Zagazig J. Agric. Res., Vol. 44 No. (5) 2017 1667-1681

Genetics and Biotechnology

http:/www.journals.zu.edu.eg/journalDisplay.aspx?Journalld=1&queryType=Master

IDENTIFICATION OF QUALITY AND MOLECULAR ASPECTS OF FIVE NEW PROMISING DROUGHT TOLERANT VARIETIES OF RICE

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Received: 14/06/2017 ; Accepted: 25/07/2017

ABSTRACT: This study aimed to evaluate quality and molecular aspects of five new promising drought tolerant varieties of rice. This study included five drought tolerant varieties *i.e.,* Orabi 1, Orabi 2, Orabi 3, Orabi 4 and Orabi 5 and three traditional varieties *i.e.,* Sakha 101, Sakha 104 and Giza 177. Physical, milling and cooking quality characters were investigated. Fourteen characters were studied, length, width, thickness and length/width (L/W) ratio as a physical quality characters. White rice, brown rice, head rice and broken rice as a milling quality characters have also studied. Gel consistency, gel temperature, kernel elongation cooking time, water uptake and protein as cooking quality characters have been concerned. High significant differences among studied varieties for physical, milling and cooking quality characters were observed. As general, Orabi varieties possessed high length/width ratio than local varieties, but, negatively correlated with head rice and positively correlated with broken rice except Giza 177. Regarding, milling criteria, all varieties possessed high percent of brown and white rice. In contrast low percent of broken rice for local varieties than Orabi varieties has been observed. Low diverse between varieties at gel consensity, in contrast large variation in gel temperature, kernel elongation, water uptake were noted between varieties. Protein content of high value was recorded in Orabi 1, 2 and 3, significant negative correlation was detected between gel consensity and cooking time, but it was a positive correlation with water uptake. In addition, significant negative correlation between cooking time and water up take was found. Orabi 5 and Orabi 3 possessed mainly criteria from traditional varieties. Adaptation year after year for Orabi drought tolerant varieties will be decrease broken rice. RAPD-PCR was applied in the present study. Random amplified polymorphic DNA polymerase chain reaction (RAPD-PCR) was presented almost unique bands in Orabi 3 and these data were identified with the dendrogram result in which Orabi 3 formed a separate cluster. Two unique bands were detected for Sakha 104 using OPA-11 and OPC-02 primers as well as Giza 177 possessed two unique bands using OPA-10 and OPA -11 primers. In addition, single unique band was detected for Orabi 4 and Orabi 5 using OPA -05 primer.

Key words: Rice, (*Oryza sativa*), drought, quality aspects, molecular marker.

INTRODUCTION

Rice (*Oryza sativa*), 2n=2x = 24 chromosomes, is one of the important food crops, It's one of the major staple foods in the world since centuries. Consumer preferences vary from region to region, (Deshpande and Bhattacharya, 1982). Rice is grown on 154 million hectares world wide in a wide range of environments and about 45% of the world's rice is cultivated in rain fed ecosystems (Nazari and Pakniyat, 2008). It is also one of the cheapest sources of food energy and nutrition (Wei *et al*., 2007). As a cereal grain, it is the most widely consumed staple food for a large part of the world's human population, especially in Asia. It is the agricultural commodity with the third-highest worldwide production, after sugarcane and maize, according to the United Nations Food and Agricultural Organization (FAO Stasistcal, 2012). In Egypt, the cultivated rice varieties require large amount of irrigation water (16500

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m^3/ha) (Sayed-Ahmed *et al.,* 1999). Accordingly, the future of rice cultivation in Egypt depends upon breeding for drought resistance because the cultivated varieties (lowland) require large amount of water and susceptibility of water deficits (Soliman, 1993 a and b). In Faculty of Agricultural, Zagazig University, Egypt. A new promising drought tolerant varieties have been developed in new rice breeding for drought stress project (NARP No. 329) (Youssef *et al*., 2010). Rice grain dimensions, traditionally including length, width, and thickness, are major breeding targets, as they affect yield, grain quality, and marketability (Huang *et al*., 2013). Grain size and shape (length-to-width ratio) have a direct implication on the commercial success of rice varieties. Long and slender grains are generally preferred by the majority of consumers (Juliano and Villareal, 1993). Milling is a critical step in the postproduction of rice, and the milling yield and quality are represented by brown rice (BR) recovery, milled rice (MR) recovery, and head rice (HR) recovery. Although milling yield is not directly associated with grain yield, high milling yield, especially high HR recovery, directly improves the commercial value of rice. In regarding, cooking and nutritional quality characters, the storage of protein play an important role for cooking and eating quality characters. Rice is a major protein source for most of the asian rice developing countries. Rice protein has the potential to enhance human nutrition in poor rural families where rice serves as the staple food (Li *et al*., 2004). Therefor, in the improvement of rice storage protein, the main target has been to improve the quantity and nutritional quality of the protein in rice. Molecular markers can be used not only for estimating the genetic diversity of germplasm collections but also for distinguishing varieties within population. (Edwards *et al*., 1992) showed that the detection of RAPD markers on the genomic map of different field crops is beneficial to improve breeding programs of these crops. It offers the simplest and fastest method for detecting a great number of genomic markers in less period of time. Molecular tools facilitate the identification of genomic locations linked to traits of interest and help in indirect selection of such complex traits without the need for difficult phenotypic measurements. In the last few decades, new DNA molecular markers, based on the PCR technique, such as random amplified polymorphic DNA (RAPD; Williams *et al*., 1990), among others, have become excellent tools for plant breeders (Lima-Brito *et al*., 2006). This technique gives fast results but also has limitations, such as dependence on the genetic background, low reproducibility, and level of polymorphism obtained (Zietkiewicz *et al*., 1994; Godwin *et al*., 1997; Fern´andez *et al*., 2002).

Therefore the present study aimed to identification of five promising drought tolerant varieties with high yielding, *i.e.,* Orabi 1- Orabi 2- Orabi 3- Orabi 4 and Orabi 5 for molecular and quality criteria with comparison of traditional varieties in Egypt *i.e.,* Sakha 101- Sakha 104 and Giza 177.

MATERIALS AND METHODS

Plant Materials

Five drought tolerant varieties and three sensitive varieties were used in this study (Table 1).

The paddy rice grains were milled using a "sakata rice milling machine" laboratory rice mill type in Rice Technology Training Center (RTTC), holding company for rice and flour mills, Hagar El-Nawatia, Alexandria, Egypt.

Physical quality characters and molecular genetic studies were carried out at Molecular Genetics Lab. Genetic Dept., Fac. Agric., Zagazig Univ., Egypt.

Methods

Physical characters *i.e.,* length and width were measured by electronic vernier caliper and the ratio of grain length/grain width was arithmetically calculated to express the character L/W ratio. Milled grains were used in the determination of white rice, brown rice, head rice and broken rice as a milling characters as described in AOAC (2000), and also used in the determination of gel consistency, gel temperature, as a cooking characters as described in IRRI (1996) for grain quality characters standard evolution system for rice. Protein content estimated

Table 1. Drought tolerant varieties and sensitive varieties which used in this study and its pedigree

Name	Code of tolerance	Pedigree
Orabi 1	Drought Tolerance	Selected line from (Giza 159*IET1444), medium grain
Orabi 2	Drought Tolerance	Selected line from IR 4786-13-2-1 after treated by EMS 0.5%, medium grain
Orabi 3	Drought Tolerance	Selected line from (Nahda *bluebell), medium grain
Orabi 4	Drought Tolerance	Selected line from moroerkan after treated by 25_{γ} Rad, fine grain
Orabi 5	Drought Tolerance	Selected line from Orabi 2 for short grain
Sakha 101	Sensitive	Local Egyptian variety, short grain
Sakha 104	Sensitive	Local Egyptian variety, salt tolerance, short grain
Giza 177	Sensitive	Local Egyptian variety, short grain

by the macro- kjeldahl method used a semi automatic equipment (kjeltec system) duplicate random sample of 0.2 gram. Each of seed meal was analyzed. Percentage of protein content was computed on the basis of multiplying the nitrogen content by factor of 6.25.

Design and Statistical Analysis

The experiment was laid out in randomized complete block design (RCBD) with 3 replications. LSD 5% and LSD 1% were used to compare the mean values according to (Gomez and Gomez, 1993). The data of this experiment were analyzed by One Way ANOVA test.

Molecular Genetic Studies

DNA Extraction

Total genomic DNA was extracted from young leaves by the CTAB (cethyltrimethylammonium bromide) method followed by an RNase-A treatment (Sigma, St. Louis, MO; R-4875) for 30 min at 37°C.

Primers

A set of twenty 10-mer oligonucleotides was analyzed for RAPD-PCR, Based on the accurate amplified bands profiles and the produced polymorphic patterns of DNA fingerprinting selected six different primers were chosen for RAPD-PCR (Table 2).

RAPD- PCR reactions

The RAPD amplification reactions were carried out in 50 µl containing 20 ng/µl of template DNA, 10× buffer (NH4)2SO4; Fermentas, St. Leon-Rot, Germany), 2.5mM MgCl2 (Fermentas), 2.5mM dNTPs, 0.25 µM primer and 1 Unit *Taq* DNA polymerase (Fermentas). The RAPD amplifications occurred under the following conditions: an initial denaturation step at 94°C for 7 min and 30 cycles at 94°C for 1 min, 35°C for 1 min and 72°C for 2 min., the final elongation step was at 72°C for 6 min RAPD amplification reactions was carried out on a Perkin-Elmer Gene Amp PCR system (model 2400), and the reaction was repeated twice.

Band analysis

The reaction products were analyzed by electrophoresis on 1.4% agarose gels, stained with ethidium bromide, and photographed under UV transilluminator by digital camera with UV filter adaptor. The synthetic DNA, ladder 100 bp (Pharmacia) was employed as molecular markers for bands molecular weight. Each amplified band profile was defined by the presence or absence of bands at particular positions on the gel. Profiles were considered different when at least one polymorphic band was identified. Fragments were scored as 1 if present or 0 if absent based on standard marker

Table 2. Sequence and operon codes of the RAPD primers used to detection of variation in different drought tolerance varieties and sensitive varieties

Primer code	Sequence (5' to 3')
OPA - 05	AGG GGT CTT G
OPA – 11	CAA TCG CCG T
OPB – 10	CTG CTG GGA C
OPC – 02	GTG AGG CGT C
OPC – 04	CCG CAT CTA C
OPC – 07	GTC CCG ACG A

using GelAnalyzer 3 (Egygene) software. Pair wise combinations, genetic similarity and genetic distances were estimated following (Lynch, 1990 and 1991). The computer package SPSS was used to construct a dendrogram based on the matrix of distance using Unweighted Pair Group Method with Arithmetic averages (UPGMA) (Sneath and Sokal, 1973).

RESULTS AND DISCUSSION

Physical Quality Characters

Concerning physical characters, length character (L. "mm") it is apparent from Table 3 that Orabi 4 variety showed the longest value "5.76" among the tested varieties, followed by Orabi 3 and Orabi 5 "5.69" while, Orabi 1 gave the lowest value "5.04". Width character (W. "mm") showed that Sakha 104 variety showed the highest value "2.85" among the tested varieties, While, Orabi 1 gave the lowest value "2.23". Thickness character (Thc. "mm") showed that Sakha 104 recorded the highest value "2", while Giza 177 followed by Orabi 1 recorded the lowest value "1.63, 1.69" respectively. Concerning L/W ratio, Orabi 4 variety showed the highest value "2.35" among the tested varieties. While, Sakha 104 variety gave the lowest value "1.90".

Results in Table 4 show a high significant differences for all physical characters *i.e.,* length, width, thickness and L/W ratio. Those revealed that the values of heritability were 96.205, 95.582, 72.63, 97.390 respectively, which showed that the observed variation among the varieties had strong genetic basis. These results are in conformity with those obtained by (Linhong *et al.,* 2013). They showed a significant difference in physical characters among 408 indica rice lines grown in eight major indica-producing provinces of china. So, it has been confermed that the milling quality is correlated with grain shape traits (Shi and Zhu, 1997; Siebenmorgen and Meullenet, 2004). Typically, grain length and length-to-width ratios are negatively associated with grain milling quality, whereas grain width and thickness tend to correlate positively with milling quality (Shi, 1994; Yang *et al*., 2001; Luo *et al*., 2004; Xu *et al*., 2004; Wang *et al*., 2005; Zheng *et al*., 2007).

Milling Quality Characters

Concerning milling characters, white rice character (W. Rice %) it is evident from Table 3 and Fig. 1 that Orabi 4 variety showed the highest value "72.6" among the tested varieties, followed by Orabi 3 "72.4". While, Orabi 1 gave the lowest value "69". Brown rice character (B. Rice%) showed that, Orabi 4 variety showed the highest value "82.6" among the tested varieties, While, Orabi 1 gave the lowest value "76.9". About Head rice (H. Rice %) and Broken Rice (Broken R. %) it was found that the both characters were closely related inversely to each other, in which, when Head rice decreased the Broken Rice increased. So Orabi 2 variety reported the lowest value in head rice character "52". While it reported the highest value in broken rice character "19". Although, Giza 177 variety showed the highest value among the tested varieties in head rice character"86.6" and the lowest value in broken rice character "2.9".

Table 3. Average means and least significant difference (LSD) for physical characters (length, width, thickness and L/W ratio) and some milling characters (white rice, brown rice, head rice and broken rice) of whole grain at 8 varieties of rice

Varieties	Physical Characters				Milling Characters			
	Length (mm)	Width (mm)	Thickness (mm)	L/W Ratio	W. Rice (%)	B. Rice (%)	H. Rice (%)	Broken R. (%)
Orabi 1	5.04	2.23	1.69	2.28	69	76.9	59	9.5
Orabi 2	5.57	2.45	1.88	2.27	71	80	52	19
Orabi 3	5.69	2.45	1.89	2.313	72.4	81.1	55.7	16.7
Orabi 4	5.76	2.45	1.94	2.35	72.6	82.6	54.6	18
Orabi 5	5.69	2.66	1.99	2.15	70.5	80.4	56	14.5
Sakha 101	5.51	2.71	1.94	2	70.2	82	61.2	9
Sakha 104	5.41	2.85	2	1.90	71.5	82	65.6	5.9
Giza 177	5.27	2.36	1.63	2.24	71.5	80	68.6	2.9
LSD 0.05	0.085	0.076	0.138	0.044	0.64	0.62	0.73	0.63
LSD 0.01	0.118	0.105	0.192	0.061	0.88	0.867	1.01	0.88

Table 4. Mean sum of squares (MS) and heritability (h^2) for some physical characters (length, width, thickness and L/W ratio) of whole brown grain and some milling characters (brown rice, white rice, head rice and broken rice) of whole grain for 8 rice varieties

SOV	D.f	Physical Characters				Milling Characters				
		Length	Width	Thickness	L/W ratio	W. Rice	B. Rice	H. Rice	Broken R.	Protein
Replications	2	0.037	0.0151	0.032	0.016	0.738	0.461	0.911	0.845	0.90
Varieties	7	0.181**	0.124**	0.056**	0.071**	4.221**	9.692**	98.035**	106.534**	4.81**
Error	14	0.002	0.0019	0.006	0.00063	0.132	0.127	0.174	0.131	0.02
h^2 in broad sense		96.205	95.582	72.631	97.390	91.187	96.168	99.469	99.633	٩٨,٦٩

* Significance at 0.05 ** Highly Significance at 0.01

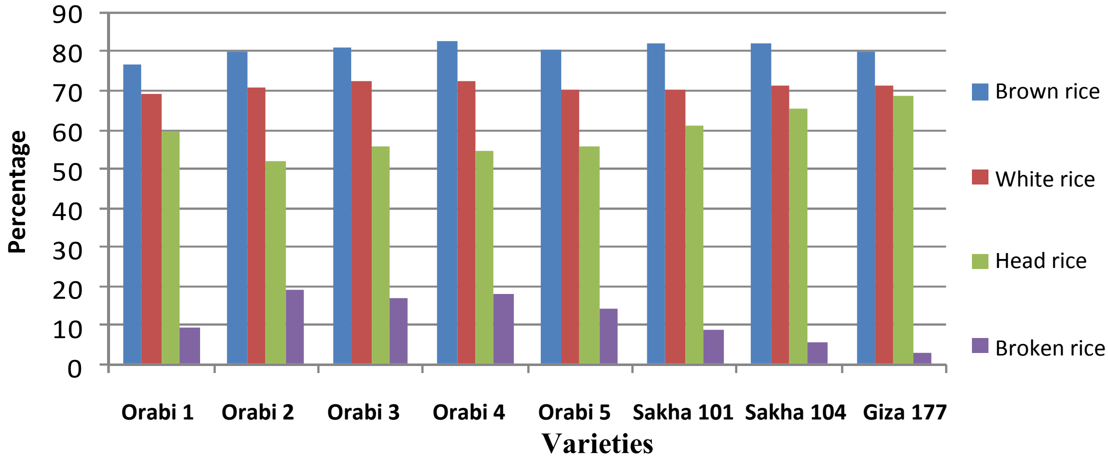

Fig. 1. Milling characters for 8 varieties as quality criteria

Table 4 indicated that rice varieties showed high significant differences for all milling characters *i.e.,* WR, BR, HR and Br R. Those revealed that the values of heritability were 91.187, 96.168, 99.469 and 99.633, respectively which showed that the observed variation among the varieties had strong genetic basis. These results are in conformity with those obtained by (Yadav and Jindal, 2001); showing significant differences of milling characters among rough rice samples of ten varieties.

Cooking Quality Characters

Concerning cooking characters, gel consensity character (G C. "mm") it is evident from Table 5 and Fig. 2 that Giza 177 variety, showed the highest value "92.8" among the tested varieties. While, Orabi 1 gave the lowest value "88.9". Gel temperature character (Gel T. °C) showed that Orabi 3 variety showed the highest value "5.6" among the tested varieties, While, Sakha 104 and Orabi 1 gave the lowest value "3.5", "3.7", respectively. Regarding to kernel elongation character (k. Elo. %), Orabi 3 recorded the highest value followed by Sakha 104 "62.31, 62.3", respectively while Orabi 5 recorded the lowest value "58.37". Cooking time character (Co. T "min") and water uptake character (WU "ml") were negatively correlated with each other so, Orabi 1 showed highest value "25.17" at cooking time but the lowest value at water uptake, while Giza 177 showed the lowest value "22.34" at cooking time but the highest value at water uptake "451.9". Protein character recorded highest value in Orabi 2 "9.95", followed by, Orabi 1 "9.8". While, the lowest value was in Giza 177 "6.5".

Table 6 indicated highly significant differences among rice varieties for all cooking characters *i.e.*, Gel C, Gel T and Protein. Those revealed that the values of heritability were 99.931, 98.210, 99.954, 99.800, 99.987 and 98.69, respectively for GC, GT, K Elo. CoT, WU and protein, which showed that the observed variation among the varieties had strong genetic basis. These results are in conformity with those obtained by (Wang *et al.,* 2007); they showed significant differences of cooking quality among 188 rice RILs derived from across between Zhenshan 97 and Delong 208. Similar result was found on average protein content of rice and varied from 5.9% -11.9%in which major seed protein glutelin accounts for 70% of total proteins on weight basis (Ogawa *et al*., 1987; Li and Okita, 1995).

Results in Table 7 show correlation coefficient (r) for eleven studied characters *i.e.,* grain length (mm), grain width (mm), L/W ratio (%), white rice (%), head rice (%), broken rice (%), gel consistency (mm), kernel elongation (%), cooking time (min), water uptake (ml) and protein (%). It was found that six out of fifty-five combinations were significantly correlated, one was positive significantly correlated and five were negative significantly

Table 5. Average mean and least significant difference (LSD) for cooking quality characters (gel consensity, gel temperature, kernel elongation, cooking time and water uptake) for white grain at 8 varieties of rice

Varieties	GC. (mm)	GT. (c)	K Elo. (%)	Co.T (min)	WU (mm)	Protein (%)
Orabi 1	88.9	3.7	59.72	25.17	422.8	9.8
Orabi 2	90.8	4.6	61.33	23.72	441.3	9.95
Orabi 3	91.7	5.6	62.31	23.41	442.6	8.25
Orabi 4	90.3	5.1	61.93	23.11	440.9	7.6
Orabi 5	89.6	5.2	58.37	24.62	440.5	7.48
Sakha 101	90.2	4.2	60.25	24.2	435.2	8.4
Sakha 104	91.3	3.5	62.3	23.22	432.6	6.8
Giza 177	92.8	4.7	59.82	22.34	451.9	6.5
LSD 0.05	0.057	0.174	0.054	0.071	0.171	0.279
LSD 0.01	0.079	0.241	0.075	0.098	0.237	0.387

Table 6. Mean sum of squares (MS) and heritability (h^2) for cooking quality characters (gel consensity, gel temperature, kernel elongation, cooking time, water uptake and protein) for 8 rice varieties

SOV	D.f	G.C.	G. T.	K. Elo.	Co. T.	W. U.	Protein
Replications	2	0.004	0.101	0.008	0.004	0.104	0.90
Varieties	7	4.548 **	1.626 **	6.174 **	2.448 **	216.924 **	4.81 **
Error	14	0.001	0.0098	0.0009	0.002	0.0095	0.02
h^2 in broad sense		99.931	98.210	99.954	99.800	99.987	98.69

*Significance at 0.05 ** Highly Significance at 0.01

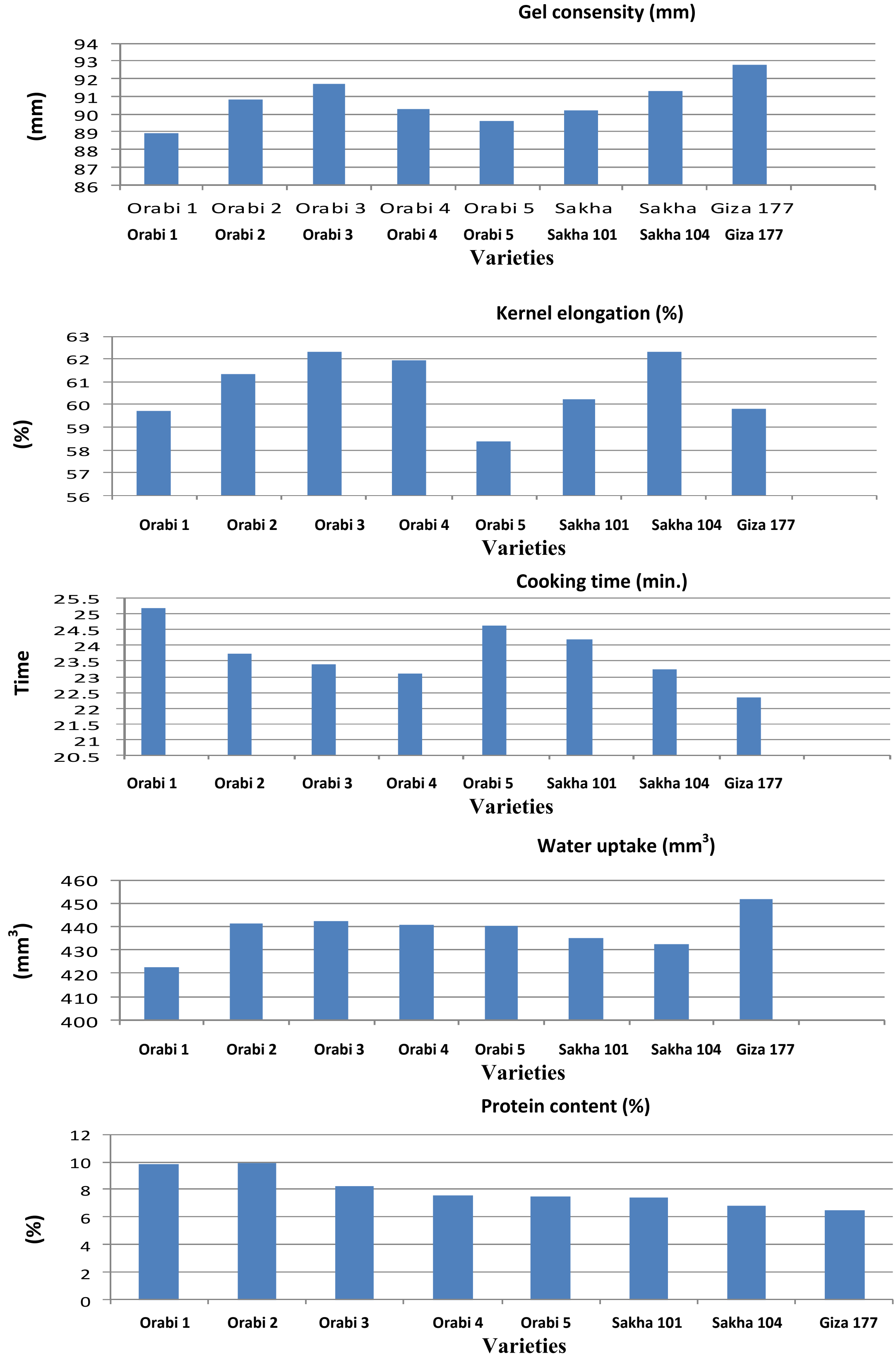

Fig. 2. Cooking quality characters *i.e.,* Gel consensity, Kernel elongation, Cooking time, water uptake and protein content for studied varieties

Table 7. Correlation coefficient (r) for eleven characters studied in the 8 rice varieties

	L. mm	W. mm	L/W (%)	W.R (%)	H R (%)	BR. R (%)	G.C mm	K. E (%)	Co.T min	W.U ml	P. (%)
L. mm		0.382	0.023	0.663	-0.597	0.705	0.081	0.300	-0.223	0.455	-0.177
W. mm			-0.889**	0.138	0.187	-0.152	0.049	0.146	-0.064	0.044	-0.443
L/W (%)				0.245	0.323-	0.359	0.152	-0.051	-0.204	-0.416	0.205
W. R (%)					-0.104	.299	0.651	0.674	-0.808*	0.657	-0.509
H. R (%)						-.980 **	0.470	-0.132	-0.379	0.073	-0.625
BR.R (%)							-0.321	0.261	0.203	0.060	0.499
G. C mm								0.391	-0.907**	0.759*	-0.559
K. E (%)									-.502	0.027	-0.018
CO.T min										0.756*	0.640
W.U ml											-0.504
P. (%)											

*,**: Significant at 5% and 1% level probability, respectively.

correlated, thirty were positive correlated but not significant and twenty- four were negative and not significant. These results were in a good harmony with results of (Rukmini *et al*., 2016; Samir *et al*., 2016).

RAPD analysis

Among the 20 RAPD primers tested, only 6 produced bands polymorphic between varieties Fig. 4 and Table 8. The total number of amplified fragments, number of monomorphic fragments, number of polymorphic fragments and percentage of polymorphism obtained per RAPD primers were shown in Tables 8 and 9. An average of 8.2 bands per primer was amplified (ranging from approximately 189 to 1696 bp) and 87.8% were polymorphic. The oligonucleotides OPC-07 presented the highest percentage of RAPD polymorphism (100%). OPC-04 oligonucleotides, presented one unique band (409 bp) to Orabi 3 variety and OPC-07 oligonucleotides, presented two unique bands (524 and 858 bp) to Orabi 3 variety while, OPA-05 oligonucleotides, presented four unique bands (295,377,533 and 1650 bp) also to Orabi 3 variety. OPB-10 presented three unique bands (626, 1332 and 1431 bp) to Orabi 4, Giza 177 and Orabi 5, respectively (Table 8), OPA-11 oligonucleotides, presented three unique bands (189, 244 and 1476 bp) to Giza 177, Sakha 104 and Orabi 3 varieties, respectively (Table 5), OPC-02 oligonucleotides, presented one unique band (1125 bp) to Sakha 104 variety.

The similarity coefficient values among all varieties and varieties based on band polymorphisms generated by RAPD-PCR after using the primers were presented in Table 10. The highest similarity value (0.898) was found between Orabi 4 and Orabi 5 varieties and the lowest value (0.469) was found between Orabi 3 and Sakha104.

The dendrogram of genetic distances among all tested varieties and varieties based on band polymorphisms generated by RAPD-PCR after using the primers is shown in (Fig. 3). The dendrogram separated all varieties and varieties into three clusters. First cluster included Orabi 4, Orabi 5, Orabi 2 and Orabi 1. Second cluster included Sakha 104, Giza 177 and Sakha 101. Third cluster formed a separate cluster with Orabi 3.

The detection of RAPD markers on the genomic maps of different field crops is beneficial to improve breeding programs of these crops. It offers the simplest and fastest method for detecting a great number of genomic markers is less period of time (Edwards *et al.,* 1992).

Table 8. RAPD Primers, molecular size (bp), monomorphic, polymorphic and unique bands for 5 new promising drought tolerance varieties and 3 local varieties of rice

Primer	M.S (bp)	Orabi 1	Orabi 2	Orabi 3	Orabi 4	Orabi5	Sakha 101	Sakha 104	Giza 177	Polymorphism
OPC-04	1303	0	1	1	0	1	0	0	0	Polymorphic
	960	0	1	1	0	1	0	0	0	Polymorphic
	833	0	1	1	1	1	1	1	1	Polymorphic
	457	1	1	1	1	1	1	1	1	Monomorphic
	409	0	0	1	0	0	0	0	0	**Unique**
OPC-07	1696	0	1	0	1	1	0	0	0	Polymorphic
	1449	1	1	1	1	1	0	1	0	Polymorphic
	1277	0	1	1	1	1	1	1	1	Polymorphic
	1144	0	1	0	1	1	1	1	1	Polymorphic
	1045	0	0	0	0	0	1	1	1	**Polymorphic**
	969	1	1	1	1	1	0	1	0	Polymorphic
	858	0	0	1	0	0	0	0	0	**Unique**
	637	0	1	1	1	1	0	1	1	Polymorphic
	576	0	1	0	1	1	0	1	0	Polymorphic
	524	0	0	1	0	0	0	0	0	**Unique**
	446	1	1	0	1	1	1	1	1	Polymorphic
OPA-05	1650	0	0	1	0	0	0	0	0	**Unique**
	1408	1	1	1	1	1	1	1	1	Monomorphic
	1229	0	1	1	1	1	0	0	0	Polymorphic
	1017	0	1	0	1	1	0	0	0	Polymorphic
	947	1	1	1	1	1	0	1	1	Polymorphic
	848	1	1	0	1	1	0	1	1	Polymorphic
	533	0	0	1	0	0	0	0	0	**Unique**
	493	1	1	0	1	1	1	1	1	Polymorphic
	377	0	0	1	0	0	0	0	0	**Unique**
	295	0	0	1	0	0	0	0	0	**Unique**
OPB-10	1431	0	0	0	0	1	0	0	0	**Unique**
	1132	0	0	0	0	0	0	0	1	**Unique**
	908	1	1	1	1	1	1	1	1	Monomorphic
	763	1	1	1	1	1	0	1	1	Polymorphic
	626	0	0	0	1	0	0	0	0	**Unique**
	521	1	1	1	1	1	0	0	1	Polymorphic
	365	1	1	1	1	1	1	1	1	Monomorphic
OPA-11	1476	0	0	1	0	0	0	0	0	**Unique**
	1203	1	0	1	1	1	1	0	0	Polymorphic
	958	0	1	1	0	0	0	1	1	Polymorphic
	776	0	0	1	1	1	1	0	0	Polymorphic
	636	1	1	1	1	1	1	1	1	Monomorphic
	486	0	0	1	1	1	1	1	1	Polymorphic
	308	1	1	1	1	1	1	0	0	Polymorphic
	244	0	0	0	0	0	0	1	0	**Unique**
	189	0	0	0	0	0	0	0	1	**Unique**
OPC-02	1476	1	1	0	1	1	0	1	0	Polymorphic
	1392	0	1	0	1	1	1	0	1	Polymorphic
	1187	1	0	1	0	1	1	1	1	Polymorphic
	1125	0	0	0	0	0	0	1	0	**Unique**
	916	1	1	1	1	1	1	1	1	Monomorphic
	824	0	0	0	0	0	1	1	0	Polymorphic
	405	1	1	0	1	1	1	1	1	Polymorphic
Total		19	29	31	30	32	20	27	24	

Table 9. Number of monomorphic fragments, polymorphic fragments, unique fragments and percentage of polymorphism obtained per RAPD Primer for all varieties and varieties

Primer	Range of fragment sizes (bp)	Total No. of fragments	Monomorphic fragments	Polymorphic fragments	Unique fragments	Polymorphism (%)
OPA-05	295-1650	10	11	5	4	90
OPA-11	189-1476	9	1	5	3	88.8
OPB-10	365-1431	7	2	2	3	71.4
OPC-02	405-1476	7	1	5	1	85.7
OPC-04	409-1303	5	1	3	1	80
OPC-07	446-1696	11	0	9	2	100
Total	189-1696	49	6	29	14	87.8
Average		8.2	1	4.8	2.3	

Table 10. The similarity coefficient values among all varieties and new lines based on band polymorphisms generated by RAPD-PCR after using the primers

Variety	Orabi 1	Orabi 2	Orabi 3	Orabi 4	Orabi 5	Sakha 101	Sakha 104	Giza 177
Orabi 1	1.000	0.714	0.551	0.735	0.714	0.694	0.714	0.694
Orabi 2		1.000	0.551	0.857	0.878	0.571	0.714	0.694
Orabi 3			1.000	0.531	0.592	0.490	0.469	0.490
Orabi 4				1.000	.898	0.673	0.694	0.673
Orabi 5					1.000	0.653	0.673	0.653
Sakha 101						1.000	0.694	0.755
Sakha 104							1.000	0.776
Giza 177								1.000

Rescaled distance cluster combine

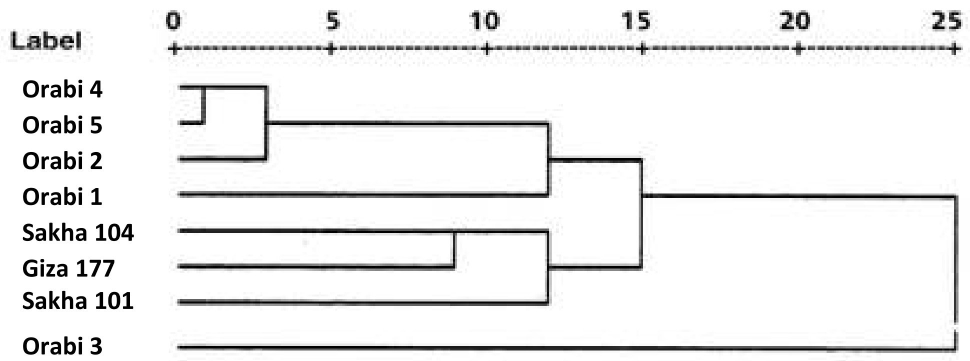

Fig. 3. The dendrogram of genetics distances among all tested varieties and varieties based on band polymorphisms generated by RAPD-PCR after using the primers

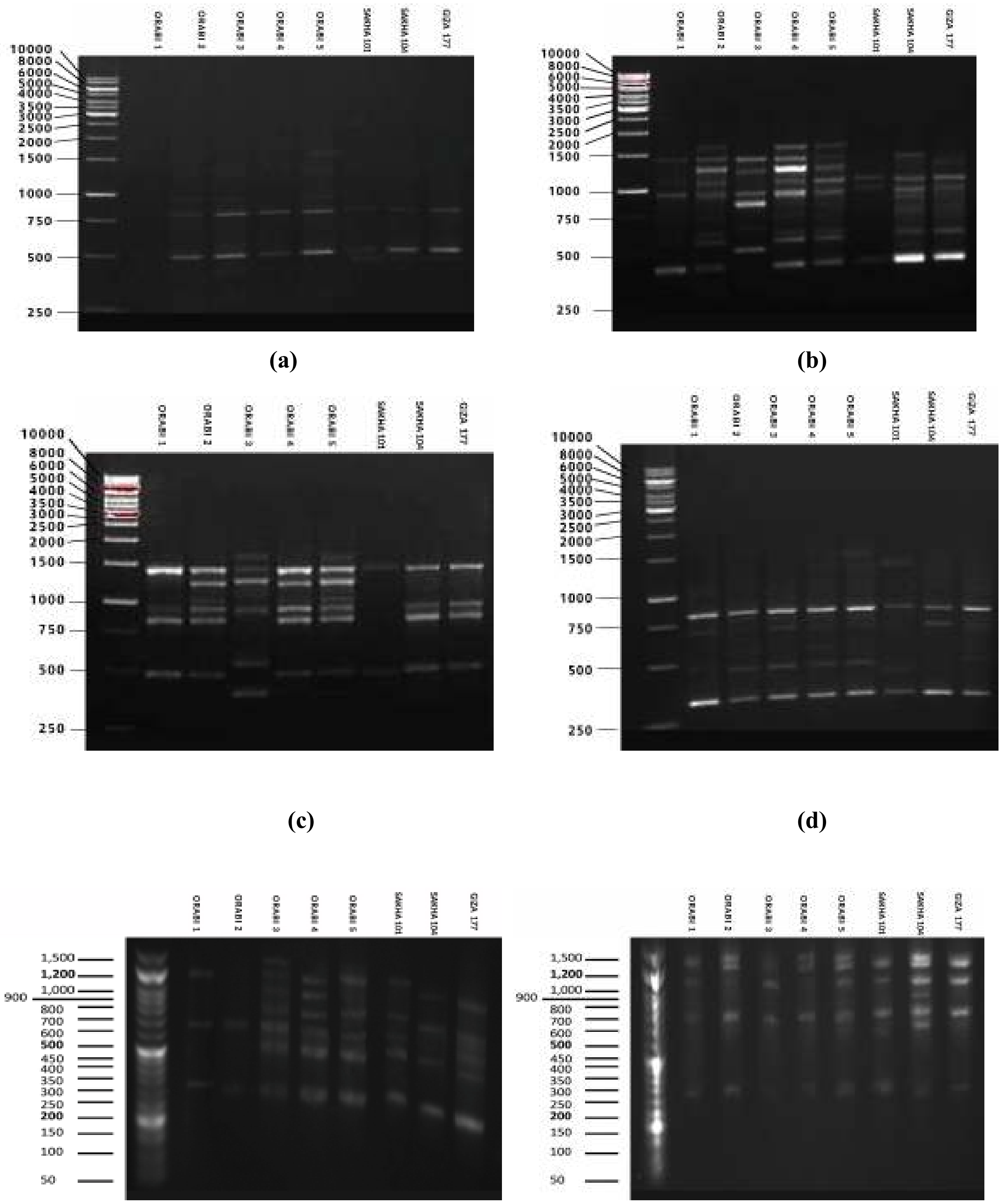

Fig. 4. The result of RAPD-PCR simplification in the 5 new drought varieties and 3 sensitive varieties based on OPC-04 (a), OPC-0 7(b), OPA-05 (c), OPB-10 (d), OPA-11 (e) and OPC-02 (f)

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تحـــديـــد خصـــائـــص الجـــودة والمعلمات الوراثية لخمسة أصناف مبشرة تتحمل الجفاف فى الأرز

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تهدف هذه الدراسة إلى تقيم خمسة أصناف جديدة واعدة تتحمل الجفاف من الأرز باستخدام صفات الجودة والمفاهيم الجزيئية، وشملت هذه الدراسة على خمسة أصناف تتحمل الجفاف هى عرابى ١ ، عرابى ٢، عرابى٣ ، عرابى ٤ وعرابى ٥ وثلاثة أصناف تقليدية حساسة للجفاف هى سخا ١٠١ و سخا ١٠٤ و جيزه ١٧٧ ، تمت الدراسة بتقييم صفات الجودة الفيزيائيه وصفات التبيض والطهى، تمت دراسة أربعة عشرة صفه وهى طول وعرض وسماكة ونسبة الطول/العرض للحبة كمثال للصفال الفيزيائية ونسبة الأرز البنى، الأرز الأبيض، الحبة الكاملة والحبة المكسورة كمثال لبعض صفات جوده التبيض، ودرجة الانتشار، درجة الجلتنة، نسبة استطالة الحبة، وقت الطهى، ومعدل امتصاص الماء ونسبه البروتين كمثال لبعض صفات الجودة الطهى، ظهرت فروق معنوية كبيرة بين الطرز الوراثية المدروسة لصفات الجودة الفيزيائية وصفات التبيض والطهي، وبصفة عامة، سجلت أصناف عرابي نسبة أعلى فى صفة الطول/العرض الحبة من الأصناف المحلية، ولكنها ترتبط سلبا مع الحبة الكاملة وترتبط ارتباطا إيجابيا مع الحبة المكسورة باستثناء الصنف جيزة ١٧٧، وفيما يتعلق بمعايير التبيض، فإن جميع الطرز الوراثية تمتلك نسبة عالية من الأرز البني والأبيض، الحبة الكاملة في الأصناف التقليدية أعلى من أصناف عرابي، وعلى النقيض من ذلك، سجلت نسبة مئوية منخفضة لصفه الحبة المكسورة فى الأصناف المحلية من أصناف عرابى، تنوع منخفض بين الطرز الوراثية في درجه الانتشار، على النقيض من ذلك وجود تباين كبير في صفه درجة الجلتنة، استطالة الحبة، معدل امتصاص الماء بين الطرز الوارثية، الأصناف التقليدية بالنسبة لمعايير صفات الجودة فى الطهى، سجلت صفه محتوى البروتين أعلى قيمة في أصناف عرابي ١، ٢ و٣ من الأصناف الأخرى، تم الكشف عن ارتباط سلبي كبير بين صفه درجه الانتشار وصفه زمن الطهى، وارتباط سلبي كبير بين صفه زمن الطهي و معدل امتصاص الماء، لا يوجد ارتباط بين صفه محتوى البروتين واغلب الصفات المدروسة تقريبا .وقد اقتربت أصناف عرابي ٥ وعرابي ٣ الأصناف التقليدية، فى أغلب معايير الجودة والأقلمة عام بعد آخر بالنسبة لأصناف عرابي المتحملة للجفاف سيخفض من نسبة الحبة المكسورة، أظهر تطبيق RABD-PCR حزمات فريدة من الحمض النووى في صنف عرابي ٣ وتطابقت هذه البيانات تحديدا مع نتيجة الديندرجغرام حيث وجد صنف عرابى ٣ في مجموعة منفصلة .ولكن، تم الكشف عن اثنين من الحزم الفريدة من نوعها فى صنف سخا ١٠٤ في برايمر OPA-11 و OPC-04 وكذلك صنف جيزة ١٧٧ امتلك اثنين من الحزمات الفريدة من نوعها في برايمر OPA-10 و OPA-11، بالإضافة إلى ذلك، تم الكشف عن حزمه واحدة فريدة لصنف عرابي ٤ وعرابي ٥ في برايمر OPA-05.

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