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一、 毕业证和学位证复印件

1. 博士毕业证复印件


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三、发表论文首页复印件

文章列表：

1. **Lilian Wu, Hugo J. de Boer, Zixiao Zhang, Xueliang Chen, Yanying Shi, Shaobing Peng, Fei Wang*. The coordinated increase in stomatal density and vein dimensions during genetic improvement in rice. Agronomy Journal (2020) 112: 2791-2804.**

2. **Desheng Yang, Shaobing Peng, Fei Wang*. Response of photosynthesis to high growth temperature was not related to leaf anatomy plasticity in rice (Oryza sativa L.). Frontiers in Plant Science (2020) 11: 26.**

3. **Le Xu, Xiaoxiao Li, Xinyu Wang, Dongliang Xiong, Fei Wang*. Comparing the grain yields of direct-seeded and transplanted rice: A Meta-Analysis. Agronomy (2019) 9: 767.**

4. **Liying Huang, Desheng Yang, Xiaoxiao Li, Shoabing Peng, Fei Wang*. Coordination of high grain yield and high nitrogen use efficiency throughlarge sink size and high post-heading source capacity in rice. Field Crops Research (2019) 233: 49-58.**

5. **Liying Huang, Fan Sun, Shen Yuan, Shaobing Peng, Fei Wang*. Responses of candidate green super rice and super hybrid rice varieties to simplified and reduced input practice. Field Crops Research (2018) 218: 78-87.**

6. **Liying Huang, Fan Sun, Shen Yuan, Shaobing Peng, Fei Wang*. Different mechanisms underlying the yield advantage of ordinary hybrid and super hybrid rice over inbred rice under low and moderate N input conditions. Field Crops Research (2018) 216: 150-157.**

7. 王飞，彭少兵*.水稻绿色高产栽培技术研究进展. 生命科学 **(2018) 30: 1129-1136.**

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ARTICLE

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The coordinated increase in stomatal density and vein dimensions during genetic improvement in rice

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Abstract

Rice (*Oryza sativa* L. ssp. *indica*) has experienced three distinct phases of considerable yield increases: Green Revolution, utilization of heterosis, and the combination of ideotype and inter-subspecific hybrid breeding. Crop breeding and selection for high yield have increased radiation use efficiency in modern *indica* rice varieties. However, the underlying leaf morphological and physiological changes have not been established. Field and pot experiments were conducted in 2016 and 2017. We investigated the relationships between the anatomical maximum stomatal conductance (g_{max}), operational stomatal conductance (g_{op}), and the anatomy of the stomata and vein in relation to leaf-level transpiration and photosynthesis across historical *indica* rice varieties. The results showed that flag leaf temperature of new varieties was reduced relative to the temperature of older varieties due to increased g_{op} and leaf transpirational cooling. Both high stomatal density and larger veins were increased in new varieties with improved yield potential, while no change was observed in stomatal length and vein density. There was a significant correlation between stomatal density and g_{op} as well as between g_{op} and the light-saturated photosynthetic rate. The present study reveals that historical selection for high yield is accompanied by leaf morphological changes that contribute to enhanced g_{op}, leaf cooling, and photosynthesis of irrigated rice inhabiting hot, high light environments.

1 | INTRODUCTION

Rice (*Oryza sativa L.*) plays a significant role in global food security (Khush, 2001; Ramankutty et al., 2018). Climate warming is expected to negatively affect future rice yield (Challinor et al., 2014; Zhao et al., 2016). Climate warming may be problematic, as climate projections indicate that 27% of the global rice production area will be exposed to at least 5 d of temperatures above the critical temperature threshold during the reproductive period ranging between 34 and 39 °C by 2050 (Gourdji, Sibley, & Lobell, 2013). High temperatures for 1–4 days at the gametogenesis stage could cause a dramatic reduction in spikelet fertility (Endo et al., 2009). A near 2 °C increase in daily temperature decreased the grain yield of *indica* rice by 16.3–21.3% (Shah et al.,

Abbreviations: *A*, light-saturated photosynthetic rate; g_{max}, the anatomical maximum stomatal conductance; g_{op}, the operational stomatal conductance; IWUE, intrinsic water use efficiency; K_{leaf}, leaf hydraulic conductance; RUE, radiation use efficiency; SLA, specific leaf area; SLN, specific leaf nitrogen content

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Response of Photosynthesis to High Growth Temperature Was Not Related to Leaf Anatomy Plasticity in Rice (*Oryza sativa* L.)

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Photosynthesis is highly sensitive to high temperature stress, and with the rising global temperature, it is meaningful to investigate the response of photosynthesis to growth temperature and its relationship with leaf anatomy plasticity. We planted 21 cultivars including eight *indica* cultivars, eight *japonica* cultivars, and five *javanica* cultivars in pot experiments under high growth temperature (HT, 38/28°C, day/night) and control treatment (CK, 30/28°C, day/night). Photosynthetic rate (A), stomatal conductance (g_s), transpiration rate (E), stomatal density (SD), vein density (VD), minor vein area (SVA), and major vein area (LVA) were measured after 30 treatment days. Results showed HT significantly increased A, g_s, and E, while significantly decreased SD and LVA. There was no significant difference in A among the three subspecies both under CK and HT, while the *javanica* subspecies had higher g_s, E, SVA, and LVA under HT, and the *indica* cultivars had higher VD and SD both under CK and HT. The *javanica* subspecies had higher relative value (HT/CK) of A, g_s, and E, while difference was not observed in the relative value of SD, VD, and LVA among the three subspecies. The relative value of A was positively related to that of g_s, while the latter was not correlated with the relative value of SD, VD, SVA, and LVA. Overall, the results suggested the increase of A and g_s at HT was not attributed to leaf anatomy plasticity in respect of stomata and vein under HT.

Keywords: rice, photosynthesis, leaf anatomy, stomata, vein

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HIGHLIGHTS

1. High growth temperature (HT) significantly affected rice leaf photosynthetic rate (A), stomatal conductance (g_s), transpiration rate (E), stomatal density (SD), and major vein area (LVA).
2. The *javanica* subspecies had higher g_s, E, and LVA under HT, and possessed higher heat resistance than *indica* and *japonica* subspecies.
3. Across different cultivars, the response of A and g_s to HT were not related to leaf anatomy plasticity such as stomatal and vein anatomy.

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Article

Comparing the Grain Yields of Direct-Seeded and Transplanted Rice: A Meta-Analysis

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Abstract: Conventional transplanted rice (TPR) has been increasingly replaced by direct-seeded rice (DSR) because of its low water and labour requirements. Whether and how DSR can be as productive as TPR has received widespread attention. Here, a comprehensive meta-analysis was performed to quantify the effects of direct seeding on rice yield and identify the management and environmental factors that contribute to the yield gap between DSR and TPR. The results showed that, overall, the yield of DSR was 12% lower than that of TPR. However, the yield loss of DSR relative to TPR was highly variable depending on management practices, soil type, and climate conditions, ranging from −2% to −42%. Weed and water management and climatic stress had the largest impact on yield performance, resulting in over 15% yield variation. With respect to soil properties, the yield gap can be significantly reduced by planting in areas with high organic carbon content, such as clayed and acidic soils. Furthermore, the DSR yield penalty was only 4% in a high-yielding condition compared to 14% in a low-yielding condition. All these factors indicate that optimizing management practices is necessary to improve DSR yield performance and narrow the yield gap between DSR and TPR. In conclusion, DSR could produce comparable yields to TPR but is more prone to yield losses due to inappropriate management practices, unsuitable soil properties, and climatic stresses.

Keywords: rice yield; direct seeding; transplanting; meta-analysis

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1. Introduction

Rice is the staple food crop for more than half of the world's population, while accounting for only 11% of the planet's cultivated land [1]. Global grain production is expected to increase by 50%, to meet the growing food demands, from 2010 to 2030 [2]. This is not an easy task, as it not only requires crop genetic improvement and management optimization but is also influenced by socioeconomic and physical factors related to rice production [3]. Rapid economic development in Asia has increased the labour demand for non-agricultural sectors, leading to a considerable decline in labour availability and increased labour wages in agriculture [4]. Meanwhile, water scarcity for rice cultivation has been serious and widespread, with approximately 18 million hectares of irrigated rice in Asia being projected to suffer from water scarcity by 2025 [5]. Therefore, rice cultivation technology must be developed to simultaneously reduce labour and water input while maintaining yield potential [6].

At present, over 70% of global rice is grown in wetlands with puddling followed by transplanting [4,7]. In a conventional transplanted rice (TPR) system, large quantities of water are applied (ca. 2500 litres) to produce 1 kg of rough rice [8]. Crop establishment consists of the following

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Coordination of high grain yield and high nitrogen use efficiency through large sink size and high post-heading source capacity in rice

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ABSTRACT

Breeding green varieties that have high yield potential and require less resource input is the ideal way to cope with the challenges that human is facing with respect to food security and environmental pollution. However, few studies have focused on how high yield and high resource use efficiency is coordinated in rice (*Oryza sativa* L.). Here three varieties with different sink size, namely Yongyou4949 (YY4949) with large sink size, Yangliangyou6 (YLY6) with medium sink size, and Huanghuazhan (HHZ) with small sink size, were used in field and pot experiments in 2015–2017. The objective was to examine how enlarged sink size coordinate high yield and high nitrogen (N) use efficiency (NUE). It was found that YY4949 produced a grain yield of 9.60-11.79 t ha^{-1} in 2015–2017, which was higher than that of YLY6 by 0.3-1.75 t ha^{-1}, and that of HHZ by 1.3-2.18 t ha^{-1}. N use efficiency for grain production (NUEg) of YY4949 reached 47.7-58.3 kg kg^{-1} depending on the weather condition, which was 5.3–12.8% higher than that of YLY6 and 15.8–20.7% higher than that of HHZ. The concomitantly higher grain yield and NUEg of YY4949 were due to: (1) higher efficiency of spikelet production in respect of dry matter, N, accumulated temperature and radiation; (2) higher biomass production and N accumulation after flowering; (3) higher RUE after flowering due to the better canopy structure. In conclusion, rice breeding in the future should continue to enlarge the sink size especially through the improvement in production efficiency of sink size, while simultaneously increase the post-heading biomass production capacity.

1. Introduction

At its current rate of growth, the global population is set to reach ~10 billion people by 2050 (UN, 2017). Increasing crop production to maintain food security while reducing agriculture's environmental impacts is the dual challenges that human is facing in the future (Cassman, 2003; Cui et al., 2018). Moreover, this objective has to be realized under the condition of changing climate (Peng et al., 2004). Hence the traditional goal of pursuing super-high yield has been replaced by achieving high yield, high quality, high efficiency, environment-friendly, and food safety simultaneously at the beginning of 21st century (Cassman, 2003; Zhang, 2007).

Rice is one of the staple food crops in the world, providing the diets and livelihoods of over 3.5 billion people (Godfray et al., 2010). Until recently, increasing yield potential has been the major goal in China's rice breeding programs due to the huge population pressure (Ling, 2008). In the last half of century, rice yield potential has been improved substantially in China due to the introduction of semi-dwarfism and the utilization of heterosis (Yuan, 1994; Khush, 2001). Together with the application of improved agronomic practices, the average rice grain yield in China increased from 2.08 t ha^{-1} in 1961 to 6.75 t ha^{-1} in 2013 (Wang and Peng, 2017). Nevertheless, this led to severe environmental problems, such as widespread soil acidification (Guo et al., 2010), devastating water pollution (Diaz and Rosenberg, 2008), and excessive greenhouse gas emissions (Zhang et al., 2016). Since 2013, China government started to transform the way of agriculture production through a series of polices, for example in 2017, the Ministry of Agriculture in China implemented Green Varieties, a new varietal evaluation and certification system for the release of major crop varieties that require less fertilizer, pesticide or water (Wing et al., 2018). This will definitely promote the transformation of China's rice breeding from super-high yield potential to coordination of high yield potential and high resource use efficiency.

Agronomic traits that facilitate the simultaneous increase of grain

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Responses of candidate green super rice and super hybrid rice varieties to simplified and reduced input practice

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ABSTRACT

Producing higher grain yield with less environmental impact is a challenge for the future of agriculture. Breeding green super rice (GSR) varieties is one of the promising ways to meet this challenge. Green super rice is supposed to have better performance than super hybrid rice (SHR) under reduced input condition. In the present study, seven elite candidate GSR varieties and five representative SHR varieties were planted under the farmers' practice (FP) and the simplified and reduced input practice (SRIP) in 2015 and 2016. The objectives were to compare the grain yield and NUE of the candidate GSR and SHR under FP and SRIP, and investigate the agronomic and physiological traits of GSR. Averaged across all varieties, the reduction in grain yield at SRIP compared to FP was 1.04 t ha^{-1} in 2015 (10.37%) and 0.50 t ha^{-1} in 2016 (5.55%). The average grain yield of GSR varieties was similar to that of SHR in 2015, but SHR had significantly greater (7.42%) average grain yield than GSR in 2016. In comparison to FP, yield reduction at SRIP for the candidate GSR and SHR varieties was 9.27% and 11.48% respectively in 2015, and 4.74% and 5.85% respectively in 2016. Grain yield of FP was significantly correlated with that of SRIP ($R^2 = 0.73$). Averaged across varieties, total aboveground nitrogen uptake and nitrogen use efficiency for grain production between GSR and SHR were comparable. Among the GSR varieties, 9Y6H exhibited relative high yield stability and NUE_g across treatments and planting years; however, SHR varieties showed consistently better yield stability than most of the GSR varieties. Overall, candidate GSR varieties had similar response to SRIP with the SHR varieties. In addition to breeding GSR varieties, future studies should also focus on the green traits of the SHR varieties.

1. Introduction

In the last two decades, increasing studies have focused on sustainable intensification of agriculture due to two great challenges that the future of agriculture faces: 1) meet substantial increases in food demand and 2) decrease agriculture's global environmental impacts (Cassman, 1999; Cassman et al., 2003; Ju et al., 2009; Godfray et al., 2010; Foley et al., 2011; Tilman et al., 2011; Mueller et al., 2012; Seufert et al., 2012; Chen et al., 2014; Cui et al., 2014). Organic farming – a system aimed at producing food with minimal harm to ecosystems, animals or humans – is often proposed as a solution, however, there is a yield penalty of organic farming ranging from 20 to 25% compared to conventional farming (Seufert et al., 2012; de Ponti et al., 2012). Closing yield gaps and increasing resource use efficiency are necessary strategies towards meeting the above two challenges through optimization of nitrogen (N) and water management and adoption of advanced crop varieties (Godfray et al., 2010; Foley et al., 2011; Mueller et al., 2012).

Rice is the main staple food for over 50% populations of the world (Tao et al., 2014). As one of the largest rice producers and consumers in the world, China occupied 18.8% of global rice growing area and contributed 28.1% of production in 2014 (FAO, 2016). Since the 1980s, rice yield has increased significantly due to crop genetic improvement, improved crop management practices, and increased agronomic inputs, especially N fertilizer input (Yu et al., 2012; Song et al., 2015). Rice breeding for high yield potential indirectly selected higher lodging resistance and tolerance to N fertilizer, which resulted in farmers applying large amounts of N fertilizer in order to maximize grain yield (Peng et al., 2002; Ju et al., 2015). The overuse of N fertilizer leads to low N use efficiency (NUE, Peng et al., 2002) and a variety of environmental consequences such as soil acidification (Guo et al., 2010). Studies showed that the amount of N fertilizer input could be

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Different mechanisms underlying the yield advantage of ordinary hybrid and super hybrid rice over inbred rice under low and moderate N input conditions

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Inbred rice

ABSTRACT

The adoption of ordinary hybrid rice and super hybrid rice significantly increased the grain yield under non-limited nitrogen (N) fertilizer condition, however, the information on direct comparison of grain yield and nitrogen use efficiency (NUE) among the high-yielding super hybrid, ordinary hybrid, and inbred rice under low and moderate N rates is limited. Therefore, field experiments with two representative cultivars of each these types were conducted under N0 (0 kg N ha^{-1}) and N90 (90 kg N ha^{-1}) treatments in 2014 and 2015 in Wuxue County, Hubei Province, China. Grain yield of the super hybrid rice was higher than that of the inbred rice by 3.33-7.41% at N0 and 5.94-10.87% at N90. Similarly, the ordinary hybrid rice outyielded the inbred rice by 4.53-6.17% and 4.35-4.69% at N0 and N90, respectively. The yield advantage of the ordinary hybrid rice over the inbred rice was mainly due to higher aboveground total dry weight (TDW), while for the super hybrid rice, higher grain yield was mainly attributed to higher harvest index (HI) at N0, and both high HI and TDW at N90. Larger leaf area index (LAI) at heading stage and higher crop growth rate (CGR) contributed to higher TDW of the ordinary hybrid rice. Total N uptake at maturity was consistently higher in the ordinary hybrid rice, while the super hybrid rice had significantly higher nitrogen use efficiency for grain production (NUEg) than the inbred rice, which was associated with higher N harvest index (NHI) and lower leaf N concentration of the super hybrid rice. In conclusion, it was found that the super and ordinary hybrid rice exhibited higher yield over the inbred rice at low and moderate N rates, but the physiological mechanisms underlying the yield advantage were different.

1. Introduction

Rice (*Oryza sativa* L.) is one of the most important food crops globally, and it is the staple food for more than half of the world's population (Godfray et al., 2010). Increasing rice production through genetically improved rice cultivars and improved agronomic practices has been the main objective in the agronomic studies (Peng et al., 2008; Zeng et al., 2017). The development of semi-dwarf cultivars in the late 1950s (Peng et al., 2008) and hybrid rice cultivars in 1970s (Yuan et al., 1994) led to two quantum leaps in the yield potential of irrigated rice in China. Yuan (1994) reported that hybrid rice had a yield advantage of about 15% over the best inbred cultivars in China. Peng et al. (1999) found that the *indica* hybrid rice increased yield potential by 9% in the tropical irrigated lowlands. The yield advantage of the hybrid rice over the inbred rice was mainly attributed to greater dry matter accumulation, which resulted from a higher crop growth rate during the early vegetative stages as a result of rapid expansion of leaf area and greater tiller number (Kabaki, 1993; Yamauchi, 1994). Hybrid rice also had more efficient sink formation relative to the rate of dry matter production at the flowering stage (Kabaki, 1993; Yang et al., 2007). In addition, the higher non-structural carbohydrate content in the culm and leaf sheath prior to heading and translocation to the spikelets after heading, and the higher LAI during the grain filling period contributed to higher grain filling percentage in the hybrid rice than the inbred rice (Yan, 1981; Yan, 1988; Song et al., 1990a; Song et al., 1990b).

In order to further increase the yield potential, China established a nationwide mega-project on the development of super hybrid rice in 1996 (Yuan, 1996). The development of super hybrid rice by combining

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彭少兵，华中农业大学教授，国家“千人计划”特聘专家，教育部“长江学者奖励计划”讲座教授，国务院学位委员会第七届学科评议组成员，农业部现代农业产业技术体系岗位科学家。现任 *Field Crops Research* 等杂志编委。长期从事作物高产生理与栽培管理、作物营养生理与养分管理、水稻光合作用与水分生理、全球气候变化与逆境生理等领域的研究工作。近十年研究成果获得省级科技进步奖一等奖两项。发表论文 213 篇，其中 SCI 收录论文 182 篇。所发表的论文被 SCI 期刊共引用 7 390 次，单篇引用最高次数达 822 次，SCI 论文 h- 指数为 44。2002 年在《中国农业科学》发表的一篇论文被国内学术期刊多次引用，引用次数高达 1 290 次，在中国知网引文数据库农业科技领域被引频次排名为第 8 位。入选爱思唯尔 (Elsevier) 中国高被引学者榜单，在农业和生物科学领域 2014 年排名第 4、2015 年排名第 6、2016 年排名第 6，至 2017 年已连续 4 年入选。2017 年入选科睿唯安 (Clarivate Analytics) 全球“高被引科学家”名单。

水稻绿色高产栽培技术研究进展

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摘　要：当前中国水稻生产面临作物高产优质、资源高效、环境安全等多方面的挑战，生产方式逐步转变为规模化、机械化和轻简化，生产目标由单一的高产转型为“高产、优质、高效、生态、安全”。现简要总结中国水稻栽培技术的变革历程，由最初高产栽培经验的理论总结到现在的高产高效栽培技术体系；阐述绿色高产栽培的内涵，未来水稻栽培需因地制宜地开展模式创新；并介绍三种绿色高效栽培模式（再生稻、双季稻双直播和双水双绿模式）的研究进展。

关键词：水稻；绿色；高产栽培；再生稻；双季稻双直播；双水双绿

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Research progress in rice green and high-yield management practices

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Abstract: Rice production in China faces several challenges, including simultaneous improvement in grain yield and quality, efficient utilization of resources, and environmental protection. Large-scale, mechanized and simplified management practices are replacing the traditional one. In addition to high yield, the objectives of future rice production also include high quality, high efficiency, environment-friendly, and food safety. In this review paper, we briefly summarized the development course of rice cultivation from the previous high yield cultivation experiences

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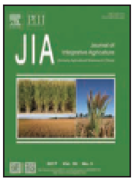

REVIEW

Yield potential and nitrogen use efficiency of China's super rice

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Abstract
In 1996, a mega project that aimed to develop rice varieties with super-high yield potential (super rice) was launched by the Ministry of Agriculture (MOA) in China using a combination of the ideotype approach and intersubspecific heterosis. Significant progress has been made in the last two decades, with a large number of super rice varieties being approved by the MOA and the national average grain yield being increased from 6.21 t ha^{-1} in 1996 to 6.89 t ha^{-1} in 2015. The increase in yield potential of super rice was mainly due to the larger sink size which resulted from larger panicles. Moreover, higher photosynthetic capacity and improved root physiological traits before heading contributed to the increase in sink size. However, the poor grain filling of the later-flowering inferior spikelets and the quickly decreased root activity of super rice during grain filling period restrict the achievement of high yield potential of super rice. Furthermore, it is widely accepted that the high yield potential of super rice requires a large amount of N fertilizer input, which has resulted in an increase in N consumption and a decrease in nitrogen use efficiency (NUE), although it remains unclear whether super rice *per se* is responsible for the latter. In the present paper, we review the history and success of China's Super Rice Breeding Program, summarize the advances in agronomic and physiological mechanisms underlying the high yield potential of super rice, and examine NUE differences between super rice and ordinary rice varieties. We also provide a brief introduction to the Green Super Rice Project, which aims to diversify breeding targets beyond yield improvement alone to address global concerns around resource use and environmental change. It is hoped that this review will facilitate further improvement of rice production into the future.

Keywords: super rice, yield potential, nitrogen use efficiency, Green Super Rice

1. Introduction

The global demand for crop production is expected to double by 2050 as a result of the increasing size of the human population, dietary shift that has resulted from greater levels of affluence and biofuel consumption (Tilman *et al*. 2011; Ray *et al*. 2015). Rather than clearing more land for food production, the augmentation of crop yields is the most promising approach for maintaining food security with the minimum environmental impacts (Foley *et al*. 2011; Tilman *et al*. 2011). Rice is a staple food crop for approximately

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9. 唯一通讯作者，SCI 收录，影响因子：2.645

symmetry

MDPI

Article

Rice Leaf Lateral Asymmetry in the Relationship between SPAD and Area-Based Nitrogen Concentration

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Abstract: Rice leaves display lateral asymmetry around the midrib, and the narrow side exhibits higher leaf area-based nitrogen concentration (Na) and soil plant analysis development (SPAD) values than the wider side. However, the difference in the relationship between the SPAD of each side and Na of the corresponding lateral half, and the optimal position along the leaf blade for SPAD measurements are not known. In this study, the relationship between SPAD and Na of both sides of the top three leaves was determined with 17 rice varieties grown over three growing seasons in two locations. The relationship between SPAD and Na displayed leaf lateral asymmetry, in which the wide side reflected a higher coefficient of determination than the narrow side. The ability to estimate Na of the whole leaf was slightly improved by averaging SPAD values across the leaf sides and measured points for the top two leaves. Apparently, it was more accurate and easier to measure SPAD readings on the wide side than the narrow side of rice leaf blade with respect to estimating plant N status. Due to the relatively poor relationship of the upper leaf, and the structural limit for SPAD measurements of the base, this study suggests that the most suitable and representative position for SPAD meter measurement on the leaf blade of rice is the lower-middle part from the leaf apex on the wide side.

Keywords: chlorophyll meter; nitrogen; plant N status

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1. Introduction

Rice (*Oryza sativa* L.) is one of the most important cultivated crops and is a staple food in the diet of more than three billion people. Over the last 50 years there has been remarkable growth in rice production, providing the foundation for progress towards global food security [1]. Rising crop yields during recent decades can be largely attributed to crop genetic improvement, improved irrigation systems, and widespread application of fertilizers and pesticides, among which increased application of nitrogen (N) fertilizer has been, by far, the most crucial [2,3]. Nitrogen is the nutrient element that is most limiting to the growth and productivity of rice. Conventional farming makes extensive use of N fertilizer to ensure profitability in soils with uncertain fertility levels, and as insurance to achieve high rice yield [4]. Despite being a dominant factor in rice production and quality improvement, the excessive use of N fertilizer has reduced N use efficiency, burdened farmers economically, and harmed the environment [5]. Leaf N status is commonly monitored to determine the requirement for top

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Genetic Improvements in Rice Yield and Concomitant Increases in Radiation- and Nitrogen-Use Efficiency in Middle Reaches of Yangtze River

Guanglong Zhu, Shaobing Peng, Jianliang Huang, Kehui Cui, Lixiao Nie & Fei Wang

The yield potential of rice (*Oryza sativa* L.) has experienced two significant growth periods that coincide with the introduction of semi-dwarfism and the utilization of heterosis. In present study, we determined the annual increase in the grain yield of rice varieties grown from 1936 to 2005 in Middle Reaches of Yangtze River and examined the contributions of RUE (radiation-use efficiency, the conversion efficiency of pre-anthesis intercepted global radiation to biomass) and NUE (nitrogen-use efficiency, the ratio of grain yield to aboveground N accumulation) to these improvements. An examination of the 70-year period showed that the annual gains of 61.9 and 75.3 kg ha^{-1} in 2013 and 2014, respectively, corresponded to an annual increase of 1.18 and 1.16% in grain yields, respectively. The improvements in grain yield resulted from increases in the harvest index and biomass, and the sink size (spikelets per panicle) was significantly enlarged because of breeding for larger panicles. Improvements were observed in RUE and NUE through advancements in breeding. Moreover, both RUE and NUE were significantly correlated with the grain yield. Thus, our study suggests that genetic improvements in rice grain yield are associated with increased RUE and NUE.

Because of population growth, dietary shifts and biofuel consumption, the global food demand will double by 2050. The current rate of increased crop production will be insufficient to satisfy predicted demand[1,2], and such problems will be further intensified by dwindling arable land area, environmental damage, climate change, and crop yield stagnation[2–5]. Therefore, to meet the global food demand, the yield potential of crops must be dramatically improved[6].

Rice is the most important staple food crop in Asia and has significantly contributed to global food security in the past, and will continue to feed approximately half of the global population in the future[3,7]. The yield potential of irrigated rice has experienced two significant growth periods, with the first period driven by the introduction of semi-dwarfism and the second period driven by the utilization of heterosis[8,9]. Although multidisciplinary attempts have been made to increase the rice yield potential over the last decade, grain yield stagnation has been observed worldwide[4,10–13]. Therefore, understanding the physiological mechanisms underlying historical improvements in the rice yield potential would facilitate the identification of critical constraints for further improvements.

Over the last two decades, a number of studies have been performed to determine yield improvements that occurred through the process of breeding for wheat (*Triticum aestivum L.*)[14], maize (*Zea mays L.*)[15], rice (*Oryza sativa L.*)[16], and soybean (*Glycine max Merr.*)[17]. In rice, annual grain yield gains of 75 to 81 kg ha^{-1} have been obtained for irrigated rice at International Rice Research Institute (IRRI) since 1966, gains of 42 kg ha^{-1} have been obtained for irrigated rice in Texas since 1944, and gains of 15.7 kg ha^{-1} have been obtained for upland rice in Brazil since 1984[16,18,19]. In China, genetic improvements have accounted for 62–74% of the yield increase

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Physiological Mechanisms Underlying the High-Grain Yield and High-Nitrogen Use Efficiency of Elite Rice Varieties under a Low Rate of Nitrogen Application in China

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Selecting rice varieties with a high nitrogen (N) use efficiency (NUE) is the best approach to reduce N fertilizer application in rice production and is one of the objectives of the Green Super Rice (GSR) Project in China. However, the performance of elite candidate GSR varieties under low N supply remains unclear. In the present study, differences in the grain yield and NUE of 13 and 14 candidate varieties with two controls were determined at a N rate of 100 kg ha^{-1} in field experiments in 2014 and 2015, respectively. The grain yield for all of the rice varieties ranged from 8.67 to 11.09 t ha^{-1}, except for a japonica rice variety YG29, which had a grain yield of 6.42 t ha^{-1}. HY549 and YY4949 produced the highest grain yield, reflecting a higher biomass production and harvest index in 2014 and 2015, respectively. Total N uptake at maturity (TN_{PM}) ranged from 144 to 210 kg ha^{-1}, while the nitrogen use efficiency for grain production (NUEg) ranged from 35.2 to 62.0 kg kg^{-1}. Both TN_{PM} and NUEg showed a significant quadratic correlation with grain yield, indicating that it is possible to obtain high grain yield and NUEg with the reduction of TN_{PM}. The correlation between N-related parameters and yield-related traits suggests that promoting pre-heading growth could increase TN_{PM}, while high biomass accumulation during the grain filling period and large panicles are important for a higher NUEg. In addition, there were significant and negative correlations between the NUEg and N concentrations in leaf, stem, and grain tissues at maturity. Further improvements in NUEg require a reduction in the stem N concentration but not the leaf N concentration. The daily grain yield was the only parameter that significantly and positively correlated with both TN_{PM} and NUEg. This study determined variations in the grain yield and NUE of elite candidate GSR rice varieties and provided plant traits that could be used as selection criteria in breeding N-efficient rice varieties.

Keywords: daily grain yield, Green Super Rice, grain yield, nitrogen use efficiency

12. 唯一通讯作者，SCI 收录，影响因子：2.87

PLOS | ONE

RESEARCH ARTICLE

Changes in the Lodging-Related Traits along with Rice Genetic Improvement in China

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Abstract

Rice yield potential was greatly improved since the green revolution, but the occurrence of lodging often restricts the achievement of potential yield. Currently, it is still obscure about how the lodging-related traits change along with the genetic improvement in yield potential of rice, although much efforts have been devoted to study the trend of and physiological mechanisms underlying changes in grain yield. Therefore, fourteen rice mega-varieties that were released and disseminated from 1930s to 2005 in China were investigated through a two-year experiment in the field condition. The results showed that large genotypic differences in lodging-related morphological traits were observed among these varieties. Lodging index (LI) of semi-dwarf varieties was significantly lower compared with that of SLX (Shenglixian). There were significant differences in LI among the semi-dwarf varieties, but no relationship between LI and the release year was found. Bending moment (BM) of semi-dwarf varieties released in 1940s-1980s was significantly lower than that of SLX. However, varieties released after 1980s had similar bending moment with SLX, but significantly higher breaking resistance (BR). The increase in both BM and BR after 1980s was related with the increase in internode diameter (ND) and stem fresh weight. Overall, this study disclosed the changing pattern of lodging-related traits in the genetic improvement of rice, and suggested that further increase in ND, internode dry weight (NDW) and dry weight per unit length (DWUL) of lower internode in modern super rice variety could effectively enhance lodging resistance and bring down LI.

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Competing Interests: The authors have declared that no competing interests exist.

Introduction

Rice (*Oryza sativa* L.) is a major staple food for more than half of world's population [1]. Yield potential of rice was greatly improved since the green revolution due to the development of semi-dwarf varieties in the late 1950s, three-line hybrids in the late 1970s, and super-hybrid rice since 1996 [2–3]. The "three-line system" for hybrid rice production includes cytoplasmic male-sterile line, maintainer line and restorer line [2]. The success of super-hybrid rice was due to a combination of superior agronomic characteristics of IRRI's New Plant Type and inter-subspecific heterosis [4], which led to a 12% advantage in yield potential compared with

13. 第一作者兼通讯作者，SCI 收录，影响因子：2.87

PLOS | ONE

RESEARCH ARTICLE

Overexpression of *OsSAP16* Regulates Photosynthesis and the Expression of a Broad Range of Stress Response Genes in Rice (*Oryza sativa* L.)

Fei Wang[1]*, Robert A. Coe[2], Shanta Karki[2], Samart Wanchana[2], Vivek Thakur[2], Amelia Henry[3], Hsiang-Chun Lin[2], Jianliang Huang[1], Shaobing Peng[1], William Paul Quick[2]

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Competing Interests: The authors have declared that no competing interests exist.

Abstract

This study set out to identify and characterize transcription factors regulating photosynthesis in rice. Screening populations of rice T-DNA activation lines led to the identification of a T-DNA mutant with an increase in intrinsic water use efficiency (iWUE) under well-watered conditions. Flanking sequence analysis showed that the T-DNA construct was located upstream of LOC_Os07g38240 (*OsSAP16*) encoding for a stress-associated protein (SAP). A second mutant identified with activation in the same gene exhibited the same phenotype; expression of *OsSAP16* was shown to be enhanced in both lines. There were no differences in stomatal development or morphology in either of these mutants, although overexpression of *OsSAP16* reduced stomatal conductance. This phenotype limited CO_2 uptake and the rate of photosynthesis, which resulted in the accumulation of less biomass in the two mutants. Whole transcriptome analysis showed that overexpression of *OsSAP16* led to global changes in gene expression consistent with the function of zinc-finger transcription factors. These results show that the gene is involved in modulating the response of rice to drought stress through regulation of the expression of a set of stress-associated genes.

Introduction

Rice (*Oryza sativa*) is one of the most important food crops feeding nearly 50% of the world's population. It serves as a model species for genomics research in grasses [1] and was the first crop plant to have the genome completely sequenced (International Rice Genome Sequencing Project 2005). This genomic information offers great potential to help understand how biological processes are regulated at the genetic level. It can also be used for crop improvement that aims to satisfy the increased demand for rice in a world undergoing rapid climate change.

14. 唯一通讯作者，SCI 收录，影响因子：1.683

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Crop Ecology & Physiology

Genotypic Differences of Japonica Rice Responding to High Temperature in China

Liying Huang, Yang Sun, Shaobing Peng, and Fei Wang*

ABSTRACT

Lacking cultivars with both high yield potential and tolerance to high temperature is the main constraint for planting japonica (*Oryza sativa* japonica) in the Middle Reaches of the Yangtze River. In this study, grain yield and quality of 11 elite japonica cultivars together with two indica(*O. sativa* indica) mega cultivars (YLY6 and HHZ) were studied in 2012 and 2013. The year 2012 was a cool year with an average temperature of 24.6°C, while 2013 was a hot year with an average temperature of 26.2°C. So genotypic differences in response to high temperature among the japonica cultivars were determined through analyzing the differences in grain yield and quality between the 2 yr. Compared with 2012, reduction in grain yield of 2013 ranged from 8.86 to 65.24% for japonica cultivars, and by −2.11 and 16.19% for YLY6 and HHZ, respectively. The reduction in grain yield resulted from decreases in grain-filling percentage and growth duration. There were significant differences in response to high temperature among these japonica cultivars. Cultivar CY2, HH3, and ZD11 escaped high temperature stress during the anthesis and grain-filling period due to their long growth duration. WYG24, YG4227, and NG44 were tolerant, while JD263, HD13, and LG7 sensitive to high temperature at anthesis. This study demonstrates genotypic differences in response to high temperature among the elite japonica cultivars from different areas of China and provides cultivars with high temperature tolerance that could be used as donors in rice (*O. sativa* L.) breeding for a warmer world.

Core Ideas

- Genotypic differences in Japonica responding to high temperature were studied in natural environment.
- There were significant differences in high temperature tolerance among the elite japonica cultivars in China.
- Some cultivars escaped high temperature in the Lower Reaches of the Yangtze River.

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RICE is the major food crop for more than half of the world population, and more than 90% of rice is grown and consumed in Asia (Khush, 1997). Indica and japonica are the two subspecies of Asian cultivated rice, and great differences exist between them in geographical distribution, ecological adaptation, plant morphological, and physiological characteristics (Oka and Morishima, 1997). Japonica is widely planted in East Asia because of its stable grain yield and high food quality at low temperature (Oka, 1988). In China, japonica is grown mainly in the three provinces of northeastern China and Jiangsu Province in the Lower Reaches of the Yangtze River (Chen et al., 2006). In addition, Anhui and Hubei Provinces also possess climatic conditions suitable for planting japonica (Zhang et al., 2012). Hubei Province in the Middle Reaches of the Yangtze River is one of the main rice growing areas in China with annual planting area of about 2.1 million hectares, however, planting area of japonica is less than 0.2 million hectares (Yang et al., 2013).

Recently, due to the trend in preferences of consumers toward high-quality rice, japonica is becoming more and more popular in China because of its better eating quality (Chen et al., 2006; Kang et al., 2006). The average annual per-capita consumption of japonica has increased from 17.5 to 30 kg at a growth rate of 0.6 kg per year in the past 20 yr (Bu, 2011). In addition, the market price and national minimum purchase price of japonica are about 20% higher than that of indica (Yin, 2014). It is predicted that the income of farmers can increase by 3 thousand yuan per year, if 1 ha of japonica rice are planted in Hubei Province (Zhang et al., 2013a). In 2012, a project aiming to replace indica with japonica in Hubei Province was started by the government (Yin, 2014). Currently, japonica is planted mainly as late rice in Hubei Province (Zhang et al., 2012). It is important to expand planting area of japonica in the middle season, since the proportion of middle-season rice is around 67% of the total rice planting area (Chen et al., 2011).

One major constraint for planting japonica in the middle season is the high temperature stress frequently occurred in the Middle Reaches of the Yangtze River, because japonica is more sensitive to high temperature than indica (Shah et al., 2014; Wan et al., 2009). The advent of global warming makes it more difficult by increasing the frequency of heat spikes (IPCC, 2014). Projections using climate models indicates that 27% of global harvested area in rice would be exposed to at least 5 d of temperatures above the

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Full Length Article

Dry Matter and N Contributions to the Formation of Sink Size in Early- and Late-maturing Rice under Various N Rates in Central China

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Abstract

Sink size with spikelets number (m^{-2}) is one of the critical factors determining grain yield in cereals including rice. Nitrogen and dry matter are regarded as the two main factors controlling the formation of sink size and the objectives of present study were to examine the potential mechanisms underlying the difference in sink size between the late maturing YLY6 and HY3 an early maturing and drought resistant variety. The difference in the contribution of N and dry matter to the formation of sink size between the two varieties was also investigated. Growth duration of YLY6 was 20 days longer than of HY3. YLY6 produced significantly larger sink size than HY3 due to more secondary branches and spikelets, which resulted in higher grain yield for YLY6. Application of N fertilizer increased spikelets number for both YLY6 and HY3. Sink size of HY3 significantly correlated with N accumulation from mid-tillering (MT) to panicle initiation stage (PI) (R^2=0.68) and N concentration in stem at PI (R^2=0.74). However, for the late-maturing variety-YLY6, formation of sink size was more associated with biomass accumulation from PI-FL (flowering, R^2=0.82). Both N and biomass accumulation significantly contributed to the difference in sink size between HY3 and YLY6, with R^2 of 0.45 and 0.84, respectively. Taken together, this study indicated that contribution of N and dry matter to the formation of sink size was different in rice varieties with different growth duration.

Keywords: Rice; Spikelets; Sink size; Growth duration; Nitrogen; Dry matter

Introduction

Stagnation in rice yield potential and production has been observed frequently in last decade (Ray *et al.*, 2012; Zhang *et al.*, 2014). Three main components are used in the estimation of grain yield in cereal crops including rice, namely spikelet number (m^{-2}), percentage of filled spikelets and 1000-grain weight. Maximum grain yield is determined by the number of spikelets (sink size), since grain weight is relatively genetically stable (Yoshida, 1981). Therefore, a large sink size is regarded as one of the essential traits in the new plant type (NPT) breeding at IRRI and China's super hybrid rice (Peng *et al.*, 2008).

Sink size includes panicles (m^{-2}) and spikelets per panicle. Since there is often a trade-off between these two traits, Yoshida *et al.* (2006) suggested that analysis of spikelet number per m^{-2} would be more effective than separate analysis of each of them. There were significant genotypic variation in the sink size among different varieties (Peng *et al.*, 2000) and it is also influenced by various environmental factors, like temperature (Munakata, 1976), CO_2 concentration (Yoshida, 1973; Kim *et al.*, 2010) and N fertilizer (Hasegawa *et al.*, 1994; Kamiji *et al.*, 2011). Horie *et al.* (1997) found a significant difference in sink size of Kishihikari when the variety was planted in three different locations. Despite of the close relationship between sink size and grain yield, very few studies highlight about the eco-physiological mechanisms underlying the formation of sink size in rice.

Studies indicates that formation of sink size is associated with N accumulation and dry matter production in the reproductive growth stage, however, there is still controversy about the specific period which determines the spikelet number (Hasegawa *et al.*, 1994; Yoshida *et al.*, 2006). Previous studies have reported that N accumulation before the spikelet differentiation is important for the final spikelet number (Wada, 1969), however, N accumulation at panicle initiation stage was found to correlate with spikelet number (Shiga and Sekiya, 1976; Kamiji and Horie, 1989). Similar results have been reported by Hasegawa *et al.* (1994), but it was suggested that variation in spikelet number from 157 field experiments could be more accounted for by

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RESEARCH ARTICLE

Optimizing nitrogen management to balance rice yield and environmental risk in the Yangtze River's middle reaches

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Abstract

Currently, the urgency of balancing rice production and environmental risk from nitrogen (N) fertilization is gaining scientific and public attention. As such, a field experiment was conducted to investigate the rice yield and the fate of applied-^{15}N for Yangliangyou 6 (a two-line hybrid cultivar) and Lvdaoq 7 (an inbred cultivar) using 10 combinations of N rates and splitting ratios in the middle reaches of the Yangtze River. The results showed that N application primarily affected fertilizer N loss to the environment, followed by plant N absorption, but had little effect on grain yield. Generally, there was no significant increase in grain yield and N accumulation in the aboveground plant when N inputs surpassed 130 or 170 kg ha^{-1}. Fertilizer N residue in soil peaked at approximately 48 kg ha^{-1} at an N rate of 170 kg ha^{-1} for both varieties; however, a sharp increase of fertilizer N loss occurred with further incrementally increasing N rates. Although a higher ratio of panicle-N fertilizer together with a lower ratio of tillering-N fertilizer at rates of 130, 170, and 210 kg ha^{-1} had no grain yield benefit, it promoted aboveground N accumulation and plant N accumulation derived from fertilizer, and it reduced the amount of N residue in soil and N loss to the environment. Overall, reducing tillering-N ratios and increasing panicle-N ratios at an N rate between 130 and 170 kg ha^{-1} using fertilizer rates of 90–0–40 kg ha^{-1} and 90–40–40 kg ha^{-1} N at basal-tillering-panicle initiation stages could reduce the adverse environmental risks of chemical N from rice production without sacrificing rice yield.

Keywords Environmental risk · Grain yield · ^{15}N tracer · Nitrogen loss · Nitrogen management · Rice

Introduction

Nitrogen (N) plays a key role in crop yield formation because of a fundamental role in biomass accumulation (Salvagiotti and Miralles 2008). Hence, excess N, often as an extra "insurance" component to prevent yield loss, is frequently applied to fields in modern rice production systems (Ju et al. 2009). The N fertilizer rate in paddy fields up to 324 kg ha^{-1} was monitored in the Yangtze River region (Li et al. 2015a). However, rice grain yield does not increase proportionally with the increasing application of N fertilizer (Huang et al. 2007; Huang et al. 2008; Yan et al. 2009). It was demonstrated that there were no increases in yield for rice cultivars 4007 and Wuyunjing15 at an N rate above 150 kg ha^{-1} in China (Yan et al. 2009). Han et al. (2012) concluded that the optimum N application rate in the middle Yangtze River basin was approximately 120–180 kg ha^{-1}. Excess N fertilizer application led to low N use efficiency (NUE) and negative environmental impacts such as water and soil pollution (Peng et al. 2002; Li et al. 2015b) and greenhouse gas emission (Chen et al. 2014; Cui et al. 2014). Efficient N fertilizer management is vital to maintaining grain yield and minimizing environmental risk in rice production.

In fact, NUE has been confirmed to be dependent on N management practices, particularly rates, timing, resources,

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Yield performance of direct-seeded, double-season rice using varieties with short growth durations in central China

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Biomass production
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ABSTRACT

The labor shortage requires that double-season rice be planted with direct-seeded crop establishment. Only the varieties with short growth durations can be used in direct-seeded, double-season rice under subtropical conditions in central China in which the thermal time is limited. The objective of this study was to evaluate the grain yield and associated plant traits of direct-seeded, double-season rice using varieties with short growth durations. Field experiments were conducted using five short-duration varieties in the early and late seasons of 2015 and 2016 in Wuxue County, Hubei Province, central China. The grain yield ranged from 6.40 to 9.88 t ha^{-1} with a total growth duration of 89 to 105 d across varieties, seasons, and years. The wide difference in grain yield was attributed to the spikelets per panicle and biomass production. Overall, Zaoxian615 (ZX615) produced relatively high grain yield across seasons and years among the five varieties due to its tall plants, heavy panicles, and high crop growth rate. The high temperatures during the vegetative stage and low daily minimum temperatures during the ripening period were critical for the yield performance of the early-season rice, whereas the grain yield of the late-season rice was largely driven by the high daily solar radiation during the reproductive and ripening periods. Our results suggested that rice breeders should develop short-duration rice varieties with a high crop growth rate and biomass production through desirable plant traits of tall plants and heavy panicles to further improve the grain yield of direct-seeded, double-season rice in central China.

1. Introduction

Rice is the staple food for more than half of the world's population (Khush, 2013). The prediction is that rice production must increase by at least 1% annually to meet the growing food demand that results from population growth and economic development (Rosegrant et al., 1995). Studies suggest that most of this increase must come from sustainable intensification on the existing farmland rather than expanding cropland area (Cassman, 1999). In other words, it counts on greater yield per unit land and time, referred to as intensification. There are two primary intensification options as follows: (1) increasing rice yield through management optimization and genetic improvement (Neumann et al., 2010); and (2) using the existing cropland more frequently each year through multiple cropping (Ray and Foley, 2013). Many studies have indicated that rice farm yield in the major production areas is approaching its climate-adjusted yield potential ceiling (Grassini et al., 2012; Ray et al., 2012), and it will be difficult to increase the rice farm yield further unless there is marked genetic improvement in yield potential (Cassman, 1999). In contrast, a great opportunity to increase cropping intensity exists in many countries, which is advocated by many researchers as an important approach for achieving food security in the future (Siebert et al., 2010; Ray and Foley, 2013).

Rice growth duration is a primary determinant of crop rotation in a rice-based cropping system, and shortening the growth period is conducive to increasing cropping intensity (Dingkuhn, 1995). Before the green revolution, most traditional rice varieties in Asia matured in 160–170 d because of sensitivity to photoperiod (Khush, 2001). These varieties could barely allow one crop of rice per year. The availability of the shorter duration modern variety, matured in 120–130 d, has led to a quantum leap in cropping intensity and increased rice production (Khush, 2001). At present, further shortening the growth period will increase the flexibility in crop rotation in intensive cropping systems and provide more opportunities for improving cropping intensity. In China, the arable land per capita is only 43.3% of the world average (FAO, 2015). Under such a condition, a double-season rice system allows two rice harvests per year, which is an effective measure to leave

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Agronomic performance of inbred and hybrid rice cultivars under simplified and reduced-input practices

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Keywords:
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ABSTRACT

Hybrid rice has higher yield potential than inbred rice under optimum growing conditions when large amount of resources are provided. However, little attention has been paid to the performance of inbred and hybrid rice cultivars under simplified and reduced-input practices (SRIP). Field experiments were conducted to evaluate the performance of widely grown inbred (Huanghuazhan, HHZ) and hybrid (Yangliangyou 6, YLY6) rice cultivars across farmers' practice (FP) and SRIP treatments in central China in 2014 and 2015. Compared with FP, reducing N input by 50.0% ($SRIP_N$) caused maximum yield reduction of 12.8%, while reducing planting density by 33.3% ($SRIP_D$) did not affect grain yield as much as $SRIP_N$. The large reduction in resource inputs did not cause substantial yield losses because of compensation among yield components. The average yield of YLY6 was 1.38 t ha^{-1} higher than that of HHZ. Higher yield of YLY6 was mainly resulted from longer total growth duration, and higher total dry weight, leaf area index, and 1000-grain weight than HHZ. More importantly, the yield advantage of YLY6 over HHZ was greater in SRIP than in FP, which implies that YLY6 was less sensitive to reduced inputs than HHZ. Overall, the yield stability of YLY6 was significantly higher than that of HHZ across the crop management treatments and years. These results suggest that hybrid rice is more suitable to simplified crop management practices with reduced inputs than inbred rice.

1. Introduction

China is the largest rice producer and consumer in the world (Cheng and Li, 2007). Rice yield in China has increased by more than two times over the last five decades (FAO, 2017), which has contributed significantly to the nation's food security. The increase in rice yield was primarily attributed to crop genetic improvement, increased agronomic input, and improved crop management practices (Cassman, 1999). In the past, the main focus of rice research in breeding and crop management was high yielding without much consideration of inputs of labor and other resources in China. Achieving super high yields was also advocated in rice production with ample supply of labor, water, and agro-chemicals. In recent three years, however, Chinese government has issued several key policy documents which emphasized on the increases of crop production efficiency with reduction in various inputs (MOA, 2015; Fang et al., 2016). As a consequence, rice production is in the unprecedented period of transition in China (Peng, 2014).

A serious labor shortage has occurred recently in the rural areas of China with the development of urbanization and the acceleration of industrialization (Fang, 2007). As result, rural labor cost has increased by 4.27 times from 2003 to 2013 (Zhong, 2016). In addition, the increase in the prices of agro-chemicals and seeds was substantial over the same period. Overall, the cost of rice production in China has increased from 10,829 CNY ha^{-1} in 2004 to 17,648 CNY ha^{-1} in 2014 (NDRC, 2015). This has resulted in a large decline in the profit of rice production and farmers' willingness to grow rice (Xu et al., 2010). More importantly, high agro-chemical inputs have put great burdens on the environment in recent years (Zhang et al., 2013). Clearly, it is vital to increase resource use efficiency with simplified and reduced-input practices (SRIP) in rice production.

Inputs of N fertilizer and seeds represent a major proportion of rice production costs, second to labor input. Rice crop in China uses about 36% of the total N fertilizer used for rice production in the world, although its planting area accounts only for 19% of the world total rice planting area (Peng et al., 2002). The average N application rate per unit area for rice production in China is 75% greater than in other countries (Peng et al., 2010). High N input leads to low N use efficiency (NUE) due to rapid N losses (Peng et al., 2006), which may further induce soil acidification (Guo et al., 2010), water pollution (Diaz and Rosenberg, 2008), and increased emissions of greenhouse gas (Cassman

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Integrated crop management practices for maximizing grain yield of double-season rice crop

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Depeng Wang, Jianliang Huang, Lixiao Nie, Fei Wang, Xiaoxia Ling, Kehui Cui, Yong Li & Shaobing Peng

Information on maximum grain yield and its attributes are limited for double-season rice crop grown under the subtropical environment. This study was conducted to examine key characteristics associated with high yielding double-season rice crop through a comparison between an integrated crop management (ICM) and farmers' practice (FP). Field experiments were conducted in the early and late seasons in the subtropical environment of Wuxue County, Hubei Province, China in 2013 and 2014. On average, grain yield in ICM was 13.5% higher than that in FP. A maximum grain yield of 9.40 and 10.53 t ha^{-1} was achieved under ICM in the early- and late-season rice, respectively. Yield improvement of double-season rice with ICM was achieved with the combined effects of increased plant density and optimized nutrient management. Yield gain of ICM resulted from a combination of increases in sink size due to more panicle number per unit area and biomass production, further supported by the increased leaf area index, leaf area duration, radiation use efficiency, crop growth rate, and total nitrogen uptake compared with FP. Further enhancement in the yield potential of double-season rice should focus on increasing crop growth rate and biomass production through improved and integrated crop management practices.

Rice is the staple food for more than half of the world's population and for more than 65% of the China's population[1,2]. Increasing world rice production in a sustainable manner is vital for ensuring global food security[3]. Global crop production can be increased by expanding the area of croplands, increasing crop yield, and increasing multiple cropping index[4]. Cropland expansion is not feasible because of urbanization and environmental concerns such as biodiversity loss and greenhouse gas emission[4]. It is essential to maintain the increase of rice yield at an annual rate of 1.5%[5] and at the same time to increase the harvest frequency of existing croplands[4] in order to keep pace with the food demand of the growing human population.

Grain yield can be increased by breeding new rice varieties with greater yield potential and by improving crop and resource management to enhance actual farm yields[6,7]. Optimum crop management especially nutrient management has proven to be highly effective in improving rice grain yield[7,8]. Other management practices such as planting methods and plant density, quality of seeds and seedlings, and irrigation regime can also affect grain yield to some extend[9–11]. Qin *et al.* argued that testing single component of management practices independently may not capture the impact a holistic package would have on enhancing rice grain yield[12]. Ladha *et al.* stated that closing the yield gap is becoming increasingly difficult to achieve by using a component technology in isolation[13]. A more integrated approach involving nutrients, water, and other agronomic management factors will allow the maximization of rice grain yield. Furthermore, simultaneously applying a number of the best compatible individual technologies could maximize overall benefits to farmers. Depending on the need and profitability of new technologies, farmers generally integrate new technologies with existing farmers' practice (FP), which has been referred to as integrated crop management (ICM) or best management practices[13]. Several recent studies have reported greater yield improvement with ICM compared with individual crop production factor[10,12,14].

In the subtropical climates, rice can be grown up to two times per year on the same field. In the subtropical environment of Hubei province in China, for example, double-season rice cropping is usually practiced with an early-season crop from April to July and a late-season crop from July to October[15]. The wide adoption of

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Temperature explains the yield difference of double-season rice between tropical and subtropical environments

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ABSTRACT

Crop yields are largely influenced by air temperature and solar radiation, but the individual effects of these weather variables are difficult to distinguish because they are often not independent. Here, we demonstrate a large effect of temperature on rice grain yield when solar radiation and crop growth duration were not confounding factors for explaining yield difference across two locations in the tropical and subtropical environments. We found that grain yield of double-season rice crops in the subtropical environment of Wuxue County, Hubei Province, China was 9–66% higher than that in the tropical environment of International Rice Research Institute (IRRI), Philippines. Such yield difference was not caused by the difference in crop growth duration from transplanting to maturity. Biomass production rather than harvest index was responsible for the yield difference. Average daily minimum and maximum temperature from transplanting to maturity at IRRI was 3.4 and 1.9 °C higher than that at Wuxue, respectively, whereas average daily solar radiation at Wuxue was lower or similar to that at IRRI. Crop's efficiency in converting solar radiation into biomass (i.e. radiation use efficiency, RUE) at Wuxue was 48% higher than that at IRRI, which was associated with the difference in temperature between the two environments. We concluded that lower rice yield in the tropical environment was associated with lower RUE, which was due to the higher temperature compared with the subtropical environment. Our results suggested the crop adaptation strategies for global climate changes should focus more on future warming.

1. Introduction

The world is facing potential food shortages due to the growing population and the threat of climate change on crop productivity (Long et al., 2015). Rice is the staple food for more than half of the world's population (Maclean et al., 2002). World rice production has nearly tripled in the past five decades mainly due to increased grain yield and partly due to increased planting area (FAO, 2015). However, the arable land used for rice production is reducing because of urbanization and industrialization in the major rice producing regions (Long, 2014). Future increase in rice production will have to depend on higher grain yield (Cassman et al., 2003) and more frequent harvests on the existing land (Ray and Foley, 2013).

Irrigated rice land contributes more than 75% of total rice production although it accounts for about 55% of total rice area. Unlike rainfed and upland rice systems, water is not a limiting factor for grain yield in irrigated rice system. Yield potential is defined as the yield obtained when an adapted cultivar is grown with the minimal possible stress that can be achieved with best management practices (Cassman, 1999). Climatic yield potential of irrigated rice is largely influenced by air temperature and solar radiation (Yoshida, 1981).

Plant maintenance respiration increases with increasing temperature (Amthor, 2000) and higher maintenance respiration reduces the amount of assimilates available for growth and yield formation (Monteith, 1981). In addition, high temperature may reduce biomass production and grain yield by accelerating the

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四、主持科研项目合同材料

1. 国家自然科学面上基金，58 万

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根据《国家自然科学基金条例》规定和专家评审意见，国家自然科学基金委员会（以下简称自然科学基金委）决定资助您申请的项目。项目批准号：32071948，项目名称：夜间温度对水稻籽粒蛋白质含量和蒸煮食味品质影响的生理机制及其栽培调控，直接费用：58.00万元，项目起止年月：2021年01月至 2024年 12月，有关项目的评审意见及修改意见附后。

请尽早登录科学基金网络信息系统（https://isisn.nsfc.gov.cn），获取《国家自然科学基金资助项目计划书》（以下简称计划书）并按要求填写。对于有修改意见的项目，请按修改意见及时调整计划书相关内容；如对修改意见有异议，须在电子版计划书报送截止日期前向相关科学处提出。

电子版计划书通过科学基金网络信息系统（https://isisn.nsfc.gov.cn）上传，依托单位审核后提交至自然科学基金委进行审核。审核未通过者，返回修改后再行提交；审核通过者，打印纸质版计划书（一式两份，双面打印），依托单位审核并加盖单位公章，将申请书纸质签字盖章页订在其中一份计划书之后，一并将上述材料报送至自然科学基金委项目材料接收工作组。电子版和纸质版计划书内容应当保证一致。**自然科学基金委将对申请书纸质签字盖章页进行审核，对存在问题的，允许依托单位进行一次修改或补齐。**

向自然科学基金委补交申请书纸质签字盖章页、提交和报送计划书截止时间节点如下：

1. **2020年10月14日16点：**提交电子版计划书的截止时间（视为计划书正式提交时间）；
2. **2020年10月21日16点：**提交电子修改版计划书的截止时间；
3. **2020年10月28日16点：**报送纸质版计划书（其中一份包含申请书纸质签字盖章页）的截止时间。
4. **2020年11月18日16点：**报送修改后的申请书纸质签字盖章页的截止时间。

2. 国家自然科学青年基金，20 万

关于国家自然科学基金资助项目批准及有关事项的通知

王飞　先生/女士：

根据《国家自然科学基金条例》的规定和专家评审意见，国家自然科学基金委员会（以下简称自然科学基金委）决定批准资助您的申请项目。项目批准号：31501255，项目名称：水稻育种进程中气孔密度的变化规律及其与光合作用的关系，直接费用：20.00万元，项目起止年月：2016年01月至 2018年 12月，有关项目的评审意见及修改意见附后。

请尽早登录科学基金网络信息系统（https://isisn.nsfc.gov.cn），获取《国家自然科学基金资助项目计划书》（以下简称计划书）并按要求填写。对于有修改意见的项目，请按修改意见及时调整计划书相关内容；如对修改意见有异议，须在计划书电子版报送截止日期前提出。**注意：请严格按照《国家自然科学基金资助项目资金管理办法》填写计划书的资金预算表，其中，劳务费、专家咨询费科目所列金额与申请书相比不得调增。**

计划书电子版通过科学基金网络信息系统（https://isisn.nsfc.gov.cn）上传，由依托单位审核后提交至自然科学基金委进行审核。审核未通过者，返回修改后再行提交；审核通过者，打印为计划书纸质版（一式两份，双面打印），由依托单位审核并加盖单位公章后报送至自然科学基金委项目材料接收工作组。计划书电子版和纸质版内容应当保证一致。

向自然科学基金委提交和报送计划书截止时间节点如下：

1、提交计划书电子版截止时间为**2015年9月11日16点**（视为计划书正式提交时间）；

2、提交计划书电子修改版截止时间为**2015年9月18日16点**；

3、报送计划书纸质版截止时间为**2015年9月25日16点**。

请按照以上规定及时提交计划书电子版，并报送计划书纸质版，未说明理由且逾期不报计划书者，视为自动放弃接受资助。

附件：项目评审意见及修改意见

国家自然科学基金委员会
生命科学部
2015年8月17日

3. 国家重点研发计划子课题，120 万

子课题编号：2016YFD0300208-03

国家重点研发计划
子课题任务书

子课题名称： 湖北双季双直播水稻高产高效的温光配置规律和生理机制研究

所属课题： 长江中游双季稻三熟区资源优化配置机理与高效种植模式

所属项目： 粮食作物丰产增效资源配置机理与种植模式优化

课题牵头承担单位： 江西农业大学

子课题承担单位：华中农业大学

子课题负责人：王飞

执行期限： 2016年01月 至 2020年12月

2016 年 8 月 26 日

课题预算表

表B2　子课题编号：2016YFD0300208-03

子课题名称：湖北双季双直播水稻高产高效的温光配置规律和生理机制研究　　金额单位：万元

序号	预算科目名称	合计	专项经费	自筹经费
	(1)	(2)	(3)	(4)
1	一、经费支出	120.00	120.00	0.00
2	（一）直接费用	107.00	107.00	0.00
3	1.设备费	12.00	12.00	0.00
4	（1）购置设备费	12.00	12.00	0.00
5	（2）试制设备费	0.00	0.00	0.00
6	（3）设备改造与租赁费	0.00	0.00	0.00
7	2.材料费	41.00	41.00	0.00
8	3.测试化验加工费	13.00	13.00	0.00
9	4.燃料动力费	2.50	2.50	0.00
10	5.差旅费	9.00	9.00	0.00
11	6.会议费	2.00	2.00	0.00
12	7.国际合作与交流费	2.00	2.00	0.00
13	8.出版/文献/信息传播/知识产权事务费	6.00	6.00	0.00
14	9.劳务费	15.00	15.00	0.00
15	10.专家咨询费	4.00	4.00	0.00
16	11.其他支出	0.50	0.50	0.00
17	（二）间接费用	13.00	13.00	0.00
18	二、经费来源	120.00	120.00	0.00
19	（一）申请从专项经费获得的资助	120.00	120.00	/
20	（二）自筹经费来源	0.00	/	0.00
21	1.地方财政拨款	0.00	/	0.00
22	2.单位自有货币资金	0.00	/	0.00
23	3.其他资金	0.00	/	0.00

注：1.课题在研期间，年度剩余资金可以结转下一年度继续使用。课题完成任务目标并通过验收，且承担单位信用评价好的，结余资金按规定在一定期限内由单位统筹安排用于科研活动的直接支出。

2．项目资金将结合项目实施和资金使用进度，由专业机构及时拨付项目牵头承担单位，项目牵头承担单位拨付至课题承担单位。同时，项目资金实行部门预算批复前预拨制度，保证科研任务顺利实施。

课题负责人签字（签章）： 苏国勤 2016年9月5日
子课题承担单位（乙方） 法定代表人签字（签章）：邓秀新 （公章）华中农业大学 2016年8月31日
子课题负责人签字（签章）：王巍 2016年8月31日

课题协议书

为了更好的完成国家重点研发计划"**粮食丰产增效科技创新**"中"**粮食作物丰产增效资源配置机理与种植模式优化**"项目下课题"**长江中游双季稻三熟区资源优化配置机理与高效种植模式**"的研究目标，本着优势互补、协同配合、共同发展的原则，经平等协商，课题主持单位 **江西农业大学** (甲方)和课题参加单位 **华中农业大学** （乙方）就完成课题达成如下协议，并由合作各方共同遵守。

一、甲乙各方承诺遵守国家重点专项相关科学研究及经费管理办法及本项目组织管理要求。

二、乙方应根据课题任务书要求及时开展相关研究，并定期报告课题进展和研究数据，按照研究计划及考核指标要求按时、保质、保量地完成任务。

三、课题实施过程中，乙方严格按照预算支出经费，独立核算并专款专用。

四、乙方积极配合项目组的安排，按要求完成项目任务。如乙方在课题执行过程中，出现研究进展严重滞后、研究方案的重大改动、经费不合理开支等方面的情形，应及时上报给项目及课题组织单位，以便及时采取应对措施。

五、各方合作研究产生的科研成果和知识产权归本项目共有。

六、本协议一式八份。

甲方（公章）：江西农业大学　　　　乙方（公章）：

法人（签章）：黄路生　　　　法人（签章）：邓秀新

日期：　　　　日期：

4. 国家重点研发计划“粮食丰产增效科技创新”子课题，120 万

课题编号：2017YFD0301401　　　　密　级：公开

国家重点研发计划
课题任务书

课题名称：	长江中下游北部稻田周年光温资源优化配置及丰产高效种植模式构建
所属项目：	长江中下游北部单双季稻混作区周年光温高效利用与水肥精确调控节本丰产增效关键技术研究与模式构建
所属专项：	粮食丰产增效科技创新
项目牵头承担单位：	华中农业大学
课题承担单位：	华中农业大学
课题负责人：	曹凑贵
执行期限：	2017 年 07 月 至 2020 年 12 月

中华人民共和国科学技术部制

2017 年 07 月 05 日

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九、课题参加人员基本情况表

序号	姓名	性别	出生日期	身份证号码（军官证、护照）	技术职称	职务	学位	专业	投入本课题的全时工作时间（人月）	人员分类	在课题中分担的任务	工作单位
1	曹凑贵	男	1963-11-15	360111196311150094	正高级	院长	博士	作物栽培与耕作学	24	课题负责人	组织、示范、推广、周年高效丰产技术研究	华中农业大学植物科学技术学院
2	刘章勇	男	1965-06-25	110108196506259335	正高级	副院长	博士	作物栽培学与耕作学	24	课题骨干	光温资源特点与高效利用机理研究	长江大学农学院
3	王飞	男	1986-05-18	13098419860518575X	中级	无	博士	作物栽培学与耕作学	24	课题骨干	双季稻区种植模式集成与示范	华中农业大学植物科学技术学院
4	汤颢军	男	1979-04-30	420703197904303379	副高级	主任科员	博士	作物栽培学与耕作学	24	课题骨干	单季稻区种植模式集成与示范	湖北省农业技术推广总站
5	马建勇	男	1987-05-20	654301198705200058	中级	无	博士	气象学	24	课题骨干	江汉平原稻区种植模式集成与示范	华中农业大学植物科学技术学院
6	周元坤	男	1967-08-21	420111196708215016	副高级	执行董事	博士	作物学	24	课题骨干	优质稻麦品种筛选与种植模式优化	武汉佳禾生物科技有限责任公司
7	李洪瑜	男	1963-11-07	420122196311076619	副高级	执行董事	博士	农学	24	课题骨干	优质稻麦品种筛选与种植模式优化	武汉亘谷源生态农业科技有限公司

单位研究经费支出预算明细表

表B5 课题编号： 2017YFD0301401　　课题名称： 长江中下游北部稻田周年光温资源优化配置及丰产高效种植模式构建　　金额单位：万元

填表说明：
1.单位类型分课题承担单位、课题参与单位；
2.组织机构代码指企事业单位国家标准代码，单位若已三证合一请填写单位统一社会信用代码，无组织机构代码的单位填写"000000000"。

序号	单位名称	组织机构代码-统一社会信用代码		单位类型	任务分工	研究任务负责人	合计	中央财政资金		其他来源资金
								小计	其中：间接费用	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	华中农业大学	统一社会信用代码	121000004200048172	课题承担单位	组织、示范、推广、周年高效丰产技术研究	曹凑贵、王飞、马建勇	486.00	486.00	63.94	
2	长江大学	统一社会信用代码	124200007570096219	课题参与单位	长江中下游北部稻田光温资源特点调查与分析；长江中下游北部稻田光温资源高效利用机理研究	刘章勇	135.00	135.00	13.32	
3	湖北省农业技术推广总站	统一社会信用代码	124200004200054573	课题参与单位	长江中下游北部单季稻区优质高产稻麦品种筛选；长江中下游北部单季稻区高效种植模式集成与示范	汤灏军	68.00	68.00	8.44	
4	武汉佳禾生物科技有限责任公司	统一社会信用代码	91420100555039830N	课题参与单位	长江中下游北部单季稻区、双季稻区、江汉平原稻区优质稻麦品种筛选与种植模式优化	周元坤	40.00	40.00	4.89	
5	武汉亘谷源生态农业科技有限公司	统一社会信用代码	91420115074456895D	课题参与单位	长江中下游北部单季稻区、双季稻区、江汉平原稻区优质稻麦品种筛选与种植模式优化	李洪瑜	40.00	40.00	4.89	
累计							769.00	769.00	95.48	

课题协议书

为了更好的完成国家重点研发计划“粮食丰产增效科技创新”中“长江中下游北部单双季稻混作区周年光温高效利用与水肥精确调控节本丰产增效关键技术研究与模式构建”项目下课题“长江中下游北部稻田周年光温资源优化配置及丰产高效种植模式构建”的研究目标，本着优势互补、协同配合、共同发展的原则，经平等协商，课题主持单位华中农业大学（甲方）和课题参加单位华中农业大学（乙方）就完成课题达成如下协议，并由合作各方共同遵守。

一、 甲乙各方承诺遵守国家重点专项相关科学研究及经费管理办法及本项目组织管理要求。

二、 双方商定，由乙方承担下列研究任务：长江中下游北部双季稻区优质高产双季稻与再生稻品种筛选；明确适宜双季稻品种的合理搭配和光温高效利用方案；明确适宜品种的评价体系；集成组装周年丰产高效模式并进行示范与推广。

三、 乙方应根据课题任务书要求及时开展相关研究，并定期报告课题进展和研究数据，发表第一标注论文 2 篇，获批地方标准 1 项，筛选优质高产双季稻和再生稻品种 3 个，建立示范基地 1 个，示范推广 3000 亩。

四、 甲方依据乙方的研究任务，拨付 壹佰贰拾 万元整（小写：¥1200000.00 元）经费给乙方。课题实施过程中，乙方严格按照预算支出经费，独立核算并专款专用。

五、 乙方积极配合项目组的安排，按要求完成项目任务，如乙方在课题执行过程中，出现研究进展严重滞后，研究方案的重大改动、经费不合理开支等方面的情形，应及时上报给项目及课题组织单位，以便及时采取应对措施。

六、 双方合作研究生产的科研成果和知识产权归本项目共有。

七、 本协议一式 份。

甲方（公章）：华中农业大学　　　　乙方（公章）：华中农业大学

法人（签章）：邓秀新　　　　法人（签章）：邓秀新

2017 年 6 月 15 日　　　　2017 年 6 月 15 日

5. 校自主创新基金，40 万

2020 年华中农业大学自主科技创新基金项目计划任务书

项目名称	再生稻模式产量与资源利用效率协同提高的栽培调控机理研究			负责人	王飞
项目类别	培育专项			项目批准号	2662020ZKPY015
项目亚类	省部级科技一等奖及以上奖励培育				
考 核 期	2020 年 5 月-2023年4月			资助金额（万元）	40
学院	植科	学位	博士	职称	副教授

经费预算表	科 目	金额（万元）	计算依据与说明（不能为空，每栏限 100 字）
	1. 设备费	0	无
	（1）设备购置费	0.00	无
	（2）设备试制费	0.00	无
	（3）设备升级改造与租赁费	0.00	无
	2. 实验材料费	8.40	无
	（1）原材料/试剂/药品购置费	8.40	主要用于购买大田试验中各种耗材，如标签牌、尼龙网、纸袋、塑料袋等，种子和化肥等农资，以及实验室氮代谢相关酶活性测定所需药品、试剂等。
	（2）其他（无特殊情况原则上不列支）**	0.00	无
	3. 测试化验加工费	9.20	主要用于试验样品氮素含量、代谢组测定。
	4. 差旅/会议/国际合作与交流费	4.00	用于往返基地和学校采样所需的差旅费用，或参加相关学术会议的差旅。
	5. 出版/文献/信息传播/知识产权事务费	3.00	用于论文发表，文献查新等。
	6. 劳务费	11.20	用于参与该项目的研究生的劳务费和临时工的劳务费。
	7. 专家咨询费	1.20	用于项目执行过程中邀请相关专家给予技术指导。
	8.其他支出	3.00	主要用于地租，每年大约用试验田 10 亩，每亩 1000 元，3 年共计 3.0 万元。
	合 计	40.00	无

预期研究目标（含具体科学问题、论文、专利、奖励、应用推广指标、争取国家级科研项目等）	（**请对照申报要求中各类项目培育目标逐条列出。**应具体、明确、详细可行、可考核。每栏限 200 字。如没有对应成果目标则填无。） 1、拟解决的科学问题：（1）再生力的基因型差异及其生理机制；（2）再生稻产量和资源利用效率协同提高的栽培调控机理。 2、拟发表论文和出版专著等情况：发表论文 3-4 篇，其中 SCI 论文 2-3 篇。 3、拟获得专利、奖励、应用推广指标等：推广示范机收再生稻丰产增效栽培技术 2000 亩；获批省部级或以上奖励 1 项。 4、团队和人才目标：无 5、争取国家级科研项目目标：申报国家自然科学基金国际合作项目 1 项。 6、其他：无
项目主持人承诺	我承诺： 1. 严格按照《华中农业大学自主科技创新基金管理办法》及《任务书》中的研究内容和目标，认真开展研究工作（科研原始记录将作为项目考核的重要内容，请注意规范保存）； 2. 若作为人才、团队、重大项目和科技奖励培育类负责人，**将每年坚持申报对应的国家或省部级项目或奖励；** 3. **按照经费预算及相关规定，及时合理的使用经费，当年拨付的经费在当年 12 月 10 日前执行完毕；** 4. 经费**开支范围主要包括：**材料费、测试化验加工费、设备费、差旅费、会议费、国际合作与交流费、出版/文献/信息传播/知识产权事务费、劳务费、专家咨询费等。**经费不得用于：**购置单件≥10 万元的大型仪器设备，开支有工资性收入的人员工资、奖金、津补贴和福利支出，支付招待费、罚款、捐赠、赞助、投资等）； 5. 在研究成果中标注"中央高校基本科研业务费专项资金资助项目（项目批准号：XXX）"或"Project XXX supported by the Fundamental Research Funds for the Central Universities"。 项目主持人（签名）：[signature]　　　　2020 年 5 月 20 日
所在单位审核意见	请审核项目的预期目标是否具体、明确、可考核；经费预算是否合规。 符合申报要求 审核人（签名）：[signature]　　单位（公章）　　2020 年 5 月 21 日
学校审核意见	☑ 审核通过 ☐ 退回修改 ☐ 其他 ________ 审核人（签名）：[signature]　　单位（公章）　　年　月　日

注：请用 A4 纸双面打印。

华中农业大学科学技术发展研究院

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五、会议报告

1.中埃农业论坛—作物科学分论坛（2016.12.14）武汉.分论坛报告.

作物科学分论坛
Session I Plant Sciences

日期:2016年12月13日-14日　　地点:华中农业大学国际学术交流中心五楼会议室
Date: December 13-14, 2016　Venue: Meeting Room on the 5th floor of IAEC

日期/Date	内容/Events	时间/Time	安排/Arrangements
12月13日 December 13	主持：熊立仲 教授 Chair: Prof. Lizhong Xiong	14:30-14:40	Prof. Xuelu Wang, Dean of College of Life Science and Technology Introduction of College of Life Science and Technology
		14:40-14:50	Prof. Daohong Jiang, Vice Dean of College of Plant Science& Technology Introduction of College of Plant Science& Technology
		14:50-15:05	Prof. Lizhong Xiong, College of Life Science and Technology, HZAU Genetic and molecular basis of drought resistance in rice
		15:05-15:20	Prof. Ahmed Kamal El-attar, Virology department-Plant pathology Institute, Agriculture Research Centre, Egypt
		15:20-15:35	Prof. Dongfa Sun, College of Plant Science& Technology, HZAU Progress of wheat breeding and genetics in HZAU
		15:35-15:45	茶歇 Tea Break
		15:45-16:00	Prof. Ni Hong, College of Plant Science& Technology, HZAU Study on fruit tree viruses-from basic technology to application
		16:00-16:15	Prof. Hoda Mahmoud Ahmed Waziri, Virology department-Plant pathology Institute, Agriculture Research Centre, Egypt
		16:15-16:30	Prof. Jibin Zhang, College of Life Science and Technology, HZAU Black soldier fly-Microbes Union: Efficient waste recycling agent and valuable renewable resource
		16:30-16:45	Prof. Changying Niu, College of Plant Science& Technology, HZAU The monitoring and management of Chinese citrus fly Bactrocera minax based on the behavioral research
		16:45-17:40	Group Discussion
	晚餐/Dinner	17:40-19:00	国交二楼自助餐厅 Buffet restaurant on the 2nd floor of International Academic Exchange Center
12月14日 December 14	主持：罗朝喜 教授 Chair: Prof. Chaoxi Luo	8:30-8:45	Prof. Tahsin Shoala, College of Biotechnology-Misr University for Science and Technology
		8:45-9:00	Prof. Chaoxi Luo, College of Plant Science& Technology, HZAU Integrated management of rice pests
		9:00-9:15	Prof. Shuangxia Jin, College of Plant Science& Technology, HZAU Studies on cotton biotechnology and fiber development
		9:15-9:25	茶歇 Tea Break
		9:25-9:40	Prof. Ali Zein El Abidin El Sayed Abd Elsalam El Zohiry, College of Agriculture, AinShams University
		9:40-9:55	Dr. Nan Peng, College of Life Science and Technology, HZAU Lactic acid and bio-feed production from lignocellulosic materials
		9:55-10:10	Dr. Fei Zhou, College of Life Science and Technology, HZAU (Engineering plastid genomes: optimization and applications in biotechnology)
		10:10-10:25	Prof. Ahmed Abd El-Ati A. Ali, Desert Research Center, Egypt
		10:25-10:40	Dr. Fei Wang, College of Plant Science& Technology, HZAU Green super rice: definition, criteria, evaluation
		10:40-10:55	Prof. Ashraf Bakry Abdou Hassan Abdel Razek, College of Agriculture, AinShams University
		10:55-12:00	Group Discussion
	午餐、午休 Lunch and break	12:00-13:30	国交二楼自助餐厅 Buffet restaurant on the 2nd floor of International Academic Exchange Center

2.中巴农业论坛—植物科学分论坛（2017.12.6）武汉.分论坛报告.

華中農業大學

HUAZHONG AGRICULTURAL UNIVERSITY

植物科学分论坛

Sino-Pakistan Forum on Plant Science

日期：2017年12月6日
Date: December 6, 2017

地点：华中农业大学国交中心5楼第二会议室
Venue: The Second Conference Room on the 5th Floor of IAEC

December 6th	主持：罗朝喜 Chair: Prof. Chaoxi Luo	14:30-14:55	介绍学院 Introduction of CPST given by Prof. Chaoxi Luo, Vice Dean of CPST（College of Plant Science& Technology）
		14:55-15:15	Prof. Shafqat Saeed, MNS University of Agriculture, Multan 报告题目：Efficient insect pollinators of different crops to enhance the potential yield in Pakistan
		15:15-15:35	Prof. Manqun Wang, College of Plant Science& Technology, HZAU 报告题目：Structural Transformation Detection Contributes to Screening of Behaviorally Active Compounds
		15:35-15:55	Prof. Shahid Mansoor, NIBGE 报告题目：Biotechnology as an engine for socio-economic development
		15:55-16:15	Tea Break
		16:15-16:35	Prof. Jiatao Xie, College of Plant Science& Technology, HZAU 报告题目：The diversity of viruses in the plant pathogenic fungus Sclerotinia sclerotiorum
		16:35-16:55	Prof. Nazim Hussain, MNS 报告题目：Mechanization in Pakistan and future needs
		16:55-17:15	Dr. Fei Wang, College of Plant Science& Technology, HZAU 报告题目：Green super rice: definition, criteria, and evaluation
		17:15-17:35	Group Discussion
	晚餐 Dinner	18:00-19:00	欢迎宴会（国际学术交流中心二楼） Welcome Dinner on the 2ndfloor of International Academic Exchange Center

协调：孙晓雨；手机：15907174084　志愿者：Muhammad Tahir Ul Qamar　手机：15271915965
coordinator: Xiaoyu Sun　Cell:15907174084　Volunteer: Muhammad Tahir Ul Qamar　Cell: 15271915965

3. 2018 年博士后学术论坛—绿色增产增效理论与技术创

(2018.11.24-11.26)北京.大会报告.

中国农业科学院作物科学研究所

关于举办 2018 年博士后学术论坛的通知

——绿色增产增效理论与技术创新

为给博士后提供交流学术成果与创新思维的平台，增强对博士后创新能力的培养，进一步提高培养质量，提升博士后对绿色增产增效理论与技术集成创新的深入了解，中国农业科学院博士后管理委员会、作物科学研究所博士后管理委员会和作物科学研究所作物耕作与栽培中心将联合主办 2018 年博士后学术论坛。

本次论坛主题为“绿色增产增效理论与技术创新”，会议将邀请所内外不同作物领域专家、青年学者、博士后等，结合自己的研究领域，围绕绿色增产增效理论与技术创新相关方面的问题作专题报告，请相关领域专家做点评；并组织参会人员围绕专家报告内容进行深入广泛的学术交流和讨论。现将有关事项通知如下：

一、论坛时间、地点

11 月 24 日下午 16:00 以后报到，入住湖湾酒店东区

11 月 25、26 日全天：湖湾酒店金色大厅一层 75 会议室

地点：北京温都水城湖湾酒店东区（北京市昌平区北七家镇王府街 55 号）

二、相关要求

1. 特邀报告时间 40 分钟，讨论交流 20 分钟。邀请的优秀青年、

时间		内容	报告人	主持人
11 月 24 日	15:30	重大工程楼西门集合出发、酒店报到入住		人事处
11 月 25 日	**早餐**			
	08:30-09:00	1、介绍与会领导及嘉宾		刘春明
		2、领导致辞		
	09:00-10:00	**特邀报告：玉米栽培研究进展**	李少昆	刘春明
	10:00-11:00	**特邀报告：湖北水稻研究与应用**	黄见良	
	11:00-12:00	**特邀报告：间套作高产高效的生态学机制及其应用**	李　隆	
	午餐			
	14:00-14:30	美国保护性农业研究与实践	宋振伟	李少昆
	14:30-15:00	华北地下水漏斗区不同轮作模式节水效果及机理探讨	杨晓琳	
	15:00-15:30	PEBP 家族基因 *RCN1* 应答干旱胁迫并参与调控水稻抽穗期	丁承强	
	15:30-16:00	绿色超级稻候选品种评价及应用	王　飞	
	休息 10 分钟			
	16:10-16:40	基于免耕覆秸的大豆绿色增产增效机械化生产技术	徐彩龙	张卫建
	16:40-17:10	小麦立体匀播绿色高产高效技术	常旭虹	
	17:10-17:40	玉米生产系统“气候-土壤-作物”三协同定量优化理论与技术体系构建	马　玮	
	晚餐			
11 月 26 日	**早餐**			
	09:00-09:30	耕作模式对土壤质量及冬小麦产量的调控效应	陈　金	吴存祥
	09:30-10:00	机械侧深施氮对晚稻产量及氮素利用的影响	朱从桦	
	10:00-10:30	长期施肥灰漠土水溶性有机物化学特征及钙-碳复合机制	张　洋	
	休息 10 分钟			
	10:40-11:10	水稻增产与稻田甲烷减排的协同理论：品种效应	江　瑜	宋振伟
	11:10-11:40	玉米生长后期倒伏研究及其对机械粒收的影响	薛　军	
	午餐			
	14:00-14:30	密植条件下东北春玉米冠根及土壤微生物特征研究	侯　帅	周文彬
	14:30-15:00	作物光合产物的积累及分配与氮吸收利用的动态平衡关系	郭倩倩	
	15:00-15:30	不同施肥措施对东北春玉米产量的影响及其环境效应	冯晓敏	
	休息 10 分钟			
	15:40-16:20	讨论交流、总结		邢丽丽
	16:30	**返程**		

4. 国家863计划现代农业技术领域"绿色超级稻新品种选育"年会（2018.3.22）陵水.大会报告.

关于召开2018年"绿色超级稻新品种选育"重大项目

交流会的通知

项目各承担单位：

2018年是项目结题年，为做好项目验收准备，经项目组研究决定，定于2018年3月20-22日在海南陵水举行项目总结交流会。请各单位负责人做好准备，届时出席会议。有关事项通知如下：

一、会议时间

2018年3月20日报到，21-22日会议，22日下午离会。

二、会议地点

海南陵水伯明顿酒店，地址：海南陵水滨河南路文化体育广场旁。

三、会议内容

1. 项目参加单位汇报课题进展情况
2. 项目重要成果凝练
3. 后续发展讨论

四、参会人员：科技部相关负责人及特邀专家，项目组各课题负责人及课题骨干

五、其他：差旅和食宿费自理

六、会议联系人：彭少兵 18602713130 speng@mail.hzau.edu.cn

王 飞 15623054850 fwang@mail.hzau.edu.cn

肖景华 13647201373 xiaojh@mail.hzau.edu.cn

承办单位：华中农业大学

2018年3月7日

8:30-10:10	9:50	课题 4 子报告 报告人：陈彩虹，广西壮族自治区农业科学院
	10:00	课题 4 子报告 报告人：任鄄胜，四川省农业科学院作物研究所
10:10-10:30	**茶歇**	
10:30-11:40	**课题 5 报告**（主持人：余新桥）	
	10:30	课题 5 总报告 报告人：王飞，华中农业大学
	10:40	课题 5 子报告 报告人：杨建昌，扬州大学
	10:50	课题 5 子报告 报告人：刘正辉，南京农业大学
	11:00	课题 5 子报告 报告人：唐启源，湖南农业大学
	11:10	课题 5 子报告 报告人：吴文革，安徽省农科院
	11:20	课题 5 子报告 报告人：钟旭华，广东省农科院
	11:30	课题 5 子报告 报告人：方福平，中国水稻研究所
11:40-14:00	**午餐及休息**	
14:00-15:30	**项目集中讨论交流**（主持人：罗利军）	

六、获奖情况

1. 全国农牧鱼业丰收奖——农业技术推广合作奖, 2019, 湖北省再生稻产业协同推广机制创新与实践. 王飞（13/35）

全国农牧渔业丰收奖

证　书

为表彰2016-2018年度全国农牧渔业丰收奖获得者，特颁发此证书。

奖项类别：农业技术推广合作奖

项目名称：湖北省再生稻产业协同推广机制创新与实践

获 奖 者：王飞（第13完成人）

身份证号码：13098419860518575X

获奖者单位：华中农业大学

中华人民共和国农业农村部

二〇一九年十二月

编号：FH-2019-11-13R

2. Fei Wang, Shaobing Peng*. Yield Potential and nitrogen use efficiency of China's super rice. Journal of Integrative Agriculture (2017) 16: 1000-1008 获 Journal of Integrative Agriculture2019 年度最具影响力论文.

证书编号：JIA124–2019

Journal of Integrative Agriculture

2019年度最具影响力论文

入选证书

论文题目：Yield potential and nitrogen use efficiency of China's super rice

论文作者：Wang Fei; Peng Shao–bing

发表年期：2017年16卷5期

Journal of Integrative Agriculture (JIA)

《农业科学学报》编辑部

2019年12月18日

七、期刊审稿情况

1. 2017-2018 年审稿 Field Crops Research 文章 4 篇

Field Crops Research

Editorial Manager

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Role: Reviewer

Username: fwang@mail.hzau.edu.cn

Completed Reviewer Assignments for Fei Wang

Page: 1 of 1 (4 total assignments)

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Action	My Reviewer Number	Manuscript Number	Article Type	Article Title	Date Reviewer Invited	Date Reviewer Agreed	Date Review Due	Date Review Submitted	Days Taken	Editor's Name	Corr. Author
Action Links	2	FIELD_2018_437	Research Paper	Chlorophyll meter-based nitrogen fertilizer optimization algorithm and nitrogen nutrition index for in-season fertilization of paddy rice	Mar 23, 2018	Apr 02, 2018	Apr 23, 2018	Apr 23, 2018	21		Xiaojun Liu
Action Links	1	FIELD_2018_8	Research Paper	Favorable Characteristics of indica Restorer Lines Having High Yield and Nitrogen Use Efficiency under Different Nitrogen Applications in Southwest China	Jan 05, 2018	Jan 07, 2018	Jan 28, 2018	Jan 25, 2018	18		Wan-Jun Ren
Action Links	1	FIELD_2017_1710	Research Paper	Nitrogen nutrient index and leaf function affect rice yield and nitrogen efficiency	Dec 12, 2017	Dec 22, 2017	Jan 12, 2018	Dec 26, 2017	4		Shiwei Guo
Action Links	1	FIELD_2017_1594	Research Paper	Early maturation and high yield achieved in Shengguang 127 by adjusting the growth period and increasing the 1000-seed weight under different planting densities	Dec 03, 2017	Dec 10, 2017	Dec 31, 2017	Dec 11, 2017	1		zhenghua xu

Page: 1 of 1 (4 total assignments)

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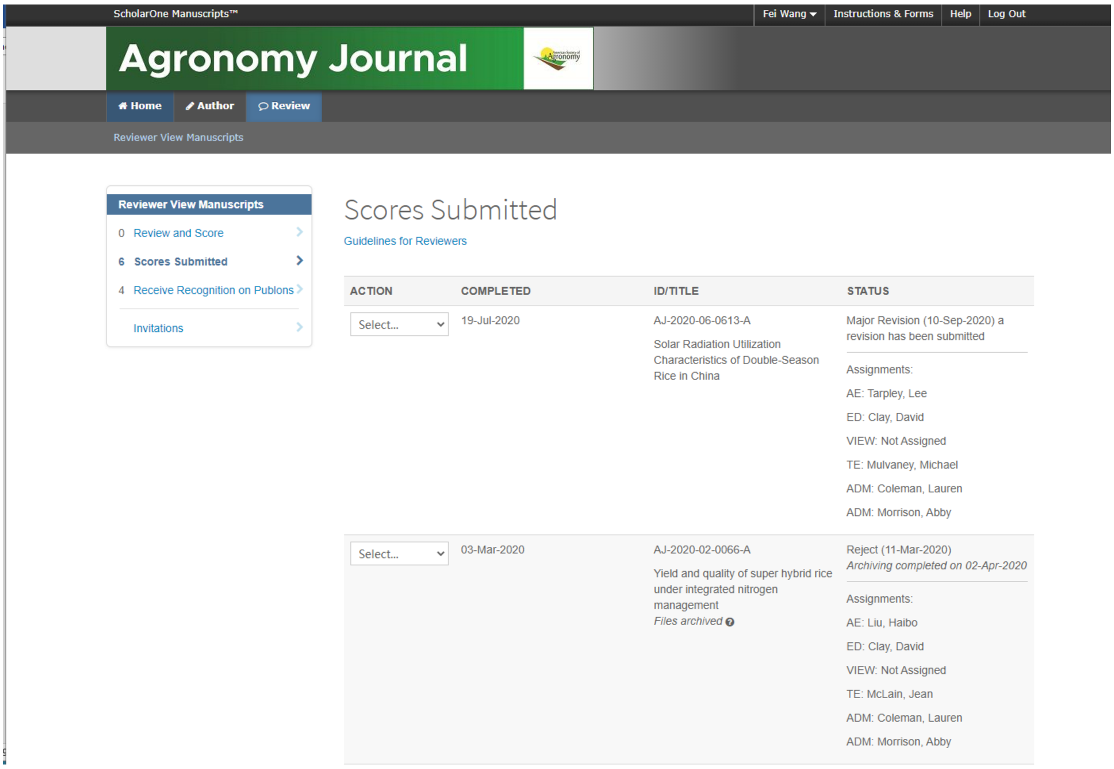
2. 2017-2020 年审稿 Agronomy Journal 文章 6 篇



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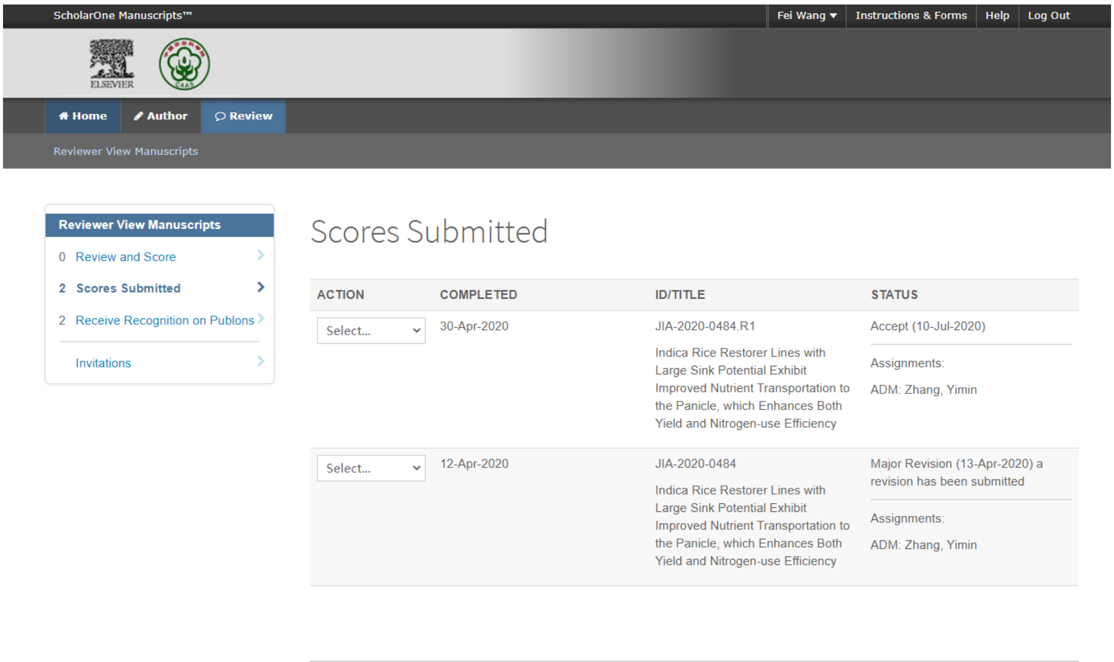
ACTION	COMPLETED	ID/TITLE	STATUS
Select...	19-Jul-2020	AJ-2020-06-0613-A Solar Radiation Utilization Characteristics of Double-Season Rice in China	Major Revision (10-Sep-2020) a revision has been submitted Assignments: AE: Tarpley, Lee ED: Clay, David VIEW: Not Assigned TE: Mulvaney, Michael ADM: Coleman, Lauren ADM: Morrison, Abby
Select...	03-Mar-2020	AJ-2020-02-0066-A Yield and quality of super hybrid rice under integrated nitrogen management *Files archived*	Reject (11-Mar-2020) *Archiving completed on 02-Apr-2020* Assignments: AE: Liu, Haibo ED: Clay, David VIEW: Not Assigned TE: McLain, Jean ADM: Coleman, Lauren ADM: Morrison, Abby

3. 2020 年审稿 Journal of Integrative Agriculture 文章 2 篇



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Select...	12-Apr-2020	JIA-2020-0484 Indica Rice Restorer Lines with Large Sink Potential Exhibit Improved Nutrient Transportation to the Panicle, which Enhances Both Yield and Nitrogen-use Efficiency	Major Revision (13-Apr-2020) a revision has been submitted Assignments: ADM: Zhang, Yimin

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