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PERFORMANCE OF SOME RICE CULTIVARS AS AFFECTED BY NITROGEN FERTILIZER SOURCES UNDER SALINE SOIL IN NORTH DELTA

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ABSTRACT

Two field experiments were conducted under salt affected soil at El-Sirw Agriculture Research Station Farm, Damietta, Egypt, during 2008 and 2009 growing seasons through rice salinity program to study the performance of three rice cultivars namely, Giza 178 Sakha 101 and Sakha 102 under three sources of nitrogen fertilizer (urea, ammonium sulphate and ammonium nitrate).The Ec and the pH of the experimental site were 10.2 ds/m^2 and 7.8, respectively. A strip plot design with four replications was used. The main finding could be summarized as follows:

The results revealed that Giza 178 cultivar had higher sink capacity, sink size and grain straw ratio than-the other tested cultivars. Giza 178 cultivar surpassed Sakha 101 and Skha 102 cultivars in number of panicles/m^2, number of grains/panicle as well as grain and straw yields (t/ha) in saline soils.

Application of nitrogen in the form of urea or ammonium sulphate were more efficient for rice than ammonium nitrate in saline soil which increased agronomic efficiency of nitrogen fertilizer and hence increase number of panicles/ m^2, number of filled grains / panicle , grain and straw yields / ha.

It could be concluded that maximum grain yield was obtained from planting Giza 178 cultivar and using urea or ammonium sulphate as a good sources of nitrogen under saline soil in North Delta.

Key words: Rice performance, cultivars, nitrogen fertilizer sources, saline soil, North Delta

INTRODUCTION

Improving salt tolerant rice to be grown in salt-affected areas could be considered as one of the ways to increase their level of production. Rice is reported as very sensitive (De Datta, 1972) to moderately (Mass and Hoffman, 1977) to salinity. Rice cultivars significantly differed in their grain yield and its attributes under salt affected conditions (Zeidan *et al*., 1980, Rahman 1985 and Abd El-Rahman *et al.,* 1988).

Also nitrogen sources could be affected rice productivity under salt affected area. De Datta *et al.* (1974) found that grain yield of rice responded to either ammonium sulphate or urea. Saares *et al.* (1983) reported that number of tillers/m^2, number of panicles/m^2, number of grains/panicle and 100 -grain weight were higher when rice fertilized by urea or ammonium sulphate. Meelu *et al*. (1987) pointed out that the calcium ammonium nitrate was significantly inferior to urea and ammonium sulphate for rice.

Concerning the interaction between rice cultivars and nitrogen fertilizer sources, Kumar and Kandaswamy (1984) studied the response of rice variety IR 20 to four sources of nitrogen (ammonium sulphate, calcium ammonium nitrate, diammonium phosphate or urea), they found that highest grain yield was recorded when ammonium sulphate was applied. Koriem *et al.* (1992) studied the response of rice variety IR 20 to three nitrogen forms (ammonium sulphate, urea and ammonium nitrate). The data indicated that the yield and yield components were significantly affected by the three nitrogen forms used. Ling and Yang (1986) showed that sink capacity (number of spikelets per unit field area), sink size (weight of panicles per unit field area) were higher when medium and short duration cultivars fertilized by urea or ammonium sulphate as a source of nitrogen.

Therefore, the present investigation was aimed to study the performance of some rice cultivars to nitrogen fertilizer sources under salt-affected area of North Delta.

MATERIALS AND METHODS

Two field experiments were conducted in the two successive seasons of 2008 and 2009 under saline soil conditions at El-Serw Agriculture Research Station Farm, Damietta, Egypt. This investigation was carried out in order to study the response of three rice cultivars, namely Giza 178, Sakha 101 and Sakha 102 to three sources of nitrogen fertilizer i.e. urea (46% N), ammonium sulphate (20.5% N) and ammonium nitrate(33.5%N)The differences between studied cultivars could be summarized as shown in Table 1. A strip plot design

with four replications was used. Cultivars were randomly arranged in the horizontal plots. While the vertical plots received the three nitrogen fertilizer sources. The plots size was 15 m (3 X 5 m) i.e. 1/280 fed. Cultivars were transplanted at heavy clay soil in rows 20 cm apart and hills 20 cm apart. Mechanical and chemical analysis of the experimental soil are presented in Table 2 as described by Page *et* a/(1982) method. The preceding crop in both seasons was barley. Calcium superphosphate at a rate of 250 Kg/ha (15.5%P_20_5) were incorporated during land preparation. Nitrogen at the rate of 96 kgN/ha was applied in two equal doses, 1/2 at 20 days after transplanting and the rest after 30 days from the first dose. The other cultural practices were applied following the recommendation for transplanted rice.

At harvest, ten guarded hills were taken for estimating the following characters:

1. Plant height (cm).
2. Number of tillers/hill.
3. Panicle length (cm).
4. Number of filled grains/panicle.
5. 1000-grain weight (g).

In addition, one square meter of each experimental unit were harvested and collected together for counting number of panicles /m^2. Sink capacity as number of spikelets/unit area (1 m^2) and sink size (weight of panicles/unit area) were determined according to Ling and Yong, 1986.

Table 1:Rice cultivars used and its characters

Characters	Sakha 101	Sakha 102	Giza 178
1- Crosses	Giza 176/Milyang79	Giza 177/C_{24}o96-7-i	Giza 176/Milyang
2-Tillering capacity	High	Low	High
3- Salt sensitivity	Moderately tolerant	Sensitive	Tolerant
4-Drought sensitivity	=	=	=
5-Duration	130-135 days	120-125 days	130-135 days
6- Type	Japonica	Japonica	Japonica X Indica

Agronomic efficiency of fertilizer was estimated as kg rice/kg N applied according to Yoshida *et al.* (1972). At harvest, plants in the six square meter of each experimental unit were harvested, labeled and transported to the threshing area for air-drying. Five days later the plants were threshed and the grain weight was recorded at 14 % moisture content. Grain and straw yields were recorded and expressed in ton/hectare.

Table 2: Mechanical and chemical analysis of the experimental soil during the two seasons.

Seasons	Mechanical analysis			Chemical analysis							PH
	Silt%	Clay%	Soil	Avilable macronutrients (PPM)			Ece ds/m^2	Na Meq/1	co_3- Meq/I	SOT Meq/I	
				N	P	K					
2008	24.17	75.62	**Heavy Clay**	19.9	20.4	219	9.2	49	1.1	31	7.8
2009	22.63	76.57	**Heavy Clay**	20.1	19.8	225	9.8	51	1.2	33	7.9

The obtained data were subjected to the proper statistical analysis of variance and combined analysis was performed along the two seasons. The differences among averages of the studied traits were judged with the Least Significant Differences (LSD) at 5 % level of significantly described by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

1. *Varietal performance:*

The three tested cultivars significantly differed concerning plant height (cm) number of tillers/hill, number of panicles/m^2, number of filled grains/panicle, 1000-grain weight (g) and grain yield (t/ha) as well as straw yield (t/ha) in both seasons and panicle length in the second season as presented in Tables 3 and 4. Giza 178 rice cultivar produced the highest number of panicles/ m^2 (450) and number of filled grains/panicle (145.5) which resulted in highest grain yield (7.303 t/ha) as well as straw yield (8.037 t/ha) over both seasons. Sakha 102 rice cultivar showed its superiority only in plant height (98.3 cm) and its inferiority in number of panicles/ m^2 (391) as well as number of filled grains/panicle (113.1) over both seasons. Where as, Sakha 101 cultivar produced the same 1000-grain weight (27.93 g), as well as, grain and straw yields as those produced by Sakha 102 cultivar as averages of both seasons.

Yield potential of cultivars is determined not only by sufficient source of photosynthetic, but also by sink capacity and size of spikelets for receiving photosynthetic from the leaves. So, the improvement in sink capacity and size are necessary for increasing yield of rice (Yoshida, 1983). Sink capacity (number of spikelets/unit field area) and sink size (weight of panicles/unit field area) of Giza 178 cultivar were higher followed by Sakha 101 cultivar, while Sakha 102 cultivar gave the lowest values in these respects as shown in Table 4.

Table 3: Means of plant height, number of tillers/hill, panicle length, number of panicles/m^2, 1000-grain weight and number of filled grains/panicle as affected by rice cultivars performance and nitrogen sources during both seasons.

Treatments	Plant height (cm)		No. of tillers/hill		Panicle length (cm)		No. of Panicles /m^2		1000-grain weight (g)		No. of filled grains/panicle	
	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009
Cultivars:												
Giza 178	89.5	89.0	20.4	20.1	21.8	21.7	460	448	20.66	20.53	148.7	142.4
Sakha 101	82.7	80.8	18.4	16.9	21.4	21.1	402	403	28.13	27.73	119.9	117.1
Sakha 102	99.3	97.2	18.0	19.1	21.3	21.0	388	395	28.26	28.00	113.9	112.4
F. test	**	**	**	**	NS	**	**	**	**	**	**	**
LSD 5%	3.9	1.2	1.8	0.4	-	0.3	12	13	0.25	0.46	2.8	1.7
LSD 1%	5.7	1.7	2.7	0.7	-	0.4	18	19	0.37	0.67	4.1	2.5
Nitrogen sources												
Urea	90.5	88.1	18.3	19.2	21.4	21.3	422	427	25.60	25.70	128.5	126.6
Ammonium sulphate	90.4	90.0	19.5	18.6	21.6	21.3	422	415	26.00	25.50	128.8	124.4
Ammonium nitrate	90.6	88.9	18.9	18.4	21.4	21.0	405	398	25.40	25.00	125.2	120.9
F. test	NS	NS	NS	NS	NS	NS	**	**	**	*	**	**
LSD 5%	-	-	-	-	-	-	10	13	0.36	0.25	2.2	1.4
LSD 1%	-	-	-	-	-	-	15	18	0.55	-	3.2	2.0
Interaction	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Also, it is evident from data illustrated in Table 4 that Giza 178 cultivar had highest agronomic efficiency of nitrogen fertilizer under saline soil compared with Sakha 101 and 102 cultivars and this may be attributed to increases in number of panicles/m^2, number of filled grains/panicle reflected increases in grain yield /ha . Differential behavior of the tested cultivars under saline soil conditions may be attributed to the differences in the level of salt tolerance which depend upon the genetically make up of these cultivars as shown in Table 1. Similar results were also reported by Zeidan *et.al.* (1980), Rahman (1985), Abd EL-Rahman *et al.*, (1988) and Abed El-Wahab (1998).

2. Nitrogen sources effects:

Highly significant differences were detected among the studied nitrogen sources regarding number of panicles/m^2,1000-grain weight (g),number of filled grains/panicle, grain (in both seasons) and straw (in the second season) yields

Table 4: Means of grain and straw yields (t/ha), agronomic efficiency of nitrogen fertilizer, sink capacity and sink size as affected by rice cultivars performance and nitrogen sources during both seasons.

Treatments	Grain yield (t/ha)		Straw yield (t/ha)		Agronomic efficiency of nitrogen fertilizer		Sink capacity No. of grains/m^2		Sink size kg/m^2	
	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009
Cultivars:										
Giza 178	7.407	7.200	8.207	7.869	77.1[n]	75.0	68408	62696	1.491	1.242
Sakha 101	5.753	5.447	7.613	7.587	59.1	56.7	48345	47295	1.301	1.280
Sakha 102	5.707	5.107	7.517	7.627	59.4	53.1	44060	44421	1.207	1.229
F. test	**	**	**	**	**	**	**	**	**	**
LSD 5%	0.238	0.175	0.243	0.117	2.4	1.8	2149	1894	0.92	0.39
LSD 1%	0.347	0.255	0.353	0.171	3.6	2.6	3126	2755	0.135	0.053
Nitrogen sources										
Urea	6.380	6.253	7.827	7.846	66.5	65.1	54881	54881	1.363	1.371
Ammonium sulphate	6.440	5.900	7.863	7.636	67.1	63.5	54888	51911	1.362	1.328
Ammonium nitrate	6.047	5.600	7.647	7.600	62.9	58.3	51043	48170	1.274	1.234
F. test	**	**	NS	*	**	**	**	**	**	**
LSD 5%	0.231	0.184	-	0.163	2.4	1.9	1747	1656	0.057	0.063
LSD 1%	0.336	0.269	-	-	3.5	2.8	2543	2410	0.083	0.091
Interaction	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

(t/ha) as showed in Tables 3 and 4. The results indicated that the three nitrogen sources had similar effect on plant height, number of tillers/hill, panicle length and straw yield/ha. Urea produced more number of panicles/m^2, number of filled grains /panicle and grain yield compared to those produced by ammonium sulphate. Moreover, ammonium sulphate produced the heaviest 1000-grain weight (25.76 g) as compared to the other sources as an average of both seasons. The increases in grain yield /ha due to using urea as a source of nitrogen may be attributed to increases in both number of panicles /m^2 and number of grains /panicle. Similar results were also reported by De Datta *et al.* (1974) and Saares *et al.* (1983).

Sink capacity and sink size of the three rice cultivars as influenced by different sources of nitrogen fertilizer are presented in Table 2. The results indicated that urea and ammonium sulphate gave higher sink capacity and size than ammonium nitrate. The increases in both sink capacity and size due to using urea and ammonium sulphate as a sources of nitrogen may be due to its effect of

increases in number of tillers per unit area although did not reach to the significant differences as shown in Table 3. These results are in harmony with those obtained by Rahman (1985) and Abd EL-Rahman *et al.* (1988).

It is evident from the results are shown in Table 4 that urea or ammonium sulphate gave the highest agronomic efficiency followed by ammonium nitrate that gave the lowest values in this respect. It could be attributed to the decrease in the losses of available nitrogen which comes from ammonium sulphate or urea under salinity condition (De Datta *et al*., 1974).

3. Interaction effects:

There are insignificant effects due to the interaction between rice effected separately.

Conclusively, it could be concluded that for maximizing grain yield of rice per unit area by planting Giza 178 cultivar and using urea or ammonium sulphate as a source of nitrogen under the saline soil at North Delta region.

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سلوك بعض اصناف الارز تحت مصادر مختلفه من التسميد النيتروجينى بالاراضى الملحيه بشمال الدلتا

على السعيد شريف - على عبد الحميد حسان
قسم المحاصيل – كليه الزراعه – جامعه المنصوره .
قسم الانتاج النباتي - معهد الكفايه الانتاجيه – جامعه الزقازيق .

اقيمت تجربتان حقليتان بمزرعه محطه بحوث السرو – دمياط تحت ظروف الاراضى الملحيه خلال موسمى ٢٠٠٨ ، ٢٠٠٩ لدراسه سلوك ثلاثه اصناف من الارز هى جبرة ١٧٨ ، سخا ١٠١ ، سخا ١٠٢ لثلاثه مصادر مختلفه من السماد الازوتى هى اليوريا (٤٦% ن) ، سلفات الامونيوم (٢٠.٥% ن) ونترات الامونيوم (٣٣.٥ ن) وكانت درجة التوصيل الكهربائى (EC) لمحلول التربه المشبع ٩.٥ ودرجة الحموضه ٧.٨٥ وتم استخدام تصميم الشرائح المتعامده فى اربعه مكررات .

ويمكن تلخيص اهم لنتائج المتحصل عليها فيما يلى :

١-اظهرت النتائج ان الصنف جيزه ١٧٨ سجل اعلى قيمه من السعه الاختزانيه SINK CAPACITY والذى انعكس على المحصول ، ولذا فقد أعطى هذا الصنف اعلى محصول من الحبوب والقش للهكتار وسجل اعلى عدد من الداليات / مترمربع وعدد الحبوب الممتلئه فى الداليه . بينما اعطى الصنف سخا اقل عدد من الداليات / متر مربع وكذلك اقل عدد من الحبوب الممتلئه للداليه وذلك تحت ظروف الاراضى الملحيه .

٢-اشارت النتائج الى ان اضافه السماد الازوتى فى صوره سماد اليوريا او سلفات الامونيوم كانت اكثر كفاءه عند مقارنتها بسماد نترات الامونيوم تحت ظروف الملوحه وذلك من خلال النتيجه المتحصل عليها من دراسه صفه الكفاءه السماديه حيث سجلا اعلى قيم للكفاءه السماديه مما ترتب عليه الزياده فى عدد الداليات/ مترمربع ، عدد الحبوب بالداليه ،ومحصول الحبوب والقش للهكتار .

٣- لم يكن للتفاعل بين عوامل الدراسه اى تأثير معنوى على جميع الصفات .

التوصية: توصى الدراسه بزراعه الصنف جيزه ١٧٨ واستخدام اليوريا او سلفات الامونيا كمصادر للنيتروجين وذلك للحصول عل اعلى انتاجيه للارز فى الاراضى الملحيه بشمال الدلتا .