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PADDY YIELD OF DROUGHT TOLERANT MUTANTS UNDER SALINITY AND WATER STRESS IN TWO TYPES OF SOIL

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ABSTRACT

In a sandy-loam soil (62.2% sand, 13.2% clay and 24.6% silt); pH of = soil 6.9 and of irrigation water = 6.3, EC=0.4 m mohs and under drip irrigation with 3200 m^3/ feddan (F), paddy yield of 22 mutants (drought - tolerant rice mutants = DTRM = Sahrawi or Desert-rice) ranged from 2160 Kg/F for line (Hegazi-GOW) to 4751 Kg/F for (Hegazi FOW line) while that of the control (the local cultivar of ordinary rice Giza 177) was only 284 Kg/F under the same conditions.

In a silty loam saline soil (26% sand, 63% silt and 11% clay), pH of soil =8.72, EC = 29.2 dSm, pH of irrigation water =8.40 and EC=2.15 dS/m and under 2000 m^3 of surface irrigation per Feddan, paddy yield of the same 22 DTRMs ranged from 168 kg/F (Hegazi-GOW line) to 3640 kg/F (Hegazi-LIC line) while that of the control (the ordinary rice cultivar Giza 177) was only 120 kg/F.

The above mentioned drought-tolerant rice mutants = Sahrawi rice breed true lines produced good yield since 1992 and they could be planted in Sahra (deserts). Their consumption is about one half of irrigation water of that of ordinary rice varieties. They also could be used under drip irrigation system.

Key words: ***Rice, Irrigation, Drought resistant, Water stress, Mutants, Gamma rays, Desert rice, sahrawi rice, Salinity.***

INTRODUCION

Rice (*Oryza sativa*) plantation in Egypt reached in some years about 2 million feddans and consumes huge amounts of irrigation water. It has been reported that water consumption of one feddan ranged from about 7500 (Annonymous 1990) to about 8100 m^3 per feddan (Annonymous 1995).

Due to the increased population and the wide gap between local consumption and production of grains, it has been decided to decrease the acreage of rice regardless the fact that this crop has been considered for many years as a cash crop after cotton. The declared aim is to reduce this acreage to about one half to save about 4 to 5 billion m^3 of irrigation water (Abo-Hegazi *et al* 1996 and 1997) to be utilized in producing other grains such as wheat and corn in newely reclaimed lands, since the country imports of them are sometimes causes a lot of foreign currencies. Therefore, the author tried since about 28 years. (Abo-Hegazi *et al* 1979) to develop some lines of rice which consume less amounts of irrigation water and could be planted using surface, drip or even sprinkler irrigation to be suitable for planting in the newly reclaimed lands which are mainly located in the Egyptian deserts (sahara).

As a mutation breeder, the author utilized all mulation breeding methods throughout his work. Mutagens were found, sometimes, to be effective in breeding various rice mutants (Abo-Hegazi 1992, Kucherenko 1990, Remli *et al* 1990 and Tanisake *et al* 1990). Abo-Hegazi (1992) declared that he obtained drought tolerant rice mutants (DTRM). Later on, he tried to plant such mutants in semi-arid desert soils (Abo-Hegazi 1995). i.e. sandy, sandy loam and silty loam soils under surface, drip, usual sprinkling and central sprinkling irrigation (pivots) using about 2000 to 4500 m^3 of irrigation water per feddan depending on the physical and chemical properties of the soil and irrigation method. Most of the DTRMs gave good yield even under desert conditions. Therefore, he called them Sahrawi-rice or Desert-rice.

Studies on some characteristies of some of the DTRMs lines were published elsewhere (Abo-Hegazi 1992, 1995, 1996, 1997 and Abo-Hegazi *et al* 1997).

The aim of the present investigation is to present a summary of data on paddy yield of 22 mutants as compared with the local culivar of ordinary rice Giza 177 in two different locations, one season each, under less irrigation (surface wih 2000 m^3 water, and drip with 3200 m^3/ feddan) to aquaint rice breeders with DTRM germplasm.

MATERIALS AND METHODS

Twenty two genotypes (lines) of drought tolerant rice mutants (DTRM = Sahrawi rice) were planted under drip irrigation using 16 nozzels/m^2, 4 liters/hr at a rate of about 3200 m^3 of irrigation water per feddan in 10X10 meters plots using 5 replications under the first season in a sandy-loam soil conditions (62.2% sand, 13.2% clay and 24.6% silt). pH of soil was 6.9 and that of irrigation water was 6.3 of EC=0.4 m mohs.

The same genotypes were also planted under surface irrigation at a rate of 2000 m^3water/ feddan in 10x10 meters plots in five replications during the second season in a silty-loam, somewhat, alkaline salty soil (26% sand, 63% silt and 11% clay), pH of soil was 8.72 (1:2.5) of EC equals 29.2 dS/m and pH of irrigation water was 8.4 of EC equals 2.15 dS/m. The ordinary rice culitvar Giza 177 was also planted as a control in the two seasons.

All expeeriments were done at Tameya el Feyoum Governorate on the 15th of May and were harvested on the beginning of September.

Data on mean yield of paddy in kg were recorded and the standard errors (SE) were calculated for the 22 mutants and the control in the two seasons (locations).

RESULTS AND DISCUSSION

Table (1). showed that under drip irrigation at a rate 3200 $m^3$of water/feddan in a sandy loam soil in the first season, the control cultivar of ordinary rice produced 284 kg of paddy/f while the DTRMs (Sahrawi-rice) paddy yield ranged from 2160 kg/f (Hegazi – GOW) to 4751 kg/f (Hegazi – FOW). The big difference between yield of the Sahrawi-rice and the ordinary rice cultivar Giza 177 may be due to the acclimatization of the later variety to high consumption of water while the mutants have been bred across several years to resist or tolerate deficiency of water.

Table 1. Mean (M) ± standard error (SE)of grain (paddy) yield of 22 drought tolerant – rice – mutants (Sahrawi-rice) and the local ordinary rice variety Giza 177 (control) in two seasons, two different water regimes and two different soils.

Variety or Mutant	Sandy-loam soil[a] using 3200m^3 of irrigation water[b] in season 1 (kg/F)	Silty-loam saline[c] using 2000 m^3 of irrigation water[d], surface irrigation in season 2, (Kg/F)
	M ± SE	M ± SE
Giza 177 (control)	284 ± 28	120 ± 12
Hegazi LIC	4259 ± 468	3640 ± 400
Hegazi BOW	3950 ± 593	3444 ± 448
Hegazi A20W	3511 ± 421	2184 ± 328
Hegazi LIG	3090 ± 402	2167 ± 304
Hegazi C_{28} D^{20}	4668 ± 654	2069 ± 310
Hegazi B^{10} W	4159 ± 624	2037 ± 526
Hegazi FOW	4751 ± 713	1471 ± 250
Hegazi BR^{1}	2479 ± 273	1470 ± 235
Hegazi HOD	2888 ± 289	1406 ± 169
Hegazi AOD	3943 ± 434	1281 ± 141
Hegazi C^{20} DD	4090 ± 491	1590 ± 207
Hegazi LIE	3572 ± 500	1134 ± 125
Hegazi BR^{5}	4101 ± 574	1083 ± 108
Hegazi LIH	2914 ± 437	864 ± 78
Hegazi LIF	3756 ± 526	781 ± 94
Hegazi GR_{10}	4190 ± 503	777 ± 85
Hegazi BR_2	4470 ± 670	687 ± 69
Hegazi BR_7	3970 ± 516	591 ± 59
Hegazi BR_8	3189 ± 415	479 ± 43
Hegazi VL – VL	2360 ± 330	347 ± 42
Hegazi BR_9	4450 ± 623	193 ± 21
Hegazi GOW	2160 ± 238	168 ± 20

a) (82.2% sand, 13.2% clay and 24.6% silt), pH=6.9.
b) pH = 6.3, EC= 0.4. mmh/cm.
c) (26% sand, 63% silt and 11% clay), pH=8.72 (1.2.5), EC=29.2 dS/m.
d) pH = 8.48, EC = 2.15 dS/m.

Table (1) also showed that when the control variety of ordinary rice Giza 177 as well as the 22 DTRMs were planted in the second season, *i.e.* in a silty loam saline soil using 2000 m^3 of water (surface irrigation), the control variety Giza 177 produced 120 kg of paddy per feddan. While paddy yield of the 22 DTRMs (Sahrawi-rice) ranged from 168 kg/f (Hegazi-GOW) to 3640 kg/F (Hegazi-LIC). Hegazi GOW surpassed the check cultivar (Giza 177) with about 40%, while paddy production of the best mutant (Hegazi-LIC) was about 30 times more than that of the control (Giza 177) in the second season. The reason concluded in the first season (under drip irrigation with 3200 m^3/f) could also be valid for the results of second season under surface irrigation in the silty loam saline soil.

Mutation breeding of rice produced several varieties with modifying characters (Kucherenko 1990, Ramli *et al* 1990 and Tanisak *et al* 1990) including salt tolerant mutants (Cheema 2006) and drought tolerent (Tran *et al* 2006).

It may be concluded that about 14 genotypes of the DTRMs starting with (Hegazi-LiC) and ending with (Hegazi-LIH) can tolerate water stress as well as moderate of soil. However, the other eight genotypes showed moderate tolerance to salinity as well as water stress but they gave good yield when planted under 3200 m^3/f of irrigation water in a sandy-loam soil.

REFERENCES

Abo-Hegazi, A.M.T, El – Azizi, A., Serri Massood, M.A. (1979). Breeding high protein rice through the use of gamma rays, Arab J. Nucl. Sci. and Applic., 12 p. 115.

Abo-Hegazi, A.M.T. (1992). Drought resistant rice mutants, characteristics and discussions on possibilities for planting them in some Arab countries which import rice. In: Book 3, part 2, 32nd Science week, suprime council of science, Damascus, Syria, p. 257.

Abo-Hegazi, A.M.T. (1995). Drought resistant rice mutants, and their feasibility for planting them in semi-arid and desert areas. In "Induced Mutations and Molecular techniques for crop improvement, Proc. of a Symp., Vienna 19-23 June 1995, FAO/IAEA, p. 653.

Abo-Hegazi, A.M.T., N.B. Rofail, E.A. Eissa and A.M. Hassan (1996). Effect of zinc on grain characteristics of drought resistant rice mutants. J. of Radioanalytical and Nuclear Chemistry, Articles, Vol. 206. No. 2 p. 349.

Abo-Hegazi, A.M.T., N.B. Rofail, E.A. Eissa and A.M. Hassan (1997). Studies on zinc and some other microelemens in seeds of drought resistant-rice – mutants by nuclear and atomic techniques. In "Book of extended Synopsis of Symp, on Nuclear and Related Techniques in Agriculture, Industry Health and Environment" 28-30 Oct. 1997, Havana, Cuba.

Abo-Hegazi, A.M.T., (1997). Water requirements and relative efficiency of utilizing irrigation water of some crops and drought resistant rice mutants which could be planted in semi-desert lands. Ibid.

Annonymous (1990). Bull of Irrigation and Water Resources (7/12414/90), Central Agency of Immobilization and Statistics, Cairo, Egypt, p. 77 August 1990. (In Arabic).

Annonymous, (1995). Report No. 9047, ARE, Land Reclamation subsector, Document of the World Bank, Feb. 1995.

Cheema, A.A. (2006). Mutation breeding for rice improvement in Pakistan: Achievements and Impact. Plant Mutation Reports, FAO/IAEA (IAEA), 1,1,36-39.

Kucherenko, L. (1990). Somaclonal variation in rice, Mutation Breeding Newsletter FAO/IAEA – Vienna, No. 35 p. 4.

Ramli Othman, Mohamed Osman and Rusli Ibrahim, (1990). Semi-dwarf mutants for rice improvement. Mutation Breeding Newsletter, FAO/IAEA, Vienna, No. 35 p. 18 (January).

Tanisaka, T., Morse, Y., Yamagata, H., (1990). Agronomic characteristics of induced breeding in rice. Mutation Breeding Newsletter, FAO/IAEA, Vienna, No. 35 p. 17.

Tran, D. Q, Dao, T.T.B., Nguyen, H D., Lan, Q. D., H. T., Nguyen, V. V., Nguyen, V. X., Le, V. N., Do, H. A. and Phan, P. (2006) Rice breeding in Institute of Agricultural Genetics, Tuliem, Hanopi, Viet Nam. Pant Mutation Reports, FAO / IAEA, (IAEA), Vienna, 1, 1: 47-49. (2006) Mutation breeding in Institute of Agricultural Genetics Viet Nam. Plant Mutation Reports, FAO/IAEA, Vienna, 1, 1: 47-49.

غلة الحبوب الكاملة لطفرات أرز تتحمل الجفاف تحت ظروف قلة ماء الرى والملوحة فى نوعين من التربة

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تم تقييم محصول الأرز الشعير لعدد 22 طفرة فى نوعين من التربة: الأولى تربة رملية طفلية (62.2% رمل، 13.2% طمى، 24.6% غرين) الأس الهيدروجينى للتربة 6.9 ولماء الرى 6.3 والتوصيل الكهربى لـه = 0.4 ملى موهز وذلك تحت رى بالتنقيط بمعدل 3200 م^3/ فدان (ف)، والطفرات هى طفرات تتحمل قلة ماء الرى أسمىناها أرز صحراوى، حيث تراوح محصولها ما بين 2160 كيلوجرام/ف (سلالة حجازى جو) إلى 4751 كجم/ف (سلالة حجازى فو) بينما كان محصول صنف المقارنة (أرز عادى) جيزه 177 تحت نفس الظروف 284 كجم/ف.

والثانية: كانت تربة غرينية طفلية (26% رمل، 63% غرين، 11% طين) وأس هيدروجينى للتربة 8.72 والتوصيل الكهربى 29.2 ، ولماء الرى كان الأس الهيدروجينى 8.4 والتوصيل الكهربى 2.15 تحت كمية رى 2000 م^3/ف (رى سطحى). زرعت نفس السلالات أو الطفرات السابقة وتراوح محصولها ما بين 168 كجم/ف (سلالة حجازى جو) إلى 3640 كج/ف (سلالة لايس) بينما كان محصول صنف المقارنة (جيزه 177) 120 كجم/ف فقط تحت نفس الظروف.

والطفرات أو السلالات المذكورة بعاليه (التى تتحمل أو تقاوم الجفاف - الأرز الصحراوى) ربيت تحت ظروف قلة ماء الري وتعطى محصولا جيدا منذ سنة 1992 ويمكن زراعتها فى تربات صحراوية كما أن استهلاكها لماء الرى يعادل نحو نصف المقنن المائى لأصناف الأرز العادية، كما يمكن زراعتها تحت ظروف الرى بالتنقيط.