

Lawn Care Rules I Grew Up With

- 1) Rototill the yard every few years to mix the dirt and loosen the soil.
- 2) Cut the grass short so it looks more sculptured
- 3) Apply NPK fertilizer 3-4 times a year
- 4) Herbicides are the best weed control agents
- 5) St Augustine grass takes a lot of water
- 6) St Augustine is prone to every grass disease
- 7) Thatch is bad and should be removed
- 8) Mushrooms may be poisonous and should be removed.

I was doing all this until one spring after a cool wet year, my yard almost disappeared. The fertilizer company first diagnosed the problem as a lack of iron but then they said I had Take-All-Root-Rot which has no cure.

Take all Root Rot (TARR) vs Brown Patch

Gaeumannomyces graminis var. graminis or avenae

Take-all patch is a serious root rot disease caused by a soil-borne fungus. It was first discovered on St. Augustine grass in 1991 but has also been found in Bermuda grass, zoysia and centipede grass. It also attacks wheat crops where it may be controlled by rotating wheat with barley, rye, canola, peanuts, cotton and other crops. Take-all patch is often confused with Brown Patch.



Take all root rot, the root (root joint or stolons) looks slimy and rotten and the leaf will soon die.



Brown patch leaves but the root looks fairly healthy and will recover in the following spring.



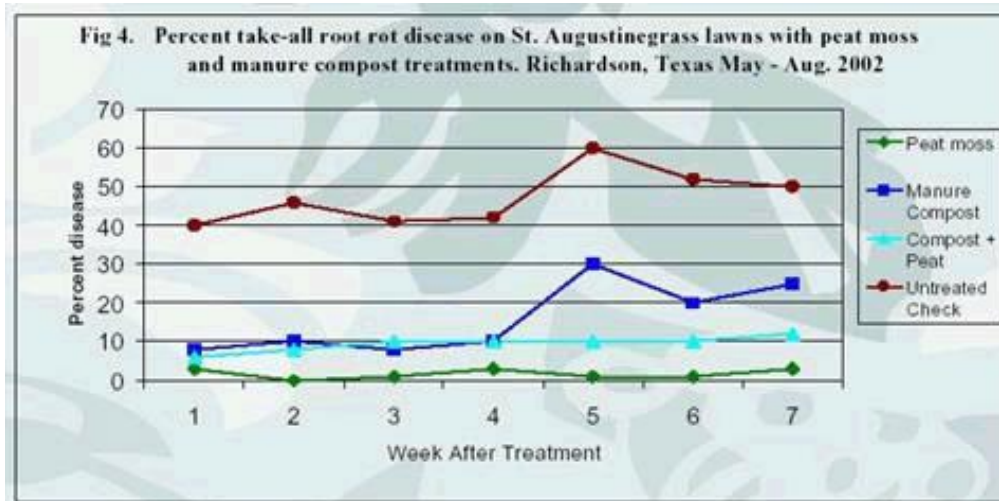
Take All Root Rot – grass disappears down to dirt in irregular pattern.



Brown Patch is a series of circles of affected areas.

Take-It-Root-Rot (TARR) and Brown Patch Causes

Take All Root Rot Fungus (<i>Gaeumannomyces Graminis</i>)	Brown Patch Fungus (<i>Rhizoctonia Solani</i> fungus)
Blackened stolons, lighter green leaves	Stolons are green but leaves have brown spots
Spreads in cooler months	Appears as temperatures rise above 80
Shows up in Summer heat	Often looks ok during winter
Prefers Alkaline soil (above 6.3)	Prefers Acidic soils (pH below 6.0)
Overexposure to commercial NPK fertilizers	Overexposure to commercial NPK fertilizers
Overexposure to "weed and feed" fertilizers	Overwatering in the afternoon
Prefer soils that are compacted	
Grows best in high nitrogen soils (too much fertilizer)	Grows best in high nitrogen soils (too much fertilizer)



http://www.plantanswers.com/root_rot_fungus.htm

Recommended TARR Treatments

In January apply 40-50 pounds of Gypsum per 1,000 square feet and water in immediately.

In the spring and fall apply Sphagnum Peat Moss at a 3 cubic feet bale per 400 square feet of lawn. This will help lower the soil PH.

In the spring and fall, when temperatures are below 85F, apply compost to enrich microbial numbers and diversity.

Cut the grass at the highest setting and water just before dawn.

Apply fungicide such as Actinovate that contains Streptomyces per label instructions

Use natural organic fertilizers, but how did fertilizers come about anyway?

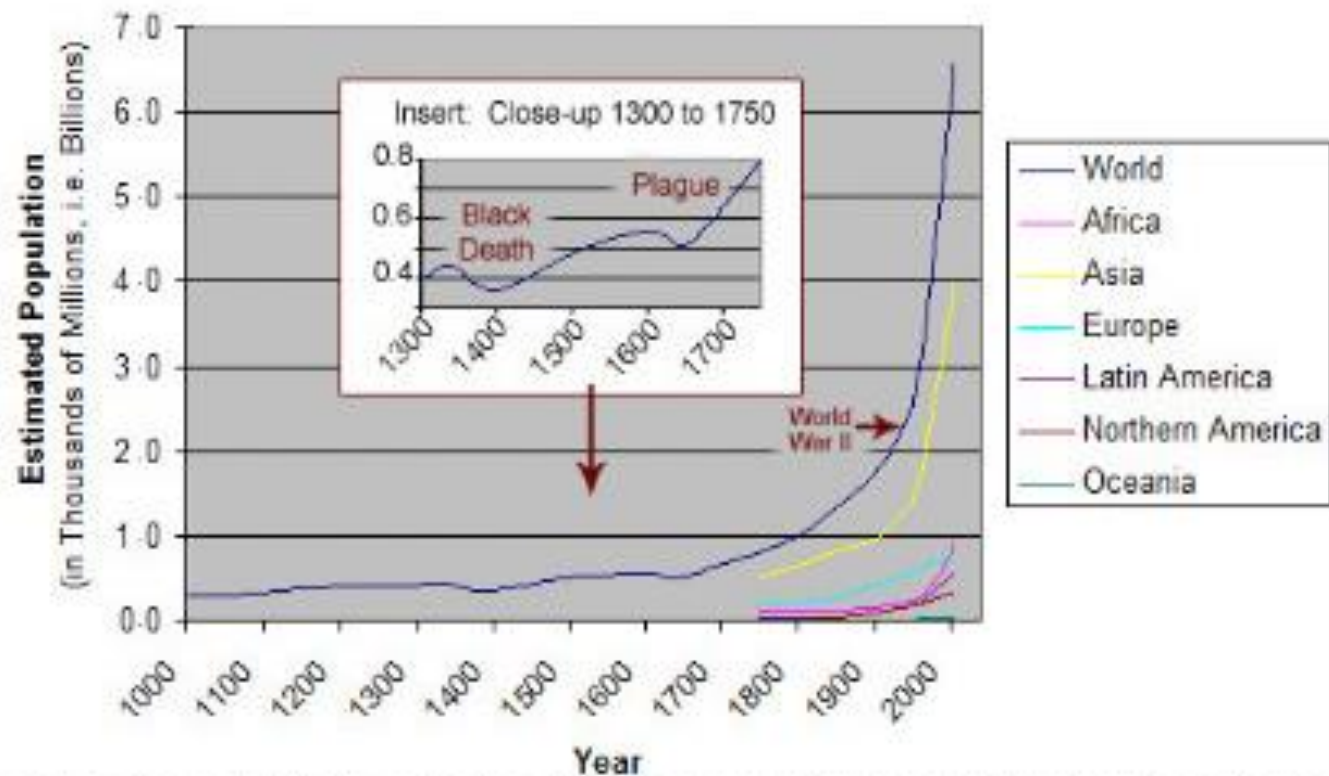
The Beginnings of Modern Agricultural Fertilization



Fritz Haber was given the 1918 Nobel Prize in Chemistry for his invention of the Haber process for synthesizing ammonia from nitrogen gas (air) and hydrogen gas which opened up large scale applications of fertilizers for food production (and cheaper explosives for war). BASF assigned Carl Bosch to upscale Haber's chemical processes which was done by 1913. Today the process is known as the Haber-Bosch process.

Dr Haber is not celebrated today because he also invented chlorine gas used in World War I and the insecticide Zyklon B which was modified by the Nazis in World War II for use in their extermination ovens (including some of

People of the World - from 1000 AD to the present day



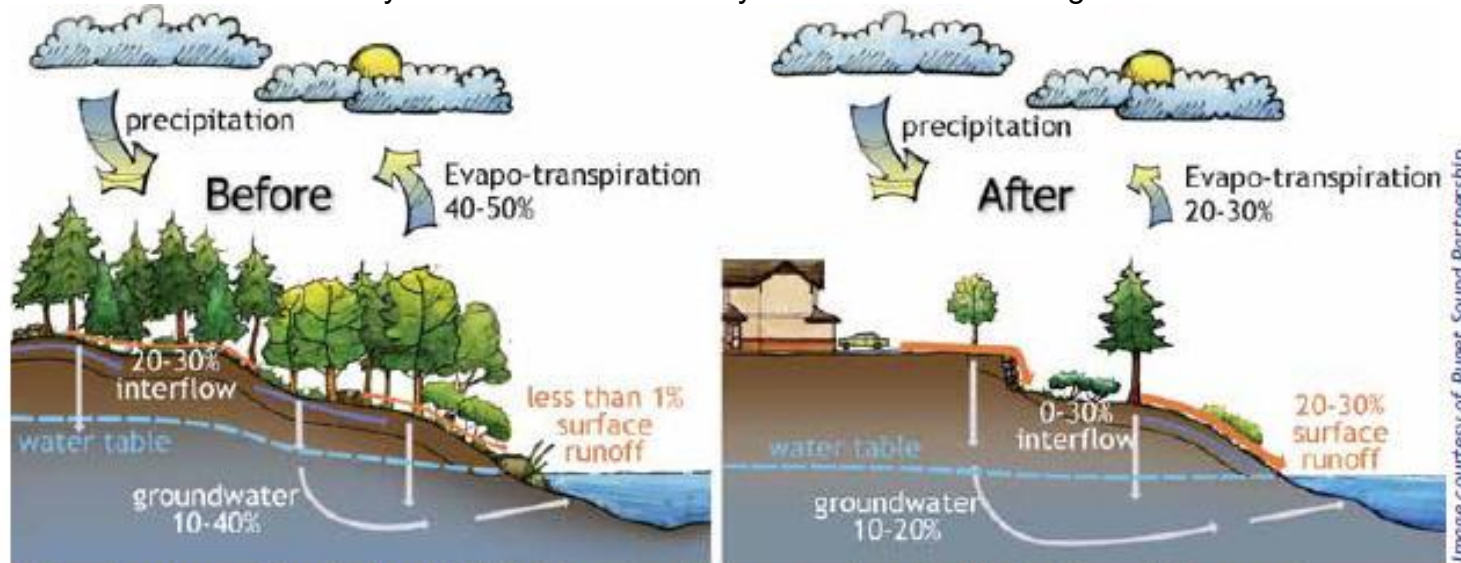
Source of data: Wikipedia http://en.wikipedia.org/wiki/World_population#Population_figures

Synthetic (Chemical) NPK Fertilizers

	Nitrogen (N)	Phosphate (P)	Potassium (K)
Main source	Comes from fossil fuels, sewage, or the air	Comes mostly from Phosphate rock but some from coal	Comes mainly as potash from mines
Use by plants	Major component in Chlorophyll	Required for growth and maturity, DNA, RNA, cell membranes	Regulates the opening and closing of stomata which regulate CO ₂ uptake
	Used to produce sugars from water and carbon dioxide (photosynthesis) for food	Plays a role in photosynthesis, respiration, energy storage and transfer, and cell division	Triggers activation of enzymes and is essential for production of ATP, required to carry energy around and between cells.
	Major component in amino acids, the building blocks of proteins.	A component of complex nucleic acids that regulate protein synthesis	Helps regulate water intake within cells

Warning: Synthetic fertilizers decrease the organic matter in the soil and the soil then loses its structure and its ability to hold water.

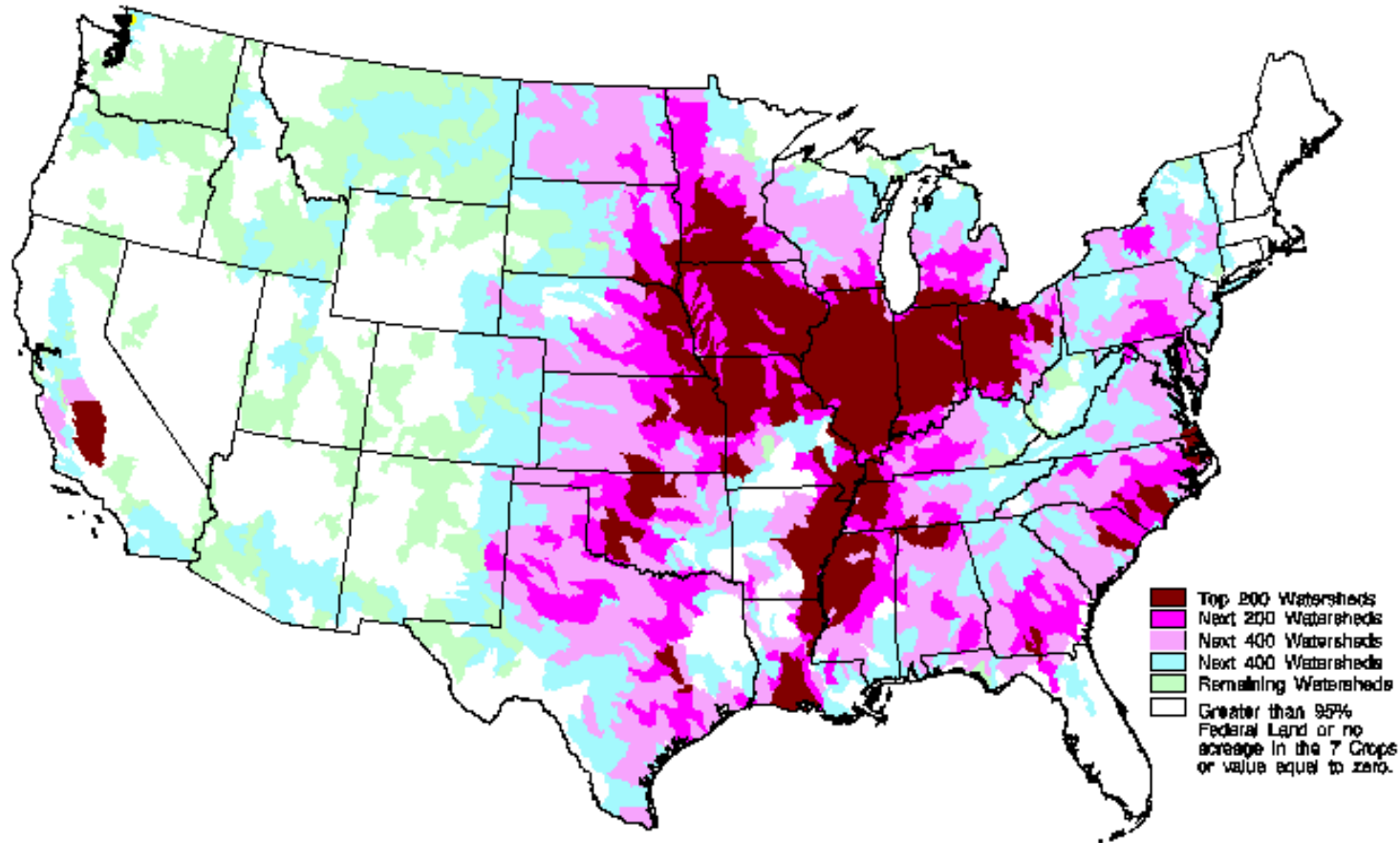
Natural fertilizers work with your soil to build a healthy foundation for lush vegetation.



Before development almost all rainfall is taken up by plants, evaporates or infiltrates through the ground.

After conventional development, surface runoff increases significantly while evaporation and infiltration into the

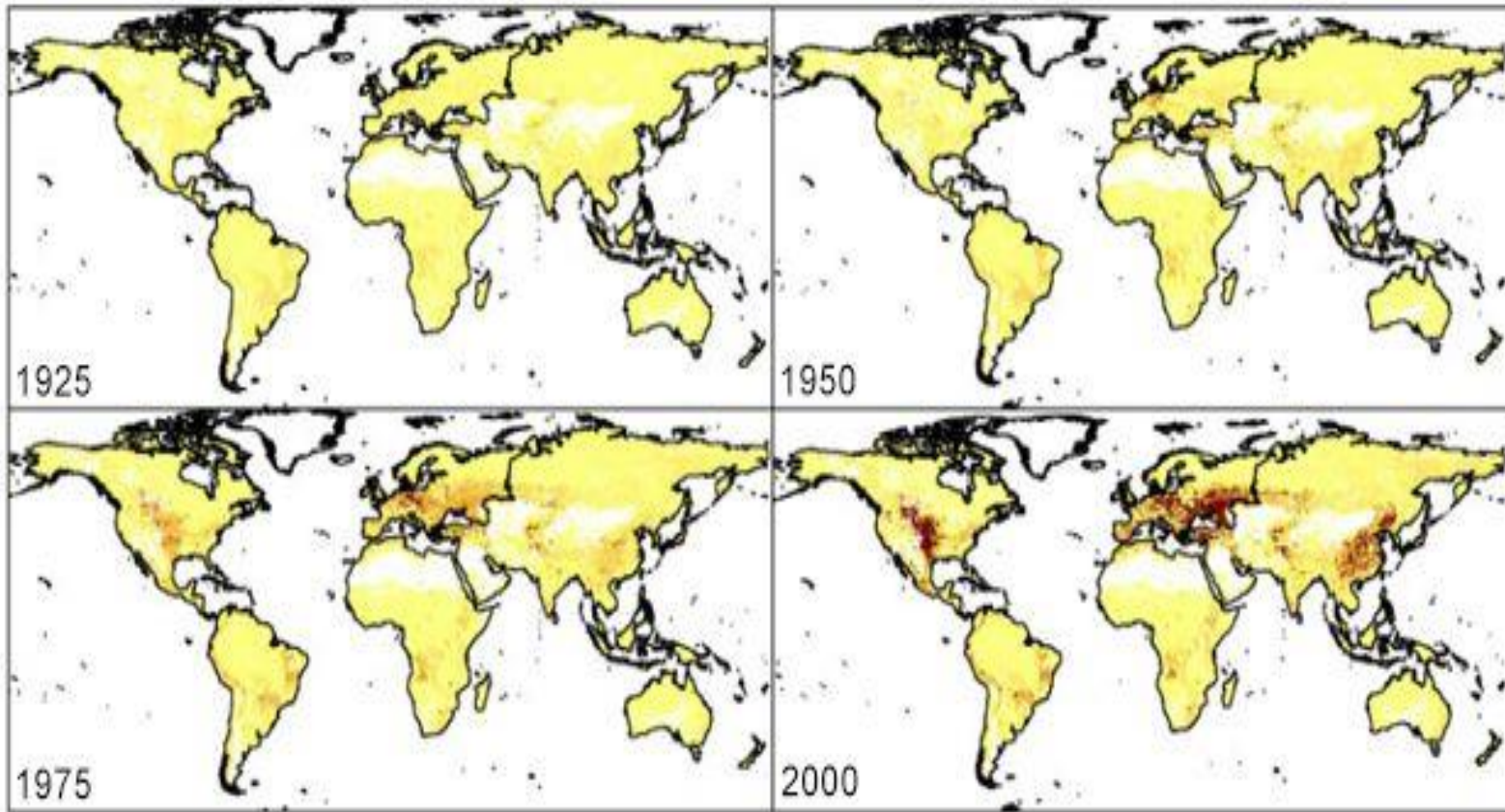
Commercial Nitrogen Fertilizer Runoff Vulnerability Index



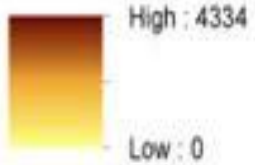
For corn, cotton, barley, wheat, soybeans, sorghum, and rice, 1992.

U.S. Department of Agriculture
Natural Resources Conservation Service
Resource Assessment and Strategic Planning Division
Map ID: BMW2135 October 1997

UN says Nutrient additions one of most significant forms of river/groundwater pollution, P more than N



Vadoso Zone N Storage (kg N/ha)

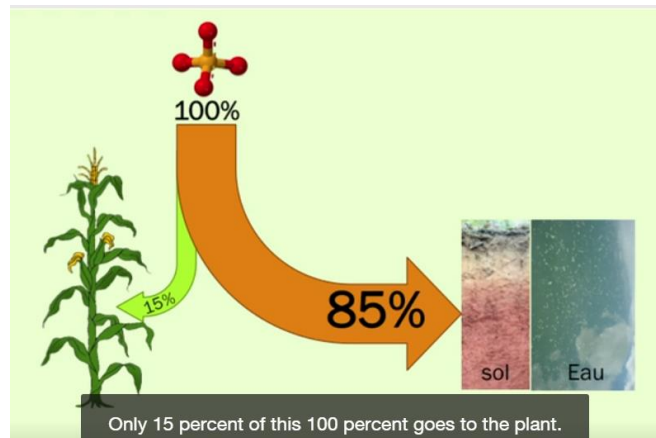


<http://www.bbc.com/news/science-environment-41945650>

BBC News, 11/10/2017, "Scale of 'nitrate timebomb' revealed"

Mohamed Hijri's Warning about Phosphorus in Fertilizer - Ted Talk

Nitrogen loss 65-70% of applied N is lost through ammonia volatilization, denitrification, leaching, immobilization, and runoff Shantanu Das, Assam Agricultural University, Jorhat, India



Phosphorus is essential for all plant and animal life. It is part of the key molecules of life such as cellular communication, cell membranes, plant energy (ATP or) and the essential DNA. Humans get their phosphorus from plants, meats, milk, and eggs. Plants get their phosphorus from the soil or fertilizers.

By 2050 the world will be running out of phosphorus.

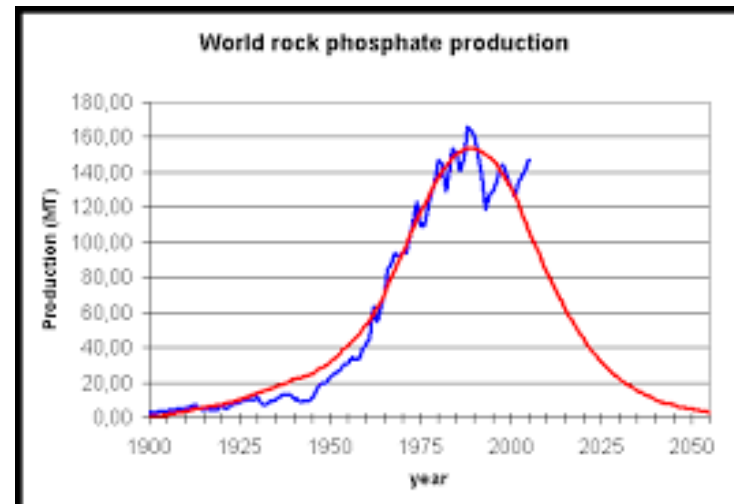
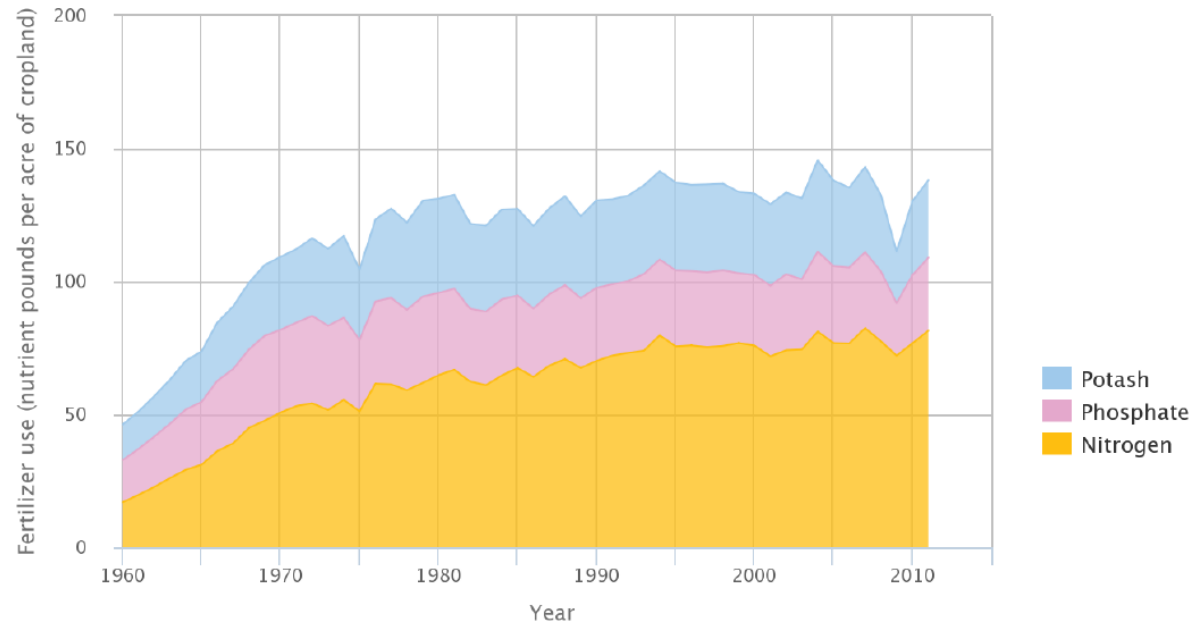


Exhibit 1. Commercial fertilizer use in the U.S., 1960-2011



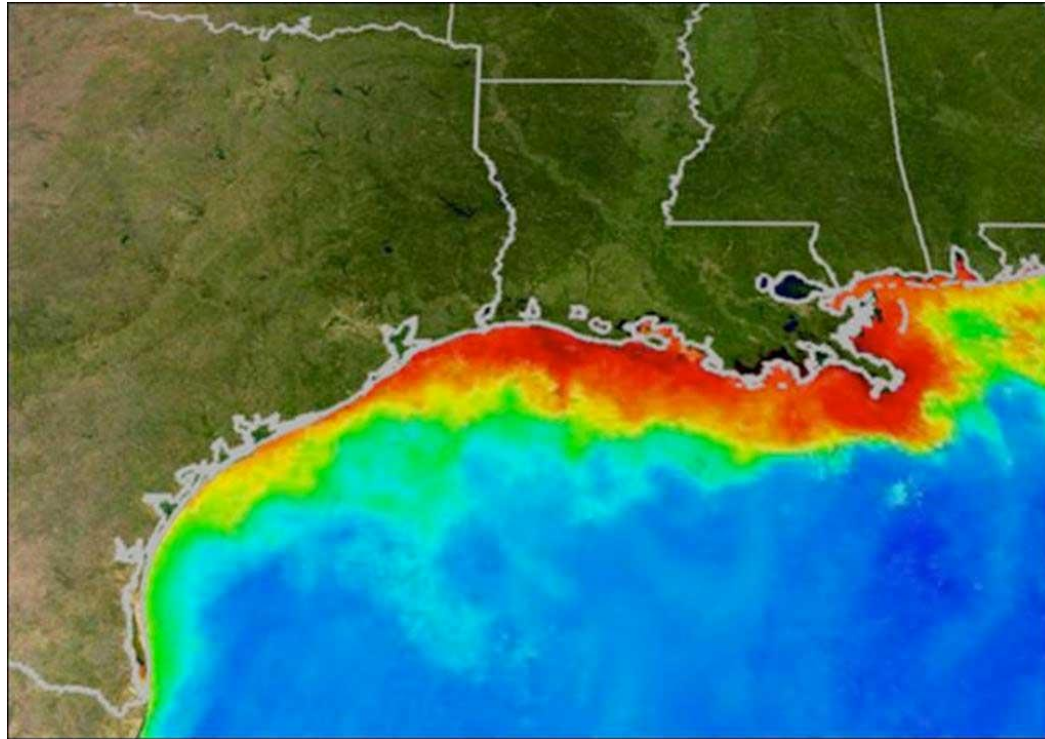
Based on sales data. Per-acre use based on the total acreage of harvested or failed cropland, as determined by USDA's National Agricultural Statistics Service.

Information on the statistical significance of the trends in this exhibit is not currently available. For more information about uncertainty, variability, and statistical analysis, view the technical documentation for this indicator.

Data source: USDA ERS, 2013b, 2014

- 1) Excess Potash is relatively harmless but it means you probably also have excess Phosphate and Nitrogen on your lawn.
- 2) Excess Phosphate leaches into local streams and lakes and produces algae blooms that reduce oxygen in those waters. Algae blooms are unsightly and adversely affect game fish in those waters.
- 3) Excess Nitrogen will cause your turf to thin out and will all kill earthworms and other beneficial microbes.

Gulf of Mexico Dead Zone of Low Oxygen due to Fertilizer Runoff



The 2017 “Dead Zone” is expected to be 8,200 square miles, 50 % larger than normal, roughly the size of New Jersey. The fish and shrimp in this area become scarce and smaller than normal which forces fisherman to travel further out in the Gulf and drives cost higher. The USGS estimates more than 360,000,000 pounds of nitrogen and 50,000,000 pounds of phosphorus, about 2,800 train cars of fertilizer, flowed into the Gulf in June 2017. What a wasted expense for farmers besides damaging the Gulf.

From this information, I asked how can I reduce my yard’s footprint while controlling TARR?

Human Association with Microbes

News reports brought to my attention the connection between the human body and microbes.

The human body hosts between 30 and 50 trillion bacterial cells and a large number of fungi, viruses, and archaea. Collectively, the microbes inside everyone make up the “microbiome”. This is far higher than the number of human cells in each body. These microbes reside on both the external portion of the body and throughout the insides of a human. These bacteria, fungi, and protozoans are mostly single-celled animal-like organisms,

We are bacteria free but get their first dose of microbes passing through the mother’s birth canal. Babies born via C-section have a markedly different microbiome from babies born naturally. Babies acquire most of their microbiome by the age of 3.

Bacteria may either be good or bad for humans. The bacteria *Helicobacter pylori* may cause stomach ulcers. It was once found in a majority of humans but today is found only in about half of the population. The absence of this bacteria is found in patients with diseases of the esophagus such as reflux and certain cancers. Thus, this bacteria has both beneficial and detrimental benefits.

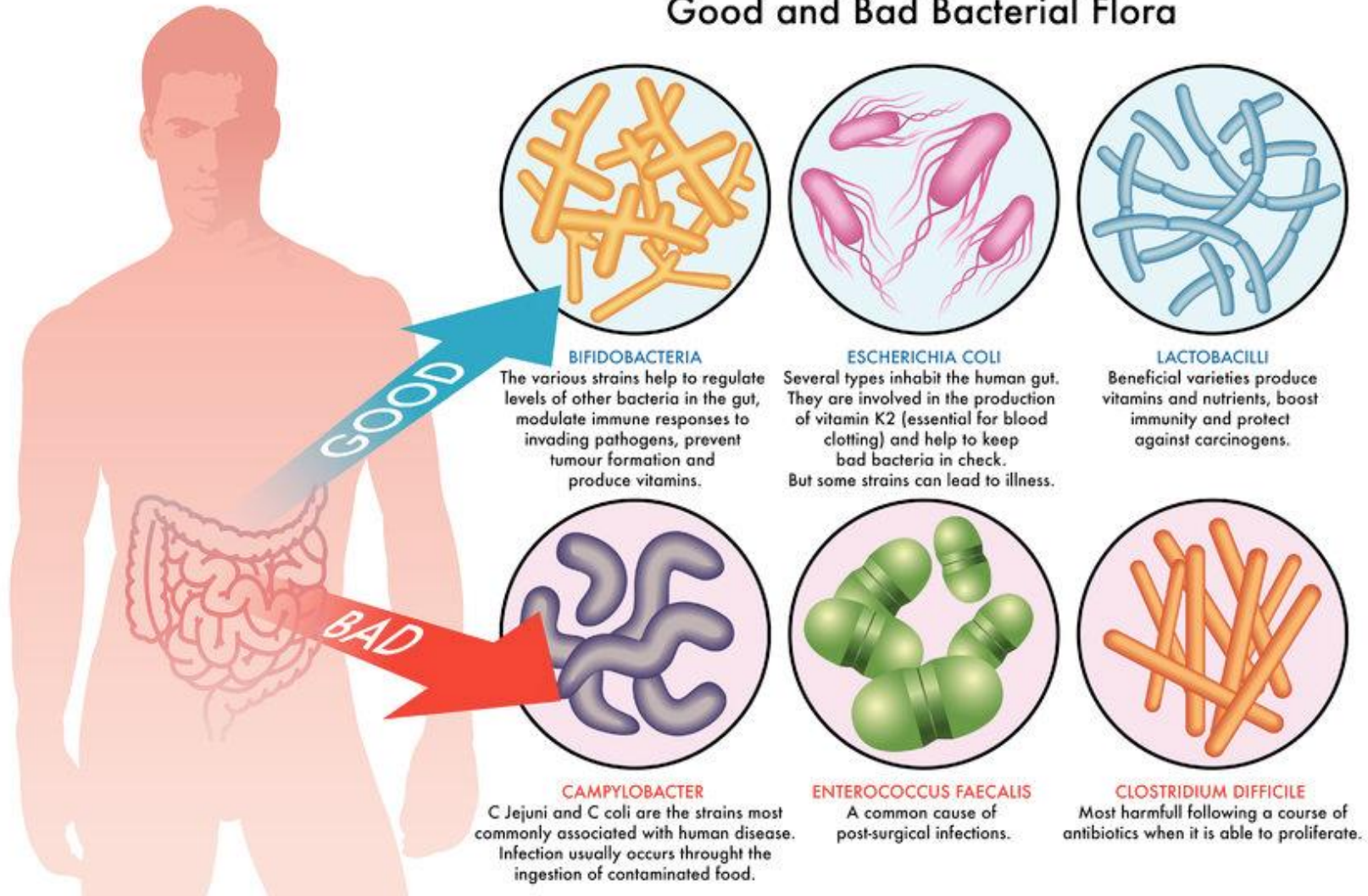
Penicillin was a major breakthrough as an antibiotic in treating numerous diseases worldwide. However, studies now indicate that overuse of antibiotics might lead to asthma, inflammatory bowel disease or even obesity.

The probiotic supplement craze has developed based on promoting good human bacteria. Currently, they are better marketed than they are scientifically tested.

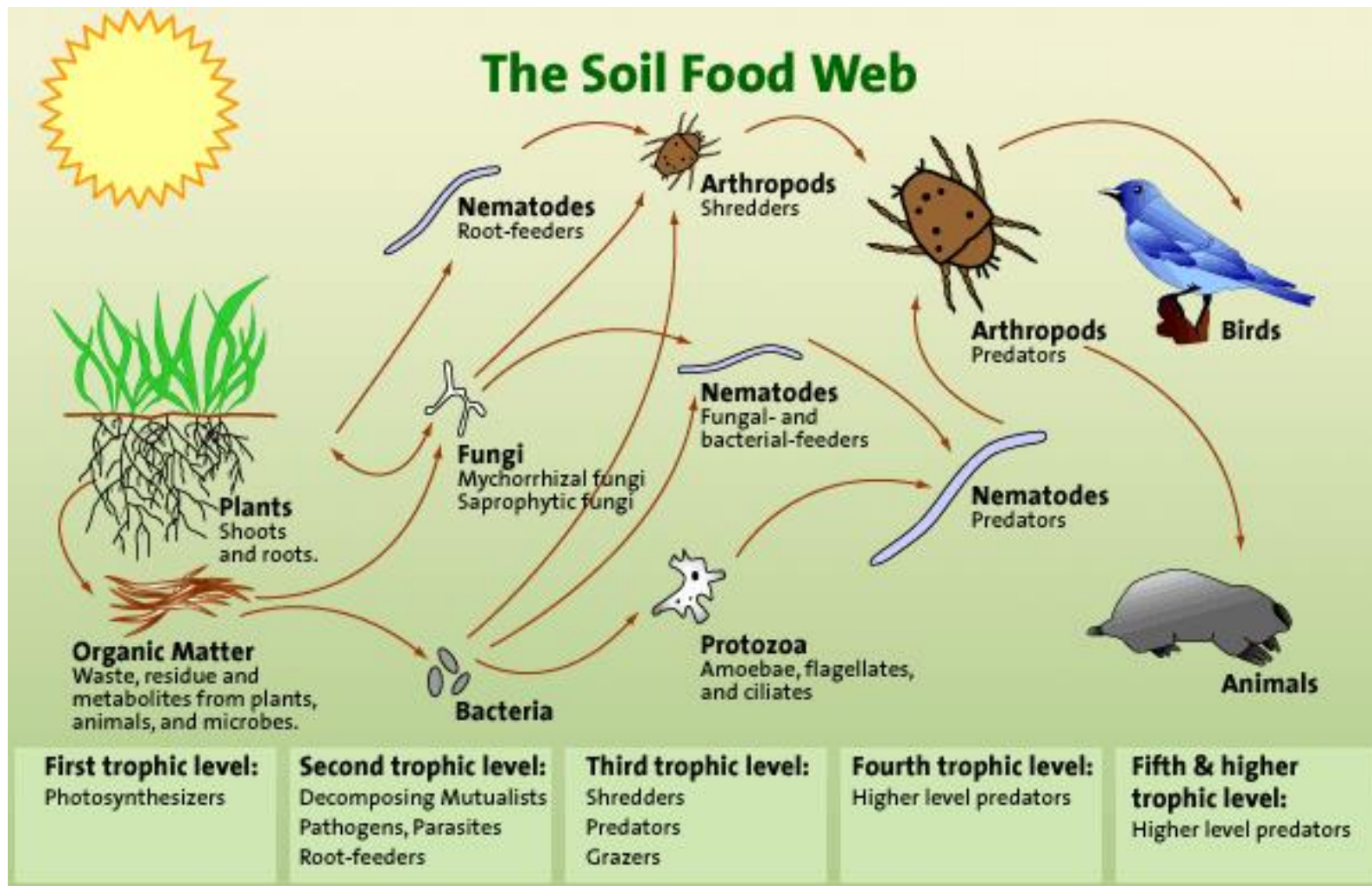
<https://www.livescience.com/27458-microbiome-surprising-facts.html>

Common Microbiota In Humans

Good and Bad Bacterial Flora



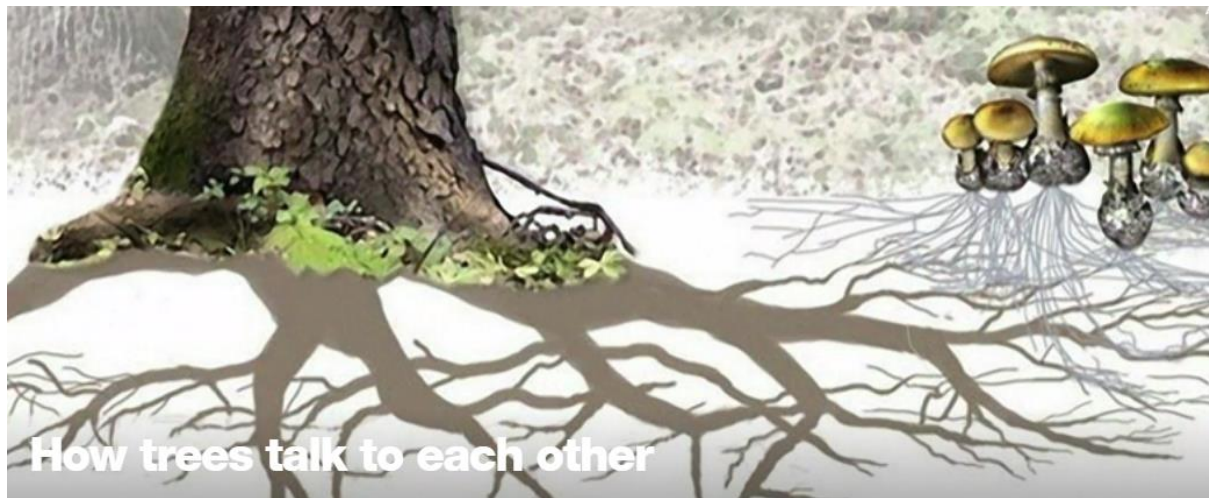
I came to the conclusion that since microbes are so important for the human body, they must also be important for lawns and crops. My research led me to “the Soil Food Web” theories first espoused by Dr Elaine Ingham.



Suzanne Simard's Insight into Tree Communication – Ted Talk



She covered three trees with plastic bubbles and then injected two of the trees with different CO₂ isotopes. When the bags were removed it was found that all three trees shared the injected isotopes.

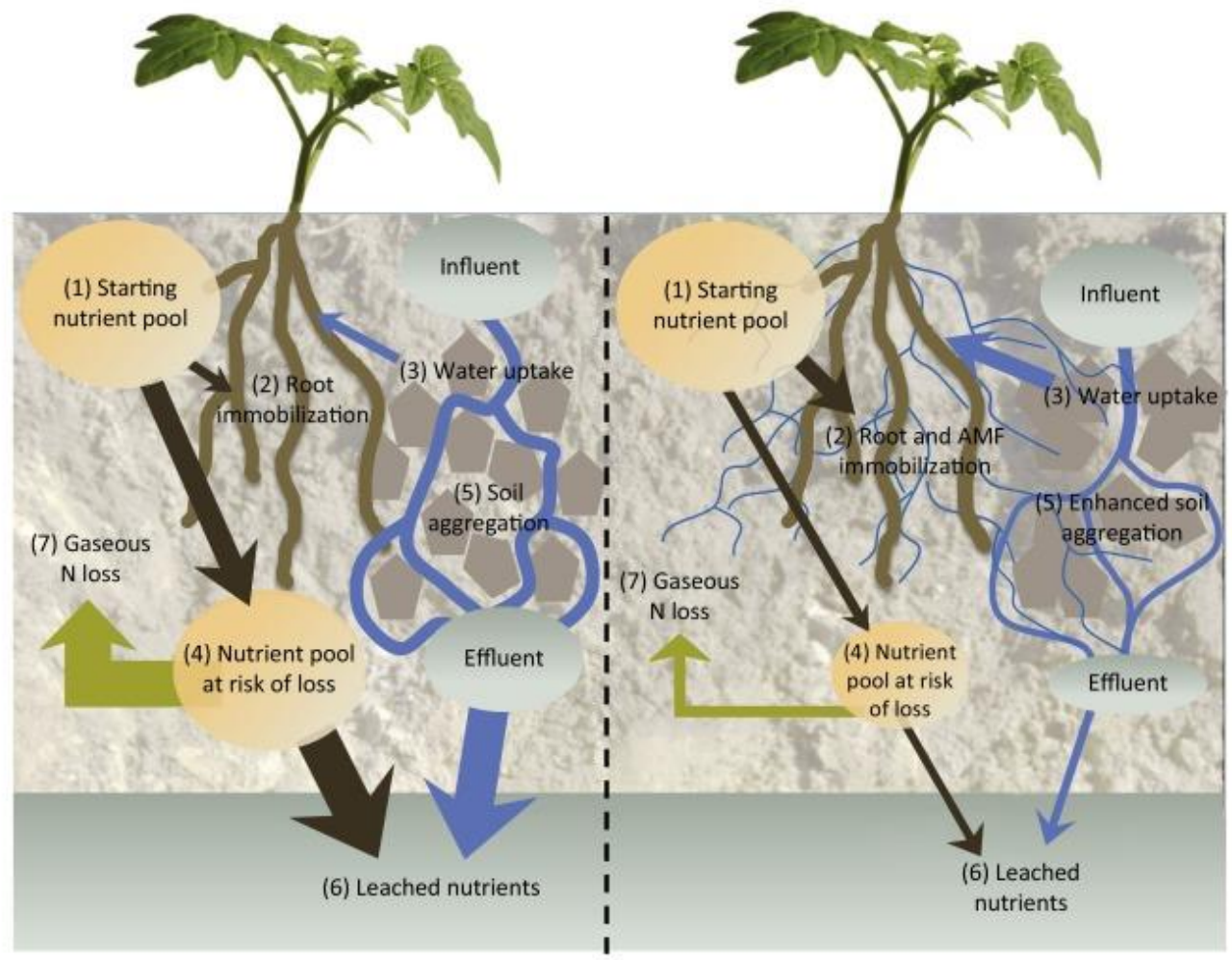


Roots can only absorb minerals that lie within .040-.060 inch of the root surface. However, the symbiotic relationship between the roots and mycorrhizae fungi results in an extended underground system for gathering and sharing minerals.



Non-mycorrhizal plant

Mycorrhizal plant



TRENDS in Plant Science

Suggestions from the Soil Food Web

- A) Annual food and seed grass crops prefer bacterial dominated soils while perennial plants and shrubs prefer fungi dominated soils.
- B) Rototilling and excessive soil disturbance destroy the soil food web.
- C) Aged brown organic materials support fungi while fresh, green organic materials support bacteria.
- D) Mulch laid on the surface supports fungi while mulch worked into the soil supports bacteria.
- E) Wet, thoroughly ground mulches speed up bacterial colonization while coarse dryer mulches support fungal activity
- F) Sugars help bacteria multiply and grow.
- G) Humic, fulvic acids, and phosphate rock dusts help fungi grow.
- H) Applications of synthetic fertilizers kill off most or all of the soil food web microbes.
- I) Stay away from additives that have high NPK numbers.
- J) Follow any chemical spraying or soil drenching with an application of aerated Compost Tea.
- K) Most conifers and hardwood trees form mycorrhizae with ectomycorrhizal fungi.
- L) Most vegetables, annual, seed grasses perennials, form mycorrhizae with endomycorrhizal fungi.
- M) Mix endomycorrhizal fungi with the seeds of annual and vegetables at planting time for better yields
- N) **Use of Roundup, fungicides, and pesticides are a definite NO-NO.**



Conventional (Horizontal) Tillage



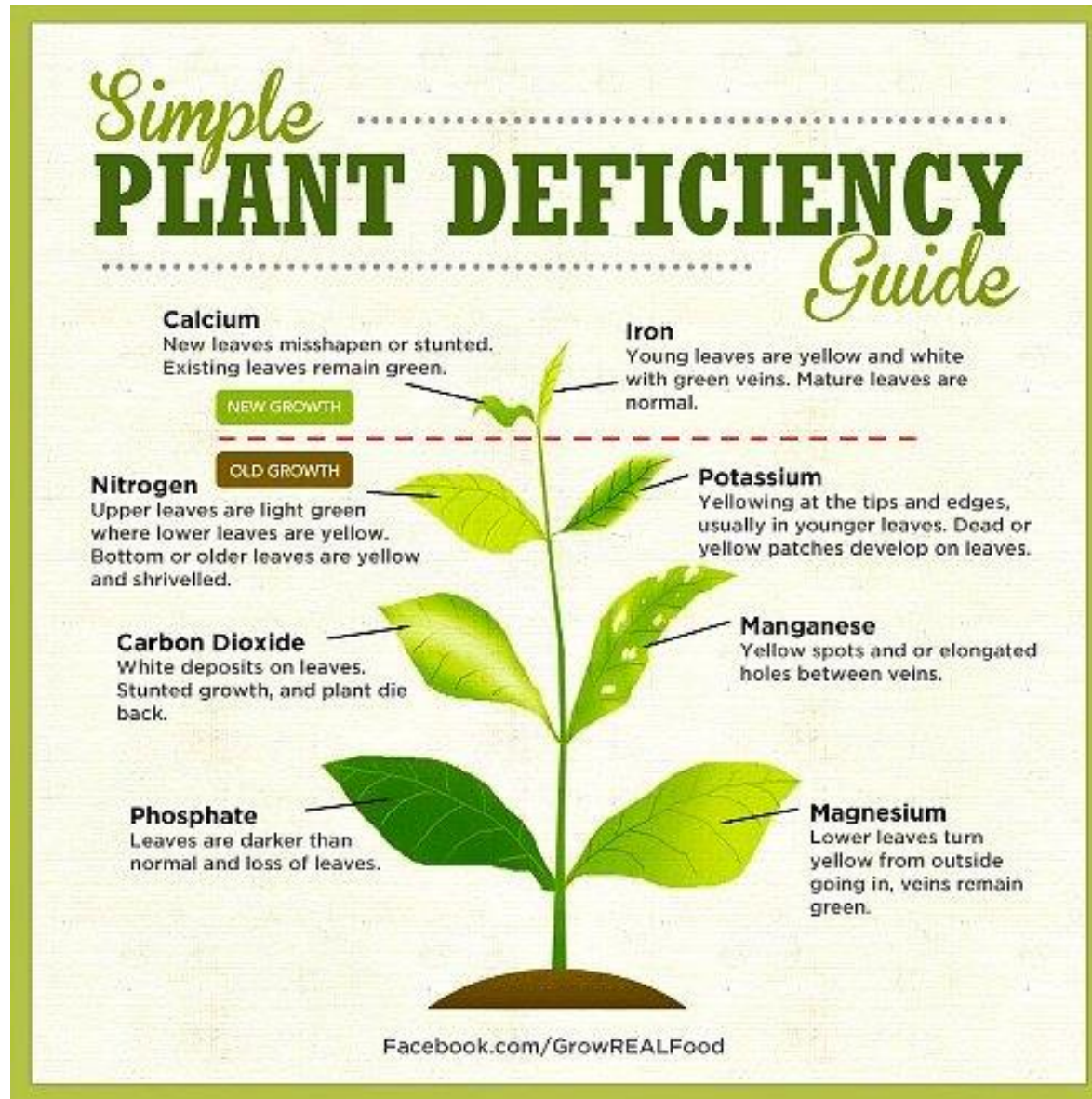
Vertical Tillage



No Tillage

No Tillage, supported by the Soil Food Web, may not be as productive as Vertical Tillage the first year, but over time, as microbes return to the soil, it will be more productive. All three require crop rotation over time.

Nutrient Deficiencies



Kens St Augustine Lawn Rules

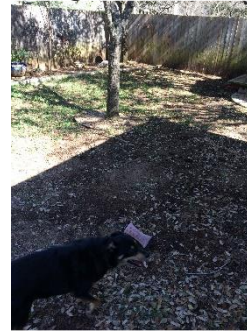
- 1) Cut St Augustine at the highest setting on your lawn mower (2.5+ inches)
- 2) Start your lawn preparation with six fortnightly applications of Compost Tea. If the lawn shows improvement, then reduce the application to monthly or quarterly.
- 3) Compost and Aeriaded Compost Teas transfers beneficial microbes and chemical needed for life from themselves to the soil but Compost Tea does not require a wheel barrow.
- 4) Compost should be applied any time the daily high temperature is below 85F
- 5) Aeriaded Compost Tea and Peat Moss may be applied any time throughout the growing season.
- 6) Compost or Aeriaded Compost Tea may be either bacterial or fungal.
- 7) Aeriaded Compost Teas are very sensitive to chlorine and preservatives in their brewing water.
- 8) Aeriaded Compost Tea should be applied within four hours of separating from their aeriaded batch.
- 9) Aerate the lawn using a plug type aerator, never rototill.
- 10) Apply Sphagnum peat moss at 3.8 cu feet per 500 square feet of lawn to lower the soil PH.
- 11) Water 1 – 1.5” in the early morning when the grass is brittle to walk on.
- 12) Apply Compost when the daily temperature is below 85F.
- 13) Only use organic fertilizers in the spring and fall.
- 14) This approach takes two years to complete but you will see improvement from the start.
- 15) Healthy St Augustine lawns have thick thatch which protects the runners from weather extremes.
- 16) Don't worry about mushrooms, these show you have a healthy fungal soil.
- 17) If you don't have abundant earthworms, your soil diversity is poor.

St Augustine spreads by runners and is considered a perennial plant. Other grasses are spread by seeds are considered annual plants.

Yard Number 1



January 2016, the previous year was cool and wet, where did the grass go?



January 2017, peat moss and compost tea are showing improvements but still have bare spots.

Yard Number 2



June 2017, original lawn with temperatures starting to hit 100F as compost tea starts biweekly applications.

Suggested Reading

Page 2	Upper Left Picture	http://www.perfectionlawnandpestcontrol.com/turf-diseases.html
Page 2	Upper Right Picture	https://ag.purdue.edu/btny/ppdl/PublishingImages/article%20images/brownpatch2.jpg
Page 2	Lower Left Picture	https://plantcaredtoday.com/take-all-root-rot-on-st-augustine-grass.html
Page 2	Lower Right Picture	https://www.whygoodnature.com/lawn-problems
Page 3	Chart	http://www.plantanswers.com/root_rot_fungus.htm
Page 4	Fritz Haber picture	http://www.the-compost-gardener.com/haber-process.html
Page 4	Haber Process Chart	http://www.the-compost-gardener.com/haber-process.html
Page 5	Graphics	http://www.plwmp.ca/surface-water-runoff/
Page 6	Graphics	https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/home/?cid=nrcs143_014062
Page 7	Left Graphic	https://www.ted.com/talks/mohamed_hijri_a_simple_solution_to_the_coming_phosphorus_crisis?language=en
Page 7	Right Graphics	https://www.ted.com/talks/mohamed_hijri_a_simple_solution_to_the_coming_phosphorus_crisis?language=en
Page 8	Graphics	https://www.pinterest.com/pin/435441857701952159
Page 9	Map	https://gulphyoxia.net/2015/04/29/gulf-of-mexico-dead-zone-cleanup-target-pushed-back/
Page 11	Graphic	https://www.slideshare.net/monqithyousif/gut-microbiota-in-health-and-disease-76411624
Pages 12,14,15	Soil Biology Primer, Dr Elaine R Ingham	
Pages 12,14,15	Teaming with Microbes, Jeff Lowenfels and Wayne Lewis, Timber Press, Portland Oregon, 2010	
Pages 12,14,15	10 Steps to Gardening with Nature, Dr Carole Ann Rollins and Dr Elaine Ingham	
Pages 12,14,15	The Hidden Half of Nature: Microbial Roots of Life and Health, David R Montgomery and Anne Bakle,	
Page 13	Graphics	https://www.ted.com/talks/suzanne_simard_how_trees_talk_to_each_other
Page 14	Graphics	http://www.cell.com/trends/plant-science/fulltext/S1360-1385(15)00056-4
Page 15	Conventional Till Picture	http://www.alamy.com/stock-photo-agriculture-field-of-mid-growth-conventional-tillage-cotton-in-late-630578.html
Page 15	Vertical Till Picture	http://www.salisburypost.com/2016/04/29/research-station-studying-wheat-tilling-and-barley/
Page 15	No Till Picture	Rodaleinstitute.org/organic-no-till
Page 17	Graphics	https://www.facebook.com/GrowRealFood/