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Growth and yield of Chinese hybrid rice in Battambang, Cambodia

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Abstract:【Objective】The aim of this experiment was to study the growth and yield of Chinese hybrid rice varieties planted in Battambang, Cambodia and to provide reference for their extension and application in Cambodia. 【Method】The experiment was conducted in the dry season of 2012 (January-April). Three Chinese rice varieties *viz.*, Zaoyou362, Teyou362, Guiyuanyou362 and one local variety (Senpidao) were planted in Battambag, Cambodia to compare their agronomic traits and yield. 【Result】There was significant difference in plant height among all rice varieties. Senpidao grew shorter than the other varieties, but its tiller number was higher than the hybrid rice varieties. Grains per panicle and panicle length of the hybrid rice were significantly higher than that of Senpidao and Teyou362 and Guiyuanyou362 showed the highest grains per panicle and panicle length, respectively. The 1000-grain weight of Zaoyou362 was higher than that of Teyou362, Guiyuanyou362 and Senpidao. The yields of Teyou362 and Guiyuanyou362 were significantly higher than both of Zaoyou362 and Senpidao. Furthermore, the grains per panicle and panicle length were significantly correlated with the yield of rice. 【Conclusion】Three Chinese hybrid rice varieties were suitable for growing in Cambodia and their yields increased by 23-38% as compared to Senpidao rice under Toul Samrong soil condition in dry season of Battambag, Cambodia.

Key words: Chinese hybrid rice; Senpidao rice; Battambang; Cambodia

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中国杂交水稻在柬埔寨马德望省的生长及产量表现

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摘要:【目的】研究中国杂交水稻品种在柬埔寨马德望省的种植长势和产量表现,为中国杂交水稻在柬埔寨马德望省的推广应用提供参考。【方法】2012年旱季(1~4月),将3个中国杂交水稻品种(早优362、特优362和桂源优362)与当地水稻品种(Senpidao)种植于柬埔寨马德望省,测定比较不同品种农艺性状和产量。【结果】不同水稻品种株高间差异显著。中国杂交水稻品种株高均显著高于当地对照品种(Senpidao),但分蘖数较低。中国杂交水稻品种的每穗粒数和穗长也显著高于当地对照品种,其中特优362的每穗粒数最多,桂源优362的穗最长。早优362的千粒重均高于其他3个品种,而特优362和桂源优362的产量显著高于其他两个品种。此外,每穗粒数、穗长和产量间表现出极显著的相关性。【结论】中国杂交水稻适合在柬埔寨种植,旱季在马德望省的Toul Samrong土壤种植可比当地品种增产23%~38%。

关键词: 中国杂交水稻; Senpidao水稻; 马德望省; 柬埔寨

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In Cambodia, agriculture is the backbone of the country's economy. Approximately 80% of people, who live in rural areas, depend on farming to make their living. Rice (*Oryza Sativa* L.) is the major crop in Cambodia and was sown on about 2.79 million hectares (50.41% of cultivated land) across the country in 2010 (MAFF, 2011). In 2010, 8.24 million tons of rice was produced in Cambodia (Fig.1), with an average yield of 2.97 t/ha (MAFF, 2011), which was lower than 4.94 t/ha produced in Vietnam in 2009 (USDA Foreigh Agricultural Service,2009)(Global Agriculture Information Report, 2009), 2.98 t/ha produced in Thailand in 2008, 6.55 t/ha in China in 2010 (FAOSTAT, 2012), 4.2 t/ha produced all other Asian countries and 4.3 t/ha produced throughout the restre the world in 2009 (FAO, 2011). Seed quality, nutrient management, soil fertility, natural disasters, traditional cultivation techniques, and water and drought issues are involved in this low productivity. The Royal Government of Cambodia plans to increase the export of milled rice to at least one million tons per year by 2015 (Council of Ministers, 2010), and agricultural research and extension play important roles in achieving this plan. Hybrid rice could be one of the best elements to achieve Government proposed rice policy, but the seed price might be an issue for poor farmers. Although it has not been promoted in Cambodia yet, hybrid rice was introduced to many countries in the recent years. Hybridization has very successfully increased yield to meet growing demand at market prices. Inbreeding local rice varieties are mainly used in Cambodia. There are a few studies on the growth of hybrid rice under Cambodian conditions. The website of GRAIN reported that the hybrid rice company, Kasekor Khmer Rongroeung Co. Ltd., a partnership between Sunland Agritech (Singapore) and Malaynesia Resources, tested the hybrid rice in 2 hectares in Snau Village, Kampong Thmar Commune, Santuk District, Kampong Thom Province in 2008 (GRAIN, 2008). Louis Kek, director of the Malaynesia Resources, expected yield of 7 to 8 t/ha, while the actual yield turned out to be 3.15 t/ha. On the other hand China obtains success in high yield of hybrid rice; weather and soil conditions are the main factors affecting rice growth and yield. In this research, three Chinese hybrid rice varieties were planted under Cambodian conditions to evaluate their growth and yields in comparison to a conventional local inbred rice variety in Battambang, Cambodia.

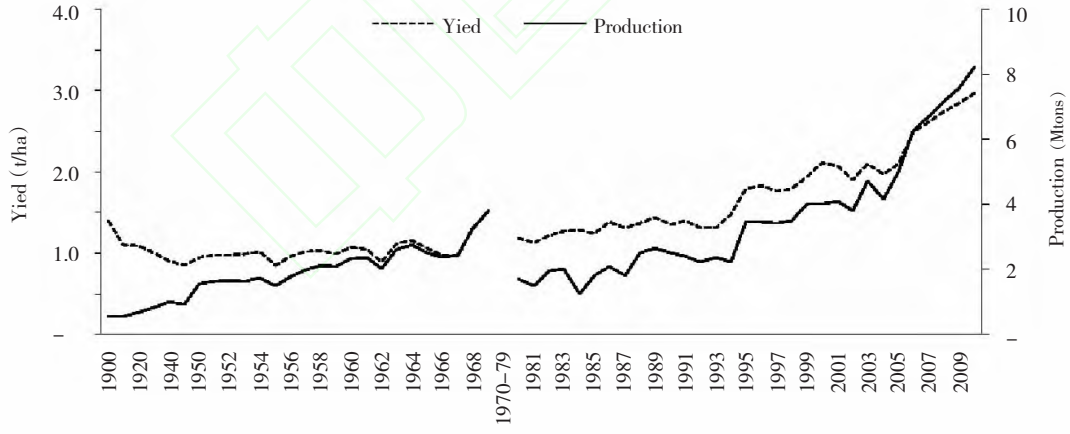

Fig.1 Rice production in Cambodia from 1900 to 2010 (Men,2007 and MAFF,2011)

1 Materials and methods

1.1 Research area and condition

This experiment was conducted in the dry season of 2012 (January–April) on Research and Training Farm (RTF), University of Battambang, Battambang (UBB), Cambodia. Chinese rice hybrid varieties *viz.*, Zaoyou362 (125 days of duration), Teyou362 (126 days of duration) and Guiyuanyou362, as well as Sen pidao (110–120 days of duration), a Cambodian local inbred rice variety, were grown simultaneously under field conditions. The randomized–completed block design was employed with three replications in plots of 4 m×4 m. When seedlings were 20–day old with 2–3 leaves, healthy seedlings were transplanted as two or three seedlings per hill, with plant spacing of 15 cm× 15 cm. Intermittent wetting and drying were taken to manage field water during the vegetative phase. The soils of experimental plot was classified by White et al. (1997) as Toul Samrong Soil (Clay) having pH 5.3

(soil:water is 1:5) organic carbon content was 1.24%, total nitrogen was 0.084%, available P (Olsen) was 83 mg/kg, exchangeable K was 1.19 meq/100 g Soil, exchangeable Ca was 5.75 meq/100 g Soil, exchangeable Mg was 5.00 meq/100 g Soil, exchangeable Na was 0.65 meq/100 g Soil, and particle size was 49.75% clay, 17.10% fine silt, 9.87% coarse silt, 20.70% fine sand, and 2.12% coarse sand. The soil characteristic was based on the results of soil analysis taken from a sample of topsoil (20 cm dept.) in rice fields located at the UBB RTF. Fertilizers were applied with 28 kg/ha of Di ammonium phosphate (DAP) and 43 kg/ha of urea as the basal fertilizers, followed by 28 kg/ha of DAP and 43 kg/ha of urea applied at 21 days after transplantation (DAT) and other 56 kg/ha of DAP and 87 kg/ha of urea at the panicle initiation (PI) stage respectively, based on the recommended rate dose (100:52:00) of White et al. (1997). Climate characteristics during growing season were shown in Tab.1.

Tab.1 Climate characteristics: rainfall, temperature, wind speed and moisture from January to April, 2012

Month	Rainfall (mm)	Evaporation (mm/d)	Maximum temperature (℃)	Minimum temperature (℃)	Wind speed (m/s)	Humidity (%)
January	16.20	4.36	31.51	23.54	2.38	74.35
February	46.80	4.42	33.50	24.22	2.52	74.17
March	57.80	4.36	34.95	25.31	2.97	73.06
April	56.30	4.61	35.55	26.65	3.25	74.33

Source: Veal Bek Chan Meteorology Station (2012)

1.2 Data analysis

Fifteen plant hills per plot were randomly selected to measure plant height, tiller number and productive tillers of rice on a weekly basis, following the first week after transplanting. Thirty panicles of each plot were selected to measure the length and determine the grain number per panicle. One thousand grains were collected from each plot and weighed. For the measurement of yield, 4 m^2 area of rice plants was harvested and adjusted to 14% moisture level, then converted to tons per hectares.

The mean values of different rice varieties such as maximum number of tillers, productive tillers, panicle length, number of grain per panicle, 1000-grain weight, plant height and rice yield were compared by Duncan's new multiple ranges test (DMRT) at 5% level, and analyzed by SPSS (Version 16.0).

2 Results and discussion

2.1 Rice growth and development

The Chinese hybrid rice varieties Zaoyou362, Teyou362 and Guiyuanyou362 seemed to be adaptable for growing under Cambodian conditions in similar ways to the local rice variety Senpidao. The maximum plant height of Senpidao rice was significantly shorter than Teyou362, Zaoyou362, and Guiyuanyou362, respectively (Fig.2). The tiller number of Senpidao rice developed to be significantly higher than three rice varieties Zaoyou362, Guiyuanyou362, and Teyou362 (Fig.3).

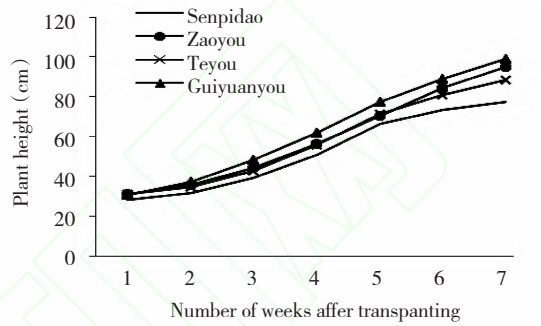

Fig.2 Plant height of 4 different rice varieties from the first to seventh weeks after transplanting

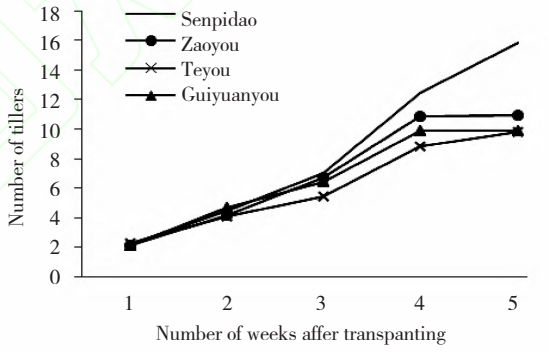

Fig.3 Tiller number of 4 different rice varieties from the first to seventh weeks after transplanting

2.2 Agronomic traits of different rice varieties

Average productive tillers of Sedpidao was 12.11/plant and this was significantly higher than other varieties, i.e. 8.64 of Zaoyou362, 8.66 of Teyou362 and 8.02 of Guiyuanyou362 (Fig.4), but it produced an average grains per panicle of 122.72, which was less than Zaoyou362, Guiyuanyou362, and Teyou362, with 168.78, 222.49, 239.30 grains, respectively (Fig.5). The panicle length of Guiyuanyou362 (25.44 cm) and Teyou362 (25.41 cm) were significantly higher than others (Fig.6). The 1000-grain weight of Zaoyou362 (27.27 g) was significantly higher than 25.39 g of Teyou362, 22.07 g of Guiyuanyou362 and 23.26 g of Senpidao rice (Fig.7). The average yield of Teyou362 (7.46 t/ha) and Guiyuanyou362 (7.75 t/ha) were quite signifi-

cant ly higher than 6.29 t/ha of Zaoyou362 and 4.79 t/ha of Senpidao rice (Fig.8). As seen from Fig.9, it was found that the grain number per panicle and panicle length were strongly correlated to rice yield. The panicle length and grains per panicle of Teyou362 and Guiyuanyou362 were the main factors that created the highest yield.

The inbred local rice (Senpidao) developed more biomass but was less productive as compared to the hybrid rice varieties. Chinese hybrid rice productivity was higher than Senpidao, i.e. 23.84% for Zaoyou362, 35.75% for Guiyuanyou362, and 38.17% for Teyou362. Because the average yield of 2.97 t/ha in Cambodia was lower than 6.29–7.75 t/ha of the Chinese hybrid rice (MAFF, 2011), the Chinese hybrid rice in this experiment also produced about two times higher yield than the hybrid rice introduced to the farmers in Kampong Thom province in 2008, by Kasekor Khmer Rongroeung Co. Ltd., that resulted in yield of 3.15 t/ha.

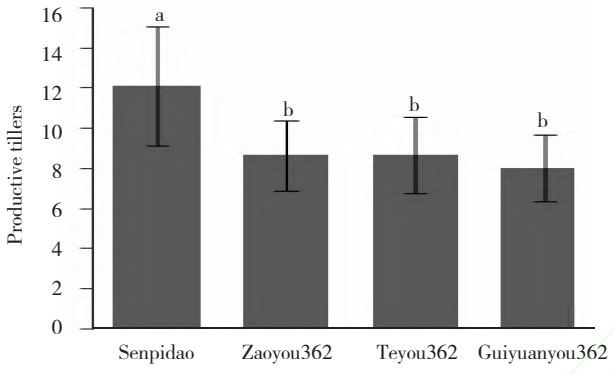

Fig.4 Productive tillers of Senpidao, Zaoyou362, Teyou362 and Guiyuanyou362

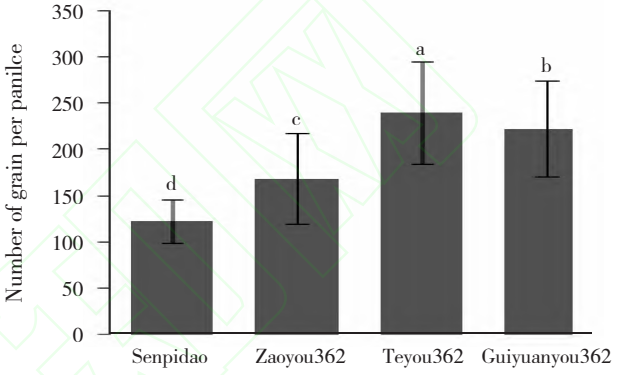

Fig.5 Number of grain per panicle of Senpidao, Zaoyou362, Teyou362 and Guiyuanyou362

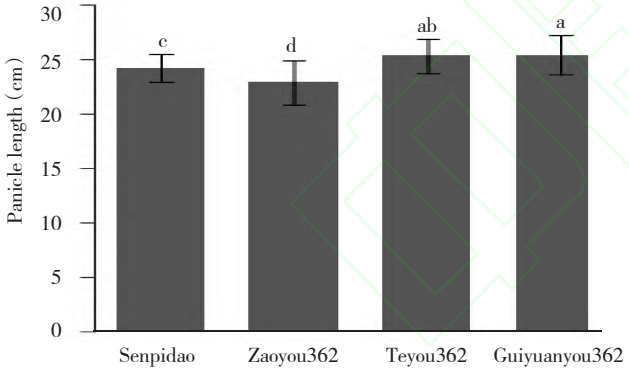

Fig.6 Panicle length of Senpidao, Zaoyou362, Teyou362 and Guiyuanyou362

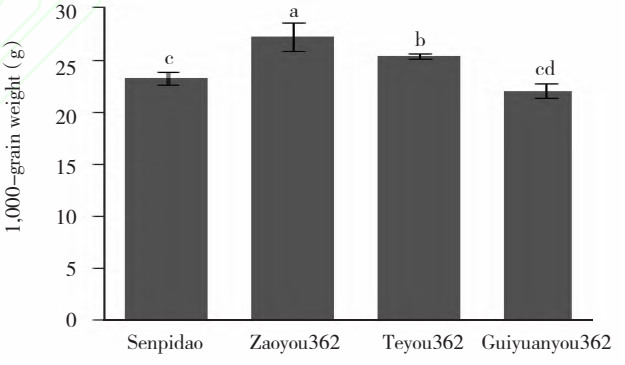

Fig.7 One thousand grain weight of Senpidao, Zaoyou362, Teyou362 and Guiyuanyou362 rice

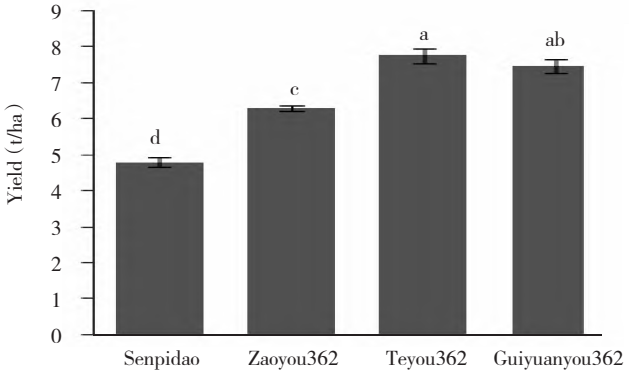

Fig.8 Yield of Senpidao, Zaoyou362, Teyou 362 and Guiyuanyou362 rice

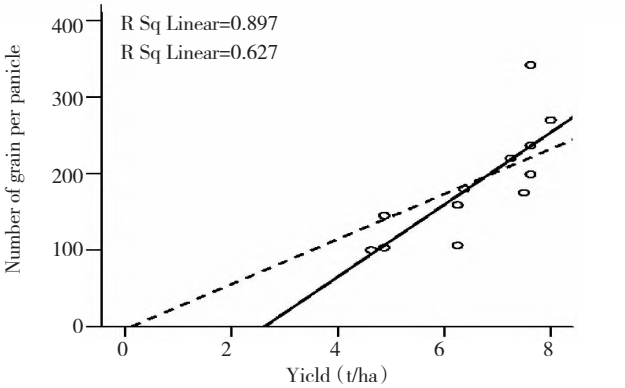

Fig.9 Relationship between the yield (–) and number of grain per panicle (––) of rice

Different letters (a, b, c or d) above bars indicate a significant difference ($P<0.05$) according to the DMRT test. The bars present standard deviation

3 Conclusion

Inbred local rice (Senpidao) produced higher vegetation but resulted in lower productivity than the Chinese hybrid rice varieties, Teyou362, Guiyuanyou362, and Guiyuanyou362. The Chinese hybrid rice varieties grew well in Toul Samrong soil under dry season conditions. The yields of Chinese varieties are 6.92 to 7.75 t/ha, this is 23 to 38% over that of the Senpidao. The Chinese hybrid rice varieties are suitable for growing under the Cambodian condition and will result in higher yields.

This experiment was conducted during the dry season, and further research could be conducted during the rainy season and at other locations. Further analysis, such as cost-benefit and measurements of aromatic and other values of the Chinese hybrid rice varieties in Cambodia, could be useful.

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