

Crop Rotations and Soil Quality

Dr. Tarlok Singh Sahota

Fibrous rooted crops, e.g. winter cereals (especially under seeded to red clover), and forages especially mixed hay, contribute most to the soil quality. If it is impractical to include forages in the rotation, seeding cover crops will help to fill the gap. Dr. Tony Vyn found the highest aggregate stability in the first year corn following two years of barley >= corn following wheat or alfalfa; the lowest aggregate stability was in the first year corn following soybeans and continuous corn was in between these extremes. North Dakota researchers observed that soil loss in a 3% slope came down from 5t/ha with continuous corn to 1t/ha with corn-corn-3 year barley and to 0.5t/ha with corn-corn-barley-3year hay.

Dr. Craig Drury found an increase in soil organic carbon of over 14 t/ha in the top 60 cm soil after 34 years of rotational corn, compared to continuous corn. John Heard, Karen Davies and Kim Jo Bliss's work at TBARS and EARS proved that soil quality, as determined by general nutrient content, organic matter and earthworm numbers, was greatest with forages and manure application as compared to continuous cereals. Manure application helped maintaining soil K. Earthworm populations were affected more by tillage than by crop rotation. Previous fall and spring tillage reduced their numbers dramatically. Lowest soil organic matter and earthworm numbers were found under the annually-tilled cereal monoculture.

Crop rotations influence nitrogen (N) supply. Inclusion of legume crops improves N supply to the following crops. Forage legumes (alfalfa and clover) contributed more N (up to 50 lb/acre) to the soil than soybean (up to 40 lb/acre) and pea/or lentil (20 lb/acre). Alfalfa yield in the fourth year is only up to 70% of the first harvest year. It is therefore advisable to rip off alfalfa fields after 3 years and seed those fields to winter wheat or spring cereals/corn. Intensification of cropping could deplete N if it isn't replenished, influence organic matter and affect N mineralization. Legume residues are easily mineralized as compared to the non-legume residues that can lower N supply and increase demand for fertilizer N. However, intensive crop rotations with recommended NPK fertilizers are reported to improve the soil organic matter and N supplying capacity of the soil.

Crops vary in their water extraction pattern from the soil. Spring seeded small grains usually deplete soil water 3 to 4 feet deep. Corn, sunflower, and sugarbeet can deplete soil water to 5 to 6 feet. Alfalfa and sweet clover are also deep-rooted crops-can be used to dry up wet areas. Oats love moisture more than the barley does.

Weaver et al's work showed that soybean yield was lowest in continuous soybean and highest in rotation with winter wheat and corn. Soybean-corn or soybean-winter wheat was in between these two extremes. Quoting this work, an OMAFRA fact sheet states that continuous soybean resulted in decline in yield, poorer soil structure, greater erosion potential and increased soybean cyst nematodes. It also points out that including winter wheat under seeded with clover in rotations with soybean can build soil structure and improve net profits! Clarence Swanton, university of Guelph, observed that soybean/and corn yields were higher with winter wheat-corn-soybean than with corn-soybean in

conventional tillage, but not with zero tillage in which soybean and corn yields from the two rotations were similar. Wheat yield is reported to be 14, 7 and 4 bushels/acre higher after soybean, corn and barley, respectively, than wheat after wheat. Recent work at TBARS indicates a barley yield improvement by ~35% after clover, and soybean yield improvement of 26% after oats-barley as compared to that after clover-barley. Legumes in rotation not only increase the yield of non-legume crops in a rotation, but their protein content too.

In view of the foregoing considerations, it is advisable to rotate crops to improve soil quality (aggregate stability, organic matter, N supplying capacity etc.) leading to increase in yields, net profits and quality of crop produce.

Published in Northwest Link, July 2007, Pages 4-5.