

Soil Organic Matter
Its Characteristics and Roles in
Agricultural Environments
Part 3

Kiyoshi Tsutsuki
Obihiro University of Agriculture and Veterinary
Medicine

Roles of Soil Organic Matter

Function of humic substance

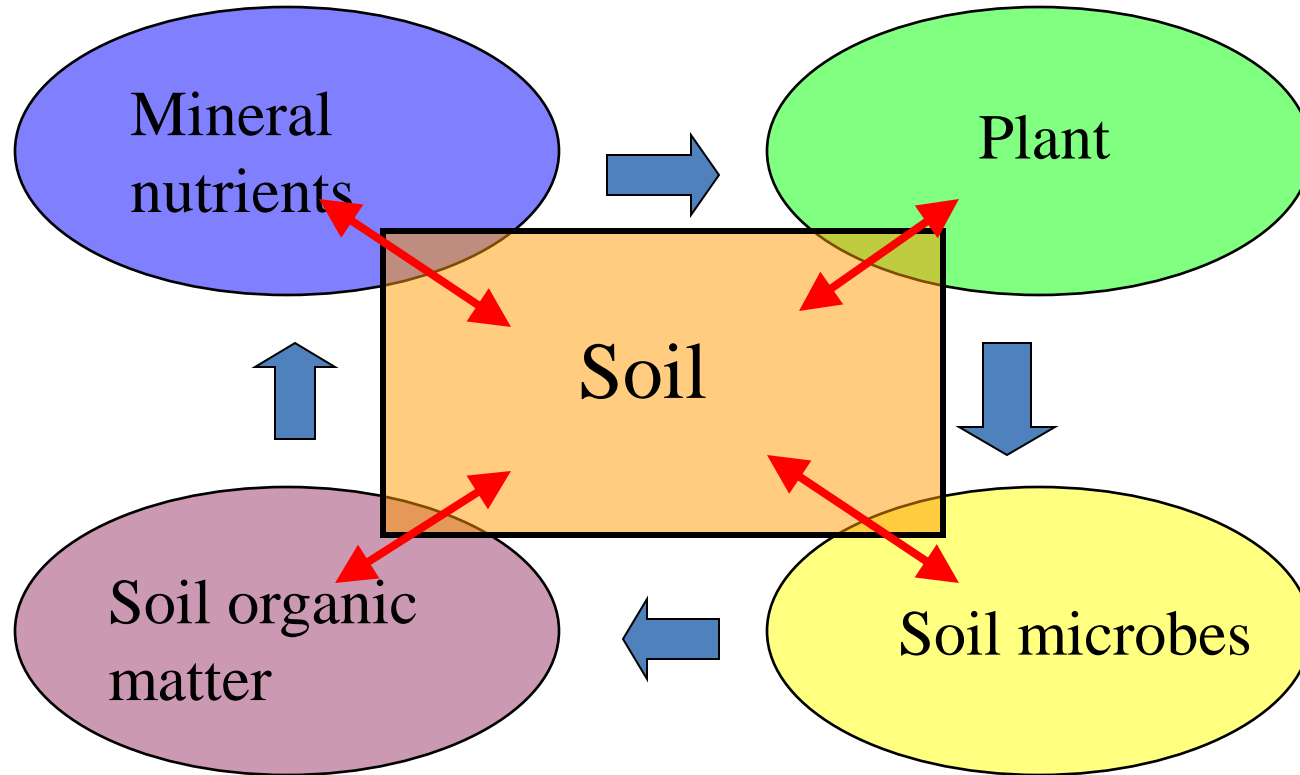
- Largest pool of carbon on the surface of earth
- Repress global warming
- Nutrition supply to plant and microbes
- Hold nutrients and water
- Improve soil physical properties
- Promote plant growth

Humic substance is not almighty, however.

- Humic substance can not support the growth of crops by itself.
- Optimum pH
- Favorable moisture condition
- Sufficient mineral nutrients
- No growth inhibiting substance

should be the background for the effect of humic substances

Role of soil organic matter



Role of Soil Organic Matter

Improvement in

- a . Soil Physical properties
- b . Chemical & Biological prpperties
- c . Plant Growth Promotion Effects

Change in concept of plant nutrition

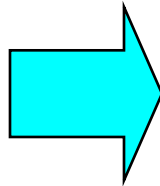
- J.Tull (early 18th century) Importance of plowing
- A. von Thaer (early 18th century)

Theory of humus nutrition

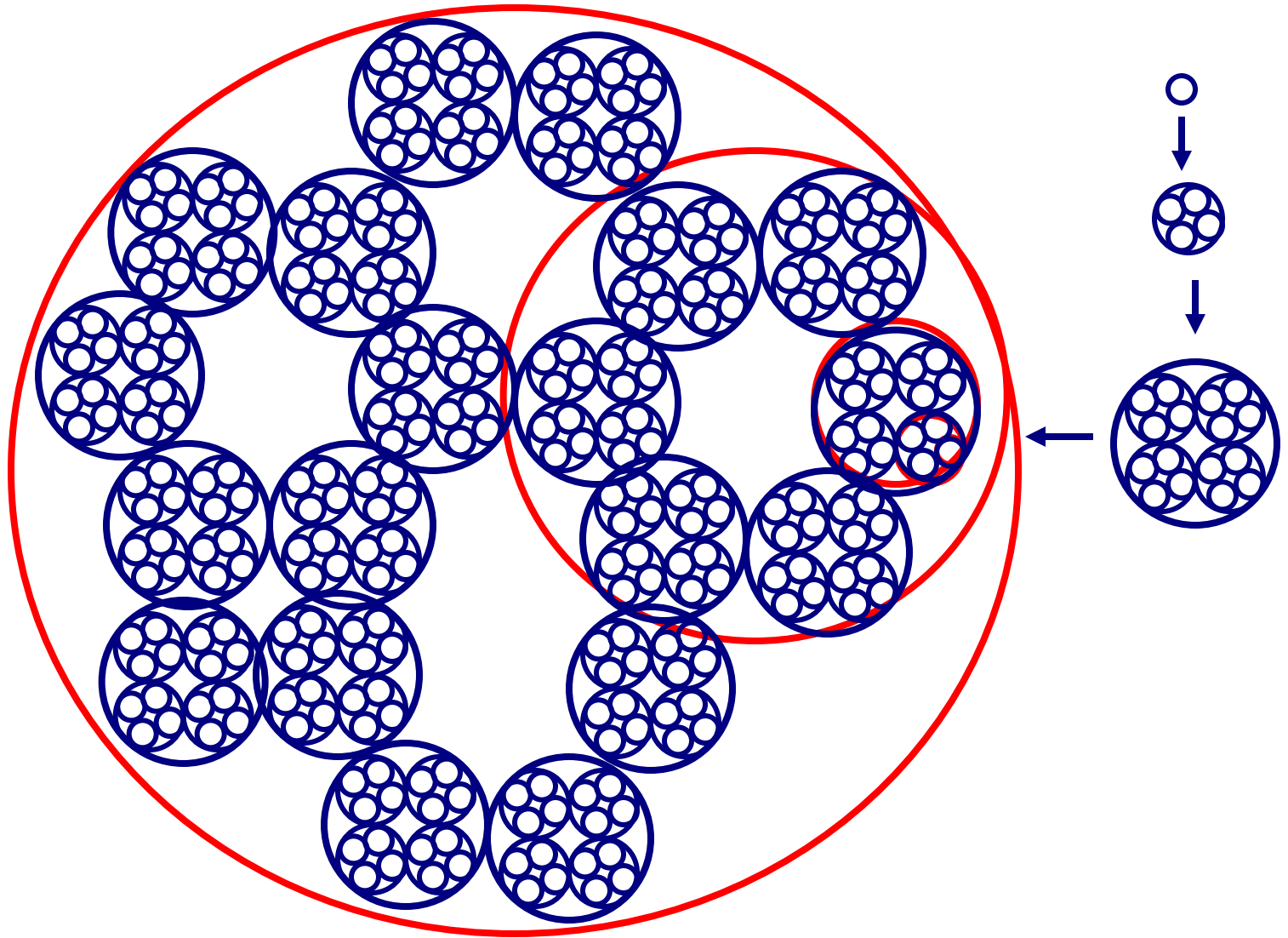
- Theodore de Saussure (early 19th century)
Importance of mineral nutrition.
Discovery of photosynthesis
- J.B. Boussingault (1834) Discovery of nitrogen fixation
- J. von Liebig (1840) **Mineral nutrition theory**

a . Improvement of Soil Physical properties by soil organic matter

Hyphae of fungi
Polysaccharide
Humic substance



Aggregate structure
Aeration and Drainage
Mitigation of soil erosion
Soil water retention
Increase in specific heat
Increase in soil temperature



Hierarchical structure of soil aggregates

Forming process of soil aggregates

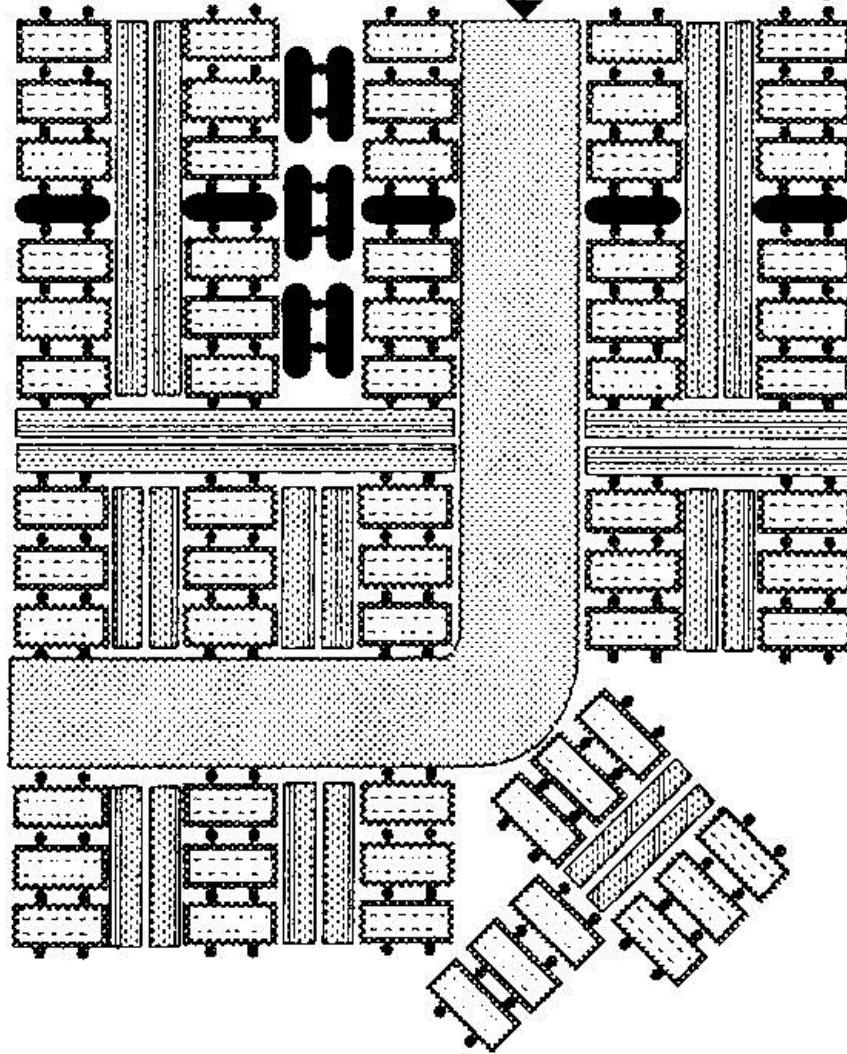
Myceria of Fungi

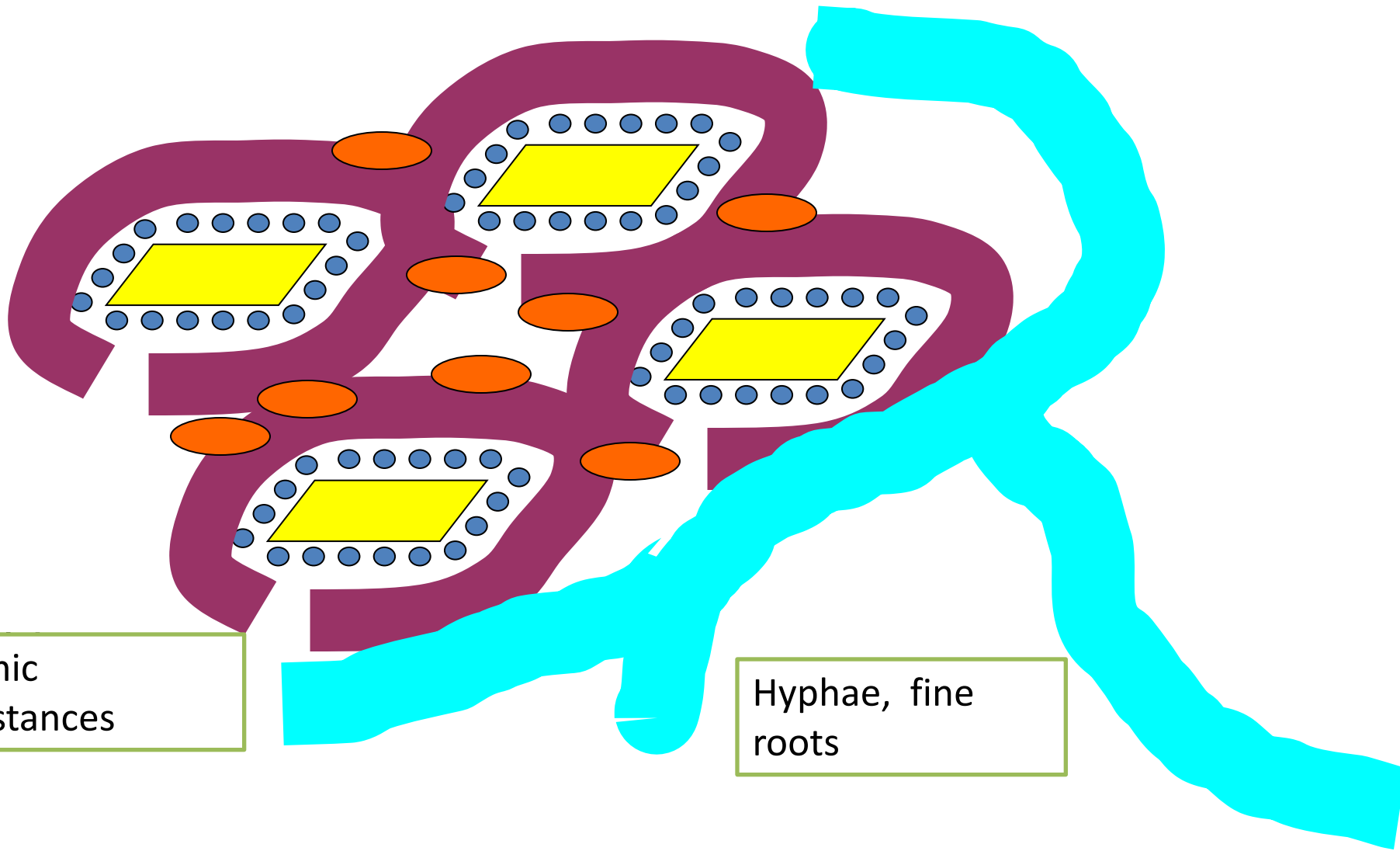
Cations

Clay minerals

Bacteria cells

Humic substances





Humic substances

Hyphae, fine roots



Clay



Cations



Bacteria

Mechanism of soil aggregate formation

Role of Mycorrhizal fungi

- Promotion of nutrient absorption
(P absorption)
- Promotion of aggregate formation
Large sized aggregate

b . Improvements in chemical and biological properties

Retention of cations and anions

Transport and translocation of mineral nutrients

Binding and inactivation of harmful artificial organics

Mitigation of the effect of pollutants

Donor of Proton (H^+)

Physiologically active substances

Nutrient supply in good balance

Source of nutrients for

heterogeneous microbial communities

Competition with pathogenic germs

c . Plant growth promotion effects

Promotion of germination and root initiation

Promotion of the growth of root and stem

Complex formation with nutrient elements

Promotion of nutrient absorption by plants

Hormone-like activity

Promotion of permeability of cell membrane

Promotion of photosynthesis, respiration,
and enzyme activity

Suppress protein and increase sugar contents in plants

Alleviation of plant growth inhibition under
cold weather and irregular meteorological conditions

Plant growth promotion effects

Plant hormone activity

Cold tolerance

Stable production under deficiency and excess of nutrients

