

Exploring innovative teaching of postgraduate agronomy courses under the “new agricultural science” paradigm: a case study of “crop chemical regulation principles and technologies”

Yongchao WANG, Songwei LI, Jiameng GUO, Hao WANG, Yulou TANG, Qinghua YANG, Ruixin SHAO*

College of Agronomy, Henan Agricultural University, Zhengzhou 450046, China

*Corresponding Author:

Email address: shao_rui_xin@126.com

Abstract: The "New Agricultural Science" initiative requires agriculture and forestry universities to cultivate high-quality agricultural talent, yet traditional postgraduate agronomy courses suffer from abstract theory, scarce teaching scenarios and outdated content. Taking the course "Principles and Technologies of Crop Chemical Regulation" as an example, innovations were implemented by optimizing content (making core knowledge precise and cutting-edge while grounding practical scenarios in production), upgrading pedagogy ("case + problem" driven learning plus online/offline blending), and aligning the curriculum with agro-industry needs and innovation contests. These measures markedly enhanced students' practical and innovative abilities, producing multiple award-winning students, and providing a useful reference for reforming postgraduate agronomy courses under the New Agricultural Science paradigm.

Keywords: new agricultural science; agronomy; postgraduate education; teaching innovation; crop chemical regulation

1 Introduction

The "New Agricultural Science" initiative was launched to spur reform across agricultural universities and colleges, ensuring they keep pace with the new-era demands of the sector. It emphasizes interdisciplinary integration and is committed to cultivating high-quality agricultural talents with innovative spirit, practical ability and international perspective [1]. The traditional graduate courses in agricultural sciences have many deficiencies, such as abstract theoretical courses, lack of teaching scenarios, and insufficient practical teaching and case analysis [2][3]. These problems hinder the ability of agricultural graduate students to meet the talent demands in agricultural development under the new agricultural discipline framework.

"The Principles and Techniques of Crop Chemical Regulation and Control" course combines theoretical and practical application aspects [4][5]. Through course learning, students can master the basic principles, technical methods and applications of crop chemical regulation and control in agricultural production, laying a foundation for future production and research work in related fields. The exploration of teaching innovation in this course is typical, and the course places greater emphasis on cultivating students' practical and innovative abilities. The course objectives align closely with the goals of new agricultural discipline development, making the teaching innovations in this course highly applicable within

this context.

2 The problems existing in the traditional teaching model

2.1 Abstract theoretical knowledge and the complexity of knowledge system construction

The study of the course "Principles and Technologies of Crop Chemical Regulation" involves the intersection of multiple disciplines such as plant physiology and biochemistry. Mechanisms like signal transduction and hormone crosstalk are invisible and intangible, which is not conducive to constructing the overall framework of the course. Taking auxin as an example, it not only promotes cell elongation but also participates in physiological processes such as plant phototropism and apical dominance. In addition, auxin interacts with other hormones like gibberellins and abscisic acid. This knowledge encompasses microscopic content with limited intuitive perception, leading to a significant increase in the difficulty of comprehension and mastery.

2.2 Lack of teaching scenarios and disconnection between theoretical and practical links

In the traditional teaching of "Principles and Technologies of Crop Chemical Regulation", the problem of inadequate integration between theoretical explanation and practical application is quite prominent. Teachers often focus on imparting theoretical knowledge such as the mechanism of plant hormone action, types and effects of chemical regulators in class, lacking organic combination with actual agricultural production cases. There is an obvious separation between theoretical teaching and practical teaching of the course, which exerts many adverse impacts on the cultivation of students' scientific literacy.

2.3 Outdated teaching content and insufficient cultivation of innovative ability

Traditional teaching content suffers from a notable deficiency in integrating new technologies and research achievements. In traditional teaching, these cutting-edge technologies and latest research results have not been timely incorporated into the teaching content, and the update speed of textbooks is slow, leading to a disconnection between the knowledge learned by students and the frontier of disciplinary development. In the learning process, students have little understanding of these emerging technologies and achievements, fail to grasp the latest research dynamics and development trends, which is unfavorable to the cultivation of students' innovative ability.

3 Exploration and practice of teaching innovation

3.1 Optimizing curriculum structure and innovating teaching content

3.1.1 Precision and frontier orientation of basic content

To ensure the precision and frontier orientation of the course content, we systematically sort out crop chemical regulation's core principles (hormone action mechanisms, signal transduction pathways), remove outdated knowledge, and strengthen interdisciplinary integration with molecular biology and genomics to deepen theory. Simultaneously, the curriculum keeps pace with industry trends by introducing cutting-edge content like green regulator R&D, intelligent technologies (e.g., UAV precision spraying, sensor-based effect monitoring), and protected agriculture regulatory schemes. A "Crop Chemical Regulation Industry Case Collection" is compiled as supplementary teaching materials. By supplementing cutting-edge knowledge, students can grasp industry development, thereby reducing the theory-production disconnection.

3.1.2 Scenario-based and production-oriented practical courses

Practical courses need to thoroughly implement the concepts of scenario orientation and production orientation. They can simulate farmland environments in different regions, such as drought and high-temperature scenarios of corn production in Henan, and set production challenges like drought and high-temperature prevention and control. This allows students to accurately adjust the types and dosages of regulators through field operations. Meanwhile, by connecting with

the industrial chain of agricultural enterprises, schools can carry out full-process practices from regulator preparation and field spraying to effect monitoring. This enables students to master technical key points in real production scenarios, improves their ability to solve practical problems, and meets the practical talent training needs of the new agricultural science.

3.2 Upgrading teaching methods and integrating theory with practice

3.2.1 "Case + Problem"-driven teaching

The teaching team should adopt a problem-driven approach by using actual production problems as the starting point, guide students to collaborate in problem analysis, literature research, and solution design, thereby cultivating their logical thinking and problem-solving abilities. This problem-driven teaching method can increase students' participation in course learning, enhance their learning enthusiasm, and foster their active learning capabilities.

3.2.2 "Online + Offline" blended teaching

The course designers should build an online learning platform to upload theoretical micro-courses, video lectures by industry experts, and extended reading materials. Offline classes focus on group discussions, scheme presentations, and practical operation guidance, realizing closed-loop teaching of "pre-class preview - in-class interaction - after-class expansion". The blended teaching mode provides richer teaching resources, such as demonstration animations of hormone interactions and dynamic changes of crop growth, which play an important role in helping students understand abstract theoretical knowledge.

3.3 Proactively connecting with industry and empowering innovation and entrepreneurship

3.3.1 Targeting agricultural development needs and deeply understanding the industry

Guided by the principle of proactively connecting with the development needs of the agricultural industry, the teaching team should deeply identify the actual demands for chemical regulation technologies in frontline production. By engaging in communication with production and scientific research personnel and internships of frontline companies, this approach not only breaks the limitation of "armchair strategizing" but also bridges the "disconnection" between classroom knowledge and industrial practical operations.

3.3.2 Taking innovation and entrepreneurship competitions as a springboard to strive for the pinnacle of capabilities

By transforming "theoretical knowledge" into "competition projects" and upgrading "technical ideas" into "solutions", students can temper the ability to decompose problems and design schemes in competitions. This not only makes up for the "disconnection between professional literacy and practical capabilities", but also elevates learning goals through competitions. In the process of promoting learning and innovation through competitions, students grow into agricultural innovative talents who understand technology, excel at innovation, and dare to take responsibility.

4 Preliminary effects of teaching innovation

With the help and inspiration of the course, students' practical and innovative capabilities have been significantly improved, and several outstanding representatives have emerged. For example, Long Haochi won the National Silver Award in the 8th China International College Students' Innovation and Entrepreneurship Competition (Internet Plus) and the 18th College Student of the Year; Yang Liuyang won the National Silver Award in the 8th China International College Students' Innovation and Entrepreneurship Competition (Internet Plus) and the title of "Merit Student" in Henan Provincial Universities; Wang Shancong won the National Gold Award in the 2025 China International College Students' Innovation Competition; Hu Xinru won the Gold Awards in the Henan Provincial College Students' Career Planning Competition in 2024 and 2025. These achievements demonstrate the effectiveness of the course innovation and lay a solid foundation for the further reform and improvement of the course.

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Conflicts of interest

The author declares no conflicts of interest regarding the publication of this paper.

References

- [1] Zhu LM, Jin F, Wang Y, Cui QX. 2021. Practice of ideological and political teaching reform of plant protection course under the background of new agriculture. *Modern Agricultural Science and Technology*, 24: 245-246+ 248.
- [2] Lu DK. 2018. Several core issues and solutions in the implementation of curriculum ideological and political education: a discussion based on professional curriculum ideological and political education. *Ideological & Theoretical Education*, 3: 64-69.
- [3] Su JH, Xu JQ, Wu SJ, Wan WB, Shi K. 2021. Scientific research based innovative ability training model for postgraduates. *Academic Degrees & Graduate Education*, 2: 36-39.
- [4] Shen XF, Feng NJ, Zhao LM, Rao, GS, Zheng, DF. 2021. Exploration on postgraduate training model under the background of "new agricultural science": a case study of crop science major of Guangdong Ocean University as an example. *Education and Teaching Forum*, 10: 1-4.
- [5] Fu JQ, Zhu Y. 2020. Curriculum ideological and political education: background, meanings and solutions. *China Agricultural Education*, 21(4): 28-34.

About the author

Ruixin Shao (1982.04-), female, Han nationality, native of Changyuan, Henan Province, Doctor, Professor; Research Direction: Crop Science;

Yongchao Wang (1987.09-), male, Han nationality, native of Gannan County, Heilongjiang Province. Doctor, Professor; Research Direction: Crop Stress Physiology and Chemical Regulation.