SOIL CONSERVATION COUNCIL OF CANADA
CONSEIL DE CONSERVATION DES SOLS CANADA

Global Warming and Agriculture

Fossil Fuel Use

In our last information sheet we discussed carbon dioxide (CO_2), its role in global warming, and how farming practices can affect the cycling of carbon and thus atmospheric CO_2 levels. This information sheet explores the direct and indirect uses of fossil fuels on the farm, their link to global warming and farming practices that can help reduce fossil fuel use.

Agricultural fossil fuel use

The most evident use of Canadian on-farm fossil fuel is for powering machinery, heating buildings, and for transporting, irrigating and drying crops. There is also substantial indirect off-farm fossil fuel use in the production of agricultural products. For example, energy is required to manufacture chemical inputs, buildings and farm machinery. Of these the largest user of energy is the manufacture and transportation of fertilizer, especially fertilizers containing nitrogen (N). The resulting CO_2 release varies between forms of nitrogen fertilizer, but on average the production and transportation of 1 kg of N releases about 1 kg of carbon (C) (or 3.7 kg CO_2) into the atmosphere.

While the amount of CO_2 emissions from energy use on Canadian farmland varies greatly, a typical farming system may release C from energy use at a rate of roughly 100 kg C per hectare per year. For example, an analysis of farming systems at Indian Head, Saskatchewan (Black Soil Zone) showed that total C emissions from direct and indirect use of energy ranged from about 110 to 125 kg C per hectare per year depending on tillage intensity. As figure 1 demonstrates, the largest sources of the CO_2 were the manufacture and transport of N fertilizer and the on-farm use of fuel followed by the manufacture of machinery.

Figure 1
Sources of $C0_2$ from spring wheat at Indian Head Sask., as affected by tillage (Coxworth, 1995).

CO_2 release (kg C/ha)

How can fossil fuel use be reduced?

The amount of CO_2 released in agricultural production, through the direct and indirect use of fossil fuels, can be reduced through the following techniques:

Reduce tillage

Reducing or eliminating tillage can save fuel. An Ontario study showed diesel fuel use declined from 30 liters per hectare for conventional tillage to 4 liters per hectare in a modified no-till system. A Saskatchewan study took this one step further and calculated both direct and indirect use of fuel. It found that reducing tillage cut emissions from direct fuel use by 40%. When indirect uses of fuel were included (pesticide fertilizer use, etc.) it was found that emissions from no-till were 92% of those in conventional tillage, while emissions from minimum tillage were in-between the two.

Use fertilizer more efficiently

The manufacturing and transporting of fertilizer is extremely energy intensive. Consequently, management techniques that produce high yields from less manufactured fertilizer can substantially reduce CO_2 emissions. Such practices include banding; applying only as much as needed based on soil tests; applying variable rates on a field according to need (i.e. precision farming); includ-

ing legumes in rotation and including livestock in the farming operation.

Legumes

Legumes are able to get much of the nitrogen they need from the air. When they die and decompose they release nitrogen that is available to subsequent crops. Including legumes in rotation can therefore cut nitrogen fertilizer needs and the carbon emissions that would be created in the manufacture and transportation of this fertilizer.

A study conducted at Melfort, Saskatchewan provides an example of this reduction. Substituting a pea crop for first year barley in a barley-barley-wheat rotation resulted in reduction of CO_2 emissions by about 28%.

Including forage legumes in rotation can increase this advantage. A Manitoba-based study compared a number of conventionally tilled crop rotations. Over a 10 year period nitrogen fertilizer use per hectare was 840 kg/ha for a wheat-wheat-flax rotation, 580 kg/ha for a wheat-wheat-pea rotation and 293 kg/ha for a rotation that included three years of alfalfa followed by wheat-wheat-pea. Since 1 kg of N production and transportation releases about 1kg of C, including alfalfa in rotation substantially reduced C emissions from the use of fertilizer. In addition to reduced N fertilizer requirements, including alfalfa also resulted in reduced energy use and C emissions associated with fuel (12% reduction), herbicide use (40% reduction) and machinery (12% reduction).

Include livestock

Farms producing livestock on grassland may require relatively little external energy compared to a farm with high inputs of fertilizer, intensive tillage and irrigation. Livestock supply an on-farm fertilizer resource and enhance the economic viability of including forages in rotation.

Use manure more efficiently

Concentrated livestock operations often mean a concentration of animal manure. While this contains many nutrients, these are not always used efficiently, in part because of the high cost of transporting heavy, bulk manure. Avoiding excessive application rates of manure on localized areas would prevent harmful loss of nutrients to the environment. On the other hand, using manure resources wisely can reduce fertilizer use and thereby reduce CO_2 emissions.

Increase energy use efficiency

Insulating farm buildings, using more efficient irrigation systems, drying crops in the field wherever possible and including any of the energy conservation measures advocated for urban areas will help lower CO_2 emissions.

Use biofuels

The use of biofuels (ethanol, mixed at proportions of about 10% with gasoline) allows tapping into the the carbon cycle for fuel rather than relying totally on carbon from fossil fuel sources. One study suggests that even if the CO_2 emitted in crop production and other green house gas emissions are taken into account, the use of ethanol from corn or wheat could reduce the global warming potential of fuel by 25-30%.

Biodiesel offers potential. While it is still more expensive than diesel derived from fossil fuels, the future may see the widespread use of biodiesel from crops such as canola, flax, soybean and sunflower. This technology offers large potential for lowering greenhouse gas emissions.

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