The Morphological and Agronomic Characteristics of Some Traditional Rice Varieties in Kampong Thom Province, Cambodia

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ABSTRACT

Traditional rice varieties are maintained and cultivated by farmers for specific needs and conditions of individual farming systems and are likely sources of germplasm for breeding new rice varieties. Unfortunate aspect of traditional rice varieties in Cambodia is lost due to the civil war in 1970's. The aim of this study was to examine morphological and agronomic characteristics of the traditional rice varieties in Kampong Thom province, Cambodia. Data were recorded for traits such as kernel (length, width and thickness), and seed coat (length, width, and thickness), plant height, and tiller number. The results showed that there were significant differences ($P<0.05$) among the eight traditional rice varieties in morphological characters e.g. length, breadth and thickness of hulled and un-hulled rice seeds. The data representing the length of unhulled and hulled rice seeds showed that Domnerbses (DS) verity had significantly the longest. Moreover, the Chaorng (CH) verity had the highest breadth and the thickest unhulled and hulled rice seeds. The varieties effect on height and tiller production at all growth stages was significant difference. Height of eight traditional rice varieties at 84 day after transplanting (DAT) ranged from 97.42 to 168.55 cm. Maximum height 224.83 cm was recorded for Chaorng (CH) verity. The result showed that the number of tillers increased till 57 DAT followed by a decline to harvest due to death of some undeveloped tillers. Domnerbses (DS) verity produced the higher number of the tillers compared to other varieties. The information of these morphological and agronomic characteristics can be used for further germplasm selection and improvement of rice variety.

Keywords: Traditional rice varieties, Morphology, Agronomic

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Introduction

Rice, a staple crop of Cambodia, is mostly cultivated in rain fed lowland and upland, accounting for about 85 % of the cropped area (Man Sarom, 2007). Khmer farmers have been growing rice for at least 2,000 years, or possibly even longer in the case of upland rice. Historians believe that rice-growing technologies may have been adopted in Cambodia along trade routes from India. Irrigated rice production technologies were introduced 1,500 years, ago (Chandler, 1993; Sokunthea, 2004). Farmer integrated rice production into their existing systems of land use which had been developed since prehistoric times. As already stated, rice is Cambodia's most important agricultural product, contributing about 10% to Gross Domestic Product (GDP) of the country (Structural policy country notes Cambodia, 2014). It is also a culturally important crop to Cambodian as rice is featured in many traditional rice varieties to keep in gene bank (Man Sarom, 2007; Chandler, 2008).

Traditional rice varieties maintained and cultivated by farmers are likely sources of germplasms for planting or being stored for the next season and for academician for breeding (Rabara *et al.,* 2014). The possesses valuable traits, viz. medicinal properties, nutrition, taste, aroma, tolerance to drought and submergence (Hanamaratti *et al.,* 2008) and indicate the systematic modification of morphological, anatomy and physiology was involved in development of the large culm trait in rice and cultivars with culm characteristics are ideal candidate for super rice breeding (Wu *et al*., 2011) and good textural but not responsive with nitrogen (Boualaphanh *et al.*, 2011). The names used by farmers to describe the phenotypic characteristics of panicle and grains were inconsistent indicators of genetic diversity (Bajracharya *et al*., 2006). Cambodia has many traditional rice varieties to enjoy the status of a rice exporting country before the civil war during 1970's. After civil war, many traditional rice varieties adapted to different ecosystem were lost because the long civil war forced the rice population moving from one place to another place and also the import of modern high-yielding varieties.

Thus, this study assessed the morphological and agronomic characteristics of some traditional rice varieties in Kampong Thom province, Cambodia. Information generated from these germplasms can be used as the basis for future collection. Having data related to the interaction of traditional rice varieties would provide the relationship between the eco-nature system and farm household.

Objective of the study

The aim of this study was to examine morphological and agronomic characteristics of traditional rice varieties in Kampong Thom province, Cambodia.

Material and Methods

Collection of traditional rice varieties

Eight traditional rice varieties were collected from two districts viz., Sandan (6 varieties) and Prasatsombo (2 varieties) of Kampong Thom province, Cambodia (Table 1). Traditional seed

samples were collected from farmer's store or barn used technical of collected data by (Semwal *et al.,* 2014) and all these varieties have been grown every year. The study areas were located between latitude 12° 42' 39" N and longitude 104° 53' 19" E of Kampong Thom province.

Morphology of seeds

A sample of 10 traditional rice seeds was randomly selected from each traditional rice variety. Grain length, width, and thickness were measured using a digital caliper (accuracy ± 0.01 mm) (Armstrong *et al.*, 2005) and seed coat color used compare sample color (IRRI, 2002).

Progeny and growth conditions

Eight traditional rice varieties were tested at a field trial of Naresuan University, Thailand. The randomized complete block design with 3 replications was used. Each variety was transplanted by using fifteen-days-old seedling in a plot of 9 m^2 with a spacing of 25 cm between rows and 25 cm between plants. (Rabara *et al.,* 2014; Wu *et al*., 2011; Sinha and Mishra, 2012). Rice plants were cultivated in the experimental field during the regular growing date of germplasm waste noted and another parameter height of the plant, tiller number (Sinha and Mishra, 2012)

Data analysis

Descriptive statistics was done using R-program (R-Version 3.2.2). The morphological traits measured were analyzed using R. in kernel and Seed coat of length, width, thickness and plant height , tiller number of rice after transplanting and calculate the phenotypic diversity of the characterized farmers' varieties following the protocol proposed by (Semwal *et al.,* 2014, Sotto and Rabara, 2000, Lexerød and Eid, 2006, Pielou, 1969, Rabara *et al*., 2014 and Oupkaew *et al.*, 2011.

Result

The agro-morphological of seed

Some morphological characteristics of 8 traditional rice varieties from two districts of Kampong Thom province, Cambodia were shown in Table 1. The results indicated that there were significant differences for seed morphological characteristics (Table 2). Mean unhulled grain length of eighth traditional rice varieties ranged from 7.93 to 9.49 mm, while hulled grain length ranged from 5.87 to 6.85 mm. The longest of unhulled grain was found with the variety Domnerbses (DS) with 9.49 mm. The variety Chaorng (CH) of unhulled grain was recorded with a maximum breadth of 3.19 mm, and a maximum thicknessof 2.25 mm. Maximum length of hulled grain was found with the variety Domnerbses (DS) with 6.85 mm. However, the variety Chaorng (CH) of hulled grain was recorded for a maximum breadth of 2.89 mm and a maximum thicknessof 2.11 mm. (Table 2).

Table 1 Variability studies in eighth traditional rice varieties from Sadan and Prasatsombor district, Kampong Thom Province, Cambodia

No.	Name of the landraces	Collector no.Dist./state	Type of rice	Unhulled grain	Hulled grain	Presence of awn
1	Neangkert (NK)	Sandan, Kampong Thom	Rain-fed	Straw-red	White	Awnless
2	Laksleuk (LS)	Sandan,Kampong thom	Rain-fed	Straw-red	White	Awnless
3	Kolphaav (KP)	Sandan, Kampong Thom	Rain-fed	Straw	White	Awned
4	Phrech (PR)	Sandan, Kampong Thom	Rain-fed	Straw	Light-brown	Awnless
5	Kromounsor (KMS)	Sandan, Kampong Thom	Rain-fed	Straw - brown	White	Awnless
6	Domnerbses (DS)	Sandan, Kampong Thom	Rain-fed (Waxy)	Straw-brown	White-brown	Awnless
7	Chaorng (CH)	Sombo, Kampong Thom	Rain-fed	Straw-brown	Brown-red	Awnless
8	Neangkong (Nkong)	Sombo,Kampong thom	Rain-fed	Straw-red-	White-red	Awnless

Modified of grain color by (Semwal *et al., 2014)*

Table 2 Morphological characteristics of unhulled grain (mm) and hulled grain (mm) in eight varieties of rice from Kampong Thom province, Cambodia.

Varieties name	Unhulled grain			Hulled grain		
	Length (mm)	Breadth (mm)	Thickness (mm)	Length (mm)	Breadth (mm)	Thickness (mm)
LS	8.64bc[1)]	2.62d	2.00bcd	6.34b	2.39c	1.81c
Nkong	8.15e	2.69cd	1.99cd	6.01de	2.46bc	1.82bc
CH	8.40d	3.19a	2.25a	6.10cd	2.89a	2.11a
KP	8.47cd	2.72c	2.05b	6.17cd	2.45bc	1.88b
KMS	8.81bc	2.88b	2.03bcd	6.32bcd	2.52b	1.85bc
NK	8.35de	2.82b	1.96d	6.04de	2.45bc	1.80c
PR	7.93f	2.40e	1.83e	5.87e	2.12d	1.68d
DS	9.49a	2.08f	1.78e	6.85a	1.87e	1.64d
F-test	**[2)]	**	**	**	**	**
Mean	8.52	2.67	1.99	6.21	2.39	1.82
C.V.%	4.93	6.26	5.26	6.71	6.29	6.67

[1)] Mean in the columns followed by same letter is not significantly different at 0.05 probability

[2)] ** is significant at 0.01 probability.

Eight traditional rice varieties at 45,51,57,70 and 84 days after transplanting had statistically significant differences in plant height. The means for height of plants varied from 97.42-168.55 cm, Chaorng (CH) had the highest plant height and Kromounsor (KMS) had the lowest plant height at 45,51,57,70 and 84 days after transplanting (Table 3).

For the number of tillers per plan of traditional rice, significant differences were observed at 45,51,57,70 and 84 days after transplanting among the varieties. Tiller numbers of eight traditional rice varieties at 28, 51, 57 and 80 days after transplanting were 13.13, 16.01, 16.68 and 13.01 cm respectively. The Neang kong (NKong) variety has produced the highest number of tiller number per plant around 13.90 number after 80 days of transplanting.

Table 3 Agronomic characteristics for eight varieties of rice from Kampong Thom province, Cambodia

Varieties name	Height (cm)					The number of tillers per plan			
	45	51	57	70	84	28	51	57	80
	Days after transplanting					Days after transplanting			
LS	99.01b[1)]	115.13bc	124.76bc	139.80bc	164.01bc	12.83bc	16.80a	17.36a	13.76a
Nkong	90.13d	106.38e	116.98e	13480bc	159.15cd	12.80bc	17.23a	17.43a	13.90a
CH	121.65a	147.80a	164.10a	190.25a	224.83a	11.20c	12.46c	12.76c	11.83bc
KP	95.33c	110.13de	120.75cde	134.33c	158.08cde	11.30c	14.16bc	15.06b	10.80c
KMS	86.45e	101.70f	111.89f	125.45d	152.66e	14.43ab	17.23a	17.66a	13.36ab
NK	100.21b	117.28b	128.66b	140.60b	164.16bc	12.20c	14.60b	15.50b	11.80bc
PR	93.21cd	111.56cd	121.85cd	137.90bc	167.78b	15.33a	17.26a	18.36a	13.56ab
DS	93.35cd	109.23de	118.98de	134.45c	157.70de	14.96a	18.33a	19.90a	15.10a
F-test	**[2)]	**	**	**	**	**	**	**	**
Mean	97.42	114.9	125.99	142.19	168.55	13.13	16.01	16.68	13.01
C.V.%	6.96	6.96	6.78	7.54	6.68	26.33	21.91	20.66	25.77

[1)] Mean in the columns followed by same letter is not significantly different at 0.05 probability

[2)] ** is significant at 0.01 probability.

Discussion

The agro-morphological of seed

The traditional rice varieties were collected from Kampong Thom province, Cambodia and transferred for planting in the agricultural practice field at Naresuan University, Thailand on 2 august, 2015. Means for length, breadth and thickness of unhulled grain from eight traditional rice varieties were 8.52, 2.67, and 1.99 mm, respectively. Based on the recorded data for the length of traditional rice grain from India by Semwal (2014), the similar result has also been found in this study. The length of traditional rice grain from India reported with the maximum unhulled grain length of 8.9 mm. In this study, the eight traditional rice varieties from Kampong Thom province, Cambodia were grouped

into two categories as medium and long based on the hulled grain length (IRRI, 2013). The mean length, breadth and thickness of the eight varieties of hulled grain were 6.21, 2.39, and 1.82 mm respectively. The longest unhulled and hulled grain were observed in the variety Domnerbses (DS) about 9.49 and 6.85 mm respectively, but there were low value of breadth and thickness The result indicated that the longer grain tend to be narrow. The variety Chaorng (CH)'s unhulled grain breadth was recorded as maximum value with 3.19 mm and maximum value of thickness with 2.25 mm. The variety Domnerbses (DS) had maximum length value for hulled grain as 6.85 mm. The maximum value for hulled grain breadth was observed with the variety Chaorng (CH) about 2.89 mm., and the maximum thickness was about 2.11 mm. Similar results of morphological characteristics of other traditional rice were also reported by several researchers (Patra, 2000; Deb and Battacharya, 2005). The land races rice are known for significant variability which refers to the seed morphological characteristics for the height and tiller number of traditional rice (Frankel *et al.*, 1995).

Conclusion

Traditional rice varieties with 8 samples have the variability in morphological characteristics, the height of rice was developing from one growth period to other period quickly. Different varieties with different tiller numbers were growing fast until 80 days and stopped then after for flowering. The information of these morphological and agronomic characteristics can be used for further germplasm selection and improvement of rice variety.

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