Weed Seed Survival in Anaerobic Digesters

By Elizabeth J. Katovich and Roger L. Becker
Agronomy and Plant Genetics, University of Minnesota

For more information, please contact:

Amanda Bilek
The Minnesota Project
651.645.6159, ext. 5
abilek@mnproject.org
www.mnproject.org

Elizabeth J. Katovich
University of Minnesota
612.625.5230
katov002@umn.edu

Roger L. Becker
University of Minnesota
612.625.5753
becke003@umn.edu

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CONFINED ANIMAL OPERATIONS ARE COMING UNDER increased regulatory pressure to manage animal manure in ways that minimize environmental problems and reduce odors. For this reason, there is increased interest in anaerobic manure digestion. Anaerobic manure digesters biologically convert manure under anaerobic conditions producing an effluent with different properties than raw manure and produce methane, which can be converted into electricity. Odor reduction is another benefit of anaerobic manure digestion.

Description of Study

A study was conducted at the Haubenschild Family farm near Princeton, MN and at the St. Paul Campus of the University of Minnesota to assess the effect of anaerobic manure digestion on weed seed survival.

- In the fall of 2001 and 2002, seeds of 6 weed species were subjected to rumen fermentation (pretreatment to stimulate cow digestion).
- A subset of seed were placed in a plug-flow anaerobic digester for 20 days (the length of time for one batch of manure to pass through the digester).
- Another subset was stored for the same time period in the manure collection pit before entering the digester.

A field germination assay was conducted by removing sod from a long-term bluegrass area to expose bare ground. The retrieved seed and digested or non-digested manure were fall-applied to the bare ground at 6000 gallon per acre as a control. A subset of weed seed not stored in manure was applied with inorganic N fertilizer. Weed emergence was monitored for next two growing seasons.

Table 1. Average cumulative weed seed germination for two seasons in a field assay when planted following 20 days storage in manure with or without anaerobic digestion. 2002 - 2004. St. Paul, MN. (Katovich and Becker 2004).

	Germination by Weed Species (%)					
Manure / Fertilizer treatment	**Vele[a]**	**Colq**	**Rrpw**	**Lath**	**Gift**	**Wipm**
Manure with anaerobic digestion	16	12	1	0	0	0
Manure without digestion	12	18	5	0	0	0
Untreated inorganic fertilizer control	14	11	4	0	0	0
LSD (P=0.05%)	NS[b]	NS	NS	NS	NS	NS

[a] Vele = velvetleaf, Colq = common lambsquarters, Rrpw = redroot pigweed, Lath = ladysthumb smartweed, Gift = giant foxtail, Wipm = wild proso millet. Mean of 4 reps of 100 seeds for each species. All seed were pretreated with rumen fermentation.
[b] NS = no significant difference.

Table 2. **First- compared to second-season cumulative velvetleaf seed germination for two growing seasons after planting following 20 days of fall storage in manure with or without anaerobic digestion. 2002 - 2004. St. Paul, MN.** (Katovich and Becker 2004).

	Cumulative velvetleaf germination (%)	
Manure / Fertilizer treatment	**First season**	**Second season**
Manure with anaerobic digestion	14	2
Manure without digestion	6	6
Untreated inorganic fertilizer control	9	6
LSD (0.05)	3	3

Study Results

Viability of weed seed used in this study ranged from 82% for wild proso millet to 99% for velvetleaf and germination ranged from 1 to 14% in preliminary tests. The rumen treatment appeared to have killed all the giant foxtail, wild proso millet, and ladysthumb smart-weed seed, since none germinated in the inorganic fertilizer control (Table 1).

Some velvetleaf, common lambsquarters, and redroot pigweed survived the rumen treatment, but manure management did not alter germination of surviving seed compared to that of the inorganic fertilizer control. Temperatures in the anaerobic digester where the seeds were placed ranged from 95 to 100° F, well below the 140° F required to kill weed seeds.

Although velvetleaf seed germination was not altered by digestion when averaged over the entire sampling period (Table 1), the rate of germination was accelerated with a higher percentage of digested velvetleaf germinating the first season compared to conventional manure or inorganic fertilizer treatments (Table 2). This may reduce velvetleaf problems in the future if it is effectively managed in the first season, since seed dormancy perpetuates annual weed problems. Velvetleaf seed appeared to be 'primed' for germination as a result of anaerobic digestion.

Results

Anaerobic manure digestion did not kill or reduce germination of weed seeds in this study. However, this process may reduce odor and generate sufficient electricity through methane conversion to not only run the operation, but also with excess electricity to sell. The possibility that anaerobic digestion might kill seed in feed that is spilled and not digested by a cow was not tested, since all seeds were exposed to rumen digestion. Still, if the weed content of feedstock is known, particularly if produced on the same land where manure will be utilized, the benefits of anaerobic digesters in odor reduction and power generation likely outweigh the risks of potential survival of weed seed and resultant potential for increased weed pressure in the field.

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Haubenschild digester barn and electrical generation building is shown above. Dennis Haubenschild (right) visits with field day tour participants.