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Crop residue and manure application

H. Mark Hanna
Iowa State University, hmhanna@iastate.edu

Jeffery C. Lorimor
Iowa State University

Michael J. Tidman
Iowa State University

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Abstract
For most producers, it is important that every field operation leave the maximum amount of residue cover on the soil surface. However, for those producers who use manure as a nutrient, reducing odors from manure applications is equally important because neighbors often complain more often about odor from manure application than about odor from the facilities. Producers find themselves balancing good crop residue cover and the reduction of odor from manure applications.

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Disciplines
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For most producers, it is important that every field operation leave the maximum amount of residue cover on the soil surface. However, for those producers who use manure as a nutrient, reducing odors from manure applications is equally important because neighbors often complain more often about odor from manure application than about odor from the facilities. Producers find themselves balancing good crop residue cover and the reduction of odor from manure applications.

Above: *Narrow knives on a drag hose applicator.*

Several researchers recently presented their findings about the effects of manure application equipment on odor, residue cover, and crop yields. The experiments evaluated swine pit manure (liquid) application methods in no-till soybean and corn residue during three crop seasons (1996-1998). Crop yield levels were taken at harvest.

Above: *Sweep incorporation on a tank applicator.*

Below: *Covering discs on a tank agitator.*

Manure was applied by one of six different treatments (in the spring and fall of each of the three crop seasons). Residue was measured immediately before and after each treatment, and odor samples were taken from the surface within 5 minutes after the manure was applied, and 1 day after treatment (or later, depending on weather conditions).

For this study, the manure was applied to the field at a rate of 5,000 gallons per acre, at an applicator speed of 5 miles per hour. Researchers used a Better-Bilt vacuum tank, model 3400 (3,400-gallon capacity) manufactured by Top Air Manufacturing. The tank had an attached tool bar with four manure outlets set at a 30-inch spacing to apply manure between 30-inch rows. The liquid manure was applied by one of six methods: 1) injection with a conventional knife (2 inches in width); 2) injection with a conventional sweep (16 inches in width); 3) surface broadcast application followed by disk incorporation (manure outlets raised to 12 inches above the soil surface and diffusing the manure on a splash plate just below the outlet); 4) surface broadcast application only (manure outlets raised to 12 inches above soil surface and diffusing the manure on a splash plate just below the outlet); 5) injection with a narrow-profile knife (a 1-inch knife designed to minimize soil disturbance); or 6) surface application behind "row cleaners" (accomplished by moving residue from a narrow strip with a spoke wheel row cleaner, applying manure in a narrow surface band, then returning the

residue over the band with spoke closing wheels).

In general, researchers found that incorporation methods resulted in higher corn yields (but not soybean yields) and lower odor. Choice of incorporation method to maintain residue cover was more important in soybean stubble with the narrow-row profile knife (5), row cleaner (6), and conventional knife methods (1), leaving more residue than injection with conventional sweeps (2) and broadcast application followed by disking (3). In corn residue, conventional knife incorporation (2) maintained residue cover as well as other incorporation methods. And surface applications resulted in higher odor levels but better preservation of crop residues.

If odor during application is a concern, avoid broadcast application methods--soil incorporation reduced odor levels by 20 to 90 percent compared with broadcast operations. (Refer to the tables for more information.)

For producers looking for answers, the best solution may lie in determining the ability of their equipment to reach an acceptable balance between reducing odor thresholds, maintaining residue cover, and affecting crop yields.

	After manure				After manure				After manure			
SOYBEAN	**application**		**After planting**		**application**		**After planting**		**application**		**After planting**	
Residue remaining and residue cover+	1995-96 residue remaining*	1995-96 residue cover+	1995-96 residue remaining*	1995-96 residue cover+	1996-97 residue remaining*	1996-97 residue cover+	1996-97 residue remaining*	1996-97 residue cover+	1997-98 residue remaining*	1997-98 residue cover+	1997-98 residue remaining*	1997-98 residue cover+
Fall	54	47	31	12	71	68	83	55	60	44	106	43
Spring	52	36	37	11	56	45	98	43	54	32	113	30
Application												
Broadcast	92	72	18	13	93	82	89	72	103	68	70	47
Row cleaner	44	35	48	14	78	69	83	54	65	42	104	43
Narrow knife	67	47	23	12	71	63	87	54	49	33	114	37
Disk/incorporate	31	25	40	8	34	31	94	27	25	17	136	22
Sweep	34	26	45	12	45	40	86	34	42	28	131	33
Knife	55	43	26	11	59	52	105	53	57	38	104	38

*Residue remaining = (% residue cover after operation/%residue cover before operation) x 100%. For example if 80% residue cover exists before field operation and 60% cover exists after operation, residue remaining = 75% [(60%/80%) x 100%].

+Percentage residue cover after operation (= 60% in example from *).

	After manure				After manure				After manure			
CORN	**application**		**After planting**		**application**		**After planting**		**application**		**After planting**	
Residue remaining and residue cover+	1995-96 residue remaining*	1995-96 residue cover+	1995-96 residue remaining*	1995-96 residue cover+	1996-97 residue remaining*	1996-97 residue cover+	1996-97 residue remaining*	1996-97 residue cover+	1997-98 residue remaining*	1997-98 residue cover+	1997-98 residue remaining*	1997-98 residue cover+
Fall	85	80	48	41	82	77	78	60	65	60	77	43
Spring	81	76	53	38	71	62	95	57	76	62	75	39
Application												
Broadcast	100	94	43	40	98	89	79	70	98	86	58	50
Row cleaner	86	81	50	40	78	71	87	60	81	70	50	34
Narrow knife	85	80	48	43	75	68	81	54	69	60	80	43
Disk/incorporate	81	76	50	37	71	65	79	50	34	30	106	30
Sweep	64	61	66	38	63	57	97	54	57	50	85	40

Knife	82	77	46	38	74	67	96	63	78	68	77	49

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+Percentage residue cover after operation (= 60% in example from *).

Odor from manure application on soybean residue	Fall 1996 At application	Fall 1996 1 day after application	Fall 1996 5 days after application	Spring 1997 At application	Spring 1997 1 day after application	Fall 1997 At application	Fall 1997 1 day after application	Spring 1998 At application	Spring 1998 1 day after application
(odor units)									
Broadcast	807	876	63	140	40	162	94	1451	211
Row cleaner	185	52	43	61	44	81	114	45	158
Narrow knife	173	64	60	12	36	85	97	181	87
Disk/incorporate	65	53	43	26	13	121	96	302	98
Sweep	94	60	43	35	16	102	109	181	64
Knife	256	113	43	33	43	128	98	257	72
Untreated soil	--	--	--	--	12	--	94	241	84

Odor units are the number of clean-air dilutions required to reach a threshold odor level for a panel of four observers.

Odor from manure application on corn residue	Fall 1996 At application	Fall 1996 5 days after application	Spring 1997 At application	Spring 1997 1 day after application	Fall 1997 At application	Fall 1997 1 day after application	Spring 1998 At application	Spring 1998 1 day after application
(odor units)								
Broadcast	389	43	216	30	183	115	1604	196
Row cleaner	67	43	188	30	100	86	385	82
Narrow knife	247	70	106	38	82	109	181	85
Disk/incorporate	75	43	56	25	157	91	273	60
Sweep	57	43	25	26	122	76	136	38
Knife	502	53	16	18	116	105	121	73
Untreated soil	--	--	--	12	--	118	241	94

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