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EFFECT OF SOAKING SEEDS IN, A MIXTURE OF CHELATED FE, MN AND ZN SOLUTION WITH AGAR AS A CARRIER, ON THE YIELD AND YIELD COMPONENT OF RICE (*Oryza sativa L*.)

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ABSTRACT

Rice is one of the major food and economic crop in Egypt. In a trial to improve grain yield ,two field experiments were carried out on clayey soil during two successive summer seasons(2004 and 2005)at Sakha Experimental Research Station (ARC) , to study the effect of soaking rice seeds for 48 hours before sowing in a nutrient solution containing a mixture of chelated Fe, Mn and Zn at 0.2% each ,with or without the biopolymer agar at 0.2% as a carrier, on the yield, yield components and chemical composition of rice grain variety Sakha 104.

The obtained results revealed that applying micronutrients by seed soaking method was very effective in improving grain and straw yields, with highly significant increase of 14.5% over control as an average of the two seasons. Also, it improved the intake of macro and micronutrients in grain yield /feddan. On the other hand , using agar at 0.2% with or without micronutrients in soaking solution had no effect on yield of grain ,straw yield and chemical composition of grains.

INTRODUCTION

Fertilizer use should be balanced and optimized to obtain the highest possible efficiency with less environmental pollution .The micronutrients should become an integral part of balanced fertilization program .Symptoms of Fe, Mn and Zn deficiencies are widespread in Egypt, and treating crops with micronutrients led to increase in yield with high net return(El-fouly and Fawzi 1996 and Monged *et al*., 2003) .Seed treatment with micronutrients by coating or soaking before sowing are valuable although they were less effective than foliar application (Ghaly *et al*.,1992,Amin *et al*.,1998 and Badr *et al*.,1998). Moreover, it is advantageous in terms of scale up, cost and ease in operation.

Soaking method appeared to be suitable for rice, as seeds as usually soaked in water for 48 hours before sowing. Monged and Mawardi (1978) and Korayem (1993) noted that soaking rice seeds in zinc sulphate solution increased yield of grains, as it increased germination, Wang and Song (2005),improved seedling vigour and plant growth (Jeybal and Kuppuswamy, 1998).

In a trial for increasing the efficiency of coating method ,Zhang and Mao (1992) found that mixing zinc sulphate with a coagulant colloid in seed treatment led to the highest increase in yield .

In this respect ,EL- Aggory *et al*.(2002, a&b) noted that mixing the biopolymer agar at 0.1% with the nutrient solution used for soaking seeds increased seedling growth of wheat and yield of peanut grown on sandy and calcareous soils .

The present investigation was carried out to study the effect of soaking rice seeds in a solution containing a mixture of chelating Fe, Mn and Zn with agar as a carrier, on yield components and chemical composition of grains.

MATERIALS AND METHODS

To realize the effect of agar on the response of rice plant to micronutrients ,two field experiments were conducted in two successive seasons (2004 and 2005) at Sakha Experimental Station, Kafr -El-Sheikh Governorate, which is considered one of the important localities for rice production in Egypt.

Surface soil samples (0-30cm) from the experimental field, were analyzed as shown in Table (1). Seeds of rice were soaked for 48 hours in the following different solutions :

(1) Control (In water).
(2) Agar solution of 0.2% .
(3) Nutrient solution containing the three chelating micronutrients Fe, Mn and Zn at the concentration of 0.2% for each.
(4) Agar solution of 0.2%containing the above three micronutrients. Such technique was similar to that developed by EL- Aggory *et al.* (2002 b).

Experimental fields of both seasons were prepared and divided to plots ($10m^2$) and the treated seeds were sown in rows 20 cm apart.

All plots received superphosphate and potassium sulphate at the rate of 15 kg P_2O_5 and 24kg K_2O/feddan, respectively, before sowing ,while urea was applied in two equal split doses ,30 days after sowing and 15 days later at the rate of 60 kg N/feddan. Thus, four treatments were designed in a complete randomized block with four replicates.

At harvest, grain and straw yields were recorded as ton /feddan. Grain samples from each treatment were taken for chemical analysis and wet digested using H_2SO_4 and $HCLO_4$ acids mixture. N,P, and K were determined according to Chapman and Pratt (1961), while Fe, Mn and Zn were determined using Atomic Absorption Spectrophotometer apparatus (GBC 933).

Yield data were statistically analyzed for each experiment and combined analysis was determined according to Snedecor and Cochran (1972).

RESULTS AND DISCUSSION

Soil analyses data recorded in Table (1) reflect the characteristics of clayey soils in Sakha.

Being they were fairly high in PH with moderate salinity. Available nutrient concentrations show low content in total soluble nitrogen fairly adequate content of available phosphorus and satisfactory content of potassium. These analyses were carried out as described by Jackson (1973). As for micronutrients contents in DTPA extract, Fe and Mn were adequate, while Zn was low according to Lindsay and Norvell (1978).

Table(1):Some physical and chemical properties of the experimental soils

Physico-chemical properties			Available nutrients (mg/kg^{-1})		
	2004	2005		2004	2005
Clay %	56.70	55.00	N(2%K_2SO_4) ext.	38.00	40.00
Silt %	23.80	24.40	P($NaHCO_3$)ext.	10.00	8.70
Sand %	19.50	20.60	K(NH4OAC)ext.	378.0	269.0
Texture class	clayey	clayey	Zn (DTPA).ext.	0.48	0.61
EC mmohs/cm	1.50	1.30	Fe (DTPA).ext.	8.30	7.90
PH	8.20	8.30	Mn (DTPA).ext	11.8	12.60

***pH:in(1:2.5)soil water suspention.**
***Ec:in(1:5)water extract.**

Yield and yield components data presented in Table (2) show the effect of different treatments on grain and straw yields, grain /straw ratio and the weight of 1000 grain.

Table(2):The effect of different soaking treatments on rice yield and yield components

Season / Soaking treatments	2004		2005		Mean of the two seasons				Grain /straw ratio	1000-grain weight (9)
	Grain yield	Straw yield	Grain yield	Straw yield	Grain yield	% increase	Straw yield	% increase		
Control(in water)	2.228	5.513	2.185	5.433	2.206	-------	5.473	-------	1:2.48	28.3
Agar 0.2%.	2.127	5.112	2.150	5.247	2.139	-------	5.180	-------	1:2.422	28.25
Micronutrients 0.2%.(Fe+Mn+Zn)	2.517**	6.275**	2.550**	6.183**	2.534**	15	6.229**	14	1:2.458	27.5
Agar and micronutrientes	2.515**	6.335**	2.512**	6.228**	2.514**	14	6.281**	15	1:2.498	27.3
L.S.D. 5% 1%	0.145 0.209	0.376 0.541	0.162 0.233	0.376 0.541	0.117 0.160		0.235 0.320			

Grain yield

Data reveal that agar had no effect on the different characters under study when used either alone or in combination with micronutrients. Such results were in agreement with that obtained by EL-Aggory *et al.* (2002 a&b) with wheat grown in heavy clayey soil at Sakha . It seems that agar acts like clay colloids in retaining water and nutrients that alleviate agar effect ,as agar was very effective in sandy and calcareous soils. However, Zhang and Mao (1992) obtained an increase in rice yield on mixing zinc sulphate with coagulant colloid in seed treatment.

Examining further such data it can be noted that the application of micronutrients with or without agar caused a high significant increase of about 15 and 14%, respectively, for both seasons, while, the average of both seasons was 14.5%. Thus, this increase can be attributed to micronutrients only. Also, such increase indicates the efficiency of applying micronutrients by seed soaking method in correcting micronutrients deficiency that improve nutrient balance, use of NPK fertilizers and yield in turn.

Furthermore, it indicates the deficiency of experimental soil in available micronutrients especially Zn. High soil pH and high clay proportion in the soil could have probably lowered the availability of micronutrients to plants (Table 1). EL- Fouly and Fawzi (1996) and Monged *et al*. (2003) noted

that deficiency of micronutrients has become a limiting factor for yield production in many location in Egypt .Ghaly *et al*. (1992), Amin *et al.* (1998) and Badr *et al*. (1998) obtained significant yield increases on treating seeds with micronutrients and added that a mixture of them was more effective than using any of them individually. The increase in crop production resulted from micronutrients application can be ascribed to their multifunctional role in growth and metabolism of plant. Wang and Song (2005)noted that soaking rice seeds in Zn solution at a concentration of 0.3 mg/L, led to increases in germination rate, seed activity and membrane penetration of seeds .In addition, Abou EL-fotoh *et al.* (2006) observed that crop yields of rice responded significantly to micronutrients spray and recorded an increase of 22% for rice grain yield .

Weight of 1000- grains:

the slight increase in 1000 grain weight in control and agar treatments than in micronutrients ones was a contrast to that obtained with grain yield (Table 2),may refer to more filling of grain .Also, it may explain that fertilizer use is still need to be optimized and balanced to achieve higher yield with better quality.

Straw yield:

Straw yield data presented in Table (2) reveal that the beneficial effect of applying micronutrients by soaking method on straw yield was as that observed with grain yield .A highly significant increase of 14.5% over control was the average obtained in both seasons. Using agar alone or in combination with micronutrients had no clear effect on straw yield.

Grain /straw ratio:

Calculating the ratio between grain and straw yield, Table (2) displays that there is no appreciable difference or trend among the different treatments .This may be due to the same average increase of 14.5% in grain and straw yields as a result of ionic balance caused by micronutrient application.

Chemical composition:

Examining further the analytical data of grain in Table (3), it can be noted that treatment of micronutrients alone exhibited the highest concentration and content of nutrients, while agar with micronutrients or agar alone showed less values. Such results may explain the effect of balance between macro and micronutrients in the first treatment, while, they show that agar may lead to fixation of nutrients like clay colloid as noted before by EL-Aggory *et al*. (2002,b).

Nutrient intake

Calculating total uptake of nutrients in grain yield /feddan in Table (4), it can be noted that micronutrient treatment caused the highest increase in macro and micronutrients. In this respect, EL- Fouly and Fawzi (1996) noted that micronutrients application led to increased root growth and thus higher uptake of N,P and K and yield in turn.

Table (3): The mean nutrient concentrations in rice grains of both tested seasons as affected by different soaking treatment

Treatments	Macronut.conc. (%)			Micronut.Conc.*u*g/g			
	N	P	K	Fe	Mn	Zn	Cu
Control	0.64	0.80	3.00	170	47.0	16.0	8.0
Agar	0.46	0.60	2.00	126	33.0	19.0	7.0
Micronut.	0.70	0.67	3.00	243	50.0	30.0	9.0
Agar+Micronut.	0.58	0.87	3.00	182	41.0	25.0	6.0

Table (4): The mean nutrient contents in rice grains of both tested seasons as affected by different soaking treatment

Treatments	Content (kg/feddan)			Content (g/feddan)			
	N	P	K	Fe	Mn	Zn	Cu
Control	14.11	17.65	66.18	375.0	103.68	35.29	17.7
Agar	09.84	12.83	42.78	269.5	70.58	40.64	14.9
Micronut.	17.73	16.98	76.02	615.8	126.70	76.02	22.8
Agar+Micronut.	14.58	21.87	75.42	457.6	103.07	62.85	15.1

Conclusion:

In the light of the obtained results, it can be concluded that application of micronutrients to rice by seed soaking method, proved to be effective in correcting deficiencies, economical and easy to adopt. Also, fertilizer use is still need to be balanced and optimized to achieve higher yield with better quality.

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تأثير نقع تقاوى الأرز فى محلول من الحديد والمنجنيز والزنك فى الصورة المخلبية مع إضافة الآجار كحامل للعناصر على المحصول ومكوناته

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أقيمت تجربتان حقليتان فى الموسمين 2004 و2005 فى محطة بحوث سخا – مركز البحوث الزراعية- بمحافظة كفر الشيخ فى تربة طينية لدراسة تأثير نقع تقاوى الأرز لمدة 48 ساعة قبل الزراعة فى محلول يحتوى على الحديد والمنجنيز والزنك بتركيز 0.2% لكل منهم مع إضافة أو عدم إضافة الآجار بتركيز 0.2% كحامل للعناصر الغذائية وأثر ذلك على المحصول ومكوناته وكذلك التركيب الكيماوى.

وقد أوضحت النتائج المتحصل عليها مايلى:

- أن نقع البذور فى محلول العناصر الغذائية السابق أدى إلى زيادة محصول كل من البذور والقش بمعدل 14.5% عن المقارنة وكذلك أدت إلى تحسين المحتوى الكيماوى للعناصر الغذائية الصغرى فى الحبوب.
- أما بالنسبة لاستخدام الآجار فإنه لم يكن له تأثير يذكر على محصول القش والحبوب ومحتواها من العناصر الغذائية.