
Terra Madre 2006
A Brief Introduction to
GROW BIOINTENSIVE
Sustainable Mini-Farming
A Selection of Images, Concepts and Techniques
GROW ABUNDANCE!


Do the best that you can,
in the place where you are, and be kind.
~Scott Nearing


Goal:
Learn from the experiences
of farmers through time.

The Chinese revere
their farmers
as
Living Libraries

…the greatest untapped source of usable energy may now be in human bodies.

—Wendell Berry

It may become the task of a future economy to give worthy employment to this energy and to reward its use.

—Wendell Berry

Healthy Soil

Produces

Healthy Plants

Produces

Healthy People

Have you seen plants growing in rows in Nature?

Why not use your farmable soil to grow :

- an abundant yield of tasty, nourishing food
- compost crops to feed the soil, and
- a thriving mini-ecosystem that enhances the planet?

How can we best nurture our community, family, soil and planet’s ecosystem?

GROW BIOINTENSIVE *Sustainable* Mini-Farming: A Bio-***Logic***ally-Intensive Way to Grow a Local Food System

GROW BIOINTENSIVE
Sustainable Mini-Farming,
If Used Properly,
Has the Potential to Grow:

2 to 6 Times More Food

Compared with Conventional Practices

GROW BIOINTENSIVE Can Use:

- 67% to 88% *less* water
- 50% to 100% *less* purchased nutrient—in organic fertilizer form
- 94% to 99% *less* energy in all forms

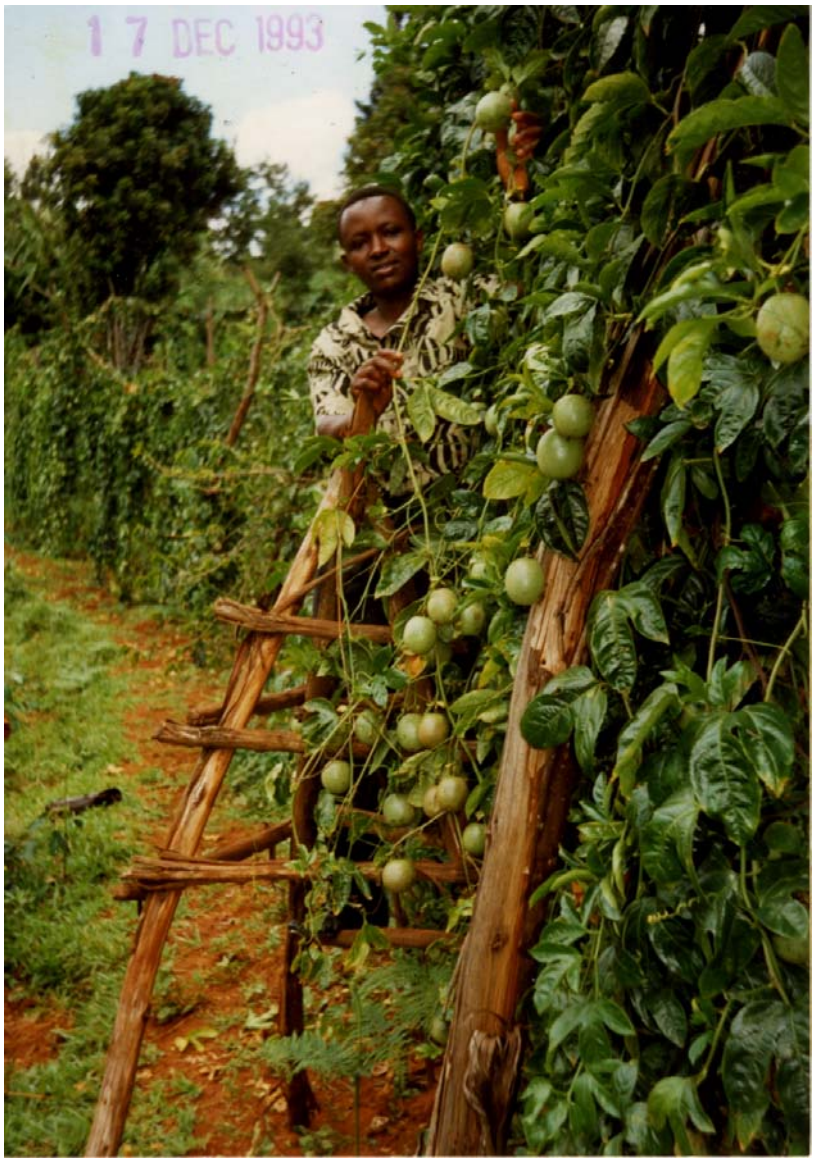
Per Pound of Food Produced

— Compared With Conventional Farming

GROW BIOINTENSIVE
Is Used In Over 130 Countries

— In Virtually All Climates and
Soils Where Food Is Grown

AFRICA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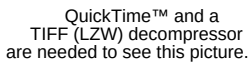
LATIN AMERICA

EUROPE

ASIA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TIFF (LZW) decompressor
are needed to see this picture.

NORTH AMERICA

Experience at the Research & Training Mini-Farm In Willits, California

With a Soil Rated

Fair for Grazing

January 1982

August 11, 1982 —After 11 Weeks

Work Involved:
2 People Working 14 Hours a Week Each:
(28 Hours a Week Total Work)
To Establish a 40 Bed Mini-Farm
(1/20 Hectare/1/8 Acre of Planted Surface)

~August 15, 1983 —2nd Year

~July 15, 1984 —3rd Year

New Soil Quality Plateau: ~July 21, 1995 —14th Growing Year

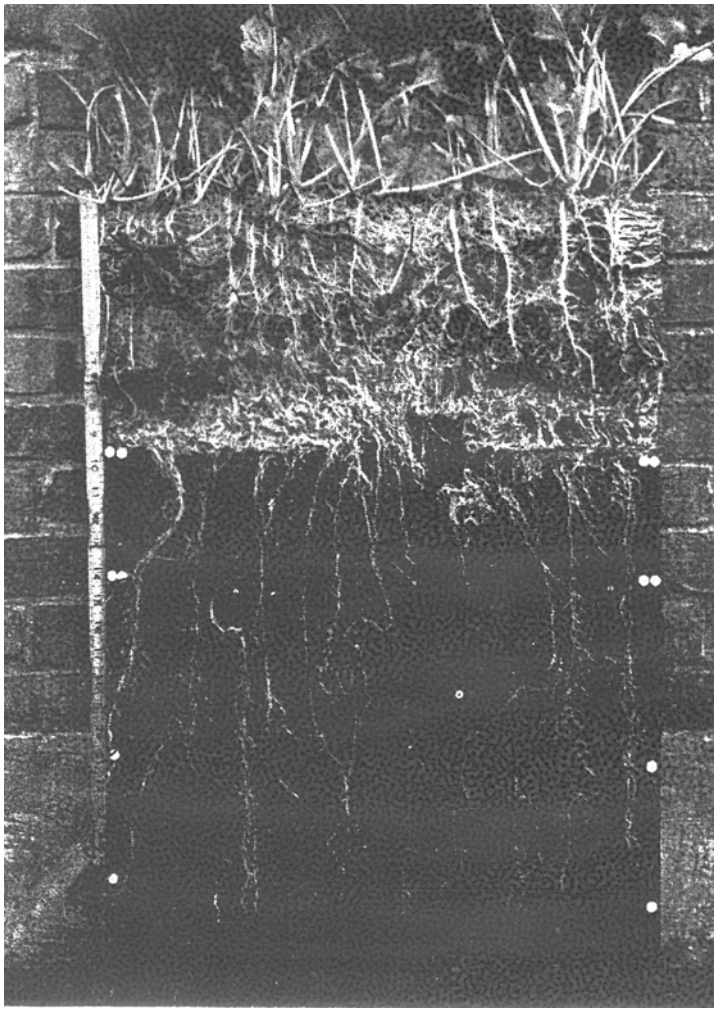
THE 8 ASPECTS OF GROW BIOINTENIVE

The 8 Elements

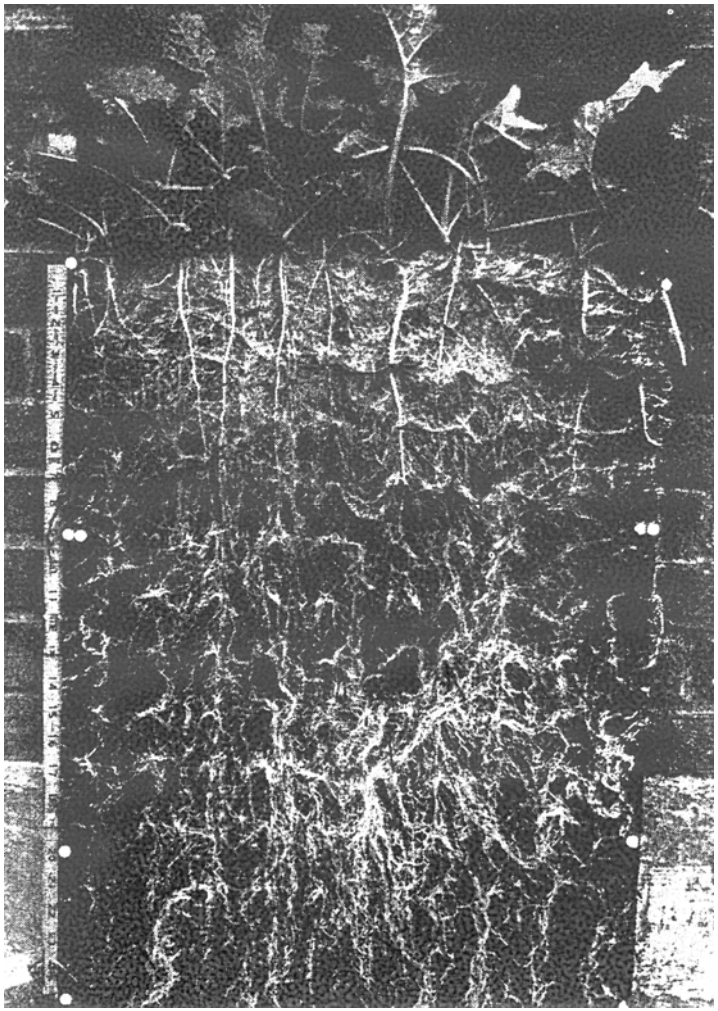
- Deep Soil Preparation/Good Soil Structure
- Compost
- Close Spacing
- Companion Planting
- Calorie and Carbon Crops
- Special Root Crops for Calorie Production
- Open-Pollinated Seeds
- A Whole System

1 - Development of Good Soil Structure through:

Deep Soil Preparation initially,
and 5 cm/2 inch-deep
Surface Cultivation ***after***
Good Soil Structure
has been Created



Most of the roots of these plants (rape - *Brassica napus* var. Dwarf Essex) are confined to the topsoil, the result of badly restricted root space due to a compact subsoil.



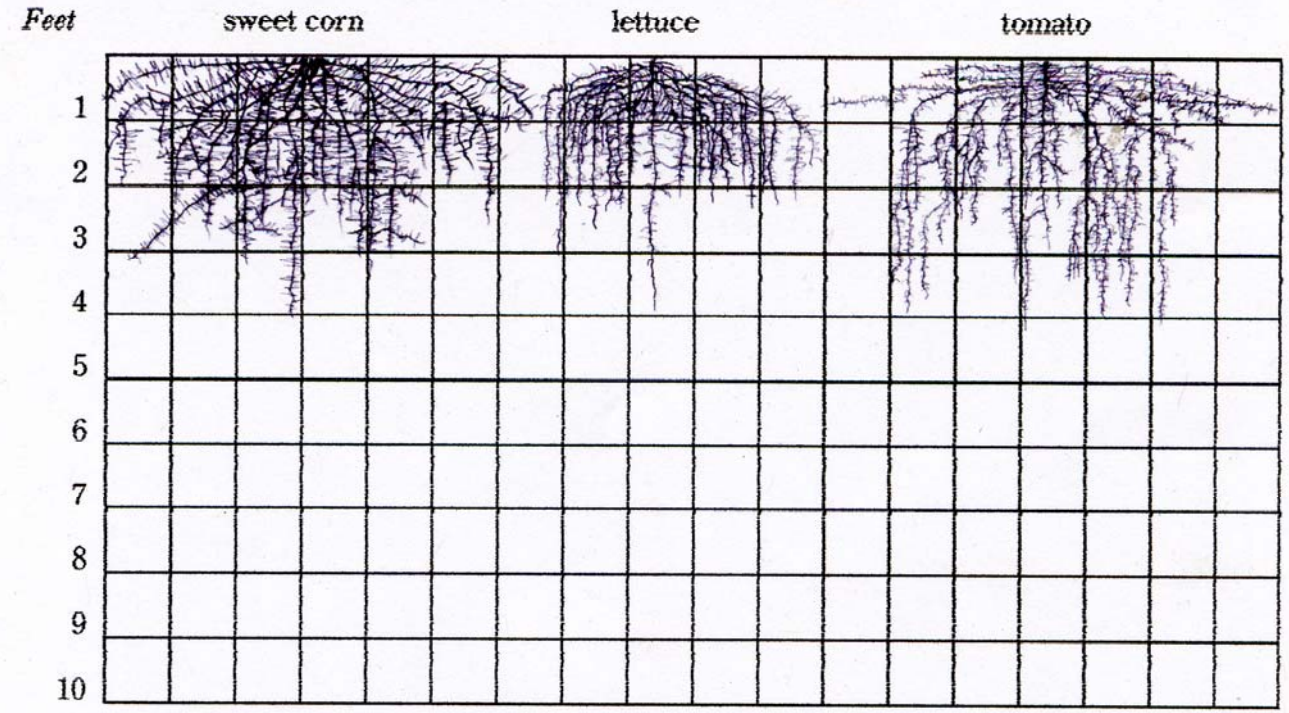
Here's how the roots of rape plants will grow when given a chance. Soil in which these plants were grown had been loosened 20 inches deep by hand with a fork. One requirement for a bountiful harvest is profuse uninhibited root development.

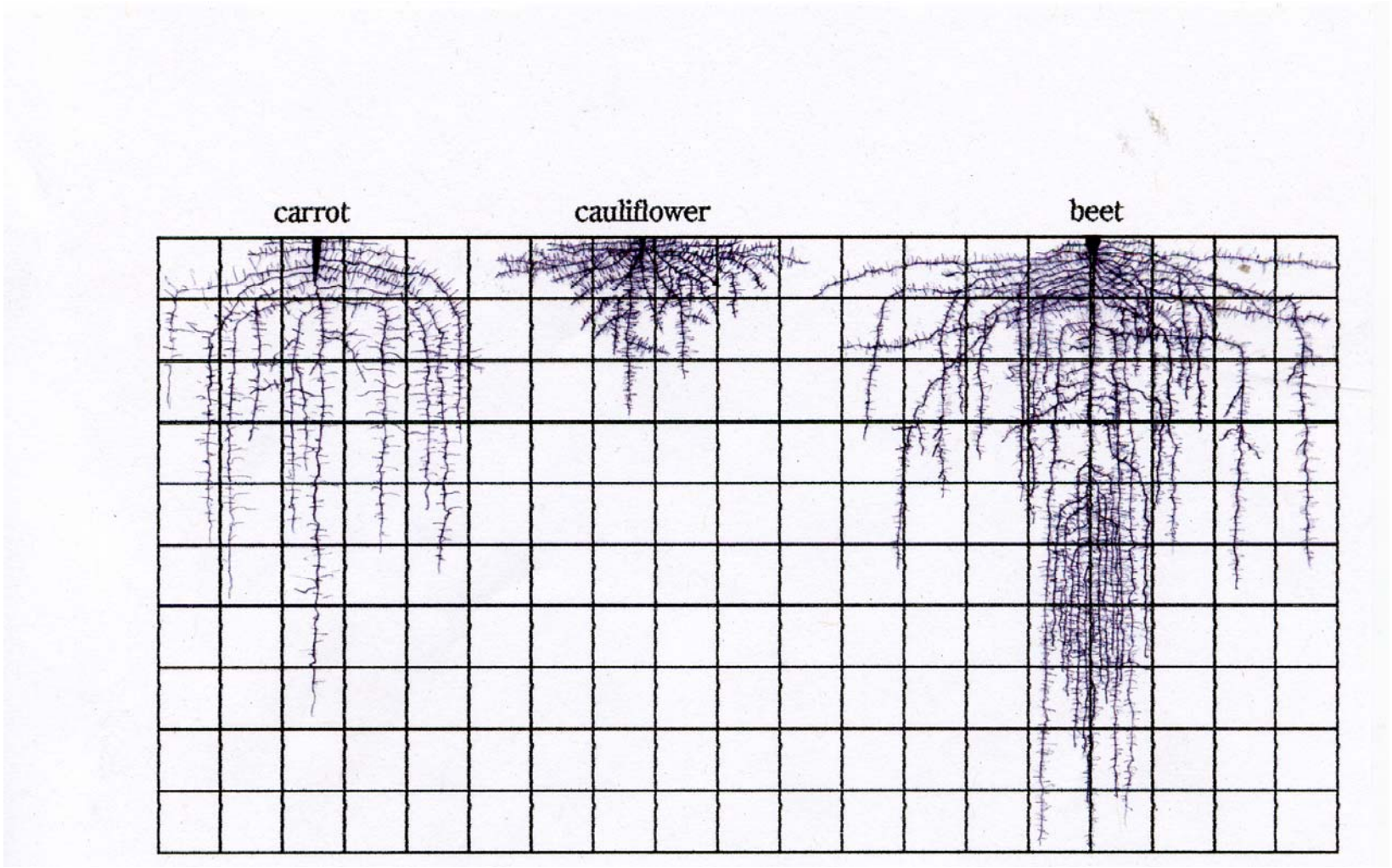
Root Development in Average Soil

Plant Roots Do Better

in A Soil With *Good Structure*

SELECTED VEGETABLE ROOT SYSTEMS SHOWN IN SCALE




carrot
cauliflower
beet

Did you know that:

- One *carrot* in average soil puts down a root 2.5 meters/ eight feet deep?
- If it does not meet a rock layer that an *alfalfa* plant puts down a root as deep as 40 meters/125 feet?
- That *one cereal rye plant* in *average* soil puts out

  5 km/3 miles of roots a day, 622 km/387 miles of roots in one season and 10,626 km/6,603 miles of roots in the same season?

The most important part of the plant—the root—is the controlling part of the plant.

The soil microbes and the plant roots need to *breathe.*

In the 1950's Professor C. K. Snyder of the University of California

-Berkeley determined:

If you improve the root health of most common field crops

just 2% to 4%,

their yields increase 200% to 400%!

At Ecology Action's first site in the Stanford University Industrial Park in Palo Alto, CA:

- The weed **mallow** in ***unimproved*** C-horizon ***soil*** grew just ***45cm/18 inches high***
- After the soil was ***double-dug***, mallow grew ***.9 m /3 feet high—twice as high***
- After the soil was ***complete-texturized double-dug only once***, mallow grew ***2.4 m/8 feet high*** from then on—**over five times as high**

Microbes in the soil, like people, need oxygen to breathe:

In order to allow the soil to maintain a good supply of air, the soil needs to have ***good structure***—with the soil particles woven together with microbe exudates, roots and root hairs.

The most important elements in the soil for the roots and plant, *in priority order,* are:

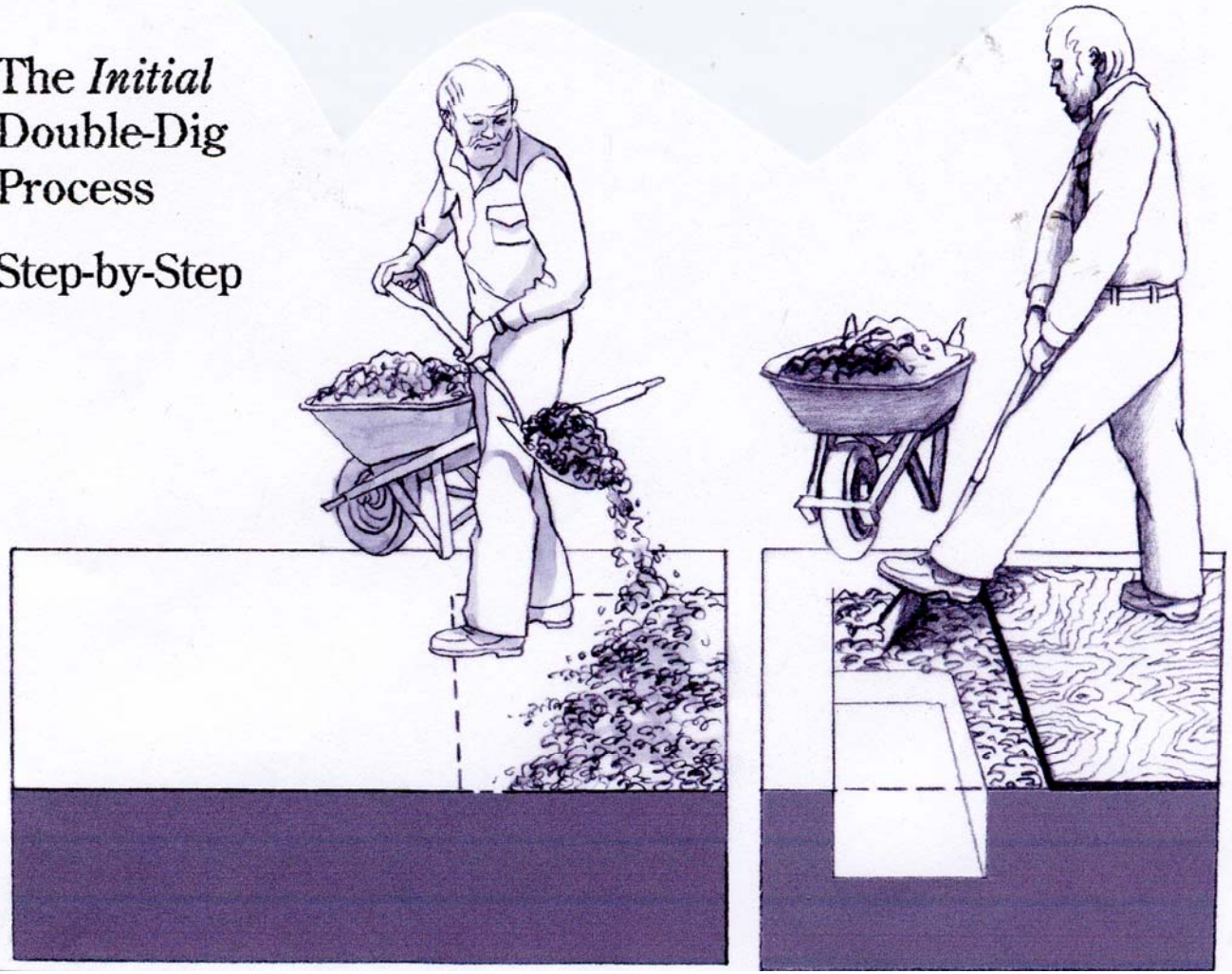
- Air
- Water
- Organic Matter
- Minerals
- Biointensive

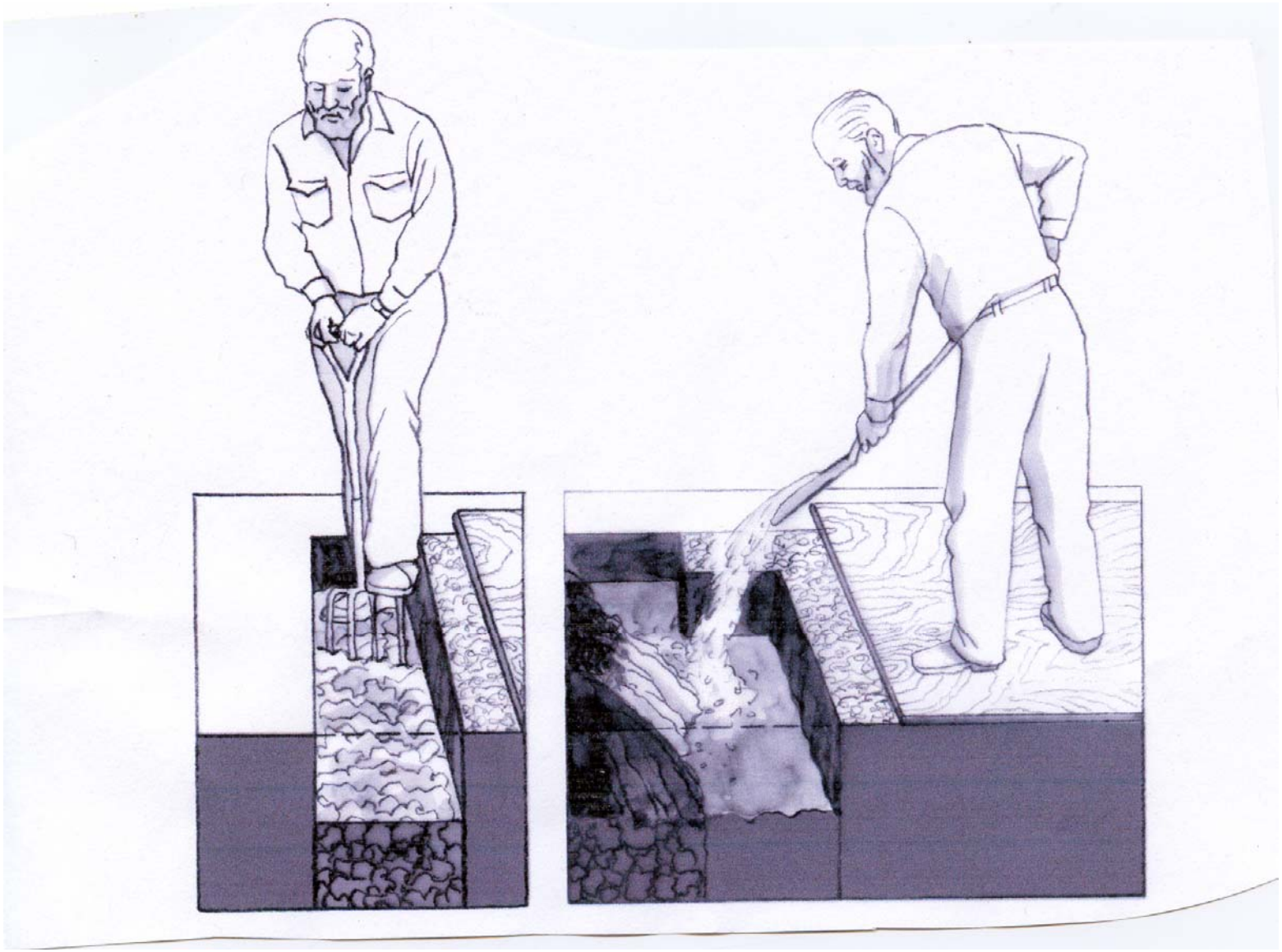
Double-Digging: A Process for facilitating good soil structure

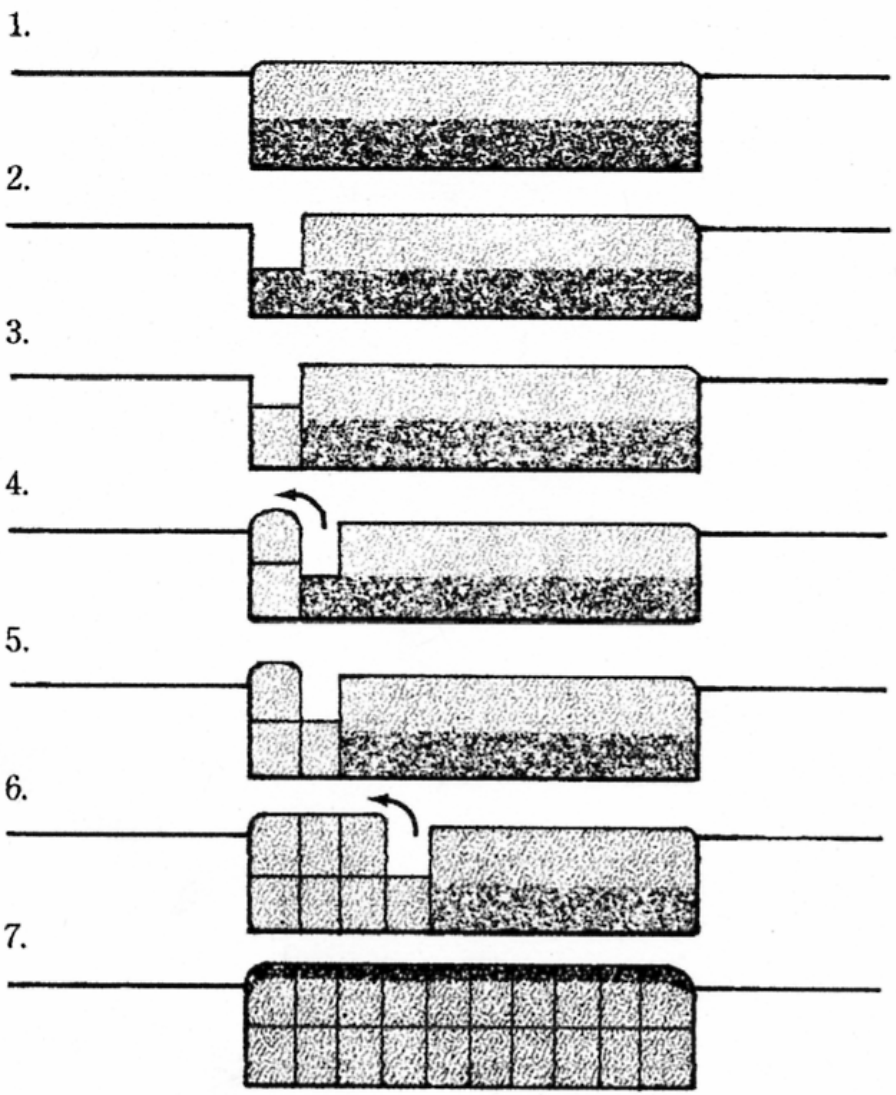
The process:

The *Initial* Double-Dig Process

Step-by-Step






1.
2.
3.
4.
5.
6.
7.

2 - COMPOST

Goal:

Maximize quality and quantity
of cured compost produced
per unit of compost built,
and maximize microbiodiversity.

In order for good soil structure to occur,

The soil needs
proper amounts of
organic matter
in the form of compost.

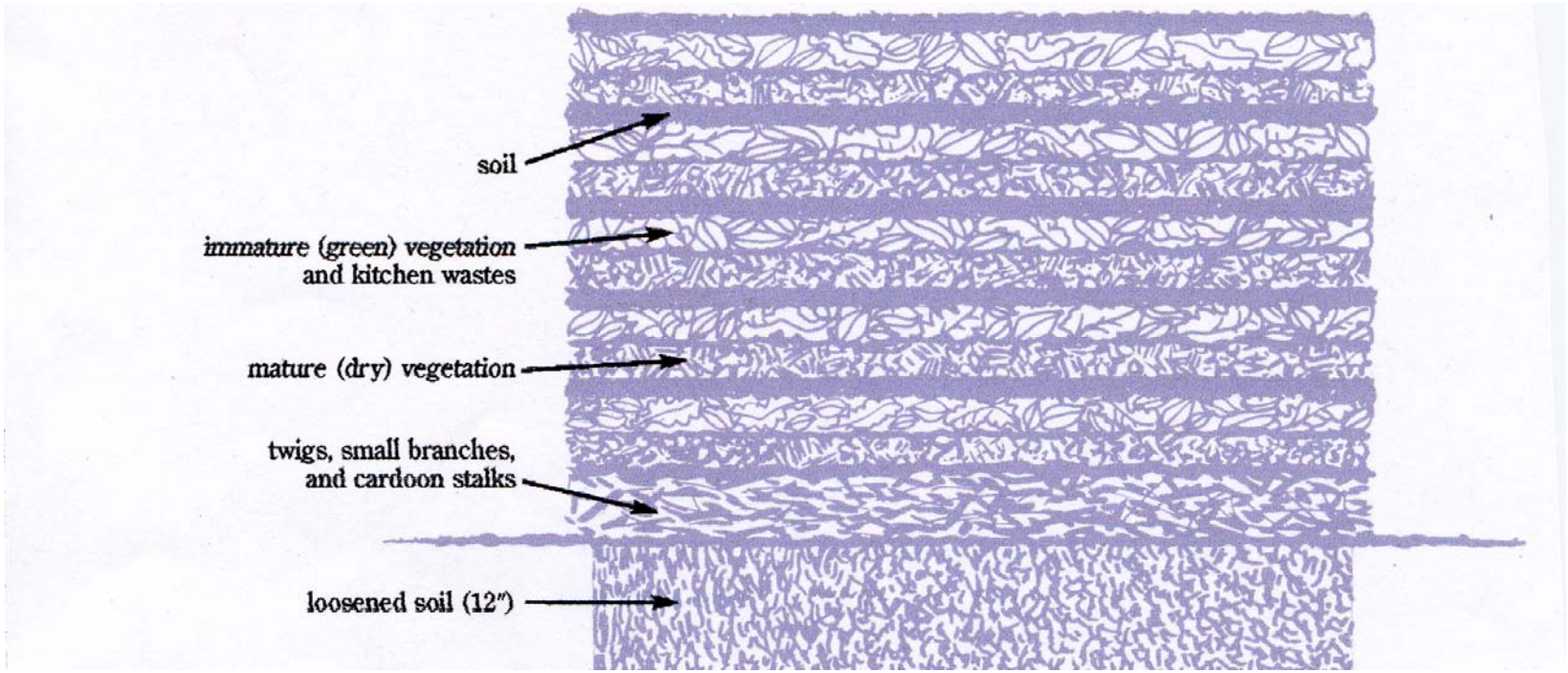
A good soil with sustainable soil fertility needs:

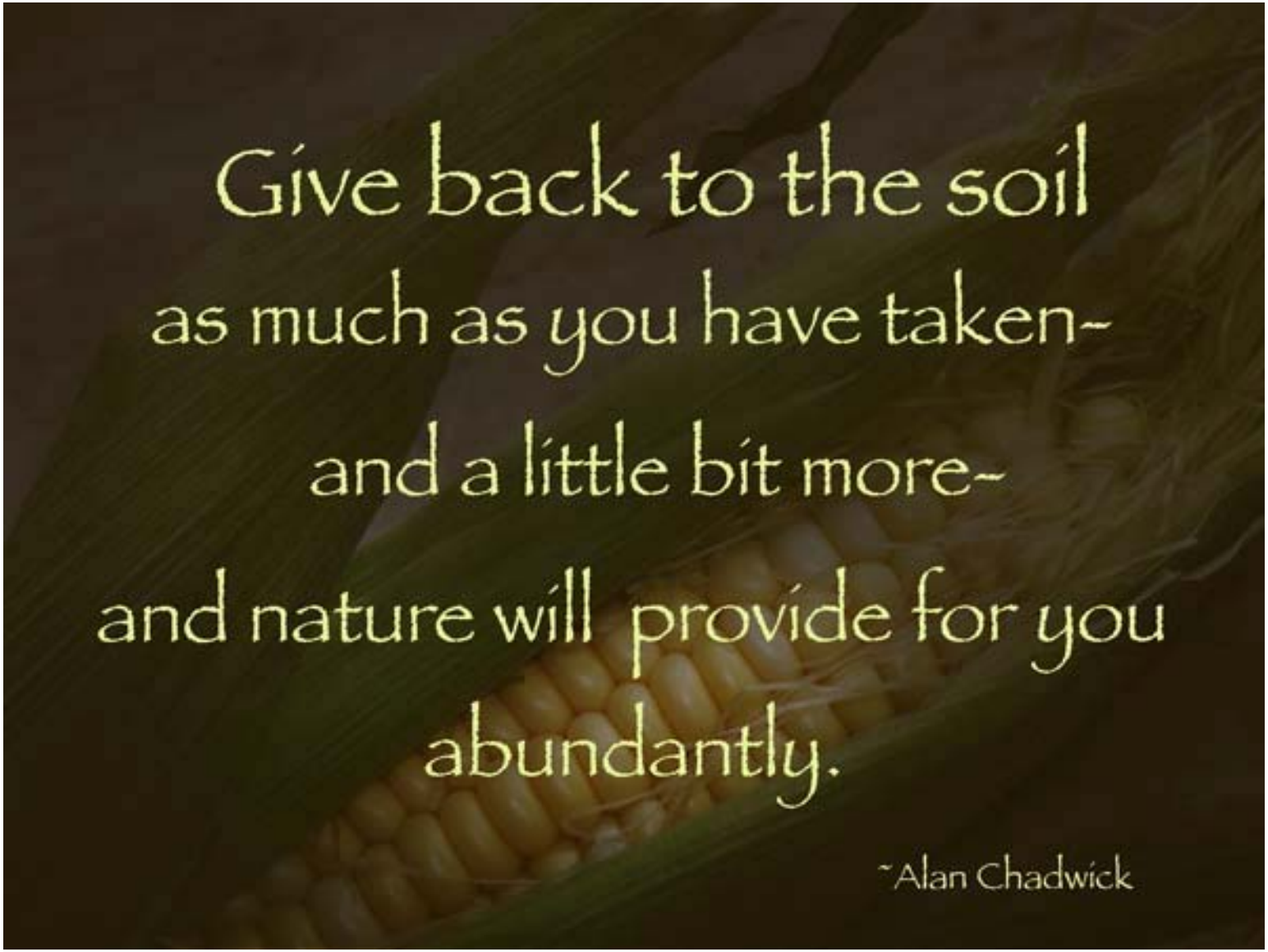
- 4% to 6% soil organic matter in ***temperate*** soils
- 3% soil organic matter in ***tropical*** soils

On the ***average, world soils*** only have
$^{1}/_{2}$% to 2% soil organic matter
—with an average of only 1 $^{1}/_{2}$%.

2% is the point at which there is only enough organic matter for the microbes to begin to "wake up"!

Cross Section of Compost Pile


soil
immature (green) vegetation
and kitchen wastes
mature (dry) vegetation
twigs, small branches,
and cardoon stalks
loosened soil (12")


Give back to the soil
as much as you have taken-
and a little bit more-
and nature will provide for you
abundantly.
~Alan Chadwick

3 - SEED PROPAGATION

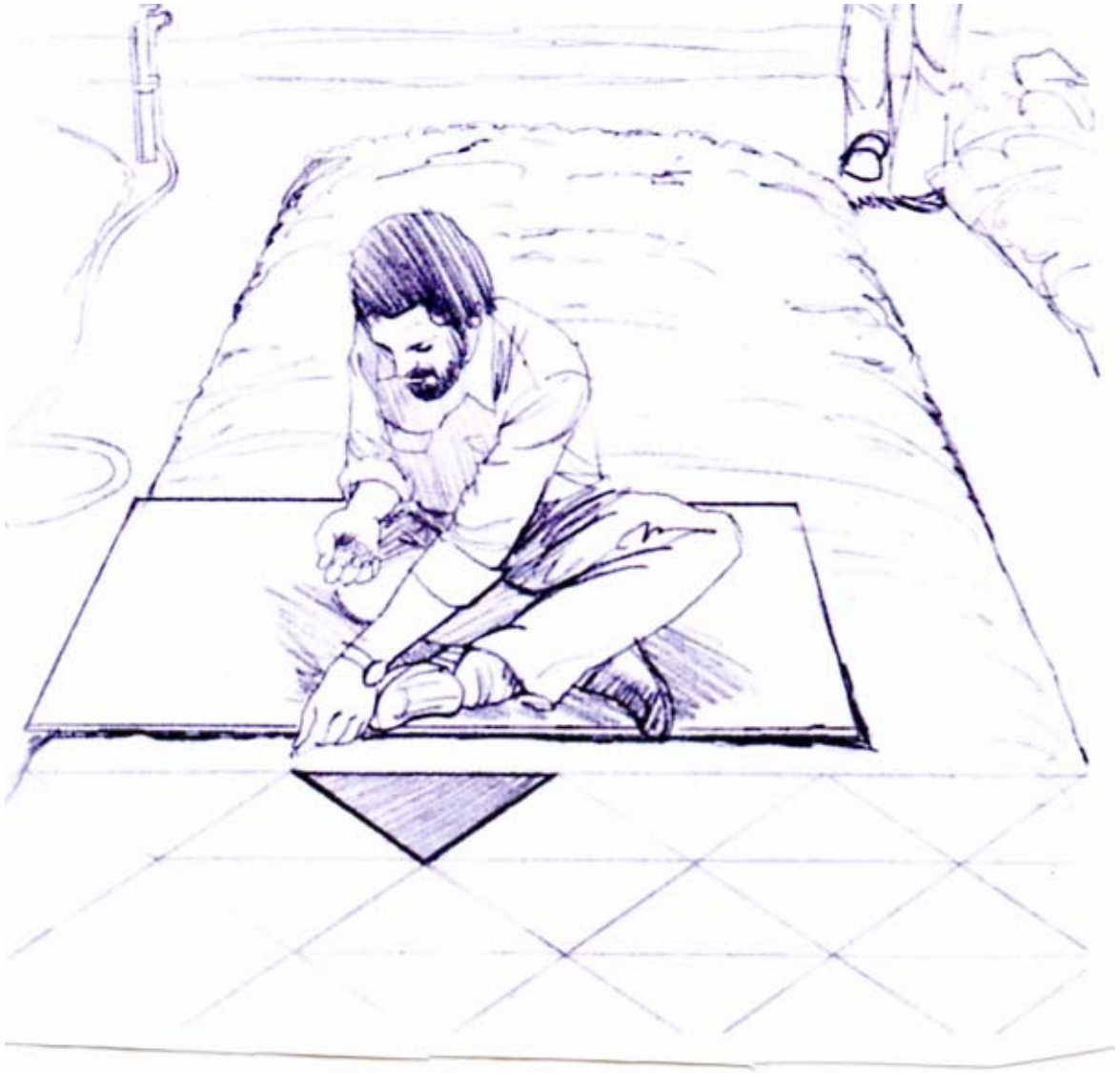
Close Spacing

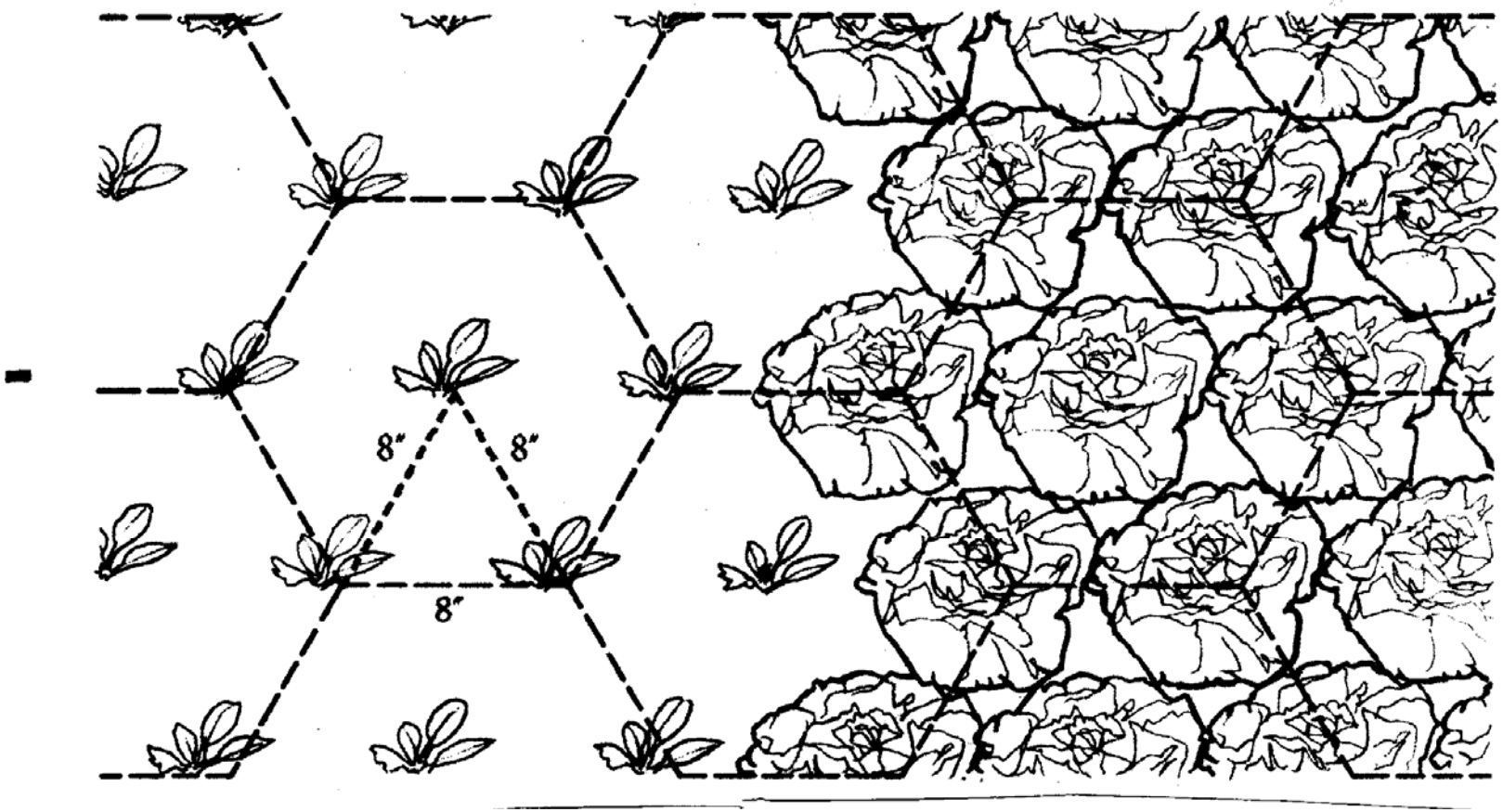

Goal:
Enhanced and uninterupted
plant growth,
including close plant spacing,
and open-pollinated seed use.

The Plants in the Flats and Growing Beds

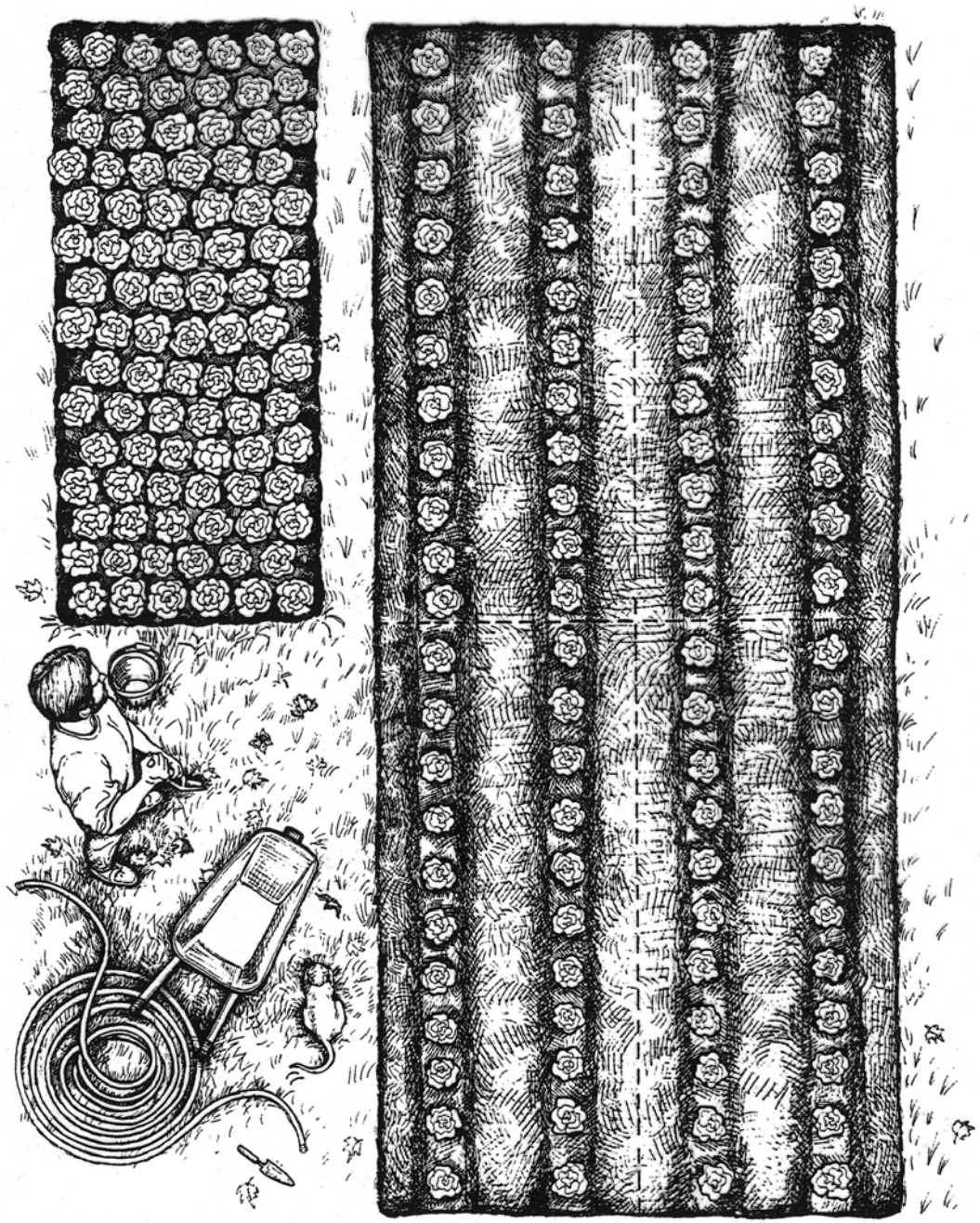
Are placed equidistant on offset spacing…

— So the plants' leaves touch, or barely touch, when they are mature.




8"
8"
8"

This provides a *living mulch,*
or *mini-climate,*
which protects the soil,
its moisture,
organic matter and microbial life.



Biointensive fertility—four times the productivity in one-quarter the area!

4 - COMPANION PLANTING

Grow Crops Together That Have A Beneficial Effect On Each Other

One Example: Corn,

Beans (A Legume),

and Squash

5 - CALORIE AND CARBON CROPS:

Grow the Food to Eat
and the Biomass Needed
for Sustainable Soil Fertility
at the Same Time

—In About 60% of Your Growing Area

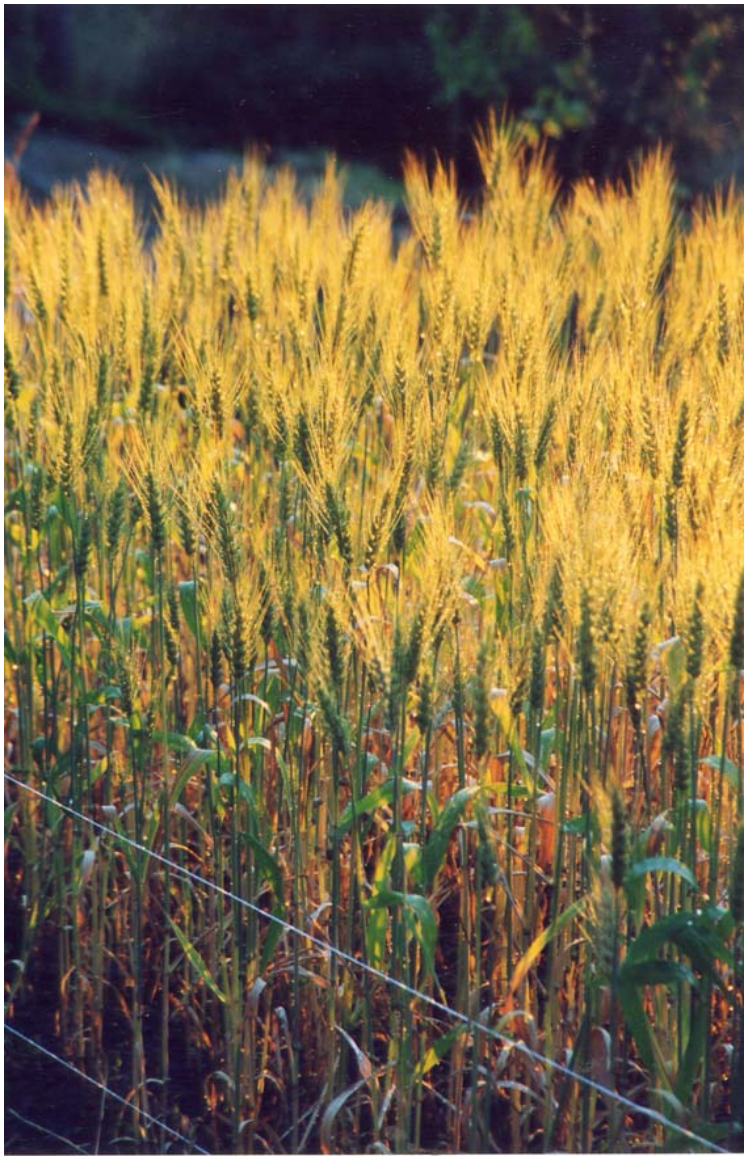

Goal:
Grow and maintain
sustainable
soil fertility.

Hot Weather Carbon- and Calorie-Efficient Crops Include:

Corn, Sorghum, Pearl Millet, Amaranth, Quinoa and Sunflowers

Cold Weather Carbon- and Calorie-Efficient Crops Include:

Wheat, Cereal Rye, Oats, Barley, Triticale and Fava Beans



6 - SPECIAL ROOT CROPS:

Grow Up to 20 Times the Calories Per Unit of Area Per Unit of Time

—In About 30% of Your Growing Area

With:

- Potatoes
- Sweet Potatoes
- Garlic
- Leeks
- Parsnips
- Jerusalem Artichokes
- Salsify

VEGETABLE AND INCOME CROPS:
Grow Additional Key Vitamins and Minerals and Income
—In About 10% of Your Growing Area

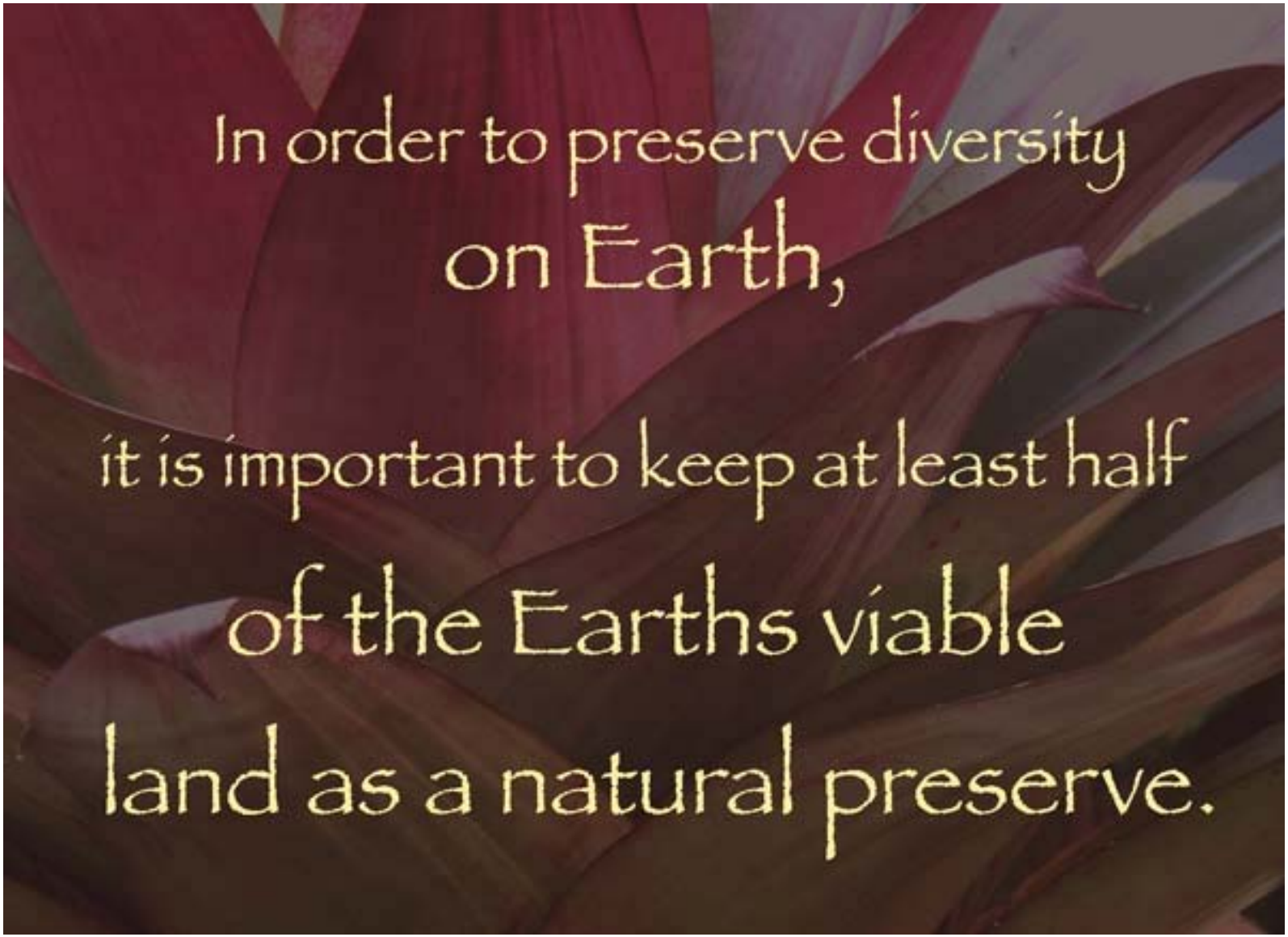
7 - OPEN-POLLINATED SEEDS

Use Open-Pollinated Seeds to Preserve Genetic Diversity and to Produce Seeds that Grow Plants that are the Same as the Parent Plant

Generally you can grow
all the seeds you need
for next year's garden or farm
on an average of just
3% more growing area!

8 -A WHOLE SYSTEM

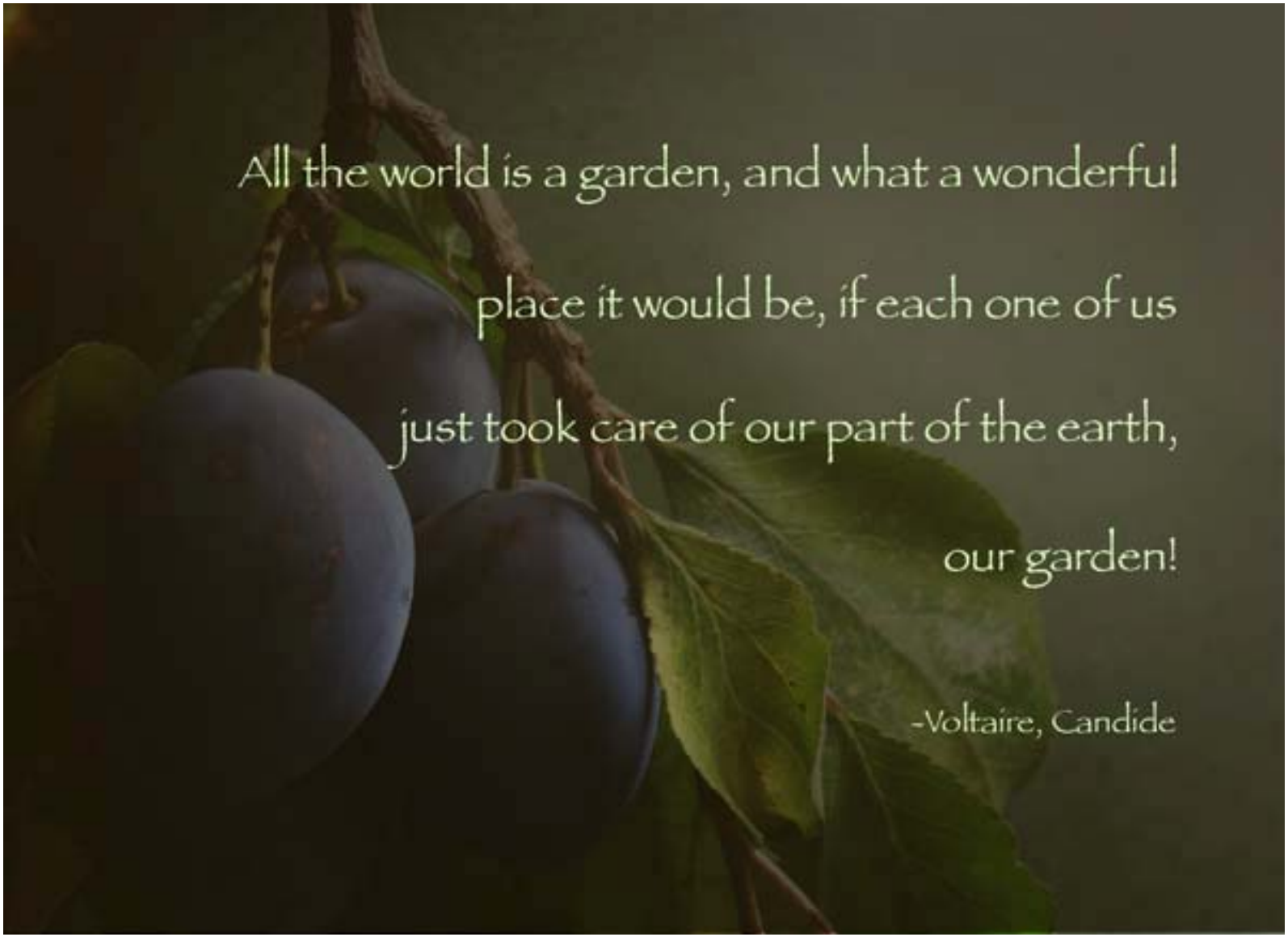
Use All 8
GROW BIOINTENSIVE
Elements *Together*
for the System to Work
Sustainably


In order to preserve diversity
on Earth,
it is important to keep at least half
of the Earths viable
land as a natural preserve.


Nature is not a place to visit,
it's home.
~Gary Snyder

For More Information
Please Visit

- www.growbiointensive.org
- www.bountifulgardens.org
- www.commongroundinpaloalto.org


All the world is a garden, and what a wonderful
place it would be, if each one of us
just took care of our part of the earth,
our garden!
-Voltaire, Candide

What kind of future do *you* want to create?

Illustrations from
How To Grow More Vegetables, Fruits, Nuts, Berries, Grains and Other Crops Than You Ever Thought Possible On Less Land Than You Can Imagine
(Ten Speed Press, 2006, Berkeley California 94707 USA)

Title Page and Graphic Art Quotations by
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of Grain of Sand, Salt Spring Island, British Columbia, Canada

CD Label Design and Photo Assistance by
Sue Ellen Parkinson,
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Conclusion
of The Main Presentation

You May Continue for
Additional In-Depth Topics

Water:

Within the Next Two Decades,
It is Expected that
Two-Thirds of the
World's People Will Not Have
Enough Water.

Farming Uses Approximately 80% of the Water Used by People on the Earth

WATER CONSERVING PRINCIPLES:

1 - COMPOST AMOUNT:

Soil that has living compost
as ***2%*** of its volume
in the upper 28 cm/11 inches of soil
can *reduce* the rainfall or *irrigation*
required for poor soils

by as much as 75%!

GROW BIOINTENSIVE
encourages maintaining
3% to 6% organic matter
in the soil.

2 - *SHADE* FROM MINI-CLIMATE/LIVING MULCH:

Soil that is shaded
can *reduce evaporation up to 63%,*
depending on soil type.

The mini-climate created
by closely spaced plants
in GROW BIOINTENSIVE
provides
good shade for the soil.

3 - SUFFICIENT SOIL NUTRIENTS:

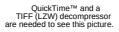
Plants transpire water.
Transpiration can be *reduced*
by as much as 75%
in soils that have
sufficient, well-balanced nutrients.

GROW BIOINTENSIVE
prepares the soil
so it provides
a high level of nutrient fertility.

TOTAL WATER SAVINGS POTENTIAL:

When you combine these 3 factors: *living compost, shade and sufficient nutrients*, the level of water consumption can be greatly reduced…

…by as much as 67% for grains
and as much as
88% for vegetables.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TIFF (LZW) decompressor
are needed to see this picture.

LESS ENERGY

To grow, transport,
package and serve
1 calorie of Strawberry
on a table in New York City
from Watsonville, California
requires
435 calories of energy!

To transport
1 calorie of fruit
to a London, England table
takes an ***average*** of
63 calories of energy.

Steve Moore, a Certified
GROW BIOINTENSIVE Teacher
in Pennsylvania,
has determined that…

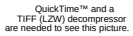
…only **0.9** calories of food energy
are produced
by conventional farming
in the production of *onions*
per ***1*** calorie expended,

while GROW BIOINTENSIVE
produces **39** *calories of onions*
per 1 calorie expended!

…and **3.85** calories of food energy
are produced
by conventional farming
in the production of ***flour corn***
per 1 calorie expended,

while *GROW BIOINTENSIVE*
produces **63** *calories*
per 1 calorie expended
— producing **16 times** more calories!

INCOME


QuickTime™ and a
TIFF (LZW) decompressor
are needed to see this picture.

EFFECTIVENESS

One study involving 15 countries demonstrated the following yield comparisons between Small Scale and Large Scale farms:

4 to 5 Units of Yield

SMALL SCALE FARMS

1 Unit of Yield

LARGE SCALE FARMS

SOIL BUILD-UP

GROW BIOINTENSIVE
has the capacity to “grow”
1 inch of Farmable Soil
in 8.5 Years
—Instead of the
500 to 2,000 Years
Normally Required in Nature.

Preliminary studies by soil scientists at the University of California, Berkeley, indicate that in as little as a 6-month period (and as many as 8 years) the soil involved in our tests (which was only a "C-horizon" subsoil material at the beginning) was built up to a humified carbon level equal to hundreds of years of natural soil development! If maintained, this improvement may make possible not only the maintenance of sustainable soil fertility, but also the reclamation of deteriorated and marginal lands. (See following graph.) The

---

A ▪▪▪▪▪▪▪▪▪

Observed increase (build-up) in carbon at Ecology Action Research Test Site (tentative figures) in soil (which was sub-soil to begin with). Program began June, 1972.

Question: What would be the fate of the carbon curve (or nitrogen curve) if the bed were now left fallow after the normal "intense" organic matter input?

1 □□□□□□□□□

Remains at "natural" steady state level?

—Unlikely

2 ●●●●●●●●●

Substantial drop, but leveling off, then rising again under "natural development?"

—Most likely. Accelerated gain of hundreds of years of soil development (in as little as six months' or as much as eight years' time with Ecology Action-type cultivation).

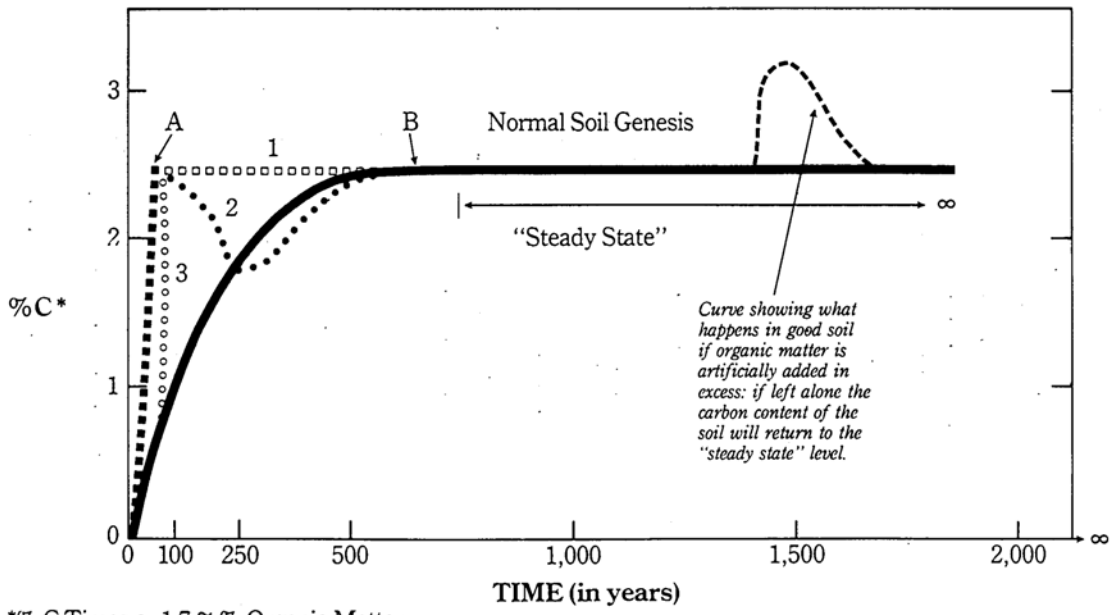
3 ○○○○○○○○○

Drastic drop back down to initial zero?

—Unlikely

B ▬▬▬

Normal build-up of soil by natural processes.



*% C Times ~ 1.7 ≅ % Organic Matter

RESEARCH

Yield Comparisons for

- Conventional
- Organic
- GROW BIOINTENSIVE

BROCCOLI: CHEMICAL AGRICULTURE vs. ORGANIC AGRICULTURE vs. BIOINTENSIVE AGRICULTURE

Chemical Agriculture Test Result | Organic Agriculture Test Result | Biointensive Agriculture Test Result

What is the most effective way to grow healthy crops in poor *soil while* improving *the fertility of the soil?*

The following comparative yields were obtained from chemical, organic and Biointensive agriculture-type tests run in our compacted "C-horizon" material at Ecology Action's first site in the Stanford University Industrial Park in Palo Alto, California. This material, which is broken down rock, normally takes about 500 years to become soil. The topsoil and subsoil from this site, the "A- and B- Horizons", had been previously removed during a construction process. Several crops were grown in side-by-side trials with each test acting as a "control" for the other tests. The broccoli test described below is a typical example. The plants in the above photograph are representative samples of the broccoli plants grown with each of these techniques. In addition, the relative differences in the results are representative of those which occurred with each of the crops tested in this way.

The stunted broccoli plant on the *left* was grown using *chemical agricultural practices:* loosening the soil about 7 inches deep and adding chemical fertilizer as indicated in its directions plus 2 cubic feet of composted organic matter without soil per 100 square feet. The crops were planted in rows with the conventional distance between rows and between plants within the rows. The broccoli heads were about 1/4 the size of an adult person's little fingernail.

The broccoli shown in the *middle* was grown using *organic farming practices:* loosening the soil about 11 inches deep and adding an appropriate amount of organic fertilizers plus 8 cubic feet of composted organic matter without soil per 100 square feet. The crops were planted in rows with the conventional distance between rows and between plants within the rows. The broccoli heads were about 4 inches in diameter and weighed about 4 ounces each.

The broccoli shown on the *right* was grown using *Biointensive agricultural practices:* loosening the soil about 24 inches deep and adding the same appropriate amount of organic fertilizers plus 8 cubic feet of composted organic matter without soil per 100 square feet. The crops were planted in raised-growing beds 6 feet wide by 19 feet long with standard Biointensive *offset* spacing (and no widely spaced rows), so the plants' leaves touched at maturity. The broccoli heads were about 10 inches in diameter and weighed about 10 ounces each, or 2.5 times greater than in the organic farming test and 120 times greater than in the chemical agriculture test. In addition, the overall yield for the Biointensive agriculture test was 7.5 times higher per unit of area than the organic farming test, because 3 times more plants could be planted per unit of area with the close "living mulch" crop spacings used in raised-bed growing-areas.

After this initial test in 1973-1974, it was discovered that more than 8 cubic feet of composted organic matter *without* soil per 100 square feet is not normally sustainable. However, 8 cubic feet of composted organic matter, including 50% soil, should produce similar, though different, parallel results.

Which Crops Produce More Compost Materials?

One produces ***7.6*** times as much!

CARBON IN COMPOST AND GREEN MANURE (Revised)

Assumptions:
- 100 sq ft (= 1 bed) of each crop at **intermediate** Biointensive yields
- Initial C:N ratio of 30:1 (except for Green Manure Clover), using other nitrogenous or carbonaceous material in the compost pile, and optimal decomposition of combined materials
- Similar curing of Green Manure (with lower C:N ratio in soil, less cured carbon may be produced)

	A TIME TO GROW CROP	B YIELD / BED lb [kg]	C % DRY MATTER	D DRY MATTER lb [kg]	E % CARBON	F "BUILT" CARBON lb [kg]	G CURING FACTOR	H CURED CARBON lb [kg]
CORN, Fodder for Compost	1 crop* (3-6 mo.)	48.5 @ [22.0] dry	x 90.6%	= 43.9 [19.9]	x 52.3%	= 23.0 [10.4]	÷ 2	= 11.5 [5.2] {4.4 units}
ALFALFA for Compost	6-month harvest from established plants	275.6@ [125.0] green	x 26.3%	= 72.5 [32.9]	x 54.3%	= 39.4 [17.9]	÷ 2	= 19.7 [8.9] {7.6 units}
CLOVER, Medium Red for Compost	6-month harvest from established plants	162.5@ [73.7] green	x 27.5%	= 44.7 [20.3]	x 54.4%	= 24.3 [11.0]	÷ 2	= 12.2 [5.5] {4.7 units}
ALFALFA or CLOVER, Med. Red, for Green Manure	newly sown, ~4 months to first cutting; + ~1 month to decompose	51.2 [23.2] green	x 18.7%**	= 9.6 [4.3]	x 54.4%	= 5.2 [2.3]	÷ 2	= 2.6# [1.2]# {1 unit}

* If conditions are optimal, two crops of corn may be grown within 6 months, therefore doubling the carbon produced.

@ Enough corn for one compost pile; enough alfalfa for 2.4 compost piles; enough clover for 1.4 compost piles, assuming a "built" volume of 27 cu ft and equal volumes of dry and green materials.

** Red Clover, before bloom, from Morrison's *Feeds and Feeding*. May be lower at point when used for Green Manure. Alfalfa may be somewhat higher.

Probably less because of low C:N ratio.

Initial Tests in Siberia Show Almost 3 Times the Yield with GROW BIOINTENSIVE

Compared with the US Conventional Average.

1995 SIBERIAN RESEARCH REPORT

- **Single-dug, unfertilized area: 34% to 274% of the U.S. average, or an overall average of 146%**

- **Single-dug, fertilized area: 46% to 473% of the U.S. average, or an overall average of 177%**

- **Double-dug Biointensive area: 38% to 1,269% of the U.S. average, or an overall average of 287%**

Experiences in

Argentina

India

and

Canada…

◀ In Argentina, Biointensive is making possible the raising of most of the diet and income for a family of four on about 8,600 square feet,* or 1/5 acre.

In India, women found that they could generate their own income by growing vegetables using Biointensive on as little as 1,116 square feet!* ▶

❧ In Canada, a woman has grown her income similarly on 2,000 square feet.*

* Additional area may be needed to ensure that these projects become fully sustainable.

Community

The Mayans in Guatemala

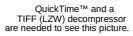
1,000 years ago

thrived with local neighborhood Biointensive food raising

when other nearby civilizations disappeared.

24 ACRE LAND TRUST
AND BIOINTENSIVE SUSTAINABLE MINI-FARMING COMMUNITY

Working together
we can create a better future!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