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Research paper

Correlation Studies between Fertilizer, Tuber Yield and Some Yield Components for Irrigated Potato Grown on Clay Soils of River Nile State, Sudan

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ABSTRACT

Potato cultivar Diamant was grown for two consecutive seasons (2004/5 - 2005/6) at Darmali Irrigated Karu Soils (clay 42-52%) to test different correlations between fertilizer, yield and some yield components (crop-ground cover and number of stolons/plant). Twenty out of 72 experimental plot units were arranged in split plot design and considered for correlation analysis to obtain different correlation coefficients between the above mentioned traits. Results revealed that in all tested traits, correlations were positive in various degrees, however, in some of them it was not significant. Fertilizer showed highly significant and positive correlation with crop cover and yield. With regard to stolons, the relation though positive, was not significant in the two seasons. Yield-crop cover correlations were significantly positive for the two seasons, while, yield-stolon correlations were positive but only significant for season 2004/5. Crop cover-stolons correlations were not significant, though positive for the two seasons.

Keywords: *Fertilizer, potato, River Nile State, tuber yield*

الارتباط بين التسميد و الإنتاجية وبعض مكوناتها لمحصول البطاطس المروى بأراضي الكرو في ولاية نهر النيل، السودان

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اجريت تجربة علي محصول البطاطس الصنف دايمونت لموسمين متتاليين (05/2004 و 06/2005) تحت الري في اراضي الكرو (نسبة الطين 42-52 %) بدارمالي لدراسة الارتباط بين التسميد والإنتاجية وبعض مكوناتها (نسبة تغطية النبات وعدد السيقان الارضية). فقط 20 من 72 وحدة تجريبية أجريت وفق تصميم القطع المنشقة هي التي استخدمت لتحليل معامل الارتباط بين التسميد والخواص المقاسة المذكورة. أثبتت النتائج أن معامل الارتباط لكل القياسات المذكورة إيجابي وفق مستويات مختلفة رغم أنه لم يكن معنوياً في بعض منها. بالنسبة للتسميد فقد أوضحت الدراسة ارتباطه العالي والمعنوي مع ألإنتاجية ونسبة تغطية النبات ولكن لعدد السيقان الأرضية فقد كانت النتيجة معنوية فقط لموسم واحد. الارتباط بين الإنتاجية ونسبة التغطية كان معنوياً للموسمين بينما كان معنوياً في موسم واحد مع عدد السيقان الأرضية. الارتباط بين نسبة التغطية والسيقان الأرضية لم يكن معنوياً رغم أنه كان إيجابياً في الموسمين.

Introduction

Most of potato grown in Sudan is occupying fertile, yet continuously cultivated revarian soils along Nile banks in Khartoum and River Nile states. In such soils symptoms of nitrogen deficiency are well known. Minerals fertilization is a common practice, hence the potato crop always exhibited noticeable tendency towards responding to fertilization, particularly with mineral nitrogen in the form of urea.

Tuber yield, crop canopy and stolon development are known to be interrelated since the work of Dyson and Watson (1971) who explained the great, small and negligible effect of N, P and K, respectively on leaf area index of cultivar King Edward. Burton (1989) indicated that the photosynthetic efficiency of the foliage depends in-part upon its content of chlorophyll, which is in turn more or less dependent to nitrogen content of the plant tissue and its effect in delaying plant senescence. Beukema and Van Der Zaag (1990) stated that shortage of nutrient supply accelerates leaf aging and suggested that there is a positive relationship between nitrogen content of the leaf and photosynthesis. They also indicated that during part of the growing season, haulm and tuber growth proceeds simultaneously showing some kind of interrelation. Vos and Oyarzum (1987) found direct correlation (r=0.91) between nitrogen content of the leaf and photosynthesis rate. However, Pyalon (1990) indicated that yield response to nitrogen is attributed to increased canopy growth. He also pointed out that; early in the season, the relationship is very clear. Using a chlorophyll meter readings, Gilello and Echeverria (2013) obtained similar results. Basu *et al.* (2002)

indicted that this relationship is a factor of a carbon partitioning coefficient (source- sink relationship). Stalin and Enzmaan (1990) stated that tuber dry matter yield at physiological maturity was positively correlated with nitrogen content of the tops and nitrogen application between 0 and 240 kg N/ha. In an experiment carried out at Shambat, Ali (1986) discovered that both nitrogen in form of urea or chicken manure has a positive effect on leaf area index and tuber yield, but she indicated that there were no significant differences due to the application of either of them on number of stolons. However, Ali and Yousif (2000) in the same condition of Shambat, indicated a positive effect of nitrogen application on number of tubers/plant. Further, similar results were obtained by Jenkins and Nelson (1992).

The objective of this study is to investigate the relationship between tuber yield and some yield components (crop cover and number of stolons/plant) and nitrogen fertilization regardless of the fertilizer form using Pearson correlation coefficient.

Materials and Methods

This study was carried out on Darmali Karu soils (clay % 42-52), in River Nile State of Sudan (longitude 34, latitude 17:48 and altitude 340 m above sea level). Potato tubers of cultivar Diamant were grown for two consecutive seasons (2004/5 and 2005/6). Twenty out of 72 total experimental plot units, laid out in split plot design, were only taken for correlation analysis. Others were excluded to avoid the interactive effect of different fertilizers. Foliar multi element fertilizer (ADB) with 8 % nitrogen in form of carbamide, ammonium and nitrate used in concentration of 30

ml/10 L of water, assigned to the main plots in 3 treatment levels (control, 2 weeks spraying and weekly spraying intervals). In the sub plots, 6 levels of urea 46 % and a combination of urea + chicken manure were applied as follows:

Level (1) 0 N/ha (control).

Level (2) 4 N/ha (180 Nitrogen kg/ha).

Level (3) 6 N/ha (270 Nitrogen kg/ha).

Level (4) 8 N/ha (360 Nitrogen kg/ha).

Level (5) 4 N/ha urea + 10 m^3 /ha chicken manure.

Level (6) 4 N/ha urea + 20 m^3 /ha chicken manure.

Chicken manure was added at planting time, while urea was added in four split doses starting 3 weeks after sowing. Treatments were replicated four times with a sub plot size of 3X3m^2, 80 cm between row and 25 cm within row spacing. Irrigation and disease and pest control were done as recommended in the north of Sudan.

The 20 samples combination analyzed using a computer statistical program SPSS were as follows:

- Four replicate readings of control treatment (without soil or foliar applied fertilizer)
- Four replicate readings of 2 weeks interval foliar applied fertilizer
- Four replicate readings of weekly foliar applied fertilizer

- Four replicate readings of the highest level of soil applied fertilizer (360 kg N/ha)
- The average of four replicate readings of 180 kg N/h +10 and 20 m^3 of chicken manure

The number of stolons were counted after 50 days from planting, while crop cover was taken using 10X10 cm quadrate after 60 days from planting.

Results and Discussion

Tables (1 and 2) show correlations between fertilizer, yield in ton/ha, % crop cover and stolon number/plant in the two seasons. Fertilizer showed highly significant (p= 0.000) and positive correlation with % crop cover and yield (0.708, 0.718 in the first season and 0.855, 0.708 in the second season, respectively). However, in the two seasons correlation between fertilizer and number of stolons/plant, though positive, was not significant. The relation between yield and crop-cover was significant and positively correlated for the two seasons (0.686 in the first season and 0.664 in the second season). Regarding the correlation coefficient between stolons and yield, results showed positive relation in the two seasons, however, it was only significant in the first season (0.523). The results obtained with regard to the effect of fertilizer on crop cover and yield were in line with that obtained by Ali (1986), Vos and Oyarzum (1987) and Stalin and Enzmaan (1990) while results obtained with regard to the number of stolons/plant were similar to those obtained by Ali (1986) and Jenkins and Nelson (1992). It also do not contradict with what was mentioned by Ali and Yousif (2000) but don't agree completely with them hence, Ali and Yousif indicated the relationship

at physiological ripening (complete tubers) while this study and that of Ali (1986) and Jenkins and Nelson (1992) referred to the relationship at early stages of growth. It is obvious that, greater number of stolons does not necessarily mean greater number of tubers at harvest, hence, Beukema and Van Der Zaag (1990) indicated only about 50 % or less develop into tubers. However, the work of Ali and Yousif stated clearly that development of tubers from stolons is largely enhanced by fertilization. Results obtained regarding correlation between stolons and yield (0.523 in the first season and 0.333 in the second season) can also justify the above-mentioned findings. Greater crop cover means greater light reception which can in turn enhance photosynthetic efficiency of potato. But at the same time, it could be concluded that; other factors also can control stolons' number such as planting depth and hilling together with environmental and genetic factors.

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Table 1: Correlation between fertilizer, tuber yield and some yield components on irrigated potato in Darmali, Sudan -season 2004/05

Character		Crop cover	Yield	Stolons
Fertilizer	Pearson correlation	0.78**	0.72**	0.23
	Sig. level	0.000	0.000	0.24
Crop cover	Pearson correlation		0.69**	0.38
	Sig. level		0.001	0.10
Yield	Pearson correlation			0.52*
	Sig. level			0.02

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).
N= 20

Table 2: Correlation between fertilizer, yield and some yield components on irrigated potato in Darmali, Sudan -season 2005/06

Character		Crop cover	Yield	Stolons
Fertilizer	Pearson correlation	0.86**	0.71**	0.28
	Sig. level	0.00	0.00	0.23
Crop cover	Pearson correlation		0.66**	0.44
	Sig. level		0.001	0.05
Yield	Pearson correlation			0.33
	Sig. level			0.15

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

N= 20