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Better Crops, Better Environment...through Science

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Fall 2008, No. 2

CROP ROTATIONS CAN HELP UTILIZE PLANT NUTRIENTS MORE EFFECTIVELY

Rotating crops on a field can be beneficial for a number of reasons. Plant disease organisms (e.g. fungal, bacterial, and/or viral) and damaging insects are usually specific to a certain crop species. By changing the crop species in a field, the amount and degree of infestation of a pest can be reduced. Another reason is that growing different crops can sometimes allow planting operations to proceed more easily as each crop type leaves different amounts and types of crop residues. For example, it is easier to no-till plant (direct seed) spring wheat into a field pea or lentil residue than into a continuous wheat residue. Also, changing crop species allows different options for weed control. In the case of winter wheat, weeds with a similar life cycle (winter annual), will tend to increase if there is winter wheat grown continuously in the rotation. By rotating with a spring-seeded crop, the winter annual weeds can be controlled with a pre-seeding spring tillage or non-selective herbicide applications. Yet another reason is that by rotating, a grower diversifies crops and can reduce marketing risks as one crop type may have depressed prices while other crops in the rotation may have steady or improved prices.

A deeper rooting crop can utilize nutrients that have moved below the rooting depth of shallow-rooted crops. Some shallow rooted crops such as potato effectively remove nutrients from only about a 2 ft. (0.6 m) depth, yet potato crops receive quite high rates of N, P, and K fertilizers. Some nutrients can be leached below the rooting depth during the year of potato growth, especially the N. Following potatoes in rotation with a deeper rooted crop such as wheat or sunflowers can utilize the leached nutrients.

Some crops can better access certain nutrients from the soil. For example, flax is able to better acquire P from a soil compared to wheat. This may be due to a more acidic rhizosphere near flax roots compared to wheat roots that cause less soluble forms of P in the soil to be more available. If wheat is planted after flax in a rotation, some of the P left in flax surface residues and decaying roots can be utilized by the wheat crop.

Certain crop species have the ability to allow mycorrhizal fungi to infect their root system. The fungal hyphae from the fungi spread out in the soil and are able to acquire nutrients that it shares with the infected crop. The combined soil contact of the crop roots plus fungal hyphae can be much greater than just the crop's root-soil contact. Also, these mycorrhizzal fungi have been shown to exhibit greater uptake of P and other immobile nutrients compared to crop roots. The crop in turn supplies photosynthetic sugars to the fungi, thus a beneficial symbiotic relationship exists. If a mycorrhizal compatible crop is followed by another mycorrhizal compatible crop, the existing fungal hyphae network can remain somewhat intact and the subsequent crop benefits. However, some crops do not form root-fungal associations (e.g. *Brassica sp.* crops such as canola) and mycorrhizal compatible crops such as wheat or corn following canola may exhibit early season P deficiencies that decrease in intensity as mycorrhizal infections begin and hyphae growth is reestablished.

Different nutrient demands by crops in rotation can be managed to a grower's advantage. For example, some crops naturally require greater amounts of specific nutrients in their growth. Canola and mustard require more S from soils compared to small grain crops such as wheat and barley. The S fertilizer supplied to a canola crop is often supplied in a seed-row blend application. But if an ammonium sulfate (21-0-0-24S) S-source is used in the seed-row blend to supply a common rate of 20 lb S/A (22.4 kg/ha), the accompanying 17.5 lb N (20 kg N/ha) may supply excessive ammonium-N (NH_4^+) and reduce canola seed germination and emergence. Some growers use the greater tolerance of wheat and barley to seed-row N in rotation with canola by supplying more S than required in the seed-row blends of wheat or barley preceding canola. The unused and residual S in the soil from the cereal crops allows less seed-row 21-0-0-24S to be required and avoid adverse NH_4^+ toxicity. It is important to understand the nutrient requirements of a specific crop, the ability of a crop to acquire nutrients, and the effects of residual nutrients on subsequent crops to help in planning crop rotations and fertilizer applications.

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Abbreviations in this article: N = nitrogen; P = phosphorus; K = potassium.

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