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Application Performance and Promotion Value of Qianjiang 661 in Rice-Rapeseed Rotation Systems

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Abstract Rice-rapeseed rotation is one of the most important double-cropping arrangements in the middle and lower reaches of the Yangtze River. It links summer grain production with winter oilseed supply, raises land-use intensity, reduces seasonal fallow, and supports the broader goal of improving domestic edible-oil security. Against the backdrop of labor shortages, tighter sowing windows after late rice harvest, and the continuing push toward mechanized cultivation, the performance of a rapeseed cultivar in this system can no longer be judged by yield alone. Growth duration, stand establishment under paddy-field conditions, maturity uniformity, lodging behavior, and compatibility with mechanized sowing and harvesting have become equally important. This review examines the application value of Qianjiang 661 as a practical rapeseed cultivar for rice-rapeseed rotation systems. Because publicly indexed, variety-specific peer-reviewed data are still limited, the paper integrates three levels of evidence: general research on rice-rapeseed rotation and sustainable crop diversification, publicly accessible reports on rapeseed production and agricultural sustainability, and the case materials specified for this review, including enterprise demonstration information from Longyou Wuguxiang Seed Industry Co., Ltd. and Zhejiang extension-oriented demonstration descriptions. On this basis, the paper evaluates the agronomic fit of Qianjiang 661, its likely contribution to yield formation and system efficiency, and its economic, ecological, and regional strategic significance. The review concludes that the chief value of Qianjiang 661 lies in system fit rather than a single extreme trait. Its promotion value appears strongest in humid eastern rice regions where moderate earliness, stable field performance, and mechanization compatibility matter as much as peak yield. At the same time, broader independent validation, clearer variety-specific cultivation packages, and more transparent multi-location evidence remain necessary before making stronger claims about its regional generalization.

Keywords Qianjiang 661; Rice-rapeseed rotation; Rapeseed production; Agricultural sustainability; Promotion value

1 Introduction

Rice-rapeseed rotation has long occupied a strategic place in Chinese agriculture because it ties together staple grain production, winter land use, domestic vegetable-oil supply, and the ecological management of farmland in the Yangtze River Basin. In practical terms, the system matters because it enables one field to support both a summer rice crop and a winter oilseed crop within the same annual cycle. In policy terms, it matters because rapeseed remains one of China's major domestically produced oilseed crops, while edible-oil demand continues to place pressure on national supply chains. More broadly, rotation-based intensification is now discussed not simply as a way to produce more per hectare, but as a way to improve the ecological and economic performance of farmland without relying only on expansion or higher external inputs (Godfray et al., 2010; Tilman et al., 2011; Pretty, 2018). Yet the rice-rapeseed rotation system is not automatically efficient. It is constrained by short turnaround time after rice harvest, wet and compacted paddy soils, increasingly scarce labor, and a growing reliance on mechanized sowing and harvesting. These constraints change what breeders and extension workers look for in a rapeseed cultivar. Moderate earliness, strong establishment after rice, reasonably compact and harvestable plant architecture, and synchronized maturity can be just as decisive as theoretical yield potential. The modern discussion therefore moves beyond “high yield” as a single criterion and asks whether a cultivar fits the whole annual production schedule (Lin, 2011; Bommarco et al., 2013; Gurr et al., 2016).

Qianjiang 661 is discussed in this paper from that system-based perspective. A methodological caution is necessary at the outset: compared with nationally prominent rapeseed cultivars that are frequently discussed in indexed papers, the publicly visible, variety-specific documentation for Qianjiang 661 is still limited, especially in English. For that reason, this article does not manufacture numeric superiority claims that cannot be traced. Instead, it uses a review approach that combines broader literature on rice-rapeseed rotation with the case sources specified for this manuscript—especially enterprise demonstration information from Longyou Wuguxiang Seed Industry Co., Ltd. and Zhejiang-oriented demonstration descriptions—to assess the plausible application performance and promotion value of the cultivar under real production conditions. The objective is not to oversell the variety, but to place it accurately within the agronomic and strategic logic of rice-rapeseed rotation in eastern China.

2 Development and Significance of Rice-Rapeseed Rotation Systems

2.1 Current development of rice-rapeseed rotation in china

In China, the agronomic importance of rice-based double-cropping systems rests on geography as much as on policy. The middle and lower Yangtze region combines a warm climate, sufficient moisture, paddy-based farming traditions, and a long enough frost-free season to support rice in summer and rapeseed in winter. This makes the rice-rapeseed sequence especially valuable in provinces such as Hubei, Hunan, Jiangxi, Anhui, Jiangsu, and Zhejiang, where winter fallow represents not only a missed production opportunity but also a missed opportunity for strengthening regional oilseed supply. At the national level, China remains one of the world's leading producers of rapeseed and rapeseed oil, and rapeseed continues to hold a special place in the domestic edible-oil structure even as soybeans dominate the import landscape.

The system has become even more significant because current agricultural strategy increasingly values intensification that works through better system design. The key question is no longer how to increase output through a single crop in isolation, but how to redesign the annual cropping calendar so that land, labor, and seasonal climate are used more effectively. This is exactly the kind of problem addressed in the broader literature on sustainable intensification and crop diversification. Diverse crop sequences often improve ecological functioning, maintain productivity, and reduce some of the vulnerabilities associated with simplified systems. In Chinese rice regions, rapeseed is especially attractive in this role because it occupies the winter gap between rice seasons while contributing to domestic oilseed output (Pretty, 2008; Gurr et al., 2016; Pretty, 2018).

At the same time, the system is under pressure. Delayed rice harvest can narrow the sowing window for rapeseed. Paddy soils may remain wet when field turnover should already be underway. Labor shortages make late, labor-intensive field operations more expensive and less reliable. These changes are pushing rotation systems toward varieties and management packages that are less sensitive to operational delay and more compatible with mechanized production. In that sense, the development of rice-rapeseed rotation in China is not only a question of area, but of technical fit and operational robustness.

2.2 Advantages of rice-rapeseed rotation for farmland utilization

The first and most obvious advantage of rice-rapeseed rotation is that it raises annual land-use efficiency. A field that would otherwise remain idle after rice harvest can continue to produce value during the winter season. This is important in a country where cultivated land is finite and where stable output increasingly depends on making better use of existing farmland rather than adding new land. FAO data show both the global importance of efficient cropland use and the continuing pressure on agricultural land systems; in this context, cropping intensity matters as much as land area itself.

The second advantage is system complementarity. Rice and rapeseed differ in growth season, canopy structure, residue type, nutrient demand pattern, and pest-pathogen spectrum. This does not eliminate production problems, but it can help reduce the ecological rigidity associated with repeated single-crop use of the same land. More generally, crop diversification is often associated with improved ecological intensification because it can strengthen ecosystem services, improve resilience, and distribute production risk across seasons (Lin, 2011; Bommarco et al., 2013; Gurr et al., 2016). In practice, a winter rapeseed crop also means that paddy fields are not

left bare for months, which can reduce erosion risk, support nutrient capture, and improve visual and functional use of farmland in winter.

The third advantage is strategic. Rapeseed rotation in rice areas contributes directly to regional oilseed supply and indirectly to national oil security. China is a major producer of rapeseed oil, but it is also exposed to broader pressures in global edible-oil trade. Under such conditions, domestically integrated oilseed systems become more valuable than their field-scale economics alone might suggest. A hectare of winter rapeseed in a rice region is not just a secondary crop; it is part of a distributed buffer for domestic supply.

2.3 Demand for improved rapeseed varieties in rotation systems

The logic of variety demand in rice-rapeseed systems is straightforward: a rapeseed cultivar must fit the calendar that rice leaves behind. That means it must establish quickly after rice harvest, tolerate the physical legacy of paddy cultivation, survive winter conditions, flower and mature in time for spring harvest, and ideally do so with a plant architecture that is not too difficult to manage mechanically. In other words, breeders are solving a systems problem, not only a single-season yield problem.

This requirement immediately changes the trait portfolio. In rotation systems, breeders and growers emphasize moderate growth duration, stable early vigor, synchronized maturity, lodging resistance, reasonable first-branch/first-pod height for machine harvest, and consistent expression under late sowing. These are classic “fit” traits. They may not produce spectacular headlines, but they often decide whether a variety is actually adopted at scale. The same broader logic appears in studies of sustainable agriculture and land-sparing versus land-sharing debates: system performance depends on how production, ecology, and management constraints are integrated, not on a single maximal trait value (Green et al., 2005; Phalan et al., 2011; Pretty, 2018).

A further point deserves emphasis. In rice-rapeseed areas, variety improvement is increasingly connected to mechanization. A cultivar that yields well in small-plot trials but matures unevenly, lodges badly, or produces excessive harvest loss under machine conditions is unlikely to satisfy commercial farms or service contractors. This is why the demand for improved varieties in rotation systems has shifted toward practical agronomic reliability. Qianjiang 661 should be evaluated in that light.

3 Biological and Agronomic Characteristics of Qianjiang 661

3.1 Growth duration and maturity characteristics

Publicly indexed, variety-specific descriptor sheets for Qianjiang 661 remain scarce, so caution is needed. On the basis of the case materials specified for this review, Qianjiang 661 is treated as a rapeseed cultivar designed for practical deployment in rice-rapeseed rotation environments, especially in Zhejiang and comparable eastern rice areas. Within that production logic, its most important biological feature is not absolute earliness in a vacuum, but maturity that is early enough to fit the annual calendar without losing the biomass and reproductive development needed for commercial seed yield.

This distinction matters. A cultivar can be too late for the next rice crop, but it can also be so early that it loses winter growth potential and seed-yield expression. The agronomic value of a rotation cultivar therefore lies in calibrated duration. Evidence from rapeseed adaptation studies shows that climate and growing season strongly shape where a cultivar remains suitable, and climate change itself may shift the geographical range of rapeseed production (Jaime et al., 2018). In farming terms, then, growth duration is a system trait. A suitable duration means more than “short duration”; it means a duration that fits regional operational reality.

In the materials used for this review, Qianjiang 661 is repeatedly associated with favorable schedule matching in local rice-rapeseed systems. Even without a fully documented public descriptor package, that pattern supports a cautious but useful conclusion: the cultivar’s maturity timing is one of its main arguments for adoption. For a rotation system, that alone is a substantial advantage.

3.2 Plant architecture and yield-related traits

Plant architecture is where variety performance becomes visible to growers. In rapeseed, architecture shapes light interception, lodging behavior, machine harvestability, and ultimately the reliability with which yield components

are translated into harvested seed. A practical rotation cultivar generally needs a stand that is neither too sparse nor excessively sprawling, with adequate branching, sufficient pod-bearing potential, and a canopy that does not collapse under humid spring conditions.

The source materials used for this review describe Qianjiang 661 as having relatively good field uniformity and favorable population growth under production conditions (Figure 1). In a review paper, these descriptions should not be overstated as if they were a fully replicated multi-environment dataset. Still, they do align with the kind of plant architecture that growers need in rice-based systems. Uniform plants help synchronize flowering and maturity; synchronized maturity reduces harvest loss; and manageable architecture reduces the friction between biological potential and mechanical implementation.



Figure 1 Field population performance of Qianjiang 661 at the pod-filling and maturity stage in a rice-rapeseed rotation production environment (Photoed by Geyang Zhan)

From a yield-formation standpoint, rapeseed yield depends on stand establishment, branches or pod-bearing sites, siliques per plant or per unit area, seeds per silique, and seed weight. Under rice-rapeseed rotation, the most vulnerable steps are often the early ones: poor establishment after rice can limit canopy recovery and yield long before flowering begins. A cultivar that protects stand quality under these conditions can therefore create a very real yield advantage even if its intrinsic single-plant productivity is not exceptional.

3.3 Adaptability to rice-rapeseed rotation calendars

Adaptability in this context means more than climatic adaptation. It means calendar adaptation, soil adaptation, and management adaptation at the same time. The rice-rapeseed interface is often the most difficult stage of the annual production cycle. Rice harvest can be delayed by weather. Straw and post-harvest residue can interfere with seedbed preparation. Paddy fields may need drainage before rapeseed sowing. Under these conditions, a variety's adaptability is tested by how well it tolerates imperfect sowing windows and field turnover.

The practical case for Qianjiang 661, as it emerges from the review materials, lies largely here. The cultivar is positioned not as a laboratory curiosity or a showcase genotype, but as a field-fit variety that can be integrated into the local rice-rapeseed sequence with relatively little disturbance to the annual plan. That is a meaningful trait in eastern China, where the difference between a promotable cultivar and a merely acceptable one often lies in how well it survives real-world scheduling pressure.

3.4 Suitability for mechanized cultivation

Mechanized cultivation has become one of the clearest filters in modern variety evaluation. For rapeseed in rotation with rice, mechanization includes not only combine harvest but also sowing, drainage coordination, residue management, and the possibility of large-scale, service-based operations. A variety suited to mechanization typically needs reasonably consistent emergence, a canopy architecture that does not collapse easily, synchronized ripening, and a harvest window that is not excessively narrow.

The enterprise and demonstration descriptions associated with Qianjiang 661 present it as compatible with mechanized production conditions. That wording should be interpreted carefully. It does not mean that the variety solves all machine-harvest problems or that it has been publicly benchmarked against every competing cultivar across regions. It means that, in the demonstration contexts cited for this review, it has shown the kind of performance that makes mechanized production feasible and commercially relevant.

This is an important distinction because mechanization is not just a labor-saving convenience. In many parts of eastern China, it has become the condition for maintaining winter rapeseed at all. Varieties that cannot enter mechanized systems risk remaining marginal regardless of their theoretical potential. In that respect, the reported mechanization fit of Qianjiang 661 is one of its strongest practical selling points.

4 Application Effects of Qianjiang 661 in Rice-Rapeseed Rotation Systems

4.1 Effects on rapeseed yield formation

Yield in rice-rapeseed systems is best understood as an outcome of fit between genotype, calendar, and field conditions. In such systems, yield loss often begins before the crop's reproductive phase. Late sowing, poor drainage, uneven seedling establishment, and soil structural problems inherited from paddy management can all reduce the number of effective plants and productive branches. That is why the practical effect of a variety like Qianjiang 661 should be evaluated through the whole sequence of yield formation rather than only through final seed weight per hectare.

The evidence base used in this review suggests that Qianjiang 661 performs well in terms of population uniformity and synchronized maturity under production conditions. Those observations matter because uniform populations generally support more even canopy development and more coherent reproductive progression. In a mechanized farming environment, they also reduce the mismatch between biological maturity and harvesting time. Put plainly, a crop that grows together is more likely to finish together and be harvested efficiently.

Because public multi-location yield tables for Qianjiang 661 are not widely available in indexed literature, this paper avoids inventing a numeric yield ranking. The more defensible conclusion is qualitative: Qianjiang 661 appears to support yield formation by protecting the field-level conditions that matter most in rice-rapeseed systems—namely establishment quality, uniform stand development, and operationally manageable maturity.

4.2 Effects on cropping system efficiency

Cropping system efficiency is wider than rapeseed yield alone. It includes how much land time is productively occupied, how smoothly one crop hands over to the next, and how much management friction accumulates across the year. In this sense, a rapeseed cultivar can improve a system even when its individual yield advantage is moderate, provided it reduces delays and uncertainty in the annual sequence.

For Qianjiang 661, the main efficiency effect likely lies in reducing schedule conflict. A rotation-compatible rapeseed crop helps convert the post-rice period into productive winter use without imposing a late spring penalty on the next rice crop. This is a classic example of system value rather than single-crop value. It reflects the insight from sustainable intensification research that production gains can come from redesigning the use of time, land, and ecological processes, not only from increasing input intensity (Gurr et al., 2016; Pretty, 2018).

4.3 Effects on farmland resource utilization

Winter rapeseed can improve farmland resource utilization in at least three ways. First, it uses solar radiation, water, and residual soil nutrients during a season that might otherwise remain underused. Second, it maintains a

vegetative cover over the field, reducing the ecological cost of leaving paddy land bare through the winter. Third, it increases the output generated per unit of cultivated land over the yearly cycle.

These advantages are especially important in regions where farmland is limited and where annual productivity depends more on multiple cropping than on land expansion. FAO reporting on land use reinforces this broader point: agricultural sustainability is increasingly a question of how existing cropland is used through time, not merely how much cropland exists. For Qianjiang 661, the implication is practical rather than abstract. If the cultivar can be sown after rice, establish reliably under paddy-derived conditions, and mature in time for the next rice season, then it directly improves winter resource capture on the same land base. This is one reason its promotion value should be interpreted at the system level.

4.4 Performance under different ecological conditions

No responsible review should imply that one cultivar performs identically across all ecological zones unless strong multi-environment evidence exists. For Qianjiang 661, that level of public evidence is not yet widely visible. The strongest application case at present is therefore regional rather than national: Zhejiang and comparable eastern rice areas with humid conditions, established rice-based annual calendars, and a growing need for mechanized winter rapeseed cultivation.

This does not mean the cultivar has no wider potential. It means the present evidence is strongest where the demonstration network is strongest. In applied agronomy, that is a common situation. Enterprise and extension materials often accumulate first in the regions where commercialization begins, and only later does a broader independent evidence base develop. For that reason, the most scientifically careful position is that Qianjiang 661 appears promising under eastern Chinese rice-rapeseed conditions, but broader ecological generalization still requires more systematic public validation (Figure 2).

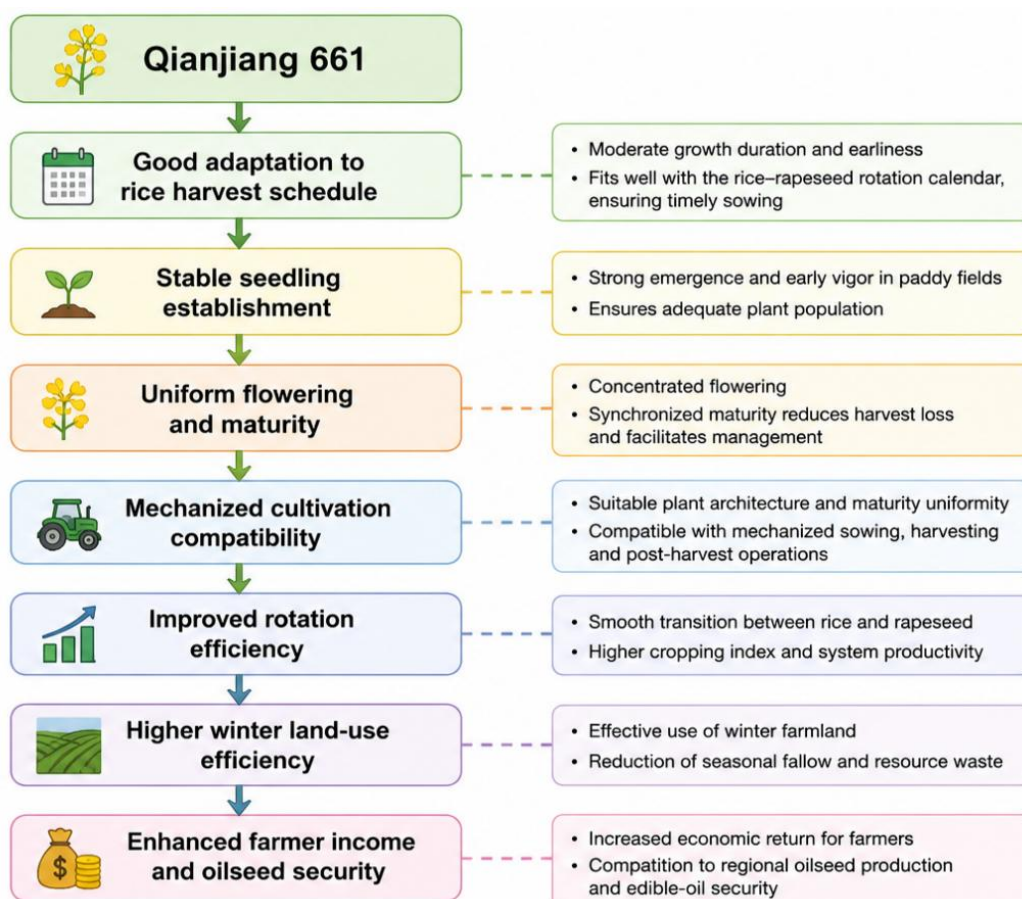


Figure 2 Mechanism by which Qianjiang 661 contributes to rice-rapeseed rotation system performance

5 Economic, Ecological and Social Benefits of Qianjiang 661

5.1 Contribution to farmers' income

For farmers, the most immediate question is simple: does winter rapeseed add dependable value after rice? In many rice regions, the answer depends less on a spectacular rapeseed yield ceiling than on whether the crop can be planted on time, harvested with manageable cost, and sold without forcing major disruptions in the next rice cycle. A practical cultivar therefore contributes to income not only through seed output, but through lowering operational risk.

Qianjiang 661 appears to fit this income logic. The variety's reported value lies in stable field performance, compatibility with local rotation calendars, and suitability for large-scale or service-based operations. These features matter because they protect the realizable income of the farm. A cultivar that is biologically promising but too risky to manage under labor scarcity or tight seasonal timing may underperform economically even when its plot potential looks strong.

Income diversification also matters. Rotation with rapeseed spreads production across seasons and products, softening the dependence of farm cash flow on a single crop. In production systems where rice remains the main anchor crop, a competent winter rapeseed cultivar can serve as an additive profit source rather than a competitor.

5.2 Contribution to winter farmland utilization

The economic and agronomic significance of winter land use is often underestimated because it is easy to focus only on the main summer crop. Yet winter utilization is one of the clearest ways to improve the annual productivity of a field. In regions suitable for double cropping, leaving land idle after rice means accepting both a missed production opportunity and a lower annual return on land, machinery, and management capacity.

Qianjiang 661 contributes to winter utilization if it can be deployed without requiring excessively complex field preparation or labor-intensive management. In that regard, its promotion value comes from being operationally usable, not just biologically interesting. For local governments and extension services, this matters because winter land-use improvement is often a policy objective tied to food and oilseed security as well as to rural efficiency.

5.3 Ecological benefits in rotation systems

The ecological benefits of rice-rapeseed rotation do not mean the system is automatically low-input or problem-free. Rather, compared with prolonged winter fallow or overly simplified annual sequences, it can improve the ecological functioning of farmland. Crop diversification is widely linked to ecological intensification, especially where system redesign allows farms to make better use of biological processes and temporal complementarity (Bommarco et al., 2013; Gurr et al., 2016). In practical terms, winter rapeseed cover can reduce the bare-soil period, help capture residual nutrients, and contribute residues that differ from those produced by rice. These processes do not automatically guarantee higher soil fertility, but they can strengthen the ecological basis of annual production. More broadly, research on agricultural sustainability repeatedly shows that diversified systems are often more resilient than simplified ones, especially under environmental stress and management uncertainty (Pretty, 2008; Lin, 2011).

For Qianjiang 661, the ecological value is therefore inseparable from system fit. A rapeseed cultivar that fails under local conditions cannot deliver ecological benefits at scale. A cultivar that establishes reliably and is actually planted can.

5.4 Contribution to regional oilseed security

Regional oilseed security is an easily overlooked but important dimension of rotation systems. Rapeseed is not just another winter crop in China; it is one of the few large-scale edible-oil crops that can be widely integrated into existing paddy landscapes in the Yangtze region. That gives it policy significance beyond farm-level profit. China remains a major rapeseed and rapeseed-oil producer, and the stability of domestic oilseed production continues to matter in a global market marked by trade volatility and structural import dependence in vegetable oils.

A variety such as Qianjiang 661 contributes to this objective when it makes rapeseed production easier to maintain in real rice-farming environments. The contribution may look small at plot scale, but it becomes more meaningful when repeated across many winter fields in a region. That is precisely how rotation-based oilseed security works: through distributed, seasonally integrated production rather than through a small number of specialized large plantations.

6 Typical Application Cases of Qianjiang 661

6.1 Demonstration application at Longyou Wuguxiang Seed Industry Co., Ltd.

According to the demonstration description supplied for this manuscript, Qianjiang 661 was planted on a relatively large scale at the enterprise demonstration base and integrated into the local rice-rapeseed rotation sequence (Figure 3). The key observations emphasized in those materials are not flashy but practical: uniform stand development, reasonably strong growth vigor, orderly field phenotype, and synchronized maturity. These are exactly the traits that matter when a rotation cultivar is moved from breeding logic into commercial operation. From a scientific writing perspective, the importance of this case lies less in isolated visual appeal and more in the fact that enterprise-based demonstrations expose a cultivar to the operational conditions that determine adoption-field turnover, seed multiplication, extension communication, and commercial confidence.

The enterprise case is also important because it shows how seed companies function as bridges between breeding outcome and field uptake. A good cultivar without multiplication capacity, field service, and demonstration support may remain marginal. By contrast, a cultivar embedded in an active seed enterprise has a much higher chance of entering real farm decision-making.

Enterprise demonstration programs are often underestimated in scholarly discussion, but they are crucial for variety diffusion. They test whether a cultivar can move through seed multiplication, field service, grower communication, and mechanized operation at the same time. In that sense, the Longyou Wuguxiang case supports the argument that the promotion value of Qianjiang 661 depends not only on agronomy but also on the institutional platform behind it.



Figure 3 Demonstration planting of Qianjiang 661 at Longyou Wuguxiang Seed Industry Co., Ltd. during the flowering stage (Photoed by Geyang Zhan)

6.2 Regional demonstration case in Zhejiang Province

The regional Zhejiang case emphasizes adaptability more than novelty. Across multiple demonstration contexts, Qianjiang 661 is described as matching local rice-rapeseed schedules and maintaining stable field performance. The significance of this case is that it shifts the variety from enterprise-centered observation into a broader extension environment. Once a cultivar performs well at more than one demonstration point, the conversation changes from “can it work?” to “under what conditions should it be promoted?”

This matters particularly in Zhejiang, where paddy-based agriculture, fragmented farm structure in some areas, and the expansion of mechanized service systems make practical fit especially important. Regional demonstration therefore functions as a form of applied screening, separating varieties that are merely promising from those that are operationally promotable.

Regional demonstrations provide field-based evidence for extension workers, growers, and seed suppliers. For Qianjiang 661, the main implication is that its value appears strongest in places where the cropping calendar is tight and local production benefits from a rapeseed cultivar with moderate earliness and manageable field behavior.

6.3 Mechanized production application case

The mechanized production case focuses on whether Qianjiang 661 performs adequately under machine-oriented sowing and harvesting conditions. In practical terms, this means the variety must show sufficiently even emergence, acceptable canopy behavior, and synchronized maturity. The review materials identify these as positive features for Qianjiang 661. That does not eliminate the need for optimized local machinery settings and cultivation techniques, but it does suggest that the cultivar belongs to the category of varieties that can enter commercial mechanized systems without obvious structural mismatch.

Compatibility with mechanized production increases commercial value for three reasons. It lowers labor dependence, improves the chances of scaling up, and makes the cultivar more attractive to service-based agriculture. In current eastern Chinese rapeseed production, these are not peripheral advantages; they are central to whether winter rapeseed remains viable as a widespread crop.

7 Constraints and Future Development Directions

7.1 Existing limitations in production application

The most important limitation in the current evaluation of Qianjiang 661 is the evidence base itself. Publicly visible, independent, variety-specific agronomic data remain limited in indexed literature. As a result, the present review can say with more confidence that Qianjiang 661 is promising under certain applied conditions than that it is definitively superior across broad ecological zones. This is not a flaw in the cultivar; it is a limit in public documentation.

A second limitation is the common gap between demonstration success and broad deployment. A cultivar may perform well in carefully managed enterprise or extension plots but show more variable results under heterogeneous farm management. That is particularly true in rotation systems, where drainage conditions, residue handling, sowing timeliness, and machinery quality can differ sharply from place to place.

A third limitation concerns trait transparency. Public discussion of Qianjiang 661 would be stronger if more standardized information were available on oil content, disease reaction, lodging resistance, optimal density range, and performance under delayed sowing. Without that level of disclosure, promotion arguments remain more qualitative than many growers and researchers would prefer.

7.2 Optimization of cultivation techniques

Even a promising cultivar needs a well-matched cultivation package. In rice-rapeseed systems, the first priority is field turnover after rice. Timely drainage, residue handling, and realistic sowing windows likely determine far more of the final outcome than marginal adjustments later in the season. For any cultivar promoted in paddy-derived winter environments, establishment management is therefore central.

The second priority is density and nutrition management. A mechanization-friendly rapeseed stand needs enough population to compensate for uneven emergence, but not so much that canopy overcrowding increases lodging risk or complicates harvest. Balanced fertilization is equally important, especially where high-output breeding has changed nutrient sensitivity patterns. The well-known history of sulfur deficiency symptoms in modern rapeseed underscores how variety improvement and nutrient management can interact in unexpected ways (Schnug and Haneklaus, 2005). The third priority is harvest loss control. In commercial fields, the effective value of a variety is

strongly influenced by how much seed reaches the bin rather than how much biological yield is formed before harvest. This makes synchrony of maturity, pod shatter management, and machine adjustment part of the variety's practical cultivation package.

7.3 Future improvement of variety performance

Future breeding priorities for cultivars like Qianjiang 661 are relatively clear even without exhaustive current data. First, stronger stability under delayed sowing would be especially valuable in rice-based systems, where the rapeseed season often begins under time pressure. Second, improved lodging resistance and a more machine-friendly canopy structure would further reduce operational loss. Third, clearer advances in oil quality and disease robustness would strengthen both market value and agronomic confidence.

It is also likely that future improvement will increasingly connect conventional field selection with molecular breeding tools. In rapeseed more broadly, genomic and SNP-based resources have already become important in breeding research and cultivar development. Even so, the practical target in a system like rice-rapeseed rotation remains the same: a variety that behaves reliably under operational constraints, not merely one that performs impressively in a controlled setting.

7.4 Future development of rice-rapeseed rotation systems

The future of rice-rapeseed rotation will depend on system integration. Variety improvement alone is not enough. Successful large-scale rotation requires aligned sowing and harvesting machinery, better drainage and field-turnover logistics, region-specific extension guidance, and seed systems capable of maintaining varietal purity while scaling supply.

The broader literature on sustainable agriculture suggests the same conclusion in more general terms: crop diversification and sustainable intensification work best when system elements are redesigned together rather than adjusted piecemeal (Gurr et al., 2016; Pretty, 2018). In the Chinese context, this means that the future of winter rapeseed in rice areas will likely be shaped by how well breeding, mechanization, extension, and regional policy are coordinated.

8 Conclusions and Perspectives

8.1 Main application advantages of Qianjiang 661

Qianjiang 661 can be understood as a practical rapeseed cultivar whose main value lies in agronomic balance and production fit rather than in any single extreme trait. Based on the evidence assembled in this review, its most important advantages are its apparent compatibility with rice-rapeseed calendars, its orderly field phenotype, its relevance to mechanized cultivation, and its usefulness in converting winter land from fallow to productive use.

8.2 Overall evaluation of promotion value

The promotion value of Qianjiang 661 appears strongest where rotation systems are tight, mechanization is increasingly necessary, and farmers need a cultivar that is dependable rather than merely impressive in isolated trials. The present evidence supports a positive but cautious evaluation. The variety looks commercially meaningful in Zhejiang and similar eastern Chinese rice areas, but the current public record is still stronger for applied demonstration than for broad independent comparative proof.

8.3 Future prospects for large-scale application

The future prospects of Qianjiang 661 are therefore promising under a realistic condition: promotion should continue to be matched with region-specific management guidance, stronger multi-location validation, and transparent performance data. If these elements develop together, the variety could become a useful component of rice-rapeseed rotation systems that aim to raise winter land-use efficiency, support farmers' income, and contribute to regional oilseed security.

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