CORNELL Manure Management Program
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# Draghose Application Systems for Manure

Draghose application systems have some important advantages for farms with a large amount of manure to spread. These systems allow manure to be spread and incorporated with an irrigation pump. The pump sends the manure to a tractor through a flexible hose. The tractor pulls the hose and a tillage implement that immediately incorporates the manure.

## ADVANTAGES

**Fast:** Using an irrigation pump without the need to develop pressure at the outlet end allows more flow per minute than in a traveling gun system. The flow rates vary depending on the pump, the flowability of the manure, the size, type and length of pipe and any elevation differences. Typical flow rates vary from 400 gallons per minute to 1,000 gallons per minute. Depending on the method used up to 40 acres can be spread before changing the setup of pipes to a new site. Reels to wind up the draghose can facilitate the change to a new site. The draghose system is a fast way to apply manure.

**Flexible:** The operator of the tractor determines how much is applied and where it is applied. The amount applied is varied by changing the speed of the tractor. A flow meter ($5,700) would make an accurate determination of the rate easier to obtain, but calculations of the area covered and the amount removed from storage can be made. The flexibility of application rates and the ability to place the manure accurately along irregular field edges is an advantage of this system. The operator's constant presence, driving the tractor, assures that the manure goes where it is intended.

**Frugal:** There are many variables in determining the cost of applying manure. The total amount to be spread and the distance from the storage to the field vary from farm to farm. Costs will typically vary from $.01 per gallon to $.005 per gallon for draghose systems. This is comparable to other manure handling systems. The equipment needed includes an irrigation pump with engine ($11,000), piping to the field ($3.00-8.00 per foot), 660 feet of draghose ($15.00 per foot) and a manifold ($2,000) to be mounted on a tillage implement. Either a hard hose irrigation reel ($30,000) to retract the draghose or another draghose and a tractor to extend the draghose will be needed. If using extension hose, a cart will be needed to wind the hose up. A cart can range from $6,000 for a self made cart to $18,000 for a new cart. A hydraulic drive is necessary for winding the hose onto the cart. There is a cost to manure spreading but the draghose system is one of the lower cost methods for larger farms.

**Authors**

Peter Wright
Dept. of Biological and Environmental Engineering
Cornell University

Shawn Bossard
Cornell Cooperative Extension of Cayuga County

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**Few Odors:** By incorporating the manure immediately into the soil, existing odoriferous compounds are tied up on soil particles. Most manure is not exposed to the air where odor is released. The aerated condition of the soil with the manure properly incorporated encourages aerobic breakdown of the manure with little odor produced. This is one of the main advantages of this system. Odor control is becoming more and more important since storage of manure for timely spreading causes more odors while non-farm rural residents and their complaints are becoming more common.

**Fertilizer Value:** Ammonia nitrogen is retained by immediate incorporation of the manure. This can be a significant increase in the amount of nitrogen available for plant growth, since the ammonium portion of the manure is lost if it is not incorporated. Losses start immediately for manure spread on the surface. It is estimated that 35% of the ammonia is lost with incorporation within the same day of application. If the manure application rate selected is used to meet the nitrogen needs of the crop, draghose incorporation will reduce the required application rate by up to 50%. This can be a disadvantage if the farm is trying to dispose of nitrogen. For farms with an adequate land base, retaining the ammonium nitrogen will be an advantage since it will allow the manure to meet the nitrogen needs of more crop acreage and slow the build up of phosphorus and potassium by spreading the manure thinner.

**Less Compaction:** Using the draghose to deliver the manure within the field eliminates the need to carry the weight of the manure across the field. Compaction from tank spreaders or injectors can reduce crop yields. Moisture condition of the soil must be adequate for the tillage operation used to incorporate the manure, but spreading manure on wetter soils can add to the losses to the environment by runoff and leaching.

**Even Application:** Wind drift and problems determining the amount of overlap needed are eliminated since the incorporation operation leaves a specific path that manure was applied to. Splash plates used by some of the incorporating implements rarely plug and provide an even application. Application is low to the ground so the wind does not affect it.

**Tillage Completed:** The tillage operation to incorporate or inject the manure may be a benefit in preparing the ground. Chisel plows, shallow chisel plows with sweeps and disks have been used to incorporate or inject the manure and prepare the ground for planting simultaneously. An aerator for hay ground has been used to improve the tilth while assisting in the infiltration of manure slurry applied with a draghose after cuttings of hay. This is not as good at incorporating the manure or controlling the odors as the more traditional tillage implements but it does help.

**DISADVANTAGES**

The need for new equipment not readily available locally is one reason this technology has not been adopted since its inception in the '70's. There are three major suppliers of draghose systems:

Liquid Waste Technology
Box 250
422 Main Street
Somerset, WI 54025
1-800-243-1406

Hydro Engineering
115 East Main Street
Young America, MN 55397
612-467-3100

Bambauer Equipment
191551 Kettersville Road
New Knoxville, OH 45871
419-753-2275

Other disadvantages are that the tillage operation may not match the soil conservation objectives of the farm and applying manure to a growing crop can't be done since the draghose will crush the plants. Some of the implements have been successful at retaining residue and even leaving a growing cover crop after the manure was injected.

The tractor operator needs to be qualified and attentive, or a liquidly mess can result. This is apt to be someone with a good sense of responsibility that you pay more.

There needs to be a relatively contiguous land base. You need to be able to reach fields from the storage. There may be problems if you need to cross a major road or someone else's

property. Some have driven pipe underneath roads and hooked up as needed. Right of ways can be obtained to cross properties if burying pipe. Highway departments should prefer to give a pipeline right of way over maintaining roads with heavy manure spreader traffic. These are challenges that must be considered.

## SYSTEM COMPONENTS

**Separation:** The fewer solids in a pumped system the better it will work. There will be less friction to slow the flows and fewer opportunities for plugging. If the separated solids can be used for bedding or sold off the farm, an additional benefit would be the improved operation of a draghose system. These systems should handle any manure that is pumpable. Although manures vary, dry matter contents up to 8-10% are workable. Wetter is better. The liquids from separation systems are typically 6% or less.

**Storage:** Liquid manure stored in earthen waste storage ponds work well with the draghose system. The extra liquid from the precipitation on the pond is easily moved by a pump and pipe network. Earthen storage is the least expensive containment system. Care should be taken to properly document and design the storage. Satellite waste storage ponds located to avoid roads, yet centrally located near the fields they will supply manure to, would keep piping distances short to increase the flow rate and then the time it takes to apply the manure.

**Pumps:** A pump designed specifically for manure should be selected. Unless the manure has been run through a separator a chopper in front of or as part of the pump is required. An open impeller will clog less and pass larger solids. The pump should have safety switches that shut it down in emergencies such as low oil pressure, high temperature and loss of head. Pressure gauges may soon plug with manure so be careful relying on them for information. For most applications an engine hooked directly to the pump eliminating PTO gears will provide cheaper power. PTO's are not made to run uninterrupted for long periods under high loads. Pumps are rated for the amount of horsepower needed at a particular rpm for a specific flow at a given head. Different size pumps are more efficient in certain conditions than others. The pump manufacturer should be utilized to select the most efficient pump for a specific site. Two pump manufacturers are:

Cornell Pump
2323 SE Harvester Drive
Portland, Oregon 97222
503-653-0338

Gorman-Rupp Company
P.O. Box 1217
Mansfield, OH 44901
419-755-1011

**Pipes:** Temporary aluminum pipe can be used to connect the storage to the draghose system and then moved to another site. The cost of this pipe varies with the price of aluminum. Used irrigation pipe is sometimes available ($2-8 per foot). Temporary pipe run above the ground can be run over, shot, sabotaged or be poorly connected causing spills. It is easier to unplug than buried pipe, but moving it after manure has been in it is a sloppy chore unless the line is flushed with clean water or blown clean with a “pig” sent through the line by an air compressor before it is disconnected.

Plastic pipes can be purchased and buried for about $3.00 per foot. Buried pipes installed correctly should last a lifetime. The pipes need thrust blocks to prevent water hammer from separating the joints at bends. The pipes should be buried below frost depth to prevent freezing. Risers placed strategically can provide access for application along the line. Although the bigger the pipe the less the friction loss, a 6-inch diameter plastic pipe will not create too large of a head loss under most flow rates.

Six-inch extension hose is an alternative to pipe. This hose costs between $7 and $8 per foot. Hoses are made at 1/8 mile lengths. Shorter hoses, called remnants, can also be obtained at a slightly lower cost. Connection ends for the extension hose can cost $200 per hose. This hose is wound up on a cart after use, and can be laid out by simply driving the route to the field. The advantage with this type of hose is that it eliminates burying pipe, and is less labor-intensive to lay out than aluminum pipe. Hose is typically cleaned out with compressed air forcing a ball through from one end to the other.

**Draghose:** The draghose has been used commercially to inject sludge since the 1960s. Agricultural applications began in the late 1970s. The hose is manufactured by the same companies that supply fire hose and irrigation hose. The hose used in manure or sludge application is specifically made heavier for the abuse it will take. The hose is constructed of an ultra-violet resistant polyurethane cover and lining with a synthetic fiber core. The outside resists abrasion yet more sharp stones in the fields will wear it out faster. The life of the hose is estimated to be 75 to 100 million gallons with a 12-foot pass. The inside is coated to provide a lower friction loss. The friction loss can be estimated, but is hard to determine exactly because of the many variables involved. For instance the friction loss is estimated to be 27 psi per 660 feet for a 4.5 inch diameter hose operated at 100 psi and delivering 800 gallons of water per minute. The hose expands slightly with increased pressure so the diameter can vary. Manure at higher viscosities will increase the friction loss. The woven synthetic fiber provides the tensile strength for the hose. A tensile strength of 40,000 pounds is typical. Two sources for the hose are:

Snap-tite Hose
217 Titusville Road
Union City, PA 16438
1-800-227-0281

Angus Fire North America
Angler-Kennebec Road & Broad Street
Anglier, NC 27501
1-800-334-3158

**Tillage Implement:** The draghose can be connected to any kind of tillage implement by mounting a manifold on it. The hose is connected to a solid swing pipe with a quick release clamp. The swing pipe protects the soft hose from damage by the tillage implement. The swing pipe hooks to a riser that distributes the manure to a number of hoses for injection or incorporation. The injection implement that works the best is a 12 inch sweep point on a chisel plow set for a 4 inch depth. This places the manure in a wide horizontal tube at a shallow depth for quicker biological breakdown and easier plant uptake. Incorporation implements may require less power to pull and do a needed tillage operation at the same time. The use of a heavy offset disk where the manure is splashed between the two gangs of disks has been successful. The first gang of disks open up the ground, the manure is applied and the second gang incorporates the manure. A rolling spike has been used to achieve some incorporation on hayland. The tractor used needs to be able to drag the hose full of manure and the tillage implement. A four-wheel drive 200 Hp tractor is recommended.

## OPERATION AND MANAGEMENT

**Communication:** Just like all manure handling systems bad things can happen. Five minutes of pumping 800 gallons per minute can deposit 16 tons of manure. Pipes can break, equipment can stop working and weather conditions can change. The draghose system pipe and equipment is as reliable as any other. It is not effected by wind changes, so weather changes don't affect it as much but in the event of emergencies it is important to be able to shut the pump down at the source quickly. Two-way radios are essential. Controlling the feeder hose whether it is a hard hose reel or another drag hose will also need communication between the applicator and another person.

**Driving Patterns:** With the hard hose reeling the drag hose, elongated figure eights are used to cover the field. Turns are made at the end of the field away from the hose to avoid running over it. In the middle of the field you move one equipment width toward the reel to leave a path for the return pass. With a hard hose length of 1300 feet and a drag hose traveling 660 feet on either side, this system can cover about 40 acres before changing to a new setup. Using a second draghose as a feeder line allows the operator to keep turning away from the draghose. As the operation moves up the field the second tractor occasionally pulls the feed line

forward. This method can cover an area 660 feet by 1320 or 20 acres per setup.

By extending the supply line diagonally into the field 600 feet and using a draghose as the feed line, a tractor can work a 40-acre field by itself by working half the field at a time and then straightening the feed line out to do the other half. This requires a shut off valve at the implement to stop the flow while turning at a 45 degree angle from the field edge at each end of the field. The flow should be shut off as the feed hose is straightened on the diagonal to start the second half of the field. A pressure relief valve at the pump will be needed with the shutoff valve at the implement to allow the pump to keep running during the shutoff periods. The pressure relief valve directs the manure back into the storage when the shutoff valve is closed. This allows the soft hoses to stay hard to avoid kinking and twisting them as they are pulled around corners and across the field. The hydraulic shutoff valve costs about $500 and the pressure relief valve costs around $625.

**Calibration:** A flow meter for this system costs $5,700 so for most applications a calculation is made to estimate the amount the storage is lowered in a given operating time to determine the average flow rate. Pressure gauges plug easily with manure. Some gauges have an oil filled tube to keep the manure away from the gauge. They can plug also. It is hard to determine exactly what is going on in a manure transfer system with out instruments that can stand the environment.

**Problems:** The flexible hose doesn't plug easily. With a chopper pump or a separator ahead of the pipe the solids left in the system move through the pipe pretty well. The nozzles and the manifold can plug. Keeping the same diameter through the distribution tubes helps to prevent plugging. When injecting the implement should be raised occasionally to be sure one of the distribution lines is not plugged.

The hose can be easily repaired with a steel sleeve inserted in the two hose ends and clamps tightened around each end. Pump problems can be minimized by installing shutoff switches and instrumentation that shuts the engine down for loss of pressure, high temperature and low oil pressure.

A plan to handle manure spills from pipe breaks or other emergencies should be available to all employees. The plan should include who to call to push up temporary dikes, to report a problem to the environmental agency, and to wash off or clean roads.

**Nutrient Management:** Because incorporation and injection retains the nitrogen in the soil, the amount of manure needed to meet the nitrogen needs of the crop is less than conventional spreading methods. A nutrient management plan with soil tests and manure tests is needed to avoid overloading the soil. Presidedress Nitrogen Tests (PSNT) should be used to determine the carryover of nitrogen from fall applications. Fall applications are subject to both denitrification and leaching losses. Nitrate testing of the ground water as a precaution is recommended. Spring incorporation is environmentally and agronomically the best option. On farm ammonia test kits are available to determine the amount of ammonia nitrogen in the manure as it is being applied.

## Who to Contact

Peter Wright
Dept. of Biological and Environmental Engineering
Cornell University
pew2@cornell.edu
(607-255-2803)

Shawn Bossard
Cayuga County Cooperative Extension
seb38@cornell.edu
(315-255-1183)

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