

Plant Growth and Soil

Soil Science for Crop
Production 1

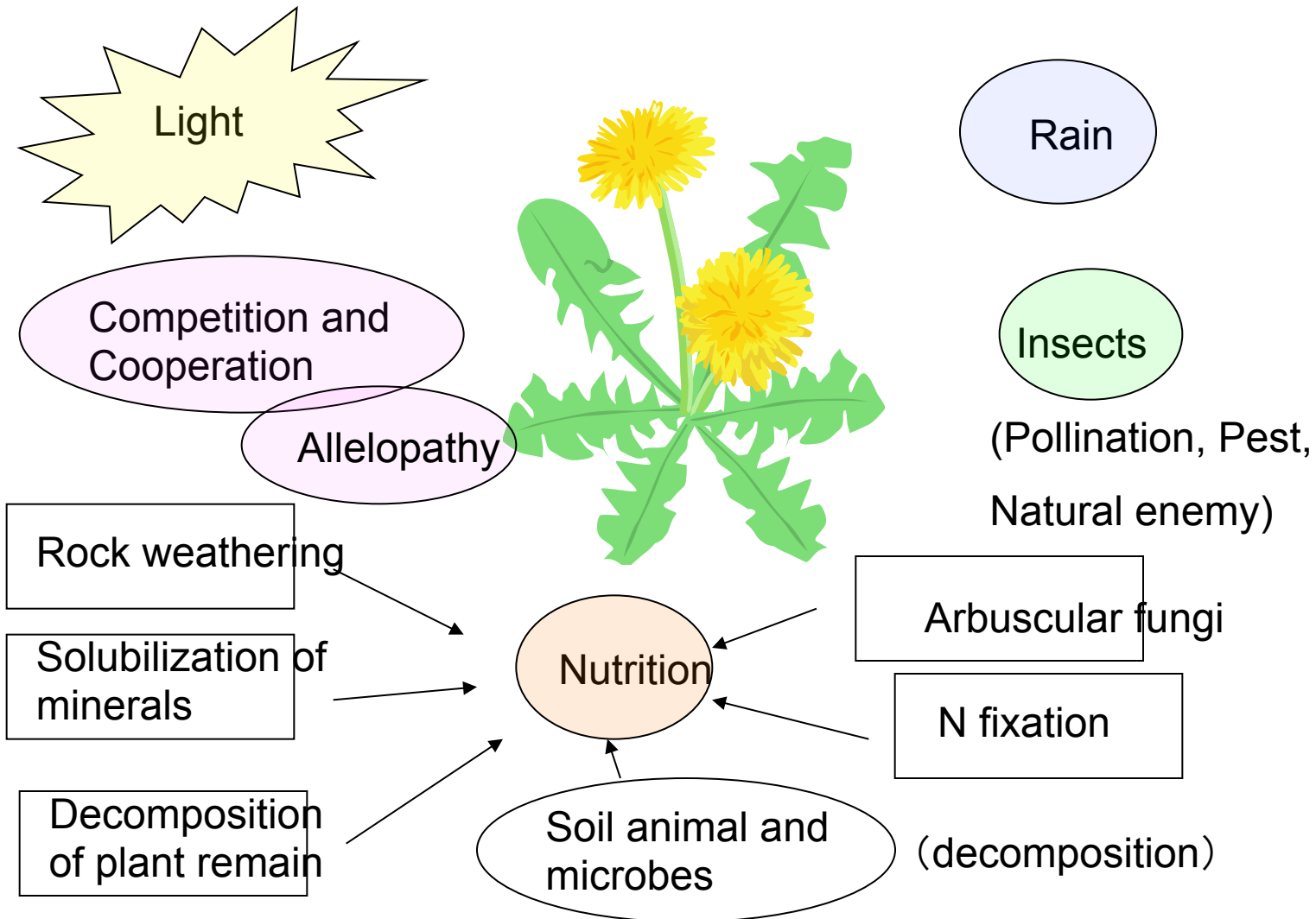
Territory of Soil Science for Crop Production

Production Techniques	Food Crop, Forage Crop, Industrial Crop, Horticulture, Garden Planning, Silviculture
Production Environment	Soil Science, Plant Nutrition, Fertilizer Science, Agricultural Meteorology
Basis	Construction and Machinery
Plant Protection	Pathology, Entomology, Weed Science
Plant Breeding	Breeding, Gene Technology, Plant Inheritance, Biological Engineering

Plants in nature and crop land

	Nature	Crop land
Diversity	Co-existence	Exclude other plants
Nutrition	Natural fertility	Fertilizer
Pests Interaction	Ecological Balance	Pesticide control
Energy	Solar	Fossil
Products	Consumed on site	Consumed outside
Succession	Proceeding	No succession allowed
Relation with human	Little - Large	Very large

How plants grow in nature



How Crops Grow

Human action

Plowing

Seeding

Fertilizer

Weeding

Pest management

Harvesting

Farmland
management

Irrigation

Drainage



Fossil Energy

Fertilizer /
Pesticides

Compost

Agr. Machinery

Transportation

Crop Production Ability of Agricultural Land

- Soil Function
 - a) Nutrient supply
 - b) Water holding, supply
 - c) Root growth environment
- Meteorological condition
- Relief
- Fertilizer Management
- Crop Growing Techniques
- Kind and Variety of Crops

Field of Soil
Science for Crop
Production

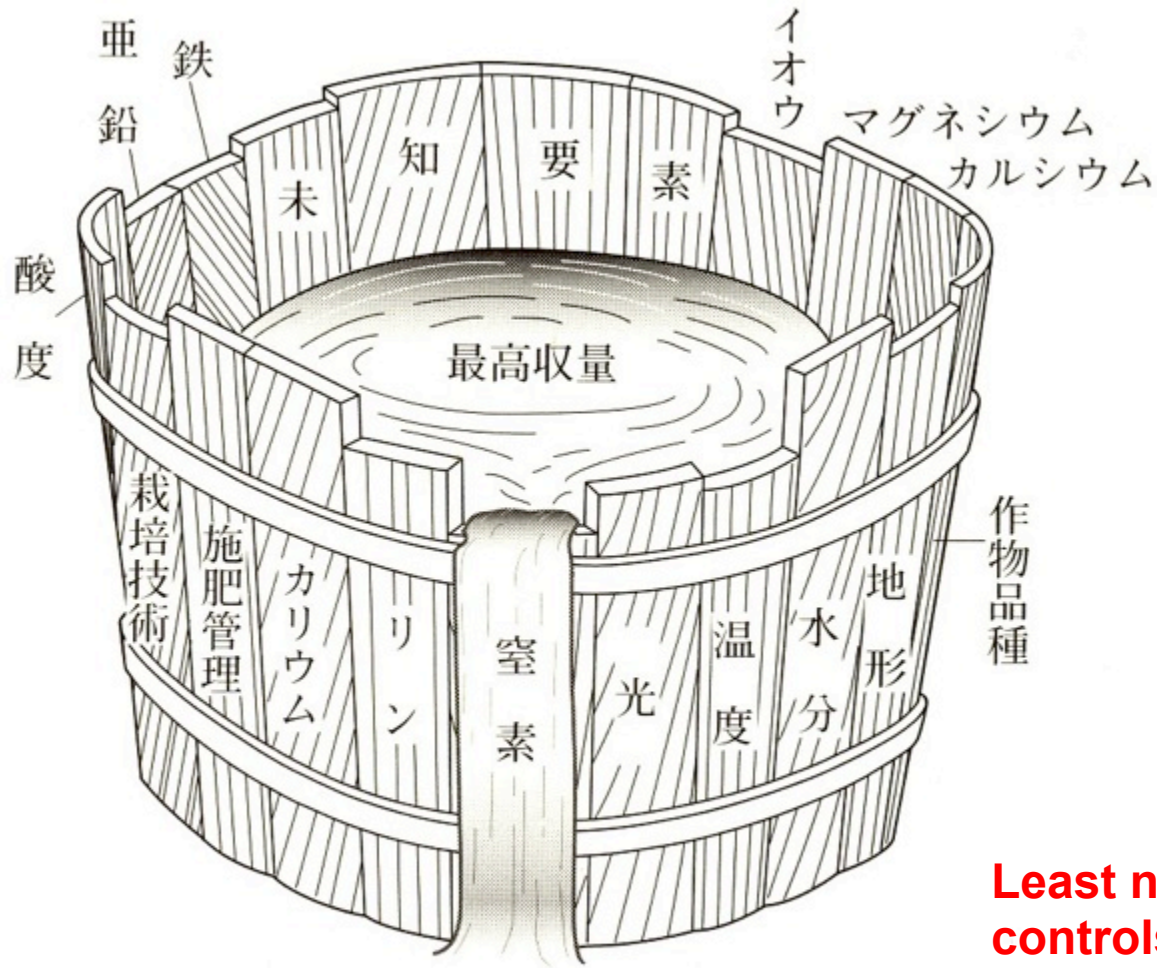


図13-1 ドベネックの要素樽

(奥田, 1968)

Least nutrient
controls the
maximum growth

Various factors are encountered in crop
production.

What is necessary for plant growth?

Water

Air (O_2 and CO_2)

Nutrients

Light

Isn't Soil
Indispensable?

Heat (Temperature)

What Soils Supply to Plants

- Water
- Air (O_2 and CO_2)
- Nutrients and Growth Hormon
- × Light
- Heat (Keep warmth)
- Support Root

How Soil Functions are elevated

- **Soil Organic Matter**

Nutrient supply, Water holding,
Hormon action, Heat Keeping , Soil
softness

- **Clay Minerals**

Nutrient holding Aggregate formation

- **Soil Microbes**

Organic Matter decomposition, Nutrient
supply, Control Pest Germs

Harmful soil factors

- Extreme acidity and alkalinity, free Al ion
- Extreme salinity
- Hydrogen sulfide • Mine poison
- Heavy metals
- Pest Germs • Parasite nematodes
- Soil hardness/ compaction
- Drought

Absence of harmful factors is an important growth factor

Soil can be a plant growth inhibition factor.

Role of soil

What is the role of soil ?

Is it indispensable for crop production ?

What can be replaceable:

Microbe → **Pesticide, fertilizer**

Organic matter → **Fertilizer**

Soil → **Growing apparatus,
Stones, Rock-wool, Uretan, Water**

Merit of hydroponic culture

Crops can be grown in all season.

Products are homogeneous.

No need or easy control of weeds, disease, and pests.

High yield, and hygienic.

Problems of hydroponic culture

Easily infected by pathogen. The damage spreads rapidly.

Organic wastes can not be decomposed or used. Incomplete cycle.

Facilities are expensive.

Environment pollution by the used nutrient solution.

Problems of hydroponic culture 2

- **Excess absorption of nutrients** (Excess nitrogen absorption brings about the lowering of crop quality, not good for health also.)
- **Imbalance in micronutrients** (Not only for the growth of crops, but also for the healthy food composition, the best composition in trace elements is unknown.)

Merits of soil culture

Necessary nutrients are supplied from soil.

Method of cultivation is easy and stable production is possible.

Cost is low.

Suppression of crop disease by soil microbes.

Merits of soil culture 2

- **Stress on crops will bring about high quality products.**
- **Moisture stress → Crops rich in sugar and vitamin.**
- **Root crops grow only on soils.**

Demerits of soil culture

Affected by the nature of land and soil, season and weather.

Can not expect the same results even under the same cultivation method.

Control of weed and disease is necessary.

Roles of soil (solid part)

Retain and supply moisture.

Retain and supply air.

Support the plant body.

Nutrient supply (Release of nutrients by weathering)

Nutrient retention (Cation exchange by clay)

Physical properties (Aggregate structure, water retention)

Why Soil and Land is necessary for Agriculture?

Soil is Almighty

Risk and cost in alternative technique

(Stable • Safe • Economy)

Adaptation of crop to soil

Recycling of material in Soil

What is soil fertility?

There are various definitions for soil fertility.
However, is soil fertility an inherent property
of soil ?

Is soil fertility an unchangeable property of
soil?

What is Soil Fertility?

Fertility I Natural fertility

Fertility II by Establishing the environment for nutrient supply from soil

Fertility III Securing the amount and quality of nutrients required for crop production

Soil fertility is established by human action

Change in Concept of Soil Fertility

- **To be easily manageable land is more important than natural fertility**
- **Such Soils are important where**
- **Fertility is easily manageable.**
- **Agricultural machines can be operated easily**
- **Water management is easy.**

Breeding contribute to the change in the value of crop land

- Development of tolerant variety on problem soils (IRRI)
- Salt tolerant
- Acid tolerant
- Micro-element deficiency tolerant (Zn • Fe • B)
- ⇒ **Unused wild land can be turned to fertile land**
- ⇒ **Supply food to starved people**