Study and Application of Soybean and Corn Strip Compound Planting Technology

Huajun SUN*, Yue CHEN

Shangqiu Academy of Agriculture and Forestry Sciences, Shangqiu 476000, China

Abstract The soybean and corn strip compound planting technology is a crucial measure for improving land use efficiency and ensuring food security. This paper deeply analyzed the principles, advantages, and key technical aspects of this technology, including variety selection, planting pattern, sowing management, and field management. It also illustrated its application effectiveness through practical cases and proposed corresponding solutions to existing challenges in its promotion. This study provides theoretical support and practical reference for the widespread adoption and efficient application of this technology.

Key words Soybean; Corn; Strip compound planting; Technology

DOI: 10.19759/j.cnki.2164 – 4993.2025.04.006

With China's population growth and economic development, the demand for grain continues to increase, making food security the primary task of agricultural development. As important grain crops, soybean and corn play a significant role in agricultural production. However, traditional monoculture planting patterns struggle to fully utilize land resources and light/heat conditions, limiting improvement in crop yield and economic benefits[1]. The soybean and corn strip compound planting technology has emerged accordingly. This technology enables synergistic growth of both crops on the same field through strip compound planting, effectively improving land use efficiency and yield per unit area. It is of great significance for ensuring national food security and promoting sustainable agricultural development.

Principles of Soybean and Corn Strip Compound Planting Technology

Light and heat resource utilization principles

Soybean is a dwarf crop with relatively strong shade tolerance, while corn is a high-stalk crop with high light demand. In the strip compound planting mode, a staggered planting pattern is created by rationally configuring row spacing and plant spacing between corn and soybean crops. Corn fully utilizes upper-layer sunlight, while soybean can perform photosynthesis using scattered light and partial direct light between corn rows. It significantly improves overall field light/heat resource use efficiency and reduces resource waste. For instance, studies show that optimized planting strip patterns can increase the use efficiency of light energy by 15% – 20%.

Nutrient complementarity principle

Bradyrhizobium japonicum possesses nitrogen-fixing capability, converting atmospheric nitrogen into plant-available forms. Beyond meeting their own growth requirements, they additionally supply corn with supplemental nitrogen nutrition. Meanwhile, the demand for nutrients such as phosphorus and potassium during corn growth differs from that of soybean. The root systems of the two crops are distributed at varying depths and breadths in the soil, leading to differential absorption and utilization of nutrients from different soil layers. This enables complementary nutrient use, improves soil nutrient use efficiency, and reduces the application of chemical fertilizers[2]. According to relevant data, adopting soybean and corn strip compound planting can increase nitrogen use efficiency by 20% – 30% and reduce nitrogen fertilizer application by 60 – 97.5 kg/hm^2.

Niche complementarity principle

From the perspective of ecological niches, soybean and corn exhibit differences in spatial distribution, temporal growth, and resource utilization. Spatially, their varying plant heights occupy different vertical spaces. Temporally, although they grow in the same season, their developmental stages differ slightly, leading to non-overlapping peak demands for resources such as light, temperature, water, and nutrients. This niche complementarity allows them to coexist harmoniously in the same field, reducing competition and making full use of various ecological resources. It maintains the stability and diversity of the farmland ecosystem while lowering the probability of pest and disease outbreaks. For example, field pest and disease incidence can be reduced by over 30% compared with monoculture, and pesticide comsumption decreases by 10% – 15%.

Advantages of Soybean and Corn Strip Compound Planting Technology

Significant economic benefits

Under the strip compound planting model, an additional 1 500 – 2 250 kg/hm^2 of soybean can be harvested while maintaining stable corn yields[3]. Based on current market prices, this provides farmers with substantial additional income. Meanwhile,

Received: April 2, 2025 Accepted: June 5, 2025

Supported by Special Project for the Construction of the National Modern Agricultural Industry Technology System (CARS-04-CES16).

Huajun SUN (1968 –), male, P. R. China, associate researcher, devoted to research about soybean breeding and physiological cultivation.

* Corresponding author.

this technology improves fertilizer use efficiency while reducing the application of chemical fertilizers and pesticides, thereby lowering production costs and further enhancing economic returns. For instance, in certain regions adopting soybean and corn strip compound planting, farmers achieved an average additional income of 7 500 – 12 000 yuan/hm^2.

High land use efficiency

Through rational field layout and planting pattern design, soybean and corn strip compound planting maximizes land resource utilization by enabling simultaneous cultivation of two crops on the same plot. Compared with traditional monoculture, this system increases land use efficiency by 30% – 40%, effectively alleviating the contradiction between China's limited arable land resources and growing grain demand[4].

Ecological environmentally friendly

The nitrogen-fixing effect of *B. japonicum* reduces nitrogen fertilizer application, minimizing pollution to soil and water caused by excessive fertilization. The decreased incidence of pests and diseases reduces pesticide usage, mitigating their negative environmental impact. Additionally, the synergistic growth of both crops improves field microclimate, enhances farmland ecosystem stability and stress resistance, and promotes sustainable agricultural development.

Significant social benefits

The widespread adoption of this technology helps increase China's total grain output and ensures national food security. Meanwhile, it provides farmers with new income opportunities, promoting rural economic development and improving farmers' living standards. Furthermore, it drives innovation and advancement in agricultural cultivation techniques, enhancing China's agricultural modernization level[5].

Key Technical Points of Soybean and Corn Strip Compound Planting

Variety selection

Corn varieties: Compact plant-type varieties with high planting density tolerance, strong lodging resistance, strong disease resistance, moderate growth duration, and plant height around 2.5 – 2.8 m should be selected, such as Denghai 605, Zhengdan 958, and MY73. These varieties maintain good growth performance and yield potential under high-density planting conditions while offering excellent lodging resistance and facilitating field management and mechanized operations.

Soybean varieties: Shade-tolerant, lodging-resistant and dense-planting-adapted varieties should be selected, such as Shangdou 2001, Shangdou 2028, and Dadou 1310. The shade- and dense planting-tolerant characteristics enable soybean to grow normally under corn shading conditions, while lodging resistance ensures stability in later growth stages, preventing yield and quality losses due to lodging.

Planting pattern

The "2 + 4" pattern: It refers to intercropping two rows of corn with four rows of soybean. The distance between corn strips is typically 2.3 – 2.5 m. Corn plants are planted with a row spacing of about 40 cm and a plant spacing of 10 – 12 cm, achieving approximately 60 000 corn plants per hectare[6]. Soybean plants are planted with a row spacing of 30 – 35 cm and a plant spacing of 8 – 10 cm, reaching about 135 000 – 150 000 soybean plants per hectare. The distance between corn and soybean strips is maintained at 60 – 70 cm. This pattern optimizes light and heat resource utilization while facilitating field management and mechanized operations.

The "3 + 6" pattern: Three rows of corn are intercropped with six rows of soybean. The distance between corn strips is 3.0 – 3.2 m. Corn plants are planted with a row spacing of 40 cm and a plant spacing of 10 cm, achieving about 67 500 corn plants per hectare. Soybean plants are planted with a row spacing of 30 cm and a plant spacing of about 8 cm, reaching approximately 180 000 soybean plants per hectare. The distance between corn and soybean strips is about 70 cm. This pattern is suitable for fields with higher soil fertility and better irrigation conditions, and can further improve land use efficiency and crop yield.

Sowing management

Sowing time: The appropriate sowing time is determined based on local climate conditions and variety characteristics[7]. Generally, corn seeds are sown when the local temperature is stabilized above 10 – 12 ℃, while soybean seeds are sown slightly later than corn, typically 7 – 10 d after corn sowing. This ensures that both crops can fully utilize light and heat resources during growth and development, avoiding conflicts in their growth processes.

Sowing depth: The sowing depth for corn is generally 5 – 6 cm, ensuring the seeds have sufficient access to soil moisture and nutrients for optimal germination. For soybean, the sowing depth is 3 – 4 cm, as planting too deep or too shallow may affect both emergence rates and seedling growth.

Seeding together with fertilization: The fertilizer-seeding simultaneous application technique is adopted. In specific, an appropriate amount of compound fertilizer is applied below or beside the seeds with a distance of 5 – 8 cm during sowing to meet the nutrient requirements of crops in the early growth stage[8]. The selection of fertilizer should be based on soil fertility and crop nutrient needs. Typically, a compound fertilizer with a suitable nitrogen, phosphorus, and potassium ratio can be selected.

Field management

Fertilizer management: In the soybean and corn strip compound planting system, scientific fertilization should be carried out according to the distinct nutrient requirements of the two crops. Corn has a high demand for nitrogen during the huge bell bottom stage, requiring heavy nitrogen fertilizer application supplemented with appropriate amounts of phosphorus and potassium[9]. Soybean have high nutrient demands during the flowering and pod-setting stages. In addition to nitrogen fertilizer, emphasis should be placed on the application of phosphorus, potassium, and micronutrients such as boron and molybdenum, which can be supplemented through foliar spraying. Meanwhile, considering the nitrogen-fixing role of *B. japonicum*, fertilizer application for soybean can be appropriately reduced.

Water management: Corn and soybean have different water requirements at various growth stages. Corn requires ample water during the jointing, huge bell bottom, tasseling, and grain-filling stages, ensuring sufficient moisture supply. Soybean is sensitive to water during flowering, pod-setting, and seed-filling stages, necessitating timely irrigation to maintain soil moisture. Meanwhile, proper drainage should be ensured to prevent waterlogging, as excessive field moisture can hinder crop growth.

Pest and disease control: It is necessary to adhere to the principle of "prevention first, integrated control". Regular field inspection help detect early symptoms of pests and diseases. For common corn pests and diseases such as corn borers, fall armyworms, and northern leaf blight of corn, as well as soybean pests and diseases like soybean aphids, pod borers, and root rot, integrated management methods can be adopted, including physical control (*e. g.*, installing insecticidal lamps and yellow sticky traps), biological control (*e. g.*, releasing natural enemies or using biopesticides), and chemical control (*e. g.*, selecting efficient, low-toxicity and low-residue pesticides).

Intertillage and weeding: During the early growth stages of crops, timely intertillage and weeding should be conducted to loosen soil and promote root development while reducing competition from weeds for nutrients, water, and sunlight. A combination of manual weeding, mechanical weeding and chemical weeding can be adopted. When using chemical herbicides, appropriate products must be selected and applied strictly according to instructions to avoid crop damage from phytotoxicity. Weed control during co-growth period: For weed management during the co-growth period of corn and soybean, highly targeted herbicides should be selected and applied by directional spraying to prevent herbicide drift onto the other crop. For example, during the 4 – 5 leaf stage of corn and the 2 – 3 leaf stage of soybean, corn-specific herbicides can be directionally sprayed to control weeds in corn fields. Similarly, during the 4 – 5 compound leaf stage of soybean, soybean-specific herbicides should be used for directional weed control in soybean fields.

Pest and Disease Control

Common soybean diseases and control techniques

Soybean root rot primarily damages soybean roots. In the early stages of infection, brown lesions appear on the root epidermis, gradually expanding and leading to root rot. Infected plants exhibit stunted growth, yellowing and wilting leaves, and in severe cases, complete plant death[10].

Occurrence regularity: The disease is more severe in highly-humid and heavy clay soils and continuous cropping fields. The pathogens can survive in soil for multiple years and spread through rainwater, irrigation, and farming operations. Before sowing, seeds are treated with fungicides such as fludioxonil and metalaxyl-M. At the early stage of disease, hymexazol or carbendazim can be used for root irrigation, with 200 – 300 ml of liquid per plant. Phytophthora root rot of soybean can occur in both seedlings and mature plants, with infected plants developing water-soaked lesions on the roots that gradually turn dark brown, leading to cortical rot and wilting death of the plants. Occurrence regularity: Low-temperature and high-humidity environments favor the disease, especially in years with frequent rainfall. The pathogen overwinters as oospores in the soil, serving as the primary source of infection the following year. For seed treatment, fungicides such as metalaxyl and fludioxonil are used. At the early stage of disease, metalaxyl or propamocarb is sprayed for control, focusing on the roots and stem base. Frogeye leaf spot of soybean primarily damages leaves, stems, and pods. In the early stages of leaf infection, chlorotic circular spots appear, and later turn brown with grayish-white centers and brown edges. On stems, the lesions are spindle-shaped and may merge in severe cases, causing stem death. Pod infections result in circular or oval spots, reducing seed plumpness[11]. Occurrence regularity: The disease thrives under high temperature, high humidity, overcrowded planting, and poor ventilation. The pathogen overwinters on infected plant debris and spreads via wind and rain. During the flowering and pod-setting stage of soybean, when the field disease incidence on leaves reaches 10%, fungicides such as carbendazim, thiophanate-methyl or difenoconazole should be sprayed for control. Applications should be repeated every 7 – 10 d for 2 – 3 consecutive treatments. Soybean rust primarily affects the leaves, initially causing small yellowish spots on the underside that later develop into raised yellowish-brown pustules. When these pustules rupture, rust-colored spores are released, and severe infections lead to yellowing and premature leaf drop. Occurrence regularity: The disease tends to occur under high temperature and humidity conditions and is more severe in southern regions. The pathogen is capable of long-distance transmission via air currents. At the early stage of infection, fungicides such as triadimefon, diniconazole, or tebuconazole should be sprayed for control at 7 – 10 d intervals for 2 – 3 consecutive times.

Common soybean pests and control techniques

Soybean aphids, both adults and nymphs, cluster on young stems, leaves, and pods to suck sap, causing leaf curling, wrinkling, and stunted growth. Severe infestations lead to dwarfed plants, reduced pod formation, and potential transmission of viral diseases[12]. Occurrence regularity: The pest produces 10 – 20 generations per year, and it is serious in high-temperature and drought years. The eggs overwinter on plants such as buckthorn and hatch when temperatures rise in spring, and then migrate to soybean to cause damage. Soybean aphids can be controlled by hanging yellow sticky traps, with 30 – 40 traps per mu to kill alate aphids. Natural predators such as ladybugs, lacewings and hoverflies can also be utilized. When the ratio of natural predators to aphids in the field reaches 1 : 150, they can effectively control aphid damage. When aphid populations reach the control threshold (1 500 aphids per 100 plants or an infested plant rate of 50%), insecticides such as imidacloprid, acetamiprid, or thiamethoxam can be sprayed for control. Soybean pod borers damage soybean when their larvae bore into pods and feed on the seeds, creating "worm holes", which reduce both soybean quality and yield. This pest produces 4 to 6 generations per year, and overwinters as mature larvae in cocoons within the soil. Adults lie in the daytime and come out at night, and lay eggs on pods. After hatching, the larvae bore into the pods and cause damage. During the peak egg-hatching period and before the larvae bore into the pods, insecticides such as emamectin benzoate, chlorantraniliprole or deltamethrin can be selected and sparyed with a focus on thorough coverage of the bean pods.

References

[1] WANG Y, LIU Q, GUO SQ, *et al.* Integrated technology of water, fertilizer and medicine for soybean and corn strip compound planting in Hexi irrigation district[J]. China Seed Industry, 2025(1): 153–155. (in Chinese).

[2] CHEN GY. Guiding opinions on pest control technology of soybean and corn strip compound planting[J]. Chinese and Foreign Food Industry, 2024(13): 108–110. (in Chinese).

[3] ZHANG B. Analysis of soybean and corn strip compound planting technology[J]. Anhui Agricultural Science Bulletin, 2024, 30(9): 16–19. (in Chinese).

[4] YANG YS, JIN L, TIAN Y, *et al.* Adaptability of different soybean varieties under maize and soybean strip compound planting model[J]. Anhui Agricultural Science Bulletin, 2024, 30(15): 26–29. (in Chinese).

[5] SONG WJ. Technical points and advantages of soybean and corn strip compound planting[J]. World Tropical Agriculture Information, 2023(3): 37–39. (in Chinese).

[6] RAN F. Key points of high-yield cultivation techniques of soybean and corn strip compound planting[J]. Guangdong Sericulture, 2024, 58(10): 33–35. (in Chinese).

[7] WEI JX. Soybean and corn strip compound planting technology and its control of diseases, pests and weeds[J]. Agricultural Development & Equipments, 2022(8): 227–229. (in Chinese).

[8] LYU XY. Corn and soybean strip compound planting technology[J]. Xiandai Nongcun Keji, 2022(9): 23–24. (in Chinese).

[9] WANG XT, XI XB, CHEN M, *et al.* Development status of technology and equipment of soybean and maize belt compound planting[J]. Jiangsu Agricultural Sciences, 2023, 51(11): 36–45. (in Chinese).

[10] HAN LL. Soybean and corn strip compound planting technology model in Suzhou area[J]. Anhui Agricultural Science Bulletin, 2023, 29(21): 34–37. (in Chinese).

[11] WANG Y, LIU Q, GUO SQ, *et al.* Integrated technology of water, fertilizer and medicine for soybean and corn strip compound planting in Hexi Irrigation District[J]. China Seed Industry, 2025(1): 153–155. (in Chinese).

[12] LIU ZX, LI XL, CHEN GR, *et al.* Strip compound planting technology of corn and soybean in Hexi irrigation area and its application effect[J]. Gansu Agricultural Science and Technology, 2018, 49(1): 90–92. (in Chinese).

Editor: Yingzhi GUANG Proofreader: Xinxiu ZHU

(Continued from page 26)

demonstrates excellent adaptability and high yield potential in most arid and marginal lands with poor soil fertility. The development of hybrid foxtail millet has further enhanced its high yield, superior quality, and stress-resistant characteristics. The research and application of high-efficiency seed production technology for water-saving and drought-resistant hybrid foxtail millet can provide ample seed reserves and support for such hybrids. This accelerates the promotion of foxtail millet cultivation in arid and semi-arid regions, effectively improves agricultural water-use efficiency, and increases its yield and farmers' and incomes, thereby contributing to ensuring food production security while advancing agricultural ecological civilization and green development principles[9].

References

[1] LU HN, KANG SZ, DU TS, *et al.* Research status and future development trend of green and efficient water-saving in agriculture[J]. Journal of Agriculture, 2018, 8(1): 155–162. (in Chinese).

[2] JOSHUA E, DELPHINE D, CHRISTOPH M, *et al.* Constraints and potentials of future irrigation water availability on agricultural production under climate change[J]. Proceedings of the National Academy of Sciences of the United States of America, 2014, 111(9): 3239–3244.

[3] LI XW. Present situation and management countermeasures of agricultural water resources utilization in China[J]. Rural Science & Technology, 2021, 12(12): 105–106, 109. (in Chinese).

[4] ZHOU WG, WANG K, WANG JQ. Research status and prospect of green water-saving agriculture[J]. Sichuan Water Resources, 2024, 45(5): 205–208. (in Chinese).

[5] ZHANG XL, SHI GL, ZHAO F, *et al.* Breeding of a new drought-resistant variety Zhangzagu 19[J]. Shaanxi Journal of Agricultural Sciences, 2020, 66(8): 3–5. (in Chinese).

[6] ZHAO YX. Discussion on basin-based management countermeasures of water environment and water resources protection in the new period[J]. Agricultural Science-Technology and Information, 2016(35): 148. (in Chinese).

[7] ZHAO ZH, XI YY, FENG XL. Water-saving planting experiment of millet hybrids in extremely arid areas[J]. Xiandai Nongcun Keji, 2018(9): 72–73. (in Chinese).

[8] ZHAO ZZ, FENG XL, SHI GL, *et al.* Drought-resistant hybrid millet under water-saving irrigation in extreme drought area of Dunhuang City[J]. Agricultural Science&Technology, 2014, 15(2): 231–235, 247.

[9] Food security analysis[EB/OL]. http://www.wfp.org/food-security, 2012.

Editor: Yingzhi GUANG Proofreader: Xinxiu ZHU