Biosolids-who pays

Deep bedded swine systems have given rise to new questions about management of both livestock and wastes.

Let's dive right into a topic that has kept PFI cooperators and ISU scientists occupied the last two years - manure, or, more generally, "biosolids." The Leopold Center for Sustainable Agriculture funded a study of swine hoophouse manure management because there is a potential for nutrient tie-up in the bedding-manure mix that comes from these units. Composting helps improve the fertilizer value of these materials. But composting carries a cost.

First a general cautionary note: the economic numbers appearing with these trials is for illustrative purposes. A component of the project is putting better numbers on the costs of composting and manure handling. You will see some high costs for the treatments involving compost. In those cases the crops have been charged with labor and sometimes equipment for composting. Some people whether cropping operations should be charged with application costs, let alone composting. Those costs are included in this report, but you may want to mentally reallocate them. Ditto for clover or cover crop seed. Any number of items in a farming system don't pencil out if considered in isolation. As ever, it will be up to you to factor the parts into the whole.

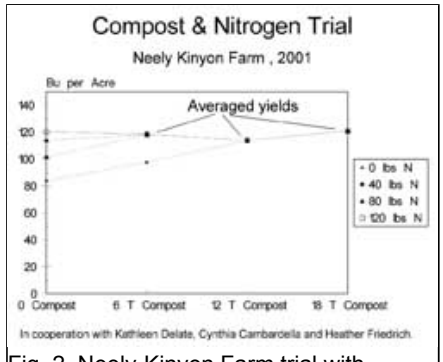

Fig. 2. Neely-Kinyon Farm trial with compost rates and rates of synthetic nitrogen.

Wayne and Ruth Fredericks, Osage, compared compost and manure to a check treatment on the same plots used in a similar corn trial in 2000. In 2001 the soybeans responded positively to both manure and compost (Table 1, click to view), though late planting, aphids, hail, and early frost reduced overall yields. The cost of the compost treatment includes Wayne's time for piling and turning the compost as well as an estimate for the time of the bucket loader used.

Paul and Karen Mugge, Sutherland, also compared compost, manure, and a control treatment (Table 1, click to view). They observed a yield benefit from both manure and compost which was great enough to cover spreading and composting costs. Because costs were less in the manure treatment than the compost strips, manure was the more profitable option on paper.

In contrast, **Colin and Carla Wilson**, Paullina, saw no statistically significant yield benefit from applying compost (Table 1, click to view). As the table indicates, only about $9.28 of the $25.16 per acre compost cost was for actual application; the remainder was composting.

Graduate student Terry Locke (right) and Matt Stewart presented composting results at the Mugge field day.

The **Neely-Kinyon Research Farm**, Greenfield, examined both compost rates and rates of synthetic nitrogen in what is call a "factorial" study. Zero, 6, 12, and 18 tons compost per acre were applied, with each compost rate subdivided into subplots of 0, 40, 80, and 120 lbs N per acre. The trial, whose results are shown in Table 1, was a joint effort by PFI and Kathleen Delate, Cindy Cambardella, and Heather Friedrich, of ISU.

The field at Neely-Kinyon had not received manure since 1997. The corn in 2001 responded to the first 6 tons per acre of compost or the first 80 lbs of synthetic nitrogen. After 6 tons there was no statistically significant yield response to nitrogen, although the zero-N treatment may have gained in yield as compost increased from 6 tons to 12 tons per acre. However, costs increased with compost rates, at least if the crops are expected to pay for composting. Only about $6 of the compost was for actual application; the rest was estimated at the "book" value of 5½ minutes labor and $3 equipment cost per ton of compost. See the sidebar on pages 6-7 for more on the economics of compost.

Dave and Becky Struthers, Collins, compared two manure application dates and a no-manure control treatment. The entire experiment received a sidedress of 80 lbs N. Spring-applied manure was the only treatment that significantly outyielded the control, besting it by some 8 bushels.

While we're on the subject of biosolids, take a look at **Dick and Sharon Thompson's** trial in Table 4 (Click to view). This Boone County farm historically has adequate soil potassium, but leaf tissue levels of K tend to be on the low side. Dick wondered if adding 0-0-60 to the farm manure and City of Boone biosolids would be more effective than adding biosolids and fertilizer to the soil separately. As it turned

out, potassium fertilizer only increased the soil test K; it had no effect on either corn yield or the corn leaf tissue potassium level.

The **Dordt College Agricultural Stewardship Center**, in Sioux Center, planted corn on top of the previous year's comparison of oats and oats-red clover (Table 4 and Fig. 3). They also applied three levels of anhydrous ammonia nitrogen across these rotational treatments, creating a "2x3 factorial" experiment. Rob De Haan, Director of the Center, wrote "We wanted to know how much N would be contributed to the corn." The table shows crop response to clover at the extremes of the nitrogen range, 0 and 180 lbs N per acre, as well as overall response to the nitrogen factor and to the green manure factor of the experiment.

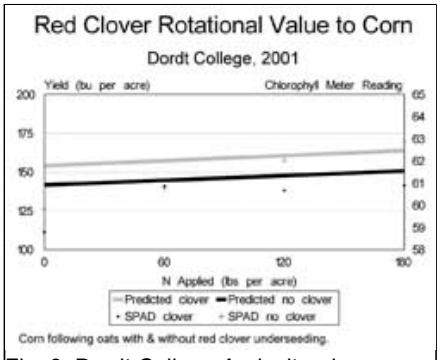

Fig. 3. Dordt College Agricultural Stewardship Center trial of the rotational benefit of red clover to corn.

The design of the trial was intended to put a figure on the "nitrogen equivalency" value of the red clover. Nitrogen equivalency is sometimes estimated by asking, "How much N do I have to add to the corn that doesn't follow clover in order to get the same yield as the corn-after-clover that received no additional N?" But this approach lumps together the rotation effect and the nitrogen contribution of the clover. A better approach examines the nitrogen response curves of corn in the two rotations and looks for the nitrogen levels where the yield maximum is reached in the two treatments. If corn after oats needs, say, 130 lbs N for maximum yield and corn after oats-clover tops out with only 60 lbs N, then the "nitrogen equivalency" of the clover's value to the corn is 130-minus-60 lbs, or 70 lbs of nitrogen per acre.

Unfortunately, to generate those response curves requires more than four N rates and more than the three replications used in the Dordt College trial. In general, it can be said that corn yields increased from the clover, and they did so regardless of the N rate. Similarly, corn yields increased with greater nitrogen, whether the corn followed clover or not. Optimal N rates or the fertilizer equivalency of the clover cannot be specified from the data, although there was a clover benefit independent of nitrogen. Fig. 3 also illustrates that the SPAD leaf chlorophyll meter showed a linear response to nitrogen in the corn that did not follow clover, but the SPAD response to N was erratic in corn following clover.