

# Graduate Course Syllabus

**Course name: Advanced plant physiology**

Course No.	1109020352		Course unit					College of Agronomy and Biotechnology			
Course category (√)	Compulsory courses () Elective courses (√)	Credit hour	3	Total class hours	60	Lectures hours	50	Discussion hours	10	Experiment hours	0
Lecturer	<b>Sangen Wang</b>	Job title degree	Professor Master degree					Specialties	Plant physiology and Biochemistry		

Range of application by majors: Botany, cell biology, biochemistry and molecular biology, agronomy, horticulture, plant protection, etc.

Prerequisite courses: Basic biochemistry, Plant physiology etc.

Teaching objectives and requirements:

To let the students have a deeper understanding and knowledge of the characteristics of plant life activities, material metabolism, energy conversion and information transmission, as well as the morphological construction, and the development of modern plant physiology etc.

Plant physiology is developed in the practice of agricultural production, people use various cultivation measures in agricultural production, the purpose is to adjust the relationship between crops and the environment, to meet the requirements of high yield and high quality crops. Therefore, theoretical research and practice should be combined. Such as to lay the theoretical basis for rational fertilization by understanding the mineral elements necessary for the normal growth and development of crops; Through the understanding of crop ecological water demand and physiological water demand, we can provide theoretical basis for making reasonable irrigation scheme and timely and appropriate high quality and efficient irrigation; Through the study of plant hormones and growth regulators, we can have our own views on preventing organ shedding, cutting rooting, promoting germination, preventing lodging, controlling dormancy, regulating growth, safe storage, etc. Using the theory of vernalization and photoperiod phenomena to make correct decisions on cultivation and seed cultivation; By plant tissue culture, learning the basic theory of plant cell totipotent, etc., to lay the foundation for the application of biotechnology, genetic engineering, etc. By mastering the basic laws of respiration, it provides reasonable and effective measures for seed germination, prevention of rotten seedlings, and storage of agricultural products; Through the further study of the mechanism of photosynthesis, it provides the theoretical basis for rational planting, reasonable intercropping, rational use of light energy and high light efficiency to cultivate seed; Improve crop resistance to environmental by studying high and low temperature, drought, waterlogging, environmental pollution and disease and insect damage.

Teaching and testing methods (it's need to be conducive to cultivating the innovative thinking and ability of graduate students):

Plant physiology is a science that studies the laws of plant life activity and reveals the relationship between plants and the environment. Advanced plant physiology is an important course for master's degree, with a total of 40 ---- 60 hours, 3 credit hours.

In the teaching, according to the actual situation, we can arrange the classroom discussion, the practice teaching, watch the slide, video, and the use of multimedia teaching is encouraged as well.

Course teaching is the main method, and student discussion is the supplementary method. The ordinary discussion results are combined with the final comprehensive closed-book examination, and take the final examination as the main part.

## Course contents and course hours allocation

### Chapter I Recent advances and prospects of Plant Physiology (5-8 hours)

1. The development of Plant Physiology; 2. Recent advances in the main research areas of Plant Physiology; 3. Prospect of plant physiology research; 4. Plant physiology and agricultural modernization; 5. Literature on Plant Physiology.

### Chapter II Structure and function of plant cells (7-10 hours)

It is further clarified that plant cells are structural units of organisms and functional units for life activities. The chemical composition of cells and the properties of protoplasm. The structural characteristics of plant cells. The chemical composition and function of biomembrane. The structural characteristics and physiological functions of cell wall and main organelles.

Advanced plant cell structure overview, eukaryotic cells and prokaryotic cells, higher plant cell structure. The nature of protoplasm. Cell wall structure and function. The structure and function of biofilm: 1) Chemical constituents of membranes: membrane lipids, membrane proteins, and membrane sugars; 2) Structure and properties of membrane; 3) Physiological function of membrane.

The structure and function of organelles. The research progress of the main organelles: vacuoles, chloroplasts, mitochondria etc.. Characteristics of plant cell totipotent and gene expression, programmed cell death and so on.

### Chapter III Water physiology and mineral nutrition of plants (7-10 hours)

To further clarify that all normal life activities of plants must be carried out under the condition of sufficient water content in the cells. There is no life without water; The importance of water in plant life activities, the status of water transport and distribution in plants, the physiological significance of transpiration and its influencing factors. The importance of plant mineral nutrition, the research progress of essential elements.

The physiological and ecological function of water, the important function of water to plants, physiological water requirement and ecological water requirement. Osmotic pressure of plant cells. Osmotic absorption of cells. Aquaporins. Transpiration. The structure, size, number and distribution of stomata, stomatal movement, stomatal opening and closing mechanism. The influence of environmental conditions on transpiration: temperature, air humidity, wind speed, light intensity, etc. The types of essential mineral elements; the research methods of essential mineral elements, and the physiological basis of fertilization. Characteristics of absorption of mineral elements by roots. The process of absorbing mineral elements in roots. Factors affecting the absorption of mineral elements by roots: temperature, soil aeration, soil solution concentration, soil pH value, ion interaction, etc.

#### Chapter IV Photosynthesis (7-10 hours)

Depth study of photosynthesis mechanism, photorespiration, the external conditions affecting photosynthetic rate and the relationship between photosynthesis and crop yield. Indexes of photosynthetic amount: photosynthetic rate (photosynthetic rate) and photosynthetic production rate.

The research progress of photosynthesis mechanism.

Primary reaction.

Electron transport and photosynthetic phosphorylation: electron transport; photosynthetic phosphorylation.

Co<sub>2</sub> assimilation.

Photosynthetic carbon cycle: chemical stage, carbon dioxide reduction stage, receptor renewal stage. 2.

Four carbon pathway. 3. Sedum acid metabolic pathway. 4. The formation of photosynthetic products.

Factors affecting photosynthesis: light intensity: light saturation point and light compensation point;

Carbon dioxide concentration: carbon dioxide saturation point, carbon dioxide compensation point;

Temperature; water content; mineral elements.

Relationship between photosynthetic efficiency and crop yield:

I. Utilization efficiency of light energy by plants; II. Ways to improve light utilization rate; III. Comparison of three types of plants.

#### Chapter V Transportation and distribution of Photosynthate and plant signal transduction (5-8 hours)

Transportation and signal transduction system of higher plants and their characteristics. Transport mechanism of organic matter transformation. Distribution law of photosynthate. Transportation and signalling system in higher plants. Short distance transportation conduction system; long distance transportation conduction system. Chemical signal system; physical signal system.

Characteristics of phloem transport:

I. Phloem transport substance; II. Direction of transport; III. Characteristics of phloem transport; IV. Mechanism of phloem transport

Distribution and regulation of Photosynthate:

I. Distribution law of Photosynthate; II. Relationship between photosynthate allocation and yield

#### Chapter VI Plant growth substance (7-10 hours)

Study in depth the auxin, gibberellin, cytokinin, abscisic acid, ethylene and other plant endogenous hormones distribution, metabolism, physiological effects and plant growth regulators and their applications.

##### **Auxin**

I. Discovery of auxin; II. Distribution and transportation of auxin in plants; III. Auxin metabolism; IV. Auxin effects: promote growth, promote adventitious root formation, nutrient allocation, tropism and other physiological effects.

##### **Gibberellin**

I. Discovery history of gibberellin; II. Chemical structure and activity of gibberellin; III. Biosynthesis and transportation of gibberellin; IV. The physiological effects of gibberellin: promoting the elongation of stems, inducing flowering, breaking dormancy, promoting male flower differentiation and other physiological effects.

##### **Cytokinin**

I. The discovery of cytokinin; II. Basic structure and activity of cytokinin; III. The physiological effects of cytokinin: promoting cell division, differentiation of buds, promote lateral bud growth, delay leaf senescence and dormancy breaking etc.

##### **Abscisic acid**

I. The discovery of abscisic acid; II. Chemistry of abscisic acid; III. Metabolic biosynthesis and oxidation of abscisic acid; IV. The physiological effects of abscisic acid : promoting dormancy, promoting stomatal closure, enhancing stress resistance, inhibiting growth and promoting abscission etc..

##### **Ethylene**

I. The discovery of ethylene; II. Biosynthesis and movement of ethylene; III. The physiological effects of ethylene: changing the growth habit, fruit ripening, promote abscission, promote flowering and increase female flowers and other physiological effects

Growth substances and chemical regulation in other plants.

Brassinolide, zeaxenone, etc.

I. Plant growth regulators commonly used in agriculture; II. Chemical regulation of crops.

#### Chapter VII Seed development and Germination Physiology (6-8 hours)

Cell growth and differentiation, plant differentiation, seed germination and seedling growth, seed development and maturation.

I. Concept and condition of seed germination;

II. Environmental conditions affecting seed germination: water, temperature, oxygen and light;

III. Physiological and biochemical changes during seed germination;

IV. Seed vigor;

V. Seed aging and deterioration.

#### Chapter VIII Plant Photomorphogenesis (5-8 hours)

Concept of photomorphogenesis

Photoperiod phenomenon

I. The concept and discovery of photoperiod; II. Reaction types of photoperiod; III. Photoperiodic induction; IV. The application of photoperiod phenomenon in agriculture.

Phytochrome, cryptochrome, photomorphogenesis and dark forms built.

#### Chapter IX Reproductive physiology of plants (5-8 hours)

To further study the plant from the vegetative growth into reproductive growth of the internal conditions and environmental conditions, the transition from vegetative growth to reproductive growth, the formation of flower organ physiology, fertilization physiology, gender expression.

#### Chapter X Resistance physiology in plants (7-10 hours)

Study in depth the concept and the type of adversity; discuss the cold resistance, heat resistance, drought resistance and waterlogging resistance of plants, effects of environmental pollution on plants. Various adverse conditions such as cold, drought, high temperature, waterlogging and environmental pollution damage to plants. The causes of adversity injury, the adaptation and resistance of plants to adversity. The ways and methods of improving plant resistance and the significance of using plants to protect environment.

Cold resistance of plants

I. Frost resistance: the mechanism of freezing and freezing injury; the adaptability of plants to freezing injury; the measures to improve the frost resistance of plants;

II. The mechanism of drought damage crops: change the membrane structure and permeability; destroy the normal metabolic process; mechanical damage;

III. Mechanism of drought resistance and ways to improve it;

IV. Waterlogging resistance: waterlogging, the effects of waterlogging on plants, and the waterlogging resistance of plants.

Environmental pollution and plant resistance

I. The harm of air pollution to plants; II. The harm of water and soil pollution to plants; III. The role of plants in environmental protection.

Cross adaptation of biological free radicals to plant membrane damage, stress proteins and plants.

#### The Catalog for main reference book (periodicals):

No.	Author	Books and Periodicals' name	Press
1	Sangen Wang, Ying Liang	Advanced plant physiology	Southwest Agricultural University. 1997
2	Zhong Wang	Plant physiology	China Agriculture Press, 2000

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