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IMPACT OF RICE STRAW ON AVAILABILITY OF SOME NUTRIENT ELEMENTS IN FLOODED RICE SOILS.

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ABSTRACT

In a field study , with rice plants, of flooded rice soils whose organic matter content was 1.5 % ,incorporation of composted rice straw either alone or in combination with nitrogen fertilizer affected the availability of some nutrients NH_4-N, P, K ,Fe^{2+},$Mn^{2+}$and Zn^{2+} in addition to NO_3-N concentration. The obtained data showed that the integration of composted rice straw plus nitrogen fertilizer increased the availability of NH_4-N, P, K ,Fe^{2+} and Mn^{2+} but decreased Zn^{2+} availability and NO_3-N concentration. Data of simple correlation coefficient (r) between the phosphorus availability and zinc availability was positively. The linear regression coefficient showed that the prediction equation for zinc availability (y) could be formuled as follows:

Available Zn = - 0.477 + 0.0540 Available P.

INTRODUCTION

The energy crisis and high fertilizer costs have created considerable interest in the use of organic materials as sources of plant nutrients for lowland rice .The benefits of organic amendments for rice production have been reported by many workers. There is however, lack knowledge on the effect various organic amendments on the changes in nutrient availability over time in flooded soils. Such information would be extremely useful for developing suitable management practices for their efficient use in rice cultivation. The present study was undertaken to determine the effects of composted rice straw and urea and their integration between them on the availability of some nutrient elements such as NH_4-N, P, K ,Fe^{2+}·Mn^{2+}, Zn^{2+} and NO_3-N concentration.

MATERIALS AND METHODS

A field experiment was conducted at the Rice Research and Training Center Farm Kafr El-Sheikh to fulfill the objectives of the present study as follows:

Soil : it was clayey in texture. The main characteristic were: clay=55.4%, silt=32.33%, sand=12.27%, pH=8.2, Ec=2.3dS/m,OM=1.5%, available NH_4-N=18.1mg/Kg, NO_3-N concentration= 15.1 mg/Kg, available P=15 mg/Kg and available K=308 mg/Kg., available Fe^{2+}=6.1 mg/Kg, available Mn^{2+}=6.1 mg/Kg, available Zn^{2+}=1.1 mg/Kg.

The above soil characteristics were determined according to the standard procedures as described by Cottenie et al., (1982) and Page et al., (1982)

Studied crop:(Oryza sativa, L.) variety Sakha 101.

Date of sowing: 20 May 2004.

Experimental treatments: The Randomized complete block design with four replications was used, involving six treatments as follows: control, 69 kg N fed.$^{-1}$ (recommended), 2 ton of composted rice straw fed.$^{-1}$ · 2 ton composted fed.$^{-1}$ + 17.25 Kg N.fed^{-1}, 2 ton composted fed.$^{-1}$ + 34.5 Kg N.fed^{-1}, 2 ton composted fed.$^{-1}$+ 51.75 Kg N.fed^{-1}

Soil was sampled three times, 30, 60 and 110 days after transplanting then stored in the refrigerator for analysis.

Ammonium ,nitrate ,phosphorus ,potassium ,iron ,manganese and zinc available were determined according to the standard procedures as described by Cottenie et al., (1982) and Page et al., (1982).The obtained data of the available zinc and available phosphorus were subjected to simple correlation and regression. The same data were also subjected to linear regressions to predict available Zn according to this formula :

$Y= a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4$ according to Snedecor and Cochran, (1982).

RESULTS AND DISCUSSION

Nutrients availability:

Data in Fig. 1 illustrate the combination effect of composted rice straw and urea on the kinetic changes of available NH^+_4 during the growing season. Data indicated that soil available NH^+_4 decreased continuously with crop growth, reaching the lowest level at harvest.

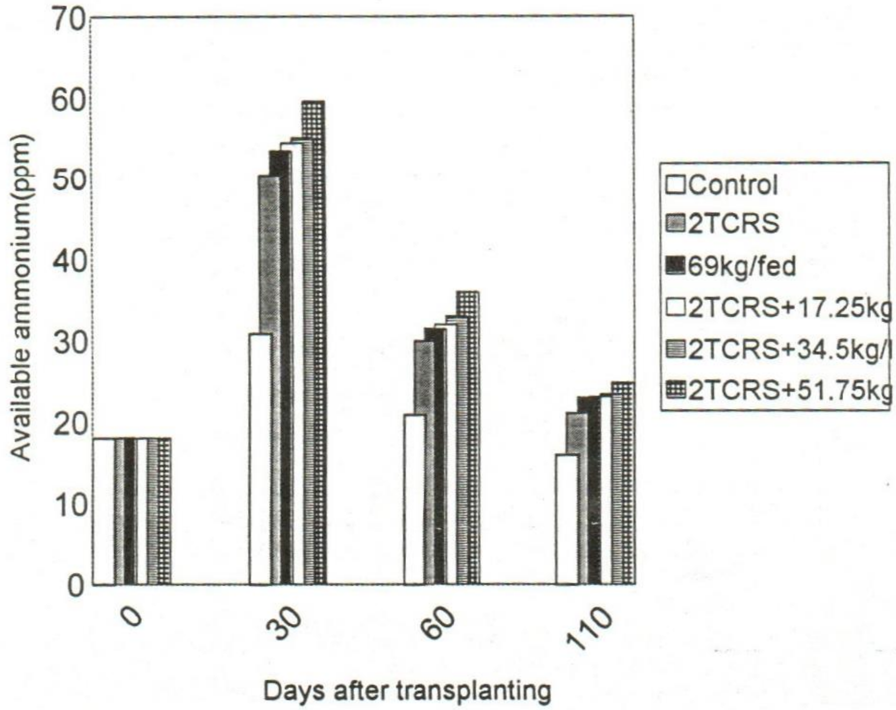

Fig 1: Means of available ammonium (ppm) as affected by the application of composted rice straw and nitrogen treatments at certain times after transplanting in 2004 season.

Soil NH^+_4 concentration increased in all treatments including the control to a peak after 30 day from transplanting, then declined to the minimum by 110 day after transplanting. Data also showed that, the concentration of available ammonium were increased greatly with increasing N-level up to 51.75 kg N.fed^{-1}. This might be due to addition urea to composted rice straw enhance the microorganism activity which increase the mineralization beside the application of composted rice straw to the soil increase of biological N-fixing activity (IRRI,1984). These data were in agreement with those reported by Gotoh *et al,* (1984). Data reported that maximum available NH^+_4 . N was detected (92.25 % increase over the control) when 2 ton of composted rice straw.fed^{-1} plus 51.75 kg N.fed^{-1} added. On the other hand the lowest value was found with control

Data in Fig. 2 illustrate the effect of combination of composted rice straw and urea treatments on the kinetic changes of NO^-_3 – N during the growing season. Regarding to the soil NO^-_3 concentration, data showed that NO^-_3 sharply decreased after transplanting until traces were left with a continuous flooding. The highest value (40.27 % increase over the control) of available NO^-_3 was found when 69 kg N.fed^{-1} added but the lowest one was observed with the control. It is interest to mention that NO^-_3 concentration was a negligible fraction as compared with NH^+_4 concentration during the growing season in the studied treatments. These findings could be explained as result of the mineraliztion of nitrogen from native and N-sources in submerged soil stopped at the ammonia stage because of the oxygen depletion (Patric and Reddy, 1978).

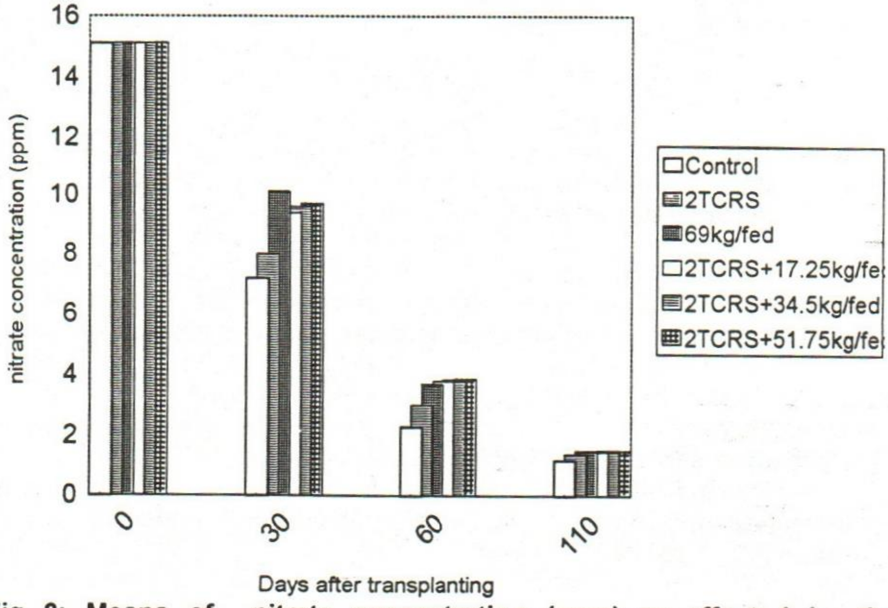

Fig 2: Means of nitrate concentration (ppm) as affected by the application of composted rice straw and nitrogen treatments at certain times after transplanting in 2004 season.

Phosphorus availability as affected by the application of composteded rice straw and urea treatments are presented in Fig.3 Phosphorus availability increased as the time of flooding increased up to 30 days after transplanting. Soil phosphorus increased from 15 ppm before flooding to 27.5 ppm with control at 30 days after transplanting. The increase in phosphorus availability due to flooding is attributed mainly to the reduction of iron, manganese and aluminum since their solubility increased with flooding and changing the soil condition from oxidized (before flooding) to reduce (after flooding) condition (DeDetta, 1983).

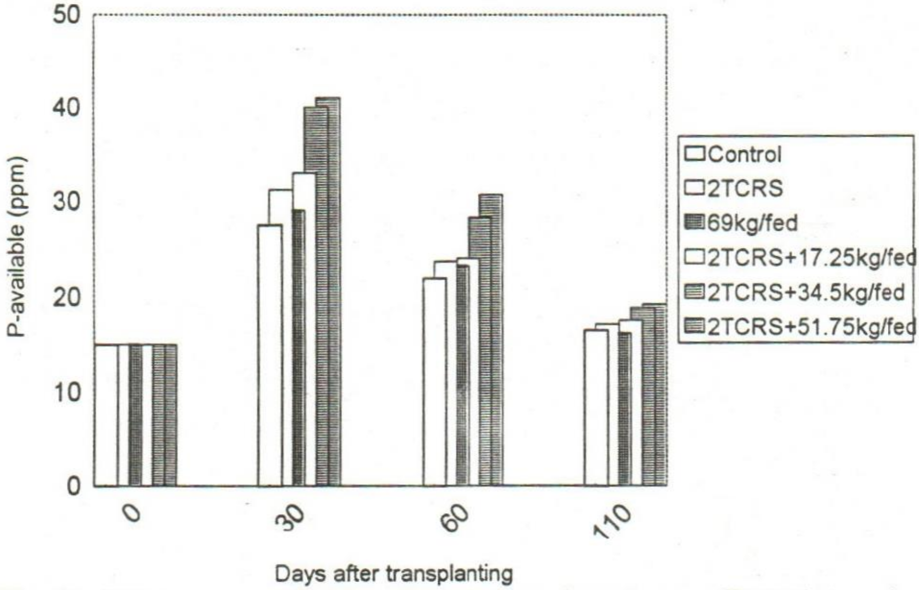

Fig 3: Means of available phosphorus (ppm) as affected by the application of composted rice straw and nitrogen treatments at certain times after transplanting in 2004 season.

Data showed that, all treatments increased phosphorus availability (ranged from 5.45 % increase over the control to 49.09 % increase over the control) compared to control. The highest value of phosphorus availability was found at 30 days after transplanting when 2 ton composted rice straw.fed^{-1} plus 51.75 kgN.fed^{-1} was applied but the lowest value of P-available was observed with control This increase may be due to releasing the phosphorus from composted rice straw.

Data indicated that, phosphorus availability increased up to 30 days after transplanting then start to decrease afterward. This mainly due to the absorption by plant beside subsequent reprecipitation).

Effect of composted rice straw and urea treatments and their combination on potassium availability in the soil presented in Fig.4. Data showed that, all treatments increased the availability of potassium up to 30 days after transplanting then start to decrease afterward at 60 DAT then start to increase again. Maximum value of K-availability was observed when 2 ton composted rice straw.fed^{-1} plus 51.75 kg N.fed^{-1} (48.14 % increase over the control). This could be one reason that soil solution K^+ is higher in the composted rice straw treatments; another reason could be the higher increase in the soil solution Fe^{3+} and Mn^{2+} caused by rice straw which release K from exchange complexes (Ponnamperuma, 1972 and Doberman and Fairhrust, 2000). Higher increase in potassium availability at 110DAT may be due to the irrigation water or alternate wet and dry.

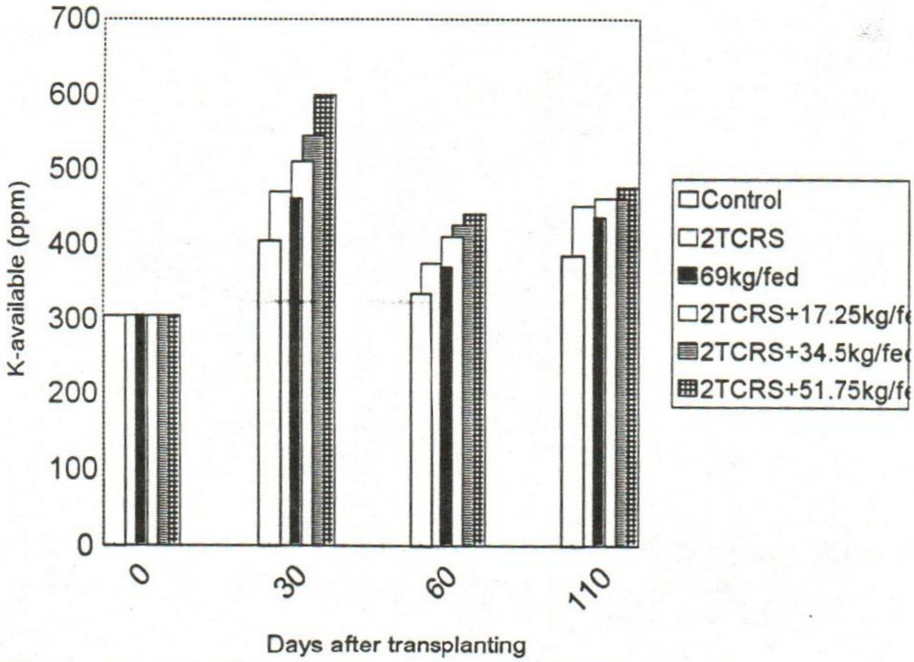

Fig 4: Means of available potassium (ppm) as affected by the application of composted rice straw and nitrogen treatments at certain times after transplanting in 2004 season.

Iron availability as affected by the application of composted rice straw and urea and their integration is presented in Fig.5. Ferrous concentration in all treatments increased to a peak 30 days (with increasing 45.55 % over the control) after transplanting then start to decrease after that. The increase in Fe^{2+} on flooding can be attributed to increase solubility of Fe^{2+} and its released from the composted rice straw beside chelating agents supplied from composted which help in maintain the solubility of iron. These findings are in agreement with those obtained by Das, (2000).

Iron availability increased from 6.1 ppm before flooding to 135 ppm after 30 days of flooding with control. The increase in native iron upon flooding might be resulted from reduction of Fe^{3+} to the more soluble Fe^{2+} during organic matter decomposition (Dobermann and Fairhurst, 2000).

Fig. 5 presented the effect of composted rice straw and their integration on manganese availability in the soil. Data showed that, the availability of Mn^{2+} followed the same pattern as that of Fe^{2+}. Native soil Mn^{2+} increased from 3.5 ppm before flooding to 90 ppm with control at 30 days from transplanting then start to decrease after that. The increase in native manganese upon flooding might be resulted from reduction of manganese (IV) oxides to Mn^{2+} but the decrease may be due to absorption by plant beside complex formation. (Doberman and Fairhurst, 2000).

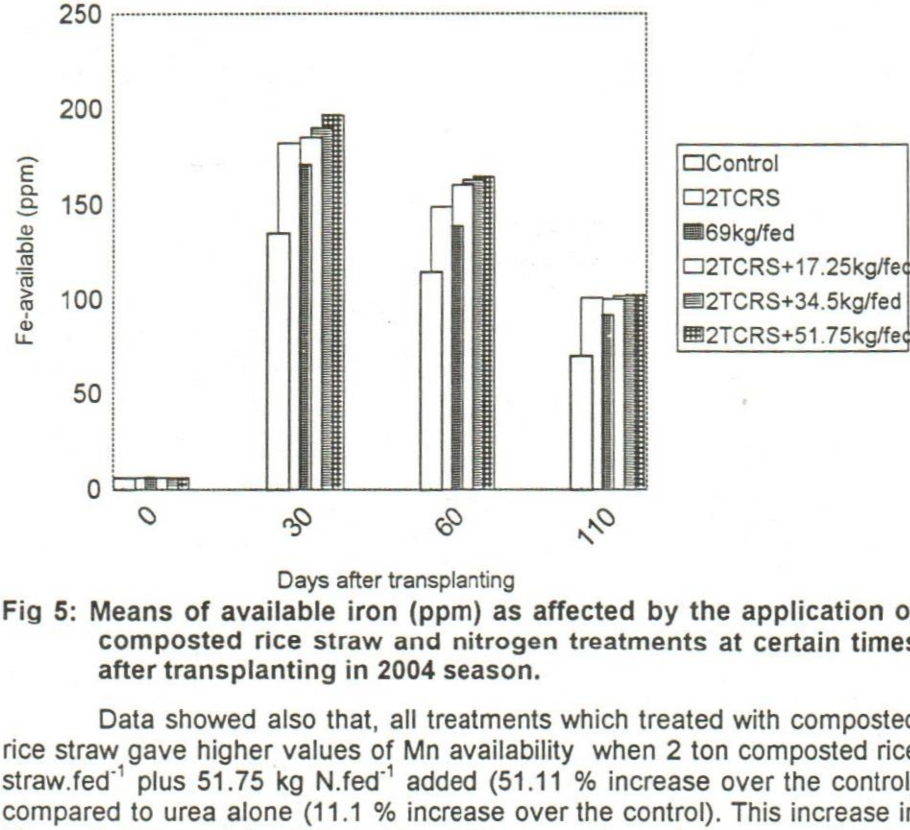

Fig 5: Means of available iron (ppm) as affected by the application of composted rice straw and nitrogen treatments at certain times after transplanting in 2004 season.

Data showed also that, all treatments which treated with composted rice straw gave higher values of Mn availability when 2 ton composted rice straw.fed^{-1} plus 51.75 kg N.fed^{-1} added (51.11 % increase over the control) compared to urea alone (11.1 % increase over the control). This increase in Mn availability mainly attributed to manganese release from composted rice straw.

Data in Fig.6 presented the effect of composted rice straw and urea treatments and their combination on zinc availability. Data showed that native soil zinc decreased from 1.2 ppm before flooding to 0.833 ppm with control at 30 days after transplanting. The reduction in native Zn due to flooding condition might be attributed to precipitation of $ZnCO_3$ due to CO_2 accumulation resulting from organic matter decomposition (IRRI, 1968).

Data revealed that, integration of composted rice straw with urea increase Zn availability at 30 days compared to control or urea alone then decreased after that. This may be due to good decomposition of composted rice straw, which increases the amount of available Zn.Data reported that the highest value of available Zn (24.57 % increase over the control) was found when 2 ton composteded rice straw.fed^{-1} plus 51.75 kg N.fed^{-1} added but the lowest value was observed with control. Data showed also that, zinc availability start to decrease continuously with time. This could be attributed to the formation of Zn-phosphates.

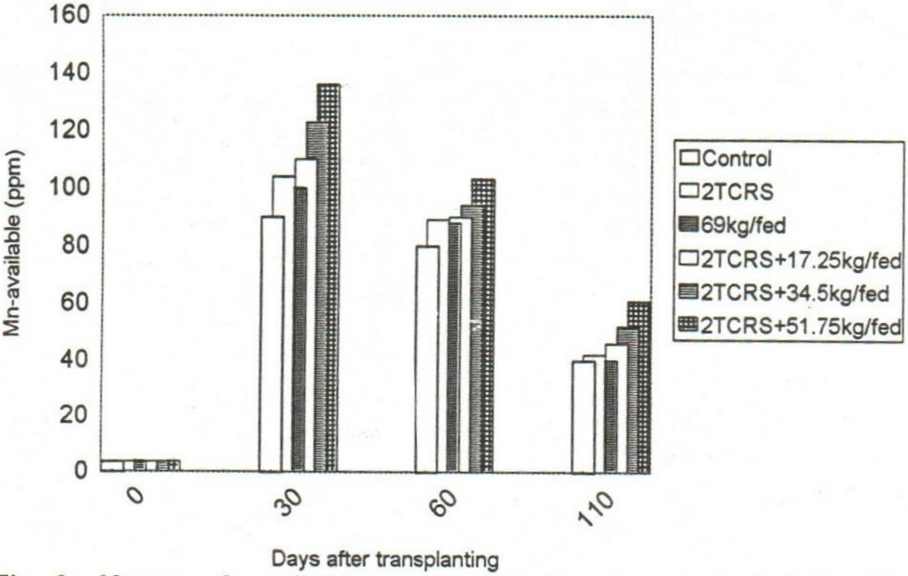

Fig 6: Means of available manganese (ppm) as affected by the application of composted rice straw and nitrogen treatments at certain times after transplanting in 2004 season.

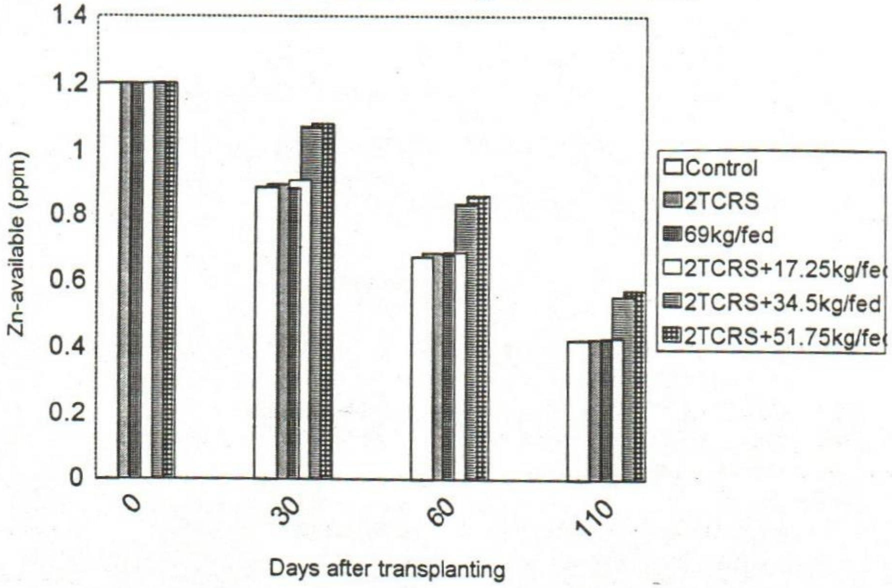

Fig 7: Means of available zinc (ppm) as affected by the application of composted rice straw and nitrogen treatments at certain times after transplanting in 2004 season.

Simple correlation coefficient (r) between available zinc (y) and available phosphorus (x) indicated that the available zinc was positively with available phosphorus. The simple correlation coefficient between y and x was 0.93**. The simple regression equation for predicating the available zinc was computed from the following equation

$Y = 7.40707 - 0.839078X + 2.52E\text{-}02X^{**}2$ with R-Sq = 97.7 % (Fig.8).

While linear regression from the following formula illustrated that phosphorus had a significant role in predicting zinc availability (R-Sq = 86.6% R-Sq (ad) = 83.3%), therefore, the expcected equation to predict the zinc availability is as follows: The regression equation is: Available Zn = - 0.477 + 0.0540 Available

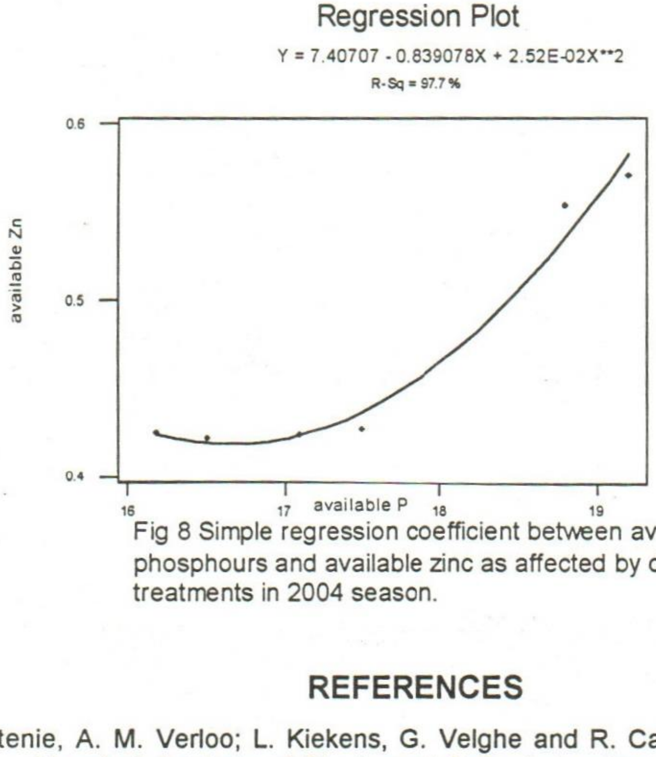

Fig 8 Simple regression coefficient between available phosphours and available zinc as affected by different treatments in 2004 season.

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تأثير قش الأرز على صلاحية بعض العنا صر فى أراضى الأرز المغمورة

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••مركز البحوث والتدريب فى الأرز- سخا- كفرالشيخ

أجريت تجربة حقلية في موسم ٢٠٠٤ في مزرعة مركز البحوث والتدريب في الأرز – سخا – كفر الشيخ مستخدما صنف الأرز سخا ١٠١ وذلك بهدف دراسة تأثير بعض الأسمدة العضوية (مكمورة قش الأرز) والأسمدة الكيماوية (اليوريا) على صلاحية بعض العنا صر الغذا ئية فى التربة. أوضحت النتائج أن كمية الأمونيوم و الفوسفورو البوتاسيوم و الحديد و المنجنيز الميسر زادت حتى ٣٠ يوم بعد الشتل وبخاصة عندما تم الستخدام ٢ طن كمبوست + ٥١,٧٥ كجم نيتروجين . فدان-١ ثم بدأت في التناقص بعد ذلك بينما البوتاسيوم زاد عند ١١٠ يوم بعد الشتل مره اخرى. أوضحت النتائج أن تركيز النترات انخفض بشكل حاد بعد ٣٠ يوم من الشتل حتى تواجدت بكميات قليلة مع استمرار الغمر. أعلى قيمة لتركيز النترات وجدت عندما ٦٩ كجم نيتروجين. فدان-١ طبقت.

إضافة الكمبوست مع السماد النيتروجيني زادت من كمية الزنك الميسر مقارنه مع اليوريا بمفردها وبخاصة عند استعمال ٢ طن كمبوست + ٥١,٧٥ كجم نيتروجين . فدان-١ . وجد أيضا من المعادلات الخطية انه يوجد علاقة ارتباط إيجابي بين-الزنك الميسر (Zn) و الفوسفور الميسر (P) ويتضح ذلك من المعادلة آلاتية:

$$Zn = -0.477 + 0.0540\,P \qquad \text{with} \quad R^2 = 86.6\ \%$$