Comparative studies on some red rice biotypes and cultivate rice on morphological and yield bases under Egyptian condition

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Abstract: This experiment was conducted at experimental farm of Rice Research Section, Sakha Agric. Research Station, Kafrelsheikh, Egypt during 2015 and 2016 seasons, the study to characterize of some red rice biotypes and ten cultivated rice on germination, growth and yield characters. The study included ten cultivated rice varieties with two biotypes of red rice were planted in randomized complete block design with three replications. The date of sowing was on the May[1st] during the two seasons; packages of recommendation were applied as recommended by RRTC. The data were collected on seed viability, seedling, physiomorphological, yield and its components characters. The obtained results could be summarized as follow: seed viability of red rice biotypes were higher than the cultivated varieties especially after 15 days of heading, the red rice biotypes were early heading and taller than the cultivated varieties. Also, it gave were higher chlorophyll content than the biotypes of red rice, indicated that to could be distinguish between the biotype of red rice and cultivated varieties in early growth stages and could be removed from seed production plots before heading to avoid the out crossing or apply alternative system for late maturity variety after early maturing variety.

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1. Introduction

Rice is one of the most important food crops in the world and its production area in Egypt changes from year to year based on available irrigation water, the total area was 1.350 million fed., and total productivity 5.3 million ton **(RRTC 2015)**.

Since rice plays an important role in the Egyptian national economy, it becomes essential to improve its production to meet the increase in the local consumption and for possible exportation. Such increase in the production could be achieved by two means: First utilization of new improved rice cultivars of high yielding ability free from red rice. Second- the application of the recent approaches in the cultural practices.

In Egypt, rice farmers are facing a serious problem created by red rice. Red rice can be defined as kernels which are distinctly red because of a red peri carp or outside bran layer. Red rice resembles very closely cultivated rice in respect to many morphological characters. It is identified as a wild rice type by the fact that the plants produced grain that shatter, possess red seed coats and possess the ability to remain viable in the soil through periods of adverse conditions. These characteristics of red rice are completely different than cultivated rice.

Red rice (Oryza sativa *L.*) is botanically classified as the same spices as cultivated rice. This weed is widespread in almost all the world rice growing area, red rice was estimated to be significantly present in at least 50% of Italian rice surface.

Red rice is therefore a problem to the rice growers because of the following reasons; Plants of red rice complete with plants of cultivated rice fore space, light and nutrition. Total yield per feddan is reduced due to grain shattering of the red rice types prior to harvesting. Moreover the presence of red rice lower the grade and price of cultivated rice.

Yield losses caused by red rice infection in rice fields vary as a function of the weed density and competitive ability of the cultivar, five plants / m^2 reduced rice grain yield by 22% **(Diarra et al 1985).**

Hybridization between cultivated and wild relative is one hypothesis for the origin of the weedy rice **(Niruntrayakul *et al* 2009),** rice is a 99.8 % self-pollinated crop it has been observed to have out crossing potential up to 6-8 % in some varieties under certain conditions (**Sahadevan and Namboodiri 1963**). Out crossing depends on flowering behavior, floral characteristics of male and female parents and variation in environmental factors **(Virmani 1994)**. Red rice occur as wild, or cultivated types and the red kernels are covered with dark or light colored husk, also, off types plants having a red pericarp or seeds considered weedy, these generally have awns of

varying degree, a high rate of out crossing, high shedding rate and dormancy, weedy rice generally shed seeds earlier than cultivated and carry genes for tolerance to various adverse conditions, **(Rood 2000).** So, the red rice plants cause highest losses of seed production fields especially with field inspection, Weedy rice has become a serious invasive weed in rice growing area in the world since 2002, causing rice yield losses, ranging from10-100% depending on the level of weedy rice infestations. The contents of red rice in paddy rice is an important commercial parameters values over 3% would imply a reduction of commodity price by about 20% **Ferrero *et al* (2002).** The present investigation aimed to study characteristics some of cultivated rice and two biotypes of red rice.

2. Materials and methods

This investigation was conducted at experimental Farm of Rice Research Section, Sakha, Kafr ELSheikh, Egypt during the two seasons 2015 and 2016. Ten rice cultivars, Sakha101, Sakha 104, Sakha 105, Sakha 106, Giza 177 Giza 178, Giza 179, Giza 182, BLack.1, BLack.2 and two biotypes of red rice, red rice 1 (strawhill) and red rice 2 (black hill), were planted on May 1st during 2015 and 2016 seasons in a Randomized Complete Block Design (RCBD) with three replications to characterize some of cultivated varieties and two biotypes of red rice, the seedlings were transplanted after 30 days. Each replicate consisted of five rows of each variety, the row measured five meters long, plant spacing 20 x20 cm and contained 25 hills. All agricultural practices were applied according to rice recommendations for **RRTC (2015).** Data were recorded on 10 randomly selected plants from each replication for the following characters, Germination % for immature and mature grains, germination index, days to heading, plant height before and after heading, chlorophyll content, flag leaf area, panicle length, panicle weight, seed set %, 1000- grain weight, grain yield / plant and harvest index %, as recommended by Standard Evaluation System (SES) of **IRRI (2008)** The statistical analysis of variance was done as described by **Steel and Torrie (1980)** using COSTAT computer software package.

3. Results and discussion

The results in Table (1) showed that there were wide differences among the two biotypes of red rice comparing with the Egyptian cultivated rice regarding for some of seedling characters.

Table (1): Mean performance of rice varieties for seedling characters during 2015 and 2016 seasons.

Varieties	2015 season			Season 2016		
	Germination of immature grains (%)	Germination index (%)	Shoot /root ratio (%)	Germination of immature for grains (%)	Germination index (%)	Shoot /root ratio (%)
Sakha 101	1.00	94.00	0.33	1.00	94.00	0.26
Sakha 104	1.00	92.00	0.76	1.00	92.00	0.75
Sakha 105	1.00	93.00	0.78	1.00	93.00	0.72
Sakha 106	1.00	96.00	0.82	1.00	96.00	0.81
Giza 177	1.00	97.00	0.86	1.00	97.00	0.83
Giza 178	1.00	98.00	0.86	1.00	98.00	0.89
Giza 179	1.00	98.00	1.38	1.00	98.00	1.36
Giza 182	1.00	94.00	1.06	1.00	94.00	1.13
Black Rice 1	1.00	93.00	0.90	1.00	93.00	0.87
Black Rice 2	1.00	92.00	0.89	1.00	92.00	0.91
Red Rice 1	65.00	99.00	1.21	66.00	99.00	1.16
Red Rice 2	61.00	98.00	1.09	62.00	98.00	1.16
LSD 0.05	1.315	1.21	0.148	1.456	1.33	0.045

For seed germination of immature grains for the two types of red rice recorded the highest values comparing with the cultivated rice, whereas, all the studied cultivars did not germinate, indicate that the red rice seed able to germinate after shattering from the panicle, this can be establish an important recommendation to that the plant should be removed from seed production plots before flowering, the same results was obtained by **(Oka 1988)** he found that weedy rice have awns of varying degree a high rate of out crossing, high seed shedding rate and dormancy. On the other side, the percentage of germinated seed was highest for all the studied bio type red rice and cultivated rice. Also, the data showed in Table (1) indicated that the viability to complete mature seed of all the rice varieties, moreover, the ratio of shoot/root recorded the highest values of the two types of red rice and indica / japonica type; Giza 178 and Giza 179 comparing to japonica type which indicate the highest value of this trait and could be used as indicator as tolerant for stress conditions.

The data in Table (2) showed the mean performance for days to heading, plant height before and after heading and chlorophyll content of some rice varieties, for days to heading the two biotypes of red rice were earlier than the late maturing cultivars Sakha

101 and Sakha 104. On the other hand, the red rice biotypes recorded the highest values of plant height before and after heading comparing to the other varieties, this means it could be differentiate among these plants in the seed production plot. In similar study red rice biotypes could cause significant rice yield losses ranged from 9 to 33 %, also, red rice height ranged from 124 to 174 cm which were taller than the cultivated varieties, moreover, red rice biotypes had more taller than the cultivated rice (**Shivrain *et al* 2009**), that referred to the red rice biotypes produced from hybridization with cultivated rice, subsequently the red rice plants exhibited growth vigor, highly tillering ability, long stature and highly sterility percentage, moreover, wide range of differences for chlorophyll content was recorded among the studied varieties, whereas, the two biotypes of red rice recorded the lowest value, while, the black rice varieties recorded the highest one, this mean that it could be distinguish between red rice and cultivated rice varieties in seed production plot, because, the red rice plant exhibited light green color. in addition the weed generally shows some particular characteristics which make it different from cultivated plants, numerous and slender tillers, hispid, light green leaves, tall plants and high shattering capacity of the grains from panicle **(Kwon *et al* 1991).**

Table (2): Mean performance of rice varieties for some physiomorphological characters during 2015 and 2016 seasons.

Varieties	2015 season				Season 2016			
	Days to heading (day)	Plant height before heading (cm)	Plant height After heading (cm)	Chlorophyll content (SPAD)	Days to heading (day)	Plant height before heading (cm)	Plant height after heading (cm)	Chlorophyll content (SPAD)
Sakha 101	107.30	73.66	95.00	43.43	107.67	74.67	94.00	43.50
Sakha 104	101.00	89.67	106.00	42.80	101.40	90.00	105.00	42.76
Sakha 105	93.00	85.33	99.00	44.93	93.17	85.67	98.00	49.66
Sakha 106	97.67	91.00	103.00	47.20	98.00	91.66	102.00	47.20
Giza 177	95.90	91.00	98.00	42.60	96.83	91.00	98.00	42.70
Giza 178	99.43	81.67	98.00	40.90	99.60	82.66	97.00	40.90
Giza 179	90.03	76.00	94.00	43.40	90.63	76.66	93.00	43.40
Giza 182	91.66	84.00	95.00	40.90	91.52	85.33	96.00	40.90
Black 1	85.60	76.00	102.00	46.86	86.23	77.33	101.00	48.53
Black 2	87.57	86.00	103.00	49.20	88.23	86.33	102.00	49.20
Red Rice 1	95.00	96.00	110.00	33.70	96.33	97.00	111.00	35.4
Red Rice 2	91.00	106.00	115.00	30.50	92.33	106.33	116.00	30.56
LSD 0.05	1.774	1.856	2.368	3.221	1.169	1.089	2.425	2.621

The results in Table (3) show the mean performances for flag leaf area, panicle length and panicle weight, the studied cultivars, the two biotypes of red rice recorded the highest value of flag leaf area, but he lowest values of panicle length and panicle weight comparing to the studied cultivars, From these results it could be concluded that, the red rice will reduce the grain yield by least 15% on the basis of harvest index of red rice biotypes which reduced by 40%, but, the harvest index of cultivated rice was more 45%, that meaning the infection with red rice in rice cultivated area will cause losses of yield. So, red rice plants must be removed from seed production plots before heading.

The results in Table (4) show that mean performance for seed set %, 1000 grain weight, grain yield per plant and harvest index %, the studied cultivars, the two biotypes of red rice recorded the highest value of number of panicles / hill, but it gave lowest values of 1000 grain weight, grain yield and harvest index % comparing to the studied cultivars, that referred to the red rice biotypes produced from hybridization with cultivated rice, subsequently the red rice plants exhibited growth vigor, highly tillering ability, long stature and highly sterility percentage. In similar study red rice biotypes could cause significant rice yield losses ranged from 9 to 33 %, also, red rice height ranged from 124 to 174 cm all of which were taller than the cultivated varieties, moreover, red rice biotypes had more taller than the cultivated rice (**Shivrain *et al* 2009**). On the other side, the cultivated rice recorded the highest values of yield components of all late maturing varieties except Giza 179. From these results it could be concluded that, the red rice will affect the grain yield by at least 15% reduction on the basis the harvest index of biotypes red rice was less than 40%, but, the harvest index of cultivated rice was more 45%, that meaning the infection with red rice in rice cultivated area will cause losses of yield. So, red rice plants should be removed the before heading in seed production plot. Yield losses caused by red rice infection in rice fields vary as a function of the weed density and competitive ability of the cultivar, five plants / m^2 reduced rice grain yield by 22% **(Diarra et al 1985)**

Table (3): Mean performance of rice varieties for morphological and yield characters during 2015 and 2016 seasons.

Varieties	2015 season			Season 2016		
	Flag leaf area (cm^2)	Panicle length (cm)	Panicle weight (g)	Flag leaf area (cm^2)	Panicle length (cm)	Panicle weight (g)
Sakha 101	34.72	24.00	3.72	34.62	25.66	3.66
Sakha 104	28.00	22.00	4.64	34.62	23.00	4.65
Sakha 105	35.43	22.00	4.10	35.62	22.66	4.02
Sakha 106	38.50	20.16	3.66	38.45	21.00	3.57
Giza 177	54.31	22.33	4.57	60.47	23.33	4.64
Giza 178	37.12	22.25	4.20	36.97	22.33	4.02
Giza 179	46.33	21.00	3.61	59.45	20.66	3.69
Giza 182	59.25	25.00	3.50	60.70	24.33	3.56
Black 1	72.44	18.25	3.30	72.78	19.33	3.60
Black 2	48.00	21.25	3.50	48.73	21.91	3.63
Red Rice 1	52.93	22.11	2.47	60.66	22.66	2.68
Red Rice 2	64.76	21.33	3.23	63.15	22.33	3.43
LSD 0.05	2.037	1.815	0.458	1.919	1.806	0.345

Table (4): Mean performance of rice varieties for yield characters during 2015 and 2016 seasons.

Varieties	2015 season				Season 2016			
	Seed set %	1000 grain weight (g)	Grain yield / plant (gm)	Harvest index (%)	Seed set (%)	1000 grain weight (g)	Grain yield / plant (gm)	Harvest index (%)
Sakha 101	88.93	28.30	47.71	45.93	89.49	28.89	48.74	47.01
Sakha 104	97.53	27.40	45.40	47.46	97.26	26.14	45.22	45.29
Sakha 105	95.28	27.16	44.08	42.99	95.44	27.20	42.88	47.65
Sakha 106	88.98	27.52	43.79	45.70	89.08	27.50	44.62	44.21
Giza 177	97.19	27.88	45.26	44.68	96.45	27.32	45.78	49.31
Giza 178	94.83	22.33	48.70	49.90	95.40	22.66	48.63	46.98
Giza 179	98.49	29.05	51.00	46.78	97.24	29.52	51.79	48.70
Giza 182	88.83	24.61	41.87	42.77	88.39	25.64	41.47	44.15
Black 1	95.64	23.71	37.13	38.10	95.31	24.44	37.56	38.55
Black 2	97.28	25.45	38.12	32.18	97.27	25.95	38.19	40.57
Red Rice 1	90.06	24.39	37.03	15.46	90.85	24.80	37.43	16.60
Red Rice 2	85.98	24.11	32.57	22.31	84.82	23.96	33.65	21.49
LSD 0.05	0.017	1.196	1.105	3.114	0.0159	0.996	1.021	1.263

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