ALLELOPATHY (AUTOTOXICITY)

The following material is a review of the above subject. It is apparent to me that the projected causes are many … mostly chemical or biological. They are greatly increased by plant stress. They are greatly increased when the competition for available resources increases.

Following the scope and research direction of these reports, a solution to the other problems will be a long time coming. How important is allelopathy and autotoxicity? Autotoxicity (affect on plants of the same species) may be the most important problem that is controlling production.

For most commercial crops, the yields are between 20% and 40% of the genetic potential. The things that affect yield increases in production are well known … nutrient availability, time of planting, weather, water and pests.

Still, we are only receiving about 30% of the genetic potential of the yields.

If we want to achieve the "near perfect plant", look at the one that grows by itself … with no other like species around it, it has a completely different "physiological look."

- Shorter internodes
- Larger diameter stems
- More fruiting points
- A massive root system
- No tap root
- When grains are mature, the plant is still green.

These differences appear when plants are still young … before light is limiting.

When plants are put into the general population, the above characteristics are altered. Why?

The research people agree, that autotoxicity is a function of toxins from either root exudates or decaying organic matter. This would indicate that microbial activity is essential. They are necessary to make the organic chemicals that are listed as toxins. Microbial conversion of organic compounds to toxins can come from either crop residue or root exudates.

Yield decreases from toxic chemicals from plant residues are decreased by crop rotation, burning, or deep plowing. Yield losses from root exudates (autotoxicity) by neighboring plants is quite another matter.

Autotoxicity from neighboring plants is the focus of my interest.

1. It happens when plants are young. You can see differences in physiology when plants are still small.
2. It is irreversible. The genetic expression is set through the plant's life.
3. Auto toxicity is transferred by roots. A plant's exudates must be toxic to the neighbor's roots. Notice the roots on "border row" plants. The part of the root system that has no neighbor is always more healthy and vigorous than the side that have neighbors of the like species.
4. The extent of toxicity will be determined by the chemical composition of the exudates amount of exudation and microbial activity.
5. Unhealthy neighbors exude more potential toxin forming chemicals.
6. Less auto toxicity occurs in cooler soils (earlier planting). Plants "grow off" differently than later planted seed. Yields are normally higher. Earlier plants are normally shorter (shorter internodes) and are higher yielding.
7. Microbial activity is less in cooler soils. It would therefore seem that microbes turn organic chemical exudates into toxins.

If the above is true:

- Fumigation of soil should increase yields. It does.
- Transplanting plants, rises in a single plant per cell, should yield more (less auto toxicity when plants are young), than plants that are planted in the field. They do.
- "Field plants are areas of "skips" (no other plants near) should look different than plants in the normal population. They do.

This evidence may not be compelling; however, it suggests that auto toxicity is limiting the genetic potential of plants.

In fact, we could make a good case for disease infections always being more serious in areas of the field with weaker plants. One could also make a good case for diseases transmission from one plant to another from affects of auto toxicity. Diseases seem to spread in a circular pattern.

Disease is always more of a problem when several plants come out of the same seed or crown … potatoes, carrots, alfalfa, and plants with shoots.

If this is true, how do we deal with the problem?

1. Fumigation?
2. Stopping or inhibiting exudates?
3. Change composition of exudates?
4. Make plants more resistant to toxins?

Number 4 is the most logical solution. Plants do have natural immunity (resistance) to toxins.

Theory: The organic root exudates from the neighboring plants are converted to toxins by the microbes that colonize in the roots of the host plant.

The solution of this problem may come from one of two directions;

A. Make plants resistant to colonization of microbes.
B. Make the plant resistant to the toxins.

This is our task. When completed, the plants in the field will look more like the plants at the "end of the row."

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