Organic Soil Management: common mistakes & misperceptions

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Ten common mistakes & misperceptions

Organic = neglect or omission

Organic = input substitution

Plants don’t know the difference

Rush without consequence

Organic systems require pre-plant tillage

Traditional tillage tools will do the trick

Haphazard cover cropping

Precision ag is incompatible with organics

Artificial drainage is incompatible with organics

Balanced farming = cation balancing
Organic by neglect or omission
Permanent Agriculture is a concept that predates Bio-dynamic and Organic Agriculture, and like them, was, in part, a response to governmental agricultural orthodoxy. Shulman (1999) comments that early in the twentieth century, “Existing institutions, such as the United States Department of Agriculture, were not considered adequate guardians of the food supply” (p. 401). The Professor of Agronomy at the University of Illinois, Cyril Hopkins, wrote:

In recent years, Whitney and Cameron have revived [the] theory of toxic excreta from plant roots, in support of a more radical theory announced by them, to the effect that soils do not wear out or become depleted by cultivation or cropping. While this theory is advanced with no adequate foundation and in direct opposition to practical experience and to so many facts of mathematics, chemistry, and geology, that it is in itself quite unworthy of further consideration, the fact is that it has been promulgated by Professor Whitney as Chief of the United States Bureau of Soils, and by Doctor Cameron as the chief chemist of the same Bureau; and, consequently, it cannot be ignored (Hopkins, 1910, p. 313).
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SOIL FERTILITY AND PERMANENT AGRICULTURE

BY

CYRIL G. HOPKINS, PH.D.

PROFESSOR OF AGRONOMY IN THE UNIVERSITY OF ILLINOIS, CHIEF IN AGRONOMY AND CHEMISTRY AND VICE DIRECTOR OF THE ILLINOIS AGRICULTURAL EXPERIMENT STATION
It is the first business of every farmer to reduce the fertility of the soil, by removing the largest crops of which the soil is capable; but ultimate failure results for the landowner unless provision is made for restoring and maintaining productiveness. Every landowner should adopt for his land a system of farming that is permanent,—a system under which the land becomes better rather than poorer.

If the independent farmer is to adopt and maintain permanent systems of profitable agriculture, he cannot accept "parrot" instruction; he must know the why and wherefore, the reason for doing things, and the ultimate effect of his agricultural practice upon the productive power of the land. Every farm is an independent enterprise in which the farmer himself is the superintendent and general manager, and he must be able to direct the business, even though he may be the only man to execute his own plans. The agriculture of a state cannot be managed from a central office. The landowner must think for the land.
THE FARM THAT WONT WEAR OUT

CYRIL G. HOPKINS
Wheat harvested from 1 ac treated with manure

Wheat harvested from 1 ac treated with manure, lime and rock phosphate
-523,000 tons of N/yr!

N budget for Illinois (units are 1000 metric tons N / yr)

(David et al., 2001)
N budget for Illinois (units are 1000 metric tons N / yr)

(David et al., 2001)
Franklin Hiram King  
(1848-1911)

One of the early agricultural scientists in the Midwest region who was very concerned by the rapid degradation of Midwest soils during the 19th century.

“We desired to learn how it is possible, after twenty and perhaps thirty or even forty centuries, for their soils to be made to produce sufficiently for the maintenance of such dense populations.”

Farmers of Forty Centuries, 1911
Fertilizing with night soil
From “Soil Erosion: A National Menace (1928)

What would be the feeling of this Nation should a foreign nation suddenly enter the United States and destroy 90,000 acres of land, as erosion has been allowed to do in a single county?

To visualize the full enormity of land impairment and devastation brought about by this ruthless agent is beyond the possibility of the mind. An era of land wreckage destined to weigh heavily upon the welfare of the next generation is at hand.
This can happen on an organic farm!
What do I do now?

Organic weed management by omission

http://biology4.wustl.edu/olsen/images/briana_field.jpg
Rescue treatments are standard in conventional agriculture

3 oz of product X should do the trick
Rescue treatments are standard in conventional agriculture.

Ohh... you are organic... hmm... You got me stumped.
Have you ever used this stuff?
Natural Way of Production of Chilean Nitrate

Formation of the Natural Chilean Nitrate today present in the Atacama Desert dates back to 200,000 years. The Atacama Desert is the driest desert on earth with less than 2 mm of rainfall per year. There is no soil on the surface of the Desert, nor any soil formation process, trace of life or biological life precursor, to the point that for NASA it is similar to the inert surface of Mars. The origin of the Natural Nitrate is supposed to be atmospheric.

Natural Nitrate is obtained from the Caliche ore in the Atacama Desert by mechanical and hydraulic processes, where the sunlight plays an essential role as source of energy. The caliche ore, a “nitrogenous rock” only undergoes physical processing at low temperatures similar to those of the surrounding environment. During processing, not even ion exchange takes place, which is unique among refined mineral fertilizers.
Guano was mined intensively off the west coast of South America during the mid- to late 1800s. During the peak years of guano mining, Great Britain imported over 150,000 tons annually.

Mountain of Guano off the coast of Peru
Guano was mined intensively off the west coast of S. America during the mid-to late 1800s. During the peak years of guano mining, Great Britain imported over 150,000 tons annually.
Do you apply chicken litter every year??

If so, have you ever estimated the P balance for your farm?
Plants don’t know the difference
Plants take up mostly inorganic forms of nutrients when inorganic forms of nutrients are readily available.

In some natural ecosystems (e.g., tundra), direct uptake of organic forms of nutrients is very important.
Our data show that all grass species were able to take up directly a diversity of soil amino acids of varying complexity. Moreover, we present evidence of marked inter-species differences in preferential use of chemical forms of N of varying complexity. L. perenne was relatively more effective at using inorganic N and glycine compared to the most complex amino acid phenylalanine, whereas N. stricta showed a significant preference for serine over inorganic N.
Jethro Tull invented the grain drill and many complementary technologies that resulted in large increases in grain yields during the 18th century.
“All sorts of dung and compost contain some matter, which, when mixt with the soil, ferments therein; and by such ferment dissolves, crumbles, and divides the earth very much; This is the chief, and almost only use of dung... This proves, that its (manure) use is not to nourish, but to dissolve, i.e., divide the terrestrial matter, which affords nourishment to the mouths of vegetable roots.”

Jethro Tull, 1731
Adoption of Tull’s tillage intensive row cropping system increased yields across Europe

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even though it was based on an incorrect theory of crop nutrition
Rushing without consequences?

Symptoms of planting when soils are too moist
Do these views look familiar?

Slow emerging seedlings in cold soil

Frosted corn
These situations are uncommon on organic farms because most experienced organic farmers plant later to:

- Increase speed and uniformity of stand establishment
- Allow a flush of weeds to be terminated before planting
- Avoid contamination with GMO pollen

Slow emerging seedlings in cold soil  Frosted corn
Most organic farmers use tillage to stimulate and then kill 1 or more flushes of weeds before planting summer crops.
Terminating spring planted oats with a soil finisher ~ 3 weeks before planting corn
Converting old sod to row crops is much easier if the soil is allowed to “mellow” between tillage operations.
Disk ripping wheat stubble in late November before corn

Rough surface maximizes infiltration, minimizes erosion and is much easier to prepare for planting in the spring
Which is worse??

Compaction probably extends several feet deep

Saturated soil is less compressible than wet soil
Leveling ruts in moist soil can create season long clods
Vertical tillage tools create fewer clods in moist soils.
Organic systems require pre-plant tillage

Ridge till and no-till soybean strips will require no pre-plant tillage this spring
WIU Allison Organic Research Farm
Tillage System experiment

Conventional till
Bio-strip-till
No-till

Established in fall 08
Options for rolling cover crops

Rodale design

Cultimulcher
Early June

1 week later
~2 weeks after planting
Early November

Plot yields ranged from 51.6 to 58.6 bu/ac

No significant differences between systems
Traditional tillage tools will do the trick

Do you have a tillage tool that could handle this situation?
10’ Howard Rotavator tilling ~ 3” deep with C blades
Complete kill after 1 pass and 2 days of sun
Organic farmers who want their tillage tools to perform non-traditional tasks may need to purchase or build non-traditional tillage tools.
Cover crops have many effects! Adapted from Magdoff and Weil (2004)
Haphazard use of cover crops

Cover crops have many effects!

Adapted from Magdoff and Weil (2004)
How will I seed the cover crop?
What will soil temperature and moisture conditions be like?
What weather extremes and field traffic must it tolerate?
Will it winterkill in my area?
Should it winterkill, to meet my goals?
What kind of regrowth can I expect?
How will I kill it and plant into it?
Will I have the time to make this work?
What’s my contingency plan—and risks—if the cover crop doesn’t establish or doesn’t die on schedule?
Do I have the needed equipment and labor?
Be realistic about potential cover crop challenges
The agronomic and economic potential of break crops for ley/arable rotations in temperate organic agriculture

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http://www.ncl.ac.uk/tcoa/files/breakcrops_orgagagr.pdf
Cover crops should be viewed as part of a crop rotation!

II. CROP ROTATIONS  THE CENTRAL MANAGEMENT TOOL IN ORGANIC FARMING

Crop rotation is a system of growing different types of crops in a recurrent succession and in an advantageous sequence on the same land (Bullock, 1992). The practice of crop rotation dates back to the Han Dynasty of China over 3000 years ago (MacRae and Meheys, 1985) and the Romans recognized the benefits of alternating leguminous crops with cereals more than 2000 years ago (Karlen et al., 1994).
Using cover crops to improve soil fertility generally requires more management than using manure or purchased nutrient amendments.
Cover crops are not idiot-proof!

There are few profits in idiot-proof systems!!
Precision ag is not compatible with organics
Precision agriculture is not compatible with organics. Uniform application of manure and granular products is much easier with GPS guidance.
How much overlap occurs when you work a field?
Do any of you plant or cultivate using GPS guidance/autosteer?
The best tool for precision ag is not the latest GPS samples or satellite image. Your observations during harvest (or other field operations) can tell a far more accurate story. Pay attention! The very best precision ag tool is you!

Guidance before GPS
The best tool for precision ag is not the latest GPS samples or satellite image. Your observations during harvest (or other field operations) can tell a far more accurate story. Pay attention! The very best precision ag tool is you!
Artificial drainage has greatly increased the number of days when soils in the Midwest are suitable for field operations but has also contributed to many environmental problems:

- Pollution of water resources
- Loss of SOM
As a result, some people think that artificial drainage is incompatible with organics.
Timely field operations are especially important in organic farming systems.
Why do crops on tiled-drained land tend to be more drought resistant?
Conservation Drainage

The optimization of drainage systems for Crop Production, Water Quality and Water Harvesting benefits
Controlled Drainage is one option.
Is a balanced approach to soil fertility the same thing as cation balancing?
Soil fertility is >> chemical fertility + cation balance is only part of chemical fertility
Healthy root function
a balance of inward and outward processes

H₂O  NO₃⁻
Transpirational stream
H₂O  Ca⁺²

Root growth

N, S, P
Root exudates activate soil microbes
Diffusion

K⁺  H₂PO₄⁻
Healthy root function
a balance of inward and outward processes

A balance of O₂ and H₂O is important for most of these processes
Feed the soil  vs.  Feed the crop ?
Both strategies are important!

Soils with low OM and poor structure tend to grow unhealthy roots which use nutrients inefficiently &

healthy roots need available nutrients!
Acute root disease is a common cause of drought stress and nutrient deficiency symptoms.
A balanced approach to soil management

Nutrient Management

TILLAGE
retention vs elimination
soil properties
method/type

Surface
Crop type
Residue decomposition
Burial
Allelopathy

Well adapted crop

SOM

Rotation
sequence
length
diversity

Inoculum
Survival

Water Management

Adapted from Bailey and Lazarovits (2003)
Small increases in OM can improve crumb structure

Superior air/water relationships

Healthier root growth and function
Biological inoculants can be helpful but are less important than SOM and good soil structure.
Balance between doing and checking what you did
THE MISSOURI PLAN (BALANCED FARMING)

J. W. Burch
University of Missouri

The Missouri Extension Service taught individual farm practices, as did all state colleges, until 15 years ago when the need became apparent for a system of farming that would tie together all of the good practices recommended by the college for a farm in a way to give the greatest net income consistent with continuing improvement of the soil. Throughout the years certain farmers have specialized in beef cattle production and perhaps failed to improve their pastures, and others specializing in crop production failed to receive high net income because of poor feeding practices. The college, with its traditional 12 to 14 departments and Extension specialists for each, undertook to save the farmer by teaching the individual practices, leaving it to the county agent or the farmer to tie these practices together, if any attempt along that line was made.

This idea of developing a system of farming, called in many states Farm and Home Planning, is called Balanced Farming in Missouri. The objective has been to achieve a balance between input and outgo of soil fertility; between type of soil and crops; between pasture and crops and the livestock system; between the livestock system and the desires and abilities of the operator and his labor supply; between net income and the needs of the farm family; between good planning, hard work and a comfortable, attractive home.