232	45	337	146	37	220	95	31	2,750	104	45	23	54.5	24	17.5	18.4	8	11	7.6	3.3	7.8	2,750
3,000	630	273	49	396	171	40.5	259	112	34	3,000	122	53	25	64	28	18	22	9.5	12	9.9	3.9	8.5	3,000
3,250	730	316	53	459	199	44	301	130	37	3,250	142	61.5	27	74	32	21	25	11	**13**	10.3	4.5	9.2	3,250
3,500	837	363	57	527	228	47	345	149	40	3,500	163	70.5	29	85	37	22.5	29	12.5	14	11.8	5.1	9.9	3,500
3,750	952	412	61	599	259	51	392	170	43	3,750	185	80	31	97	42	24	33	14	15	13	5.8	10.6	3,750
4,000	1072	464	65	675	292	54	442	191	45	4,000	209	90	33	109	47	26	37	16	16	15	6.6	11.4	4,000
4,250	1200	520	69	755	327	57	494	214	48	4,250	233	101	35	122	53	27	41	18	17	17	7.3	12	4,250
4,500	1334	578	74	839	363	61	549	240	51	4,500	259	112	38	136	59	29	46	20	18	19	8.2	12.8	4,500
4,750	1474	638	78	927	402	64	607	263	54	4,750	287	124	40	150	65	30	51	22	19	21	9	**13.5**	4,750
5,000	1621	702	82	1020	442	68	668	289	57	5,000	315	137	42	165	71	32	56	24	20	23	9.9	14.2	5,000

*Inside pipe diameter
Per 660 feet pipe: C-160, head loss (feet and PSI) due to friction loss, velocity (feet/second) per 660 ft
Courtesy of Puck Enterprises.

TABLE 2 Hazen Williams chart of the pressure loss in a 10-inch drag hose pumping at 3,000 gallons per minute

Flow (GPM)	5"*			5.5"			6"			Flow (GPM)	7"			8"			10"			12"			Flow (GPM)
	HEAD LOSS		V	HEAD LOSS		V	HEAD LOSS		V		HEAD LOSS		V	HEAD LOSS		V	HEAD LOSS		V	HEAD LOSS		V	
	Feet	P.S.I.	FT/S	Feet	P.S.I.	FT/S	Feet	P.S.I.	FT/S		Feet	P.S.I.	FT/S	Feet	P.S.I.	FT/S	Feet	P.S.I.	FT/S	Feet	P.S.I.	FT/S	
800	54	82	**13**	34	15	11	22.4	10	9	800	11	4.6	7	5.5	2.4	5	2	0.8	3.3	0.77	0.3	2.3	800
1,000	82	35	16.4	52	22	**13.5**	34	15	11	1,000	16	7	8	8.4	3.6	6.4	3	1.2	4	1.2	0.5	2.8	1,000
1,250	124	54	20.4	78	34	17	51	22	**14**	1,250	24	10.5	10	13	5.5	8	4	2	5	1.8	0.8	3.6	1,250
1,500	174	75.5	24.5	109.7	48	20	72	31	17	1,500	34	15	**12.5**	18	8	9.6	6	3	6	2.5	1.1	4.3	1,500
1,750	232	101	29	146	63	24	95	41	20	1,750	45	19.5	15	23.5	10	11	8	3.5	7	3.3	1.4	5	1,750
2,000	297	129	33	187	81	27	122	53	23	2,000	58	25	16.7	30	13	**13**	10	4.5	8	4.2	1.8	5.7	2,000
2,250	369	160	37	232	100	30	152	66	25.5	2,250	72	31	19	37.5	16	14	13	5.5	9	5.2	2.3	6.4	2,250
2,500	449	195	41	282	122	34	185	80	28	2,500	87	38	21	46	20	16	15.4	7	10	6.3	2.7	7.1	2,500
2,750	536	232	45	337	146	37	220	95	31	2,750	104	45	23	54.5	24	17.5	18.4	8	11	7.6	3.3	7.8	2,750
3,000	630	273	49	396	171	40.5	259	112	34	3,000	122	53	25	64	28	18	22	9.5	12	9.9	3.9	8.5	3,000
3,250	730	316	53	459	199	44	301	130	37	3,250	142	61.5	27	74	32	21	25	11	**13**	10.3	4.5	9.2	3,250
3,500	837	363	57	527	228	47	345	149	40	3,500	163	70.5	29	85	37	22.5	29	12.5	14	11.8	5.1	9.9	3,500
3,750	952	412	61	599	259	51	392	170	43	3,750	185	80	31	97	42	24	33	14	15	13	5.8	10.6	3,750
4,000	1072	464	65	675	292	54	442	191	45	4,000	209	90	33	109	47	26	37	16	16	15	6.6	11.4	4,000
4,250	1200	520	69	755	327	57	494	214	48	4,250	233	101	35	122	53	27	41	18	17	17	7.3	12	4,250
4,500	1334	578	74	839	363	61	549	240	51	4,500	259	112	38	136	59	29	46	20	18	19	8.2	12.8	4,500
4,750	1474	638	78	927	402	64	607	263	54	4,750	287	124	40	150	65	30	51	22	19	21	9	**13.5**	4,750
5,000	1621	702	82	1020	442	68	668	289	57	5,000	315	137	42	165	71	32	56	24	20	23	9.9	14.2	5,000

*Inside pipe diameter
Per 660 feet pipe: C-160, head loss (feet and PSI) due to friction loss, velocity (feet/second) per 660 ft
Courtesy of Puck Enterprises.

Creating a cost-effective equipment plan

A method used to optimize resources and maximize crew efficiency is to implement a base system that travels to each job site. This base system would consist of the necessary equipment and hose required to pump manure a set distance from the manure source, such as a 2-mile radius around a lagoon. The base system would have the same standard price for every job, whether it extends the base system's allotted reach or not, and every mile beyond that is an additional fee.

Utilizing a base system in your operations allows you to estimate how many of your customers have distances beyond your standard set of equipment. This helps to better assess the return on investment when deciding if you should put more money into equipment. With your base system established, you'll need to plan ahead for each job to allow for the most efficient use of time while on-site.

A little math and some extra time planning and training before the season can help custom applicators not only become more efficient but also more profitable.

Planning the crew for you

With your hose and booster pump plan ready, the next planning process comes down to crew member assignments. Personnel pay can be a major cost in an operation, but some teams can get an application job done with as few as three people. For every job, there are three areas to cover: the site's manure source, the hose mover and the application injection vehicle.

The crew member at the source maintains eyes on the agitator and lead pump, and they can provide support when needed. This area assignment is responsible for ensuring proper agitation from the source, as well as keeping up with fuel use and obtaining manure samples. The employee manning the hose mover keeps the operation running smoothly by transitioning the hose for the next set to minimize downtime. This also reduces stress on the hose, which leads to fewer hose failures and coupler issues.

In the tractor cab, the crew member running the manure applicator ensures the proper speeds and flowrates for the field. This employee is responsible for applying the manure at an accurate application rate according to the manure management plan, as well as proper documentation of information. An automated pump control system will help you maintain control of pumps on the line and assist in documentation of equipment performance.

End-of-season review

The end of each season is a good time to reflect on the accomplishments and shortfalls of the season's operations. In addition to fuel usage and labor costs, business owners should be tracking their expenses through the season and reviewing changes year over year. Based on the experience in the field that season, examine what worked well within your operation structuring and what needs attention. If the numbers aren't promising at the end of the day, you're left with two options: raising rates or becoming a more efficient operation. Before the next season, take the time to create a plan of action that works for your team based on a balanced system that optimizes your equipment and hose selections.