WEEDS: Don't Shoot The Messenger

(or at least not until you understand their message)

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All too often when farmers start talking weeds a common first question is *"How do I get rid of a bad case of...?"* when a more appropriate question is *"I wonder why my field has a bad case of...?* The subtle difference in the question requires a surprisingly dramatic paradigm shift in your view of weeds. Weeds must shed their role as 'problems', 'pests', 'hours of frustration' and take on the role of 'symptoms', 'story tellers', and 'healers'. Weed advocates consider weeds as plants with a mission and look to learn what the weeds are trying to tell us about our soil conditions (e.g., pH, drainage, compaction, etc.) or our management practices (e.g., crop rotation, row spacing, stocking rate, tillage, etc.).

Weeds redefined:

Nicolas Lampkin, in *Organic Farming*, stresses that it is the human activity of agriculture that generates weeds and therefore defines a weed as "any plant adapted to man-made habitats and interferes with human activities." For weed spin doctors even that definition is too harsh because it focuses too much on the negative. The first step in our weed propaganda is to begin viewing the appearance of weeds as benefits in the agro-ecosystem. We are all familiar with the saying "nature abhors a vacuum" – well, cultivation essentially creates a vacuum as whole communities of plant and soil life have been disrupted and/or destroyed. Nature's response – weeds. Within days, pioneer plants such as pigweed, lambsquarters, and purslane grow rapidly and thickly to anchor the soil and generate organic matter to feed the soil life. These fast-growing annuals provide shade, hold moisture, moderate soil temperatures that allow other plants such as biennials and perennials (including grasses) to initiate growth. If left for another season, this land will have fewer fast-growing annuals and favour later successional plants. However, our agricultural systems keep the soil in an unnatural state of continuous disturbance and as a result we deal with primarily the early colonists. Most of these fast-growing annuals grow without associated mycorrhizal fungi (primarily because their life cycle is too short to benefit from a symbiotic partnership). Expectedly, soils rich with mycorrhizal fungi (e.g., pastures, forests floors, agricultural soils rich in organic matter especially through the use of composts) have fewer annual weeds. Elaine Ingham, Soil Foodweb Inc., suggests that the presence of the fungi serves as a "signal" that keeps annuals from needing to germinate.

Extreme Weed Make-Over

Looking for the positive in weeds helps us in being able to understand what they are telling:

- Weeds can act as a green manure or cover crop.
- Weeds can serve to cycle nutrients from the sub-soil (e.g., deep-rooted weeds such as dandelions or burdock)
- Deep-rooted weeds can break up hard pans, thereby regulating water movement in the soil.
- Weeds can conserve soil moisture.
- Weeds can be indicators of soil conditions
- Weeds can provide habitats for beneficial organisms

Learning from your weeds:

Now, that we better appreciate why weeds appear in our agricultural systems, we can take a closer look at how we can use weeds as indicators for our soil conditions. It is important to note that many weeds can tolerate a wide range of conditions and therefore the appearance of a few individual weeds should not prove evidence of an underlying soil condition. For example, perennial sow thistle and dock indicate poor drainage, but dock prefers more acidic soils, while thistle favours a higher pH. If several species that prefer similar conditions predominate such as plantain, coltsfoot, and ox-eye daisies it's a clearer indication that the soils are waterlogged or have poor drainage than if you found just one of those species.

Soil pH and Soil Fertility

In addition to helping protect and improve the organic matter content of the soil, weeds can also be useful in indicating the acidity or alkalinity of the soil. Most agricultural crops do best in a slightly acidic soil (pH 6 to 6.5), but an increasing presence of weeds such as plantain, sorrel, dandelion may suggest that the pH is dropping below a desirable level. However, here it is important to distinguish that the correlation between low pH and acidic soil is not conclusive. Much of Albrecht's work highlighted that low pH in acidic soils was in fact an issue of low soil fertility or an imbalance of soil nutrients. For example, many alfalfa producers have witnessed a dramatic invasion of dandelions in their stands subsequent to the spreading of high levels of potash. Essentially, the potash had suppressed calcium levels in the soil. The deep-rooted dandelion scavenges calcium from lower depths and upon its death releases the calcium at the soil surface.

The imbalance of magnesium relative to calcium can lead to tight soils and eventually anaerobic conditions. Calcium causes soil particles to move apart for good aeration and drainage and require fungi to prevent their leaching out of the soil. Magnesium makes particles stick together and if soils become too tight oxygen becomes limited and beneficial forms of soil life disappear. In such conditions residues within the soil do not decay properly and increased carbon dioxide in the soil favours fermentation of the organic matter resulting in by-products such as alcohol and formaldehyde. These substances inhibit root penetration as well as create favourable conditions for soil diseases such as pythium and phytophora. Fermentation can also create methane gas which is conducive to the appearance of velvetleaf or ethane gas which helps jimsonweed to prosper. Grasses with their fine and numerous roots attempt to break up tight soils, while the presence of many grassy weeds may indicate tight soils.

Soil Condition

Agricultural practices such as cultivation, fertilization, grazing management can have a great impact on the soil and in turn on the appearance of particular weed species. Frequent tillage will disturb the billions of viable seed in the soil seed bank and with sunlight will germinate and occupy bare soil. Weeds such as lambsquarters and redroot pigweed can produce 75,000 to 130,000 seeds per plant, respectively and can remain viable in the soil for up to 40 years. The presence of legumes such as vetches, medics, and clovers may

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suggest soils lacking nitrogen. In contrast, weeds growing on the same soils that appear pale yellow and/or are stunted also indicate low fertility. Overgrazing of pastures may lead to compacted soils and the presence of perennial bluegrass species and bentgrasses will predominate. Compaction (irrespective of cause -- heavy machinery or livestock) can be viewed as a fertility imbalance which in turn could be viewed as a soil life imbalance. As mentioned above the lack or imbalance of calcium can allow for soils to become compact and without the proper biology in the soil (in the case of calcium, i.e., fungi) calcium will not stay in the soil.

This article is based primarily on the knowledge and observations of farmers. Farmers who saw what was growing in front of them and wanted to better understand the connection between what was growing in their soil and the various management practices they were employing. The American Poet Emerson once wrote, "What is a weed? A plant whose virtues have not yet been discovered," perhaps referring to their greatest virtue to farmers as messengers of the soil.

Recommended reading:

Weeds and what they tell. 1981. Ehrenfried E. Pfeiffer. Bio-dynamic Farming and Gardening Assoc. USA.

The Value of Weeds. 1982. Soil Association. UK.

Both of these books are available on loan from the COG Library

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Indicator Weeds and Soil Conditions

Wet, Waterlogged, Poor Drainage

Creeping Buttercup, Coltsfoot, Ox-eye Daisy, Curled Dock, Mosses, Plantains, Garden sorrel, Perennial Sow Thistle, Broad-leaved Meadowsweet

Acidic or Low Lime

Eastern Bracken, Silvery cinquefoil, Coltsfoot Ox-eye Daisy, Dandelion, Curled Dock, Hawkweed, Field Horsetail, Knapweeds, Prostrate Knotweed, Mosses, Common Mullein, Nettles, Plantains, Garden sorrel Sheep Sorrel

Hard-Pan

Field Bindweed, Quack grass, Pineappleweed, Stinkweed

Tilled or Cultivated Soil

Buttercup, Chickweed, Prostrate Knotweed, Lambsquarters, Prickly Lettuce, Mustards, Nettles, Redroot Pigweed, Plantains

Alkaline

Bladder Campion, White Mustard, Perennial Sow Thistle, Foxtail Barley

Heavy-clay soil

Chicory, Coltsfoot, Dandelion, Annual Sow-Thistle, Canada Thistle

Dry Soils

Silvery cinquefoil, Field Horsetail

Overgrazed

Perennial Bluegrasses, Bentgrasses

Nutrient Imbalance

Eastern Bracken (low K, low P), Yarrow (low K), Stinkweed (High lime)

Saline soils

Shepherd's Purse, Russian Thistle

Compacted

Velvetleaf, Jimsonweed

Adapted from a handout by Stuart Hill and Jennifer Ramsey for Ecological Agricultural Projects at MacDonald Campus of McGill and published in The Soul of the Soil, A Guide to Ecological Soil Management, 2nd Edition, By Grace Gershuny and Joseph Smillie.