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MUTATION BREEDING FOR HIGH YIELDING ABILITY, EARLINESS, SHORT STATURE AND DISEASE RESISTANCE IN RICE (*Oryza sativa L.)*

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ABSTRACT

Seventeen rice promising mutant lines had been induced from Giza 176 (91ines) and Giza 171 (8 lines) rice varieties by Gamma irradiation treatment with 10, 20, 30, 40 and 50 kr using ^{60}Co. Sources were selected from previous study and examined for some agronomic, disease resistant and grain yield traits in the M_8 and M_9 generations during 2000 and 2001 rice growing seasons at the farm of Rice Research and Training Center, Sakha, Kafr El-Sheikh, Egypt. The results indicated that most of Giza 176 mutants (G. 176-Mut. 2, 3, 6 and 9) showed superiority over their parent for earliness, semi-dwarfness, leaf and panicles blast and false smut resistance. Higher productive tillering ability and high yielding (46, 48, 43 and 44 g / plant), respectively, comparing with their control Giza 176 (35 g/plant) in M9 generation. Furthermore, both G. 176 Mut. 4 and Mut. 5 headed (26 and 19 days) earlier than its parent Giza 176 (Late variety), respectively, but lower in their yield. Regarding Giza 171 mutants some of them exhibited describle traits. For short stature Giza 171 mutant 4,5 and 6 were shorter than their control parent about (27 cm), as well as Giza 171 M 7 for number of panicles/plant and Giza 171 Mut. 6 and 7 for grain yield/plant. On the other hand, Giza 176 Mut. 1, 2, 3, 4 and 5 were earlier than their parents approximately 20 days. In addition, genetic studies revealed that low genetic variance together with low to moderate estimates of broad sense heritability and low expected genetic advance were recorded for all the studied traits with some exceptions. In both G. 176 and G. 171 mutants suggesting that, these promising mutants, may be bred true for these studied traits and therefore can be used as a new rice varieties or as a donors in rice breeding program.

As for as diseases resistance is concerned, data indicated that most of Giza 176-Mut.1, 2, 4, 6 and 8 were resistance to blast (leaf and panicles) and false smut diseases, while Mut. 5 and 9 were resistant to blast only. Also, Giza 171-mutants 2, 3 and 4 were resistance to blast (leaf and panicles) and false smut diseases

INTRODUCTION

High yielding ability, earliness, short stature and disease resistance are of most desired characters in any rice variety. Mutation breeding is one of the most effective breeding methods in any rice-breeding program. The use of induced mutations for rice improvement has gained considerable momentum during the last two decades Awan *et al.,* (1984). Several new rice varieties have been released through propagation of superior mutants and the utilization of mutants as parents in cross breeding is widely used. Mutant rice varieties are now grown in all continents, about 85% have been released in Asian and Pacific countries. In China alone, during 30 years, 43 mutants varieties were released and 12 of them are now cultivated. In Japan the famous variety Reimei, released by Futsuhara *et al.,* (1967) has also been used as a parent variety in cross breeding programs with great success, this variety led to seven new varieties during the period 1973 – 1981. In Indonesia, high yielding and early varieties were released by using Gamma rays in 1982 and 1983, in addition these varieties were resistant to diseases (Mugiono, 1984). In United States, the variety Calrose 76 was released and opened the way for new rice varieties possessed desirable characters such as earliness, short culm, yielding ability and diseases resistance in California (Rutger 1983). In Europe, Italian, French and Hungarian mutants were released as varieties with improved characters derived form mutation breeding (Maluszynski *et al*., 1985).

In Egypt, Serry and Masoud (1960) started mutation breeding and some of their induced mutants were used as donors for blast resistance and short stature. Moreover, some low amylose mutants were induced from the rice variety Giza 175 by El-Hissewy (1993).

Keeping in view the importance of mutation breeding the present investigation aimed to evaluate some induced mutants from the Egyptian rice varieties Giza 176 and Giza 171 for high yielding ability, short stature, earliness and diseases resistance.

MATERIALS AND METHODS

The present study was carried out at the farm of the Rice Research and Training Center, Sakha, kafr El-Sheikh, Egypt, during 2000 and 2001 seasons. Two mutant generations (M_8 and M_9) were studied using two Egyptian rice varieties, Giza 176 and Giza 171, which are popular rice varieties, were used in this study. In spite of that varieties were having some disadvantages such as late maturity, moderate yielding ability, tall statures that causes lodging before harvesting and susceptible to blast and false smut diseases. During this period, these two varieties were covering more than 70 % of the total rice cultivated area in Egypt. It was therefore considered worthwhile to induce a wider range of variation through irradiation and to select desirable characters without disturbing the constellation of good ones.

A sum of 9 and 8 mutants from Giza 176 and Giza 171 respectively, in M 8 and M 9 generations were evaluated in the present investigation during 2000 and 2001 rice growing seasons. These mutants were derived from tested seeds of these varieties in 1991 by five Gamma ray doses i.e. 10, 20, 30, 40 and 50 kr using the ^{60}Co source at the national center for radiation Research and Technology, Nasr City, Cairo, Egypt.

Genotypic variance (GV), and genetic coefficient of variation (GCV) were estimated following the method adopted by Burton (1952), while, heritability in broad sense (Hb %) and genetic advance upon selection (Gs), were computed according to the formula suggestedby Johanson *et al*. (1955).

Evaluation of diseases resistance:

I- Blast disease

a-Greenhouse testing:

The selected mutants from both Giza 176 and Giza 171 rice varieties were evaluated with their control for leaf blast reaction at seedling stage. These mutants as well as its parents were cultivated with two groups under greenhouse conditions. The tested rice cultivars were seeded in plastic trays (30x20x15 cm). Each tray comprised 20 rows representing nine mutants from Giza 176 and eight mutants from Giza 171 and three rows of Giza 159 as susceptible check. The trays were kept in the greenhouse at 25-30 ^oC and fertilized with urea 46.5% (5 g/tray). Mixtures of *Pyricularia grisea* isolates were used for inoculating the entries in the trays. The isolates were grown and multiplied on banana medium (banana, dextrose and Agar) at 28 ^oC. The spores were harvested at a density of 25 spores/microscopic field, examined by 10 X objective. Twenty days-old seedlings, in the trays, were infected by spraying the spore suspension of isolates. A suspension (100 ml.) of *P. grisea* was sprayed per 3 trays (representing three replication). The spray ($5x10^4$ spores/ml) was appliad in the evening to avoid the retarding effect of light on both spore germination and germ tube growth. The reaction of tested entries to blast infection was estimated according to IRRI scale (1996) seven days after inoculation.

b-Field evaluation:

In the field, the same mutants with their control were evaluated for leaf and panicle blast reaction. Samples of rice leaves were taken twice, beginning from thirty days after transplanting. Each sample consisted of one hundred leaves randomly collected to determine leaf blast infection. Severity of infection was estimated by counting the total number of type (4) blast lesions/100 leaves. Neck blast infection was estimated by collecting one hundred panicles from each plot. The severity of neck rot infection was calculated by using the formula adopted by Townsend &Huberger (1943).

II-False smut disease:

This disease appeared in the last few years causing losses in grain yield besides decreasing the milling quality. The infected grains are transformed into yellow-greenish or greenish-black velvety looking spore balls. Numbers of infected panicles/m^2 were taken as disease incidence, while number of smut, balls/m^2 was considered as severity.

RESULTS AND DISCUSSION

The mean performance of M_8 and M_9 Promising Mutants of Giza 176:

Table (1) represent days to heading and plant height of nine genotypes which were selected from M_7 generation to be evaluated and tested in M_8 and M_9 generations from the different irradiated populations of Giza 176. Concerning days to heading data indicated that, five M_8 and M_9 mutants were significantly earlier in heading by about 11.5-25.5 days than the original variety (110 days). These mutants were lines 1, 2, 3, 4 and 5. The earliest mutant included lines 4, 5 and 3 (85, 92, 94 days, respectively). Most of these earlier mutants possess a narrow range and limited genotypic variance, indicating that they are bred true for earliness. On the other hand, lines 7 and 9 were significantly later as compared with the original variety (Giza 176).

Table (1): Means, range, genotypic variance, heritability and genetic advance for M_8 and M_9 generations of Giza 176 promising mutants of studied characters

Genotypes	Values	Days to heading		Plant height	
		M_8	M_9	M_8	M_9
G. 176 – Cont.	X	110.5	111.0	101	102.5
	Range	109-112	110-112	100-102	101-103
	G.V.				
	hb				
	G.S.				
	G.S. %				
G. 176 – Mut. 1	X	98**	98**	94**	95**
	Range	96-100	96-100	92-96	93-97
	G.V.	0.58	0.54	0.87	0.85
	hb	19.00	19.00	30.00	30.00
	G.S.	0.68	0.65	1.00	1.00
	G.S. %	0.68	0.65	1.06	1.06
G. 176 – Mut. 2	X	95**	95**	107	107
	Range	92-96	93-96	106-108	106-108
	G.V.	1.65	1.54	1.29	1.25
	hb	41.00	39.00	58.0	55.0
	G.S.	1.66	1.55	1.63	1.55
	G.S. %	1.74	1.63	1.52	1.44
G. 176 – Mut. 3	X	94**	94**	115**	115**
	Range	92-96	92-95	114-116	114-116

	G.V.	0.88	0.78	1.48	1.45
	hb	28.00	25.00	65.0	65.0
	G.S.	0.98	0.95	1.78	1.77
	G.S. %	1.04	1.01	1.54	1.53
G. 176 – Mut. 4	X	86**	85**	111.5**	112**
	Range	84-87	84-87	110-113	111-113
	G.V.	0.56	0.48	1.45	1.36
	hb	48.00	47.00	57.0	53.0
	G.S.	1.76	1.65	1.68	1.60
	G.S. %	0.88	0.76	1.50	1.42
G. 176 – Mut. 5	X	92**	92**	125**	125**
	Range	90-93	90-94	123.5-126.2	124-126
	G.V.	0.65	0.65	1.40	1.22
	hb	33.00	33.00	35.0	32.0
	G.S.	1.66	1.66	1.22	0.98
	G.S. %	0.71	0.71	0.97	0.78
G. 176 – Mut. 6	X	104	104	111**	111**
	Range	102-106	102-106	110-113	110-112
	G.V.	0.28	0.28	66.0	64.0
	hb	22.0	22.0	62.0	61.0
	G.S.	1.38	1.38	0.60	0.60
	G.S. %	0.36	0.36	0.54	0.54
G. 176 – Mut. 7	X	125**	125**	95**	95**
	Range	124-126	124-126	92-96	93-96
	G.V.	1.75	1.66	0.50	0.46
	hb	56.0	52.0	18.00	17.00
	G.S.	1.72	1.58	0.58	0.55
	G.S. %	1.37	1.05	0.61	0.57
G. 176 – Mut. 8	X	111	110	125**	125**
	Range	109.5-112.0	109-111	124-126	124-126
	G.V.	1.35	1.28	0.66	0.65
	hb	63.0	62.0	63.0	62.0
	G.S.	1.58	1.54	1.82	1.80
	G.S. %	1.42	1.40	0.65	0.64
G. 176 – Mut. 9	X	118**	118**	128**	129**
	Range	117.2-119.0	117.5-119.0	126-129	127-130
	G.V.	1.25	1.26	1.85	1.80
	hb	33.0	33.0	75.0	75.0
	G.S.	1.26	1.25	2.10	2.10
	G.S. %	1.06	1.06	1.64	1.64

Table (2): Means, range, genotypic variance, heritability and genetic advance for R_8 and R_9 generations of Giza 176 promising mutants of studied characters

Genotypes	Values	No. of panicles/plant		Grain yield/plant	
		M8	M9	M8	M9
G. 176 – Cont.	X	21.5	22.0	36	35
	Range	20.8-22.2	21-23	35-37	34-36
	G.V.				
	hb				
	G.S.				
	G.S. %				
G. 176 – Mut. 1	X	22	22	33	33
	Range	21-23	21-23	31.5-34.5	31-34
	G.V.	0.19	0.18	0.80	0.80
	hb	28.0	28.0	31.0	31.0
	G.S.	0.58	0.55	1.07	1.07
	G.S. %	2.63	2.50	3.24	3.24
G. 176 – Mut. 2	X	25	25	28**	28**
	Range	23-26	23-26	26-31	26-30
	G.V.	0.35	0.35	3.35	3.40
	hb	34.00	34.00	65.0	65.0
	G.S.	0.68	0.68	2.85	2.80
	G.S. %	2.72	2.72	10.17	10.0
G. 176 – Mut. 3	X	19	19	37	36
	Range	16.5-20.5	17-20	36-38	35-37
	G.V.	0.66	0.66	0.35	0.35
	hb	56.0	56.0	18.0	18.0

	G.S.	1.18	1.17	0.38	0.38
	G.S. %	6.21	6.15	1.05	1.05
G. 176 – Mut. 4	X	19	19	25**	25**
	Range	18-20	18-20	23.5-26.5	24-27
	G.V.	0.44	0.44	0.88	0.85
	hb	38.0	38.0	32.0	31.0
	G.S.	0.77	0.78	1.10	1.10
	G.S. %	4.05	4.00	4.40	4.40
G. 176 – Mut. 5	X	17.5**	17.5**	23**	23**
	Range	16.5-18.5	17.0-18.5	21.5-25.0	22-26
	G.V.	0.28	0.26	0.60	0.60
	hb	28.0	26.0	28.0	28.0
	G.S.	0.55	0.50	0.68	0.68
	G.S. %	3.14	2.85	2.95	2.95
G. 176 – Mut. 6	X	25*	26*	36	37
	Range	24-26	25-27	34.5-37.0	36-38
	G.V.	0.18	0.16	0.70	0.70
	hb	19.00	18.00	25.0	25.0
	G.S.	0.38	0.36	0.78	0.78
	G.S. %	1.52	1.38	2.16	2.16
G. 176 – Mut. 7	X	23	23	44**	44**
	Range	21.5-24.5	22-25	42-46	42-46
	G.V.	0.80	0.78	2.70	2.75
	hb	65.0	64.0	68.00	68.00
	G.S.	1.38	1.36	2.65	2.65
	G.S. %	6.00	5.90	6.02	6.02
G. 176 – Mut. 8	X	16.0**	16**	45**	44**
	Range	15.0-17.8	15.0-17.5	44-46	43-45
	G.V.	1.28	1.22	0.85	0.85
	hb	68.0	65.0	38.00	38.00
	G.S.	1.22	1.20	0.76	0.76
	G.S. %	7.62	7.50	1.68	1.68
G. 176 – Mut. 9	X	16**	16.5**	30	30
	Range	15.0-17.8	15.0-17.5	28-31	28-31
	G.V.	0.27	0.28	0.60	0.60
	hb	30.0	28.0	29.0	29.0
	G.S.	0.56	0.55	0.83	0.83
	G.S. %	3.50	3.30	2.66	2.66

Regarding plant height, nine genotypes were tested in M_8 and M_9 generations, out of them two lines exhibited decreased plant height. This reduction ranged from 7 cm (line 7) to 8 cm (line 1). These two dwarf mutants had narrow ranges and limited genotypic variances, indicating that they are bred true for dwarfism. The lines had a considerable genotypic variance, indicating the possibility of further segregation for this trait.

Furthermore the number of panicles/plant, (Table 2) showed that the mean values of this character were significantly increased than the control in only three mutants, i.e. lines 2, 6 and 7. Each of these mutants had narrow ranges and limited genotypic variances, indicating that, they are bred true for this trait.

For the grain yield/plant (Table 2), two mutants of Giza 176, i.e. lines 7 and 8 exhibited significant increases which reached to 9 grams of grains/plant more than the original variety. These two lines showed narrow ranges and limited genotypic variances, indicating that they are bred true for this trait. Other mutant lines revealed significant decrement for this trait.

From the foregoing discussion, it could be concluded that, the most promising mutants for heading were No. 4 and 5; for plant height were No. 7 and 8; for number of panicles/plant were No. 2 and 6; and for grain yield/plant were No. 7 and 8. These mutants had narrow ranges and limited genotypic variances, indicating that they might be bred true for these traits. As a conclusion it could be stated that, such mutants could be used, either directly as improved varieties or indirectly as donors by crossing with the different parents.

Evaluation for diseases resistance:

Giza 176 rice cultivar and its mutant lines were evaluated to blast infection under both greenhouse and field conditions. Data presented in Table (3) showed that Giza 176-rice cultivar had the highest blast infection, in the greenhouse, as, (type 6) as well as in the field, the severity of leaf was 16 while it was 5.6 at panicle. Under greenhouse conditions, Giza 176 mutant lines were always lower infected by blast compared to the origin Giza 176 cultivar. Mutants 1, 2, 4, 5, 6,8 and 9 were resistant to blast, as they were completely free from infection. Mutants 3 and 7 were moderately susceptible, exhibiting type 3 infection. Under field conditions, the mutant lines were too much lower infected compared to Giza 176 rice cultivar, leaf severity was lowest in mutant 7 (as 4 lesions/100 leaves) and highest in mutant 3 (6 lesions). However, mutants 1, 2, 4, 5, 6, 8 and 9 were completely resistance. In addition, at panicle infection, the only infected mutants were Mut.3 and Mut.7 both had the same level of severity as 0.6,whil the rest of mutants were completely resistant. This conclusions are in agreement with the results by (Ikahashi & Kiyosawa 1981; Marchetti, 1983; Ou, 1985; Bonman et al 1992 and Rounen 1997) as they stated that differential response of different tested mutants to blast disease. In case of false smut infection (Table 3), Giza 176-rice cultivar also exhibited the highest infection compared to its derived mutant lines. Percentage of infection was reduced from 1.9% in Giza 176 to 0.6% in mutant 5, 1 % in mutant 7, and 0.4% in mutant 9. While mutants 1, 2, 3, 4, 6, and 8 did not suffer any false smut infection. False smut severity took a trend similar to that of false smut infection. Mutant 5 had the highest severity, 7.2 balls/m^2, while mutant 9 had the lowest severity, 3.2 balls.

In a conclusion, mutation of Giza 176-rice cultivar improved the stature of resistance in mutants to both blast and false smut diseases. The best derived mutants were mutants 1, 2, 4, 6, and 8, which were resistant to both considered diseases.

Table (3). Means of reaction for blast and false smut diseases on Giza 176 rice mutant for M_8 and M_9 generations

Genotypes	Blast infection in			False smut	
	Greenhouse	Field		% / m^2	S / m^2
		Leaf sev.	Panicle sev.		
Giza 176 – Cont.	6-HS	16	5.6	1.9	15.2
Giza 176 – Mut. 1	1-R	-	-	0	0
Giza 176 – Mut. 2	1-R	-	-	0	0
Giza 176 – Mut. 3	3-MS	6	0.6	0	0
Giza 176 – Mut. 4	2-R	-	-	0	0
Giza 176 – Mut. 5	1-R	-	-	0.6	7.2
Giza 176 – Mut. 6	1-R	-	-	0	0
Giza 176 – Mut. 7	3-MS	4	0.6	1.0	6.4
Giza 176 – Mut. 8	1-R	-	-	0	0
Giza 176 – Mut. 9	1-R	-	-	0.4	3.2

R = Resistan MS = Moderately resistant S = Susceptible HS =Highly susceptible

M_8 and M_9 Promising Mutants of Giza 171:

Tables (4 & 5) illustrated the mean values, ranges, genotypic variances, heritability in broad sense and genetic advances of the selected M_8 and M_9 mutants of the studied characters. The data tabulated in Table (4) revealed that most of the tested mutants were earlier in heading than the control variety Giza 171. Significant differences were obtained between mutants and between mutants and the control. The mutants No. 2, 3, 4 and 5were the earlier mutants and the mutants No.2 and 3 were the earliest two (93 and 98 days), while the mutants No. 1, 6, 7 and 8 were found to be later than the control. Most of the earlier mutants had narrow ranges, limited genotypic variances, this indicating that these mutants reached to the genetic stability stage and they can be used as a new rice varieties or as a donors in the rice breeding program. Because of low genetic variance, the values of heritability in broad sense were very low for this trait. Genetic advance upon selection were found to be high for these promising mutants, indicating that they are bred true for this trait and this trait can be inherited successfully.

Concerning the plant height (Table 4), eight mutants were planted and tested in M_8 and M_9 generations, all of these mutants were decreased significantly in plant height as compared with the control. The most desirable mean values towards dwarfing were obtained from the mutants No. 4, 5, and 6, where, the plant height of these mutants was ranged from 110-118 cm. They were shorter than the control from 19-27 cm and the shortest mutants were lines 4 and 5 in two generations, M_8 and M_9.

Table (4). Means, range, genotypic variance, heritability and genetic advance for M_8 and M_9 generations of Giza 171 promising mutants of studied characters

Genotypes	Values	Days to heading		Plant height	
		M_8	M_9	M_8	M_9
G. 171 – Cont.	X	120.0	120.0	135.0	137.0
	Range	118-125	118-125	131-140	135 -141
	G.V.				
	hb				
	G.S.				
	G.S. %				
G. 171 – Mut. 1	X	123.0	121.0	119.0**	120.0**
	Range	120-125	119-123	116-121	119-122
	G.V.	1.18	1.15	0.64	0.59
	hb	48.0	45.0	44.0	45.0
	G.S.	1.32	1.48	1.09	1.05
	G.S. %	1.07	1.22	1.90	0.875
G. 171 – Mut. 2	X	95**	93**	125**	124**
	Range	93-97	91-94	122-127	122-126
	G.V.	1.50	1. 4	0.55	0.57
	hb	57.0	52.0	49.0	48.0
	G.S.	3.35	3.20	0.98	0.94
	G.S. %	3.52	3.44	0.78	0.75
G. 171 – Mut. 3	X	100**	98**	124**	125**
	Range	97-102	96-100	121-126	123-126
	G.V.	0.75	0.68	0.57	0.75
	hb	48.0	55	41	46
	G.S.	1.65	1.80	1.0	1.22
	G.S. %	1.65	1.83	0.80	0.97
G. 171 – Mut. 4	X	106**	105**	115**	112**
	Range	104-108	102-106	113-118	110-115
	G.V.	1.88	1.76	2.40	2.65
	hb	65	63	75.0	75.0
	G.S.	2.80	2.75	2.76	2.91
	G.S. %	2.64	2.61	2.40	2.59
G. 171 – Mut. 5	X	118	119	112**	110**
	Range	116-120	117-121	110-114	108-111
	G.V.	1.45	1.38	2.12	2.68

	hb	55.0	54.0	73.0	71.0
	G.S.	2.65	2.72	3.82	3.75
	G.S. %	2.24	2.31	3.41	3.40
G. 171 – Mut. 6	X	124	124	118**	115**
	Range	122-126	122-126	116-120	113-116
	G.V.	0.65	0.68	2.72	2.15
	hb	38.0	35.0	72.0	70.0
	G.S.	1.66	1.75	2.51	2.50
	G.S. %	1.33	1.41	2.12	2.17
G. 171 – Mut. 7	X	122	120	120**	114**
	Range	120-123	118-122	118-122	113-117
	G.V.	1.06	1.47	2.10	1.18
	hb	66.0	70.0	71.0	65.0
	G.S.	2.80	2.98	2.55	1.43
	G.S. %	2.29	2.48	2.12	2.13
G. 171 – Mut. 8	X	125	122	117**	118**
	Range	123-127	121-124	114-119	116-120
	G.V.	1.35	1.26	1.39	1.50
	hb	55.0	62.0	62.0	63.0
	G.S.	2.88	2.63	1.98	1.94
	G.S. %	2.30	2.15	1.69	1.64

Table (5). Means, range, genotypic variance, heritability and genetic advance for R_8 and R_9 generations of Giza 171 promising mutants of studied characters

Genotypes	Values	No. of panicles/plant		Grain yield/plant	
		M_8	M_9	M_8	M_9
G. 171 – Cont.	X	18.0	19. 0	30.0	29.0
	Range	17-19	18-20	27-31	26-30
	G.V.	0.70	0.65		
	hb				
	G.S.				
	G.S. %				
G. 171 – Mut. 1	X	24**	26**	33.0	34.0
	Range	22-27	24-27	31-35	32-36
	G.V.	0.95	0.88	0.78	1.10
	hb	62.00	58.00	55.00	58.00
	G.S.	1.75	1.52	1.45	1.60
	G.S. %	7.29	5.84	4.39	4.70
G. 171 – Mut. 2	X	16	17	35	34
	Range	14-17	15-19	33-37	33-35
	G.V.	1.10	1.35	1.28	1.40
	hb	61.00	67.00	60.00	58.00
	G.S.	1.44	1.96	1.83	1.37
	G.S. %	9.00	11.52	5.22	4.02
G. 171 – Mut. 3	X	17	17	33	35
	Range	14-18	15-18	32-35	33-37
	G.V.	0.67	0.90	0.85	0.98
	hb	48.00	58.00	52.0	56.0
	G.S.	1.18	1.48	1.37	1.46
	G.S. %	6.94	11.52	5.22	4.02
G. 171– Mut. 4	X	15.0	15.5	38.0**	40.0**
	Range	14.17	15-17	37-39	38-42
	G.V.	2.50	1.15	0.85	0.78
	hb	78.00	63.00	48.00	50.00
	G.S.	2.87	1.76	1.18	1.32
	G.S. %	19.13	11.73	3.10	3.30
G. 171– Mut. 5	X	18	20	34	30.0
	Range	17-19	19-21	32-36	28-32
	G.V.	0.90	0.75	1.70	1.15
	hb	56.0	83	77.00	61.00
	G.S.	1.56	1.30	2.36	1.68
	G.S. %	8.66	6.50	6.94	5.60
G. 171 – Mut. 6	X	24.0**	24.0**	40.0**	40.0**

	Range	22-26	22-26	38-42	41-44
	G.V.	2.25	2.12	0.95	0.90
	hb	68.00	62.00	50.0	54.0
	G.S.	2.58	1.78	1.85	1.75
	G.S. %	10.75	7.41	4.62	4.16
G. 171 – Mut. 7	X	19.10	20.0	38.0**	41.0**
	Range	18-20.	18-21	36-40	39-42
	G.V.	1.25	1.05	1.25	1.22
	hb	64.0	61.0	62.00	61.00
	G.S.	1.84	1.65	2.82	1.79
	G.S. %	9.68	8.25	4.78	4.36
G. 171– Mut. 8	X	25.0**	26.0**	36.0	34.5
	Range	23-27	25-28	34-37	33-36
	G.V.	1.42	1.82	1.80	1.70
	hb	65.0	72.0	65.0	67.0
	G.S.	2.10	2.28	2.32	2.28
	G.S. %	8.40	8.76	6.44	6.60

The mutants No. 4,5 and 6, in addition to shorter in plant height, had narrow ranges and limited genotypic variances, indicating that, they are bred true for this trait. While the mutants No. 6 and 7 showed, wide ranges and highest values of genotypic variances, indicating that further selection could be achieved for this trait in advanced generations.Regarding the number of panicles/plant (Table 4), the mutants No. 1 6 and 8, gave the highest mean values of the number of panicles/plant and the values ranged from 24 to 26 panicles/plant, and the best promising mutant was No. 8. All these three promising mutants had narrow ranges and limited genotypic variances indicating that, they might be bred true for this trait. The other mutants gave the lowest mean values and ranged from 15 to 20 panicles/plant for the two generations through the course of this investigation.

For grain yield/plant as shown in Table (5), the mean values of this character increased significantly than the control in seven mutants, i.e. lines 1, 2, 3, 4,5,6,7and 8. The highest mean values were detected in the case of mutants No. 8and No. 6, respectively. Most of these mutants exhibited narrow ranges and limited genotypic variances, indicating that, they might be bred true for this trait. From the foregoing discussion, it could be indicated that the most promising mutants for earlier heading were No.2 and 3 for shorter plants height were No. 4, and 6; for the higher number of panicles/plant were No1 and 7and for the higher grain yield/plant were No6and 7. Therefore, the best desirable mutants were No. 6 and 7, where they possess so many desirable characters as compared with the control.

Giza 171 rice cultivar and its mutant lines were evaluated to blast infection under both greenhouse and field conditions. Data presented in Table (6) showed that Giza 171-rice cultivar had the highest blast infection, in the greenhouse, as (type 6). In the field leaf, severity was 24 while panicle severity was 10.6 %. Under greenhouse conditions, Giza 171 mutant lines were always lower infected by blast compared to the origin Giza 171 cultivar. Mutants 2, 3 and 4 were resistant to blast, as they were completely free from infection. Mutants 1 and 7 were moderately susceptible, exhibiting type 3 infection, while mutants 5, 6 and 8 were susceptible to blast with 4-5 type. Under field conditions, the mutant lines were too much lower infected compared to Giza 171 rice cultivar, leaf severity was lowest in mutants 1 and 7 (each with 8 lesions/100 leaves) and highest in mutant 8 (16 lesions). However, mutants 5 and 6 had 12 and 14 lesions / 100 leaves. Also, panicles of the mutants 2, 3 and 4 were free from blast infection. The highest panicle-infected was mutant 8 (6.8%), while the remaining mutants had close panicle infection, ranging between 4.2

and 4.6%. This results are in agreement with results reported by (Marchett 1983, Aidy *et al., 1994)*

In case of false smut infection (Table 6), Giza 171-rice cultivar also exhibited the highest infection compared to its derived mutant lines. Percentage of infection was reduced from 3.5% in Giza 171 to 0.5% in mutant 1, 1.5% in mutant 7. Three mutants; 5, 6 and 8 had 2.5% infection, while mutants 2, 3 and 4 didn't suffer any false smut infection. False smut severity took a trend similar to that of false smut percentage. Mutant 6 had the highest severity, 17.6 balls/m^2, while mutant 1 had the lowest severity, 4.0 balls. However, mutants 2, 3 and 4 didn't have any smut balls.

In a conclusion, mutation of Giza 171-rice cultivar improved the stature of resistance in mutants to both blast and false smut diseases. The best derived mutants were mutants 2, 3 and 4 which were resistant to both considered diseases

Table (6): Means and percentage of M_8 and M_9 generations for Giza 171 mutants of blast and false smut disease

Genotypes	Blast infection			False smut/m^2	
	Greenhouse	Field		%	Sev.
		Leaf severity	Panicle severity		
Giza 171 – Cont.	6 HS	24	10.6	3.5	20
Giza 171 – Mut. 1	3 MS	8	4.6	0.5	4
Giza 171 – Mut. 2	2 R	0	0	0	0
Giza 171 – Mut. 3	1 R	0	0	0	0
Giza 171 – Mut. 4	1 R	0	0	0	0
Giza 171 – Mut. 5	4-5 S	12	4.6	2.5	12
Giza 171 – Mut. 6	4 S	14	4.5	2.5	17.6
Giza 171 – Mut. 7	3 Ms	8	4.2	1.5	6
Giza 171 – Mut. 8	4-5 S	16	6.8	2.5	12

R = Resistant MS = Moderately resistant S = Susceptible HS =Highly susceptible

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التربية للتبكير وقصر الساق والمحصول العالى والمقاومة للأمراض بإستحداث الطفرات

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إنتخبت سبعة عشر سلالة طفرية مبشرة إستحدثت من صنفى الأرز جيزة ١٧٦ (٩ سلالات) والصنف جيزة ١٧١ (٨ سلا لات) بمعاملتها بأشعة جاما بمعدلات ١٠ ، ٢٠ ، ٣٠ ، ٤٠ ، ٥٠ كيلو رونتجن باستخدام عنصر الكوبالت المشع من دراسة سابقة واختبرت فى بعض الصفات الزراعية والمقاومة للأمراض ومحصول الحبوب فى كل من (الجيل الطفورى الثامن والتاسع) أثناء مواسم زراعة الارز ، ٢٠٠٠، ٢٠٠١ بمزرعة مركز البحوث والتدريب فى الرز – سخا – كفر الشيخ – مصر .

أوضحت النتائج أن معظم الطفرات المستحدثة من الصنف جيزة ١٧٦ خاصة الطفرات ارقام ٢ و ٣و٦و٩ قد أظهرت تفوقاً على الصنف جيزة١٧٦ (الكنترول) فى صفات التبكير وقصر الساق فى مقاومتها لمرض لفحة الأوراق والسنابل والتفحم الكاذب وزيادة القدرة على إنتاج الداليات والمحصول العالى ٤٦ ، ٤٨، ٤٣، ٤٤ على الترتيب مقارنة بمحصول الصنف جيزة ١٧٦ (الكنترول) ٣٥,٠٠ جم/نبات . علاوة على ذلك فإن كل من الطفرتين (رقمى ٤ ، ٥) كانت مبكرة (١٩-٢١ يوماً) عن الصنف جيزة ١٧٦ (صنف متأخر) على التوالى ولكنها كانت أقل منه فى المحصول .

و بالنسبة للطفرات المستحدثة للصنف جيزة ١٧١ اظهرت بعض الطفرات صفات مرغوبة مثل الطفرات (أرقام ٤ ، ٥ ، ٦) لصفة طول النبات ، حيث كانت أقل طولاً من جيزه ١٧١(الكنترول) بحوالى (٢٧ سم) اما طفرة ٧كانت لصفة عدد الداليات/نبات والطفرتين (طفرة ٦ ، ٧) لمحصول الحبوب/نبات . وعلى الجانب الأخر فإن الطفرات (جيزة ١٧١ طفرة ٢ ، ٣) كانت مبكرة عن الصنف جيزة ١٧١ (الكنترول) بحوالى ٣٥-٤٤ يوماً تقريباً .

إضافة إلى ذلك أثبتت الدراسات الوراثية أن التباين الوراثى كان منخفضاً وكذا كانت درجة التوريث بالمعنى الواسع منخفضة إلى متوسطة وأن التحسين المتوقع من الإنتخاب كان منخفضاً لجميع الصفات المدروسة مع بعض الإختلافات فى طفرات كل من الصنفين جيزة ١٧٦ وجيزة ١٧١ . وهذا يوضح أن هذه

الطفرات ربما أن تكون صادقة التربية لهذه الصفات المدروسة ، وبناءً عليه يمكن إستخدامها إما كأصناف أرز جديدة أو كآباء فى برنامج التربية .

كما كانت معظم طفرات الصنف جيزة ١٧٦ (١،٢،٣، ٤،٦،٨) بالترتيب مقاومة لمرض اللفحة فى الأوراق والسنابل ومرض التفحم الكاذب كذلك أظهرت الطفرات رقمى (٥، ٩) مقاومة لمرض اللفحة على الأوراق والسنابل فقط ومن الناحية الأخرة على الصنف جيزة ١٧١ أظهرت الطفرات (٢،٣،٤) بالترتيب مقاومة كاملة لمرض اللفحة والتفحم الكاذب.