J. Plant Production, Mansoura Univ., Vol. 2 (9): 1233 - 1247, 2011

INFLUENCE OF PRECEDING WINTER CROPS AND IRRIGATION INTERVALS ON RICE TREATED WITH HUMIC AND ASCORBIC ACIDS IN NORTH DELTA

Ibrahim, E. M.
Crop Intensification Research Dept. Field crop Research Institute. ARC. Giza, Egypt.

ABSTRACT

A field experiments were conducted at Tag El-Ezz Agric, Res. Station, Dakahlia governorate Egypt, during the two successive summer seasons of 2005 and 2006 to study the effect of three preceding winter crops (flax, sugar beet and faba bean), three irrigation intervals (every 4, 6 and 8 days) in addition to humic (HA) & ascorbic acids (AA) on growth and yield of rice(sakha 101). The main results could be summarized as follows:

Preceding winter crops, irrigation intervals and humic & ascorbic acids had a significant effect on all studied characters in both seasons. Grain yield of rice grown after faba bean attained increase 17.4 and 13% (average of two seasons) compared to rice grown after flax and sugar beet, respectively. Irrigation of rice fields every 6 days recorded the highest values in all studied characters in both seasons expect plant height and straw yield/fad. Irrigation every 6 days increased yield/fad by 4.4 and 21.4% compared to every 4 and 8 day respectively. Application of ascorbic acid gave the highest mean values in all studied characters in both seasons, which attained increase in grain yield reached to 9.3 and 3.8 % compared to control and humic acid, respectively. The highest grain yield (4.87 and 4.97 ton/fad) was recorded by the interaction among cultivation after faba bean, irrigated every 6 days and spraying by ascorbic acid.

The relationship between grain yield from one side and its attributing variables on the other side was done using correlation, multiple linear regression and stepwise regression. The simple correlation coefficient cleared significant positive correlation between grain yield t/fad and each of individual studied characters, also cleared that there was significant positive correlation among all characters that were studied and each of other. Multiple regression analysis indicated that the relative contribution for all characters were 91.67 % from the total variation for yield t/fad. Results of stepwise regression analysis revealed that four out of nine variables contributed by 91.55 % in the total variation for yield t/fad. These variables were flag leaf area, 1000-grain weight, filled grains % and number of grains/panicles with R^2 being 89.67, 1.15, 0.40 and 0.73 %, respectively.

INTRODUCTION

Rice *(Orayza sativa, L)* is one of the most important cereal crops in the world as well as in Egypt. The total world grain product of rice is exceeded only by that of wheat and corn. In Egypt, rice is considered as one of the most important source for human food and for hard currency earning as an exportable crop. The need to raise its productivity more and more per unit land area is a native goal to meet the consistent demands from this crop. Improving rice production can be achieved through optimizing the cultural practices such as preceding crops, irrigation water and natural additives, many researches reported that the leguminous crop was the best for precursors than cereal crop because they the ability to improve soil fertility and save mineral nitrogen. In this respect, Bassal *et al.* (1996), El-Wehaishy (1998), Ebaid and Ghanem (2000) and Ibrahim (2002) reported that legumes greatly increase the soil fertility especially nitrogen in the soil when their roots are turn into the land and concluded that grain yield and its attributing variables were superior compared with that after non legumes. Wang *et al.* (2009) revealed that improvement in growth and yield of rice as a result of increasing in soil microbial biomass nitrogen by preceding winter crops.

Irrigation water is necessary under the Egyptian condition to fulfill the need of reclamation and the water requirements of the different crops . Rice cultivation in several countries experienced water shortage problems. Moiller (2001) found that water productivity can be increased by increasing yield per unit area through better agronomic practices and suitable irrigation system, one of the ways for saving water is increasing irrigation intervals with minimum yield reduction or using drought tolerant and short period rice cultivars. In this respect, Nour and Mahrous (1994), Nour *et al.* (1994) and El-Hawary (2000) reported that average number of panicles/m^2, 1000-grain weight as well as grain and straw yields decreased by prolonging irrigation intervals from 4 up to 8 and 12 days. Therefore, attempts are made to improve crop productivity in new reclaimed soils . One of these approaches to reduce rice production owing to the short of irrigation water is by speech of preceding winter crops, through sowing rice plants after crops which leave some parts after harvesting leding to increase organic fertilizers and soil organic matter content. Zayed (2005) reported that increase soil organic matter content had several advantages; like conservation of water which sufficient plants requirement for long time and slowing the release of macro- and micro- nutrients. El-Kalla *et al.* (2006) reported that 6 days interval for rice irrigation (sakha 101 cv.) was the optimum.

Humic and ascorbic acids are important natural additives to improve growth and yield in plants. Humic substances are an important soil component because they constitute a stable fraction of carbon and improve water holding capacity, pH buffering and thermal insulation (Mc Donnell *et al.*, 2001), stimulate plant growth by the assimilation of major and minor elements, enzyme activation and /or inhibition changes in membrane permeability, protein synthesis which activate the biomass production (Ulukan,2008), regulating endogenous hormone levels and finally it was hypothesized that humic and ascorbic acids increase the photo- chemical efficiency (Fragbenro and Agboola. 1993). Oxidative stress is one of consequence of the condition stress which led to sever crop damage and loss of productivity (Vaidyanathan *et al.* 2003), The effectiveness of any given antioxidant in the plant depends on which free radical is involved, how and where it is generated and where the target of damage is, several antioxidant enzymes participate in order to detoxification of activated oxygen species and enhance plant tolerance to drought and salinity (Demiral and Turkan 2005). Ascorbic acid is an excellent antioxidant consists of molecules that can neutralize harmful reactivate oxygen species generated by salt, water, chilling and ozone stress and it directly scavens O^2 and OH (Halliwell, 1974), through doing as a co-factor in synthesis of absisic acid, gibberellins and ethylene under high levels of stress condition, the availability co factor of AA was decreased and result increased absisic acid biosynthesis (Pastori *et al.* 2003). Fadzilla *et al.* (1997) and Saker *et al.* (2010) reported increasing of shoot and yield of rice under saline conditions due to the activity of antioxidant enzymes and induction systemic resistance that triggered by a number of chemicals which led to improve growth and yield.

The present study was conducted to study the influence of preceding winter crops and irrigation intervals on growth and yield of rice treated with humic and ascorbic acids in north delta.

MATERIALS AND METHODS

The present investigation was carried out at Tag El-Ezz Agric. Res. Station, Dakahlia governorate, during 2005 and 2006 seasons to study influence of preceding crops, irrigation intervals on growth and yield of rice treated with humic and ascorbic acids. Each of preceding winter crops (flax, sugar beet and faba bean) was done in separate experiment. Every experiment of preceding winter crop was carried out in a split-t plot design with three replicates. The main plots were occupied at random with three irrigation treatments: Every 4 days, 6 days and 8 days.

The sub-plots were assigned to by control, humic acid and ascorbic acid.

Humic acid and ascorbic acid were obtained from Al- Gomhoria Company of chemicals, Egypt.

Agricultural practices:

Nursery filed:

The nursery area was fertilized with calcium super phosphate (15.5%P2O5)at the rate of 200kg/fad on dry soil before ploughing. Nitrogen in the form of urea (46% N) was added at the rate of 70 kg N /fad. Zinc sulphate (24% Zn SO4) at the rat of 25 kg/fad was applied after paddling and before seeds broadcast. Rice grains at the rate of 60 kg/fad were soaked in each of water only, humic acid (1000 ppm) or ascorbic acid (300 ppm), for 24 hours and incubated for 48 hours. Thereafter, grains were sown at May 10^{th} and 15^{th} in the first and second seasons respectively. Weeds were chemically controlled using Saturn 50% at the rate of 2 liters/fad as recommended, seven days after sowing. Blood-worm was controlled by furadan 10% at the rate of 6 kg/fad. Rice variety (Sakha 101) was obtained from Rice Research and Training center, Sakha, Kafer El-Sheikh, Egypt. Description of this cultivar is presented in Table 1.

Permanent field:

The permanent filed was well prepared through ploughing and leveled, calcium super phosphate (15.5 % P_2O_5) at the rate of 200 kg/fad was applied during soil preparation, leveled and then divided into the experimental unit which occupying an area of 21m^2 (4.2 m. apart and 5 m. length). The preceding winter crops were as the pervious crops mentioned in both seasons. Nitrogen in the form of urea (46% N) was added at the rate of 70 kg

N/fad in two splits; 2/3 of the rate as basal application at high tailoring stage and 1/3 of the rate as top dressing at seven days before panicle initiation. Weeds were controlled using Saturn 50% at four days after transplanting as recommended. Other cultural practices were performed as recommended. Each irrigation treatment was thoroughly separated from each other water it was surrounded by deep channels to prevent any lateral movement of water from irrigation treatment to other. Plants were sprayed twice after 35 and 50 day from sowing (during the vegetative growth stage) with each of:

1- Water only (control).
2- Humic acid (HA) at 1000 ppm.
3- Ascorbic acid (AA) at 300 ppm.

Table 1: Genotypic and phenotypic characteristics of rice cv. Sakha 101.

Cultivar	Sakha 101
Crosses	G.178/Milyang 79
Leaves type	Bright erect
Tillering capacity	High
Stature	Short
Grain	Short
Response to N	High
Blast resistance	Resistant
Salt sensitivity	Sensitive
Drought resistance	Sensitive
Duration	140 days
Type	Japonica

Soil analysis:

Samples of soil were collected from the surface layer (0-30) after harvesting winter crops in the two seasons. The samples were analyzed for nitrate according to Kieldahl method as described by Jakson (1958), available P according to Olsen *et al.* (1954) and K was determined by flame photo metrically using E.E.L flame photometer as mentioned by Richards (1945). The filed soil was clayay in texture and available N, P, K and pH are presented in Table (2).

Table 2 : Available N, P, K (ppm) and pH of soil after flax, wheat and faba bean in 2005 and 2006 seasons.

Preceding crop	2005				2006			
	Avalible nutrients (ppm)			pH	Avalible nutrients (ppm)			pH
	N	P	K		N	P	K	
Flax	28.0	10.8	194	8.2	29.0	11.0	200	8.1
Sugar beet	31.0	11.7	203	8.0	33.0	11.5	211	8.0
Faba bean	41.0	13.2	219	7.8	43.0	13.8	226	7.7

The studied characters:

At harvest a sample of 10 plants was chosen at random, from each plot to study Plant height (cm), flag leaf area (cm^2) by multiplying the maximum length and width of the flag blade in constant factor (0.75), according to

Palamiswamy and Gomez (1974). , number of panicles/m^2 (the plants in the inner of 1/4 meter of each experimental unit were harvested, then converted to no. of panicles/m^2), panicle length (cm), number of grains/ panicle grains weight/ panicle (g), filled grains % and 1000- grain weight (g).

The plants in two square meters of each experimental unit were harvested, collected together, labeled, thrashed and the grains were separated. The grain and straw yields were recorded in kg/m2 separately, then it was converted into: Grain and straw yields (t/fad).

Statistical analysis:

The collected data were statistically analyzed according to the technique of analysis of variance for the split- split plot design by means of "MSTAT-C Computer software package and least significant difference (LSD) method was used to test the differences between treatment means at 5% probability, as published by Gomez and Gomez (1984). The relationships among dependent and independent variables through calculate simple correlation coefficient by Snedecor and Cochran (1989) to estimate the correlation coefficient (r) between each of dependent and independent variable, multiple regression analysis by Draper and Smith (1987) to calculate the coefficient of determination (R^2) to estimate relative contribution of independent variables for each dependent variable and to get the prediction equations and stepwise multiple regression analysis to determine the variables accounting for the majority of the total variability independent character by Draper and Smith (1987). Dependent variables for rice t/fad (Y) and the independent variables (X) were presented in Table 3.

Table 3: Independent variables that were related with grain yield t/fad (Y) of rice

Independent variables	
Plant height (cm)	X1
Flag leaf area (cm^2)	X2
No. of panicle/m^2	X3
Panicle length (cm)	X4
No. of grains/panicle	X5
Grains weight/panicle (g)	X6
Filled grains/panicle%	X7
1000-grain weight (g)	X8
Straw yield (t/fad)	X9

RESULTS AND DISCUSSION

1-Preceding crops:

Data presented in Table 4 show that the preceding crops had a significant effect on all studied characters in both seasons. Rice preceded by faba bean was superior in all studied characters compared with those preceded by flax and sugar beet in both seasons. Rice grain after faba bean recorded 4.100 and 4.27 ton/fad in the first and second seasons, respectively, while gave 3.541 and 3.741 t/fad after sugar beet, whereas recorded 3.389 and 3.526 t/fad after flax.

Table 4: Yield and yield attributes of rice as affected by preceding winter crop, irrigation intervals and humic & ascorbic acids during 2005 and 2006 seasons.

Characters	Plant height (cm)		Flag leaf area (cm^2)		NO. of panicle/m^2		Panicle length(cm)		No. of seeds/panicle		Seeds weight/panicle (g)		No. of filled grain%		1000-grain weigh (g)		Grain yield (t/fad)		Straw yield (t/fad)	
Season	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006
Treatments																				
A-Preceding crop:																				
Flax	90.8	94.6	17.9	19.0	374.7	384.7	17.1	18.4	93.9	98.0	2.8	2.9	82.8	86.0	27.3	28.4	3.389	3.526	3.807	3.963
Sugar beet	96.9	101.1	19.6	21.3	384.8	400.0	19.3	20.7	99.5	104.3	3.1	3.3	85.1	89.9	29.3	30.6	3.541	3.741	4.104	4.252
Fababean	102.9	103.1	22.9	24.3	395.0	409.2	21.1	22.2	109.4	113.0	3.4	3.6	89.9	95.0	33.3	34.0	4.100	4.270	4.574	4.774
LSD 5%	1.1	NS	0.2	0.3	2.4	2.7	0.2	0.2	0.5	0.6	0.03	0.12	0.5	0.9	0.3	0.3	0.122	0.044	0.030	0.043
B-Irrigation inerval:																				
4 days	102.4	106.2	21.9	23.3	393.8	407.7	20.5	21.7	106.1	111.2	3.3	3.4	88.8	93.7	31.7	32.9	3.770	4.100	4.552	4.841
6 days	99.5	99.7	22.8	24.4	400.3	414.1	20.7	22.1	110.3	113.9	3.4	3.6	90.3	95.1	32.2	33.4	4.044	4.185	4.111	4.348
8 days	88.7	92.8	15.6	16.8	360.4	372.1	16.4	17.4	86.6	90.1	2.7	2.8	78.7	82.0	26.0	26.8	3.215	3.252	3.822	3.800
LSD 5%	0.6	0.8	0.4	0.5	3.2	3.3	0.3	0.3	0.9	1.2	0.03	0.15	0.4	0.7	0.3	0.3	0.131	0.070	0.052	0.023
C- humic & ascorbic acids																				
Control	93.0	93.2	18.6	19.7	372.6	388.4	17.8	18.7	94.8	98.5	2.9	3.1	82.7	85.9	27.2	28.2	3.496	3.637	3.952	4.096
Humic acid	97.1	101.0	20.1	21.6	386.8	398.4	19.2	20.7	102.5	106.6	3.1	3.3	86.5	91.2	30.5	31.3	3.704	3.863	4.215	4.356
Ascorbic acid	100.4	104.6	21.7	23.3	395.1	407.1	20.5	21.9	105.6	110.1	3.3	3.4	88.6	93.7	32.1	33.6	3.830	4.037	4.319	4.537
LSD 5%	0.8	NS	0.4	0.3	3.6	1.8	0.7	0.4	1.5	1.2	0.07	0.19	0.7	1.3	0.5	0.5	0.094	0.064	0.062	0.041
D-Interaction:																				
AB	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
AC	NS	*	*	*	NS	NS	*	*	*	*	NS	NS	*	NS	*	NS	*	NS	*	NS
BC	*	*	*	*	*	NS	*	*	NS	*	*	*	NS	*	NS	*	*	NS	*	*
ABC	*	*	*	*	NS	NS	NS	NS	*	NS	NS	NS	*	*	*	NS	*	*	NS	NS
C.V	2.00%	2.40%	2.10%	2.30%	1.10%	1.20%	1.70%	2.10%	0.90%	1%	1.90%	4.00%	1.00%	1.90%	1.60%	1.90%	4.58%	4.03%	1.50%	1.70%

The superiority of yield and yield components of rice grown after faba bean may be due to its effect of increasing in soil microbial biomass nitrogen which led to enriching the soil with nitrogen fixed by Rizobium and organic matter residues which improving the physical, chemical and biological properties of the soil, which contributed to the superiority of growth and yield. Increasing total nitrogen concentration in both leaf and stem was reflected in a corresponding increase in protein-N in drought resistant lines and in ammonical-N drought – susceptible lines (CRRI, 1978). Similar results were obtained by Metwally (1994), Bassal *et al.* (1996), El-Wehaishy (1998), Ebaid, Ghanem (2000) and Ibrahim (2002) and Wang *et al.* (2009).

2- Irrigation intervals effect:

Soil moisture availability is the main limiting factor for growing crops. Moisture stress affects plant height , tiller number , leaf area, dry weight of shoot and root and grain yield of rice. Water deficit during the reproductive stage is most damaging to rice crop Abd Allah (2004) and Gouranga and Singh (2006). Irrigation interval had significant effect on all studied characters in both seasons (Table 4). Irrigation every 6 days attained the highest values in all studied characters expect plant height and straw yield resulted under every 4 days. Prolonging irrigation interval over 6 days had a negative effect on plant height, flag leaf area, no. of panicle/m^2, panicle length, no. of seeds /panicle, seeds weight/panicle, filled grains/panicle, 1000-grain weight, grain yield and straw yield as shown in this investigation, rice plots irrigated every 8 days recorded the lowest values in all studied characters. Irrigation of rice plants every 4 or 8 days caused 6.8, 20.5 % and 2.03, 22.3 % reduction in grain yield per fad. compared to those irrigated every 6 days in 2005 and 2006 seasons, respectively. These results are in accordance with those reported by El-Wehishy and Ghanem (1996) and Abd El-Rahman *et al.* (2004) they found that the reduction in no. of panicle/m^2 when rice plants irrigated at 9 and 12 days interval may be due to exposing rice plants to the soil water deficit during tillering stage. The reduction in panicle grain weight caused by increasing irrigation intervals over 8 days might be attributed to the decrease in photosynthesis ability during grain filling stage which led to the decrease in metabolites quantity which translocated and stored in grains resulting in a decrease in 1000-grain weight and then reduce the panicle grain weight, Chattarjee and Maiti (1983) found decrease in photosynthetic pigments rate of rice plants by increasing irrigation interval. The reduction in grain yield/fad caused by increasing irrigation interval over 8 days may be due to the decrease in each of no. of panicle/m^2 panicle grain weight and 1000- grain weight, Abo-Soliman *et al.* (1990) and Nour *et al.* (1994) recorded reduction about 9% in the grain yield when irrigation every 9 days and 31% when irrigation every 12 days El-Kalla *et al.* (2006) and Sakr *et al.* (2010) found that irrigation every 6 days was the optimum.

3-Humic and Asborbic acids effects:

All studied characters of rice showed significant increments by treatment with humic (HA) and ascorbic (AA) acids compared to control (Table 4). Rice treated with HA and AA recorded increase in grain yield by 3.9 and 9.4% and 5.3 and 10.2% compared to control in the first and second seasons, respectively. These improvements in growth and yield may be due to the important role of humic acid in increased the available N, micronutrients and the organic carbon at the optimum dose of HA (Bama 2009 and Bama & Selvakumari 2009), improve water holding capacity, pH buffering and thermal insulation (Mc Donnell *et al.*, 2001), stimspeciesulate plant growth by the assimilation of major and minor elements, enzyme activation and/or inhibition changes in membrane permeability, protein synthsis and finally the activation of biomass production (Ulukan, 2008). Additionally they used as a growth regulating by regulate endogenous hormone levels and it was hypothesized that they increase the photo-chemical efficiency (Fragbenro and Agboola. 1993). Ascorbic acid play an important role not only in scavenging and detoxification of activated oxygen AOS by react super oxide dismutases with super oxide radicals O^{2-} to produce H2O2, ascorbate peroxidase together with monodehydro ascorbate reductase which reduces H2O2 to water (Vaidyanathan *et al.* 2003 and Dermial & Turkan 2005), but also in improving growth and developmental processes of rice through improve drought resistance, its content of total phenols in plant which is known as antifungal, antibacterial and antiviral (Ozaki *et al.* (2003), improvment of physiological processes in plant such as ion uptake, cell division, enzymatic activation and protein synthesis and increase lignin biosynthesis and plant cell wall lignifications (Xunzhong and Ervin (2004). Ascorbic acid might be detoxificat the effect of Cl on photo system II and improve the membrane integrity by correct high Na to Co2 ratio (Fadzilla *et al.*,1997, Lin and Kao, 2001 and Sakr *et al.*, 2010).

4-Interaction:

The interaction between studied factors had a significant effect on some characters in which preceding crops and irrigation intervals (AB) gave the highest values of grain yield/fad (4.64 and 4.76 ton), 1000-grain weight (36.7 and 37.6 g), seed panicle weight (3.79 and 4.10 g), No. of panicles/m^2 (419.3 and 431.0) and flag leaf area (27.1 and 28.9 cm^2) were obtained when planting rice plants after faba bean as previous crop and irrigation every 6 days in the first and second season, respectively (Table 5). Preceding crops and humic & ascorbic acids (AC) gave the highest values of flag leaf area (24.7 and 26.1 cm^2) in the first and second season, respectively, 1000-grain weight and grain and straw yields (35.3g, 4.12 and 4.73) in the first season were obtained when rice treated with ascorbic acid and planting after faba bean (Table 6). Irrigation intervals and humic & ascorbic acids (BC) gave the highest values of flag leaf area (24.3 and 26.3 cm^2), number of panicles/m^2, grain yield/fad (409.2 and 4.19 t/fad) in the first season, respectively and to 1000-grain weight (36.1g) in the second season were attained when rice treated with AA and irrigation every 6 days (Table 7). Preceding crops and irrigation intervals and humic & ascorbic acids (ABC) gave the highest values of flag leaf area (29 and 31cm^2) and grain yield/fad (4.87 and 4.97 t/fad) were obtained when rice planting after faba bean irrigated every 6 days with treated with ascorbic acid in the first and second seasons, respectively Table(8).

Table 5: Means of Grain yield, 1000-grain weight, seeds/panicle weight, no. of panicles and Flag leaf area as affected by the interaction between preceding crops and irrigation intervals

Char.	Grain yield (ton/fad)						1000-grain weight (g)						Seeds/panicle weight (g)						No. of panicles/m²						Flag leaf area (cm²)					
Seasons.	2005			2006			2005			2006			2005			2006			2005			2006			2005			2006		
A B	4	6	8	4	6	8	4	6	8	4	6	8	4	6	8	4	6	8	4	6	8	4	6	8	4	6	8	4	6	8
Flax	3.60	3.53	3.03	3.89	3.69	3.00	30.6	27.3	24.1	31.6	28.4	25.2	3.18	2.89	2.42	3.3	3.0	2.52	391.3	383.8	348.9	400.6	395.8	357.8	20.7	19.0	14.1	22.0	19.9	15.9
Sugar beet	3.50	3.96	3.22	3.82	4.11	3.29	29.1	32.7	26.1	31.0	34.1	26.8	3.17	3.50	2.68	3.31	3.68	2.77	391.2	397.8	365.4	404.3	415.6	380.6	21.0	22.3	15.3	22.9	24.6	16.4
Faba bean	4.27	4.64	3.39	4.59	4.76	3.47	35.3	36.7	27.8	36.2	37.6	28.3	3.63	3.79	2.92	3.7	4.10	2.98	398.8	419.3	367.0	418.2	431.0	378.4	24.1	27.1	17.4	25.1	28.9	18.9
LSD5%	0.7			0.6			0.7			0.9			0.08			0.26			6.9			5.3			0.7			0.7		

Table 6: Means of Flag leaf area, 1000-grain weight and straw yield/fad as affected by the interaction between preceding crops and humic & ascorbic acids.

Char.	Flag leaf area (cm²)						1000-grain weight (g)			Grain yield (t/fad)			Straw yield (t/fad)		
Seasons.	2005			2006			2005			2005			2005		
A C	Control	Humic acid	Ascorbic acid.	Control	Humic acid	Ascorbic acid	Control	Humic acid	Ascorbic acid	Control	Humic acid	Ascorbic acid	Control	Humic acid	Ascorbic acid
Flax	16.4	18.1	19.2	17.3	19.1	20.6	24.3	27.9	29.8	3.14	3.39	3.63	3.56	3.88	3.99
Sugar beet	17.9	19.6	21.2	19.1	21.4	23.3	26.6	30.0	31.3	3.46	3.50	3.57	3.92	4.16	4.23
Faba bean	21.4	22.6	24.7	22.6	24.2	26.1	30.8	33.7	35.3	4.04	3.89	4.12	4.29	4.61	4.73
LSD 5%	0.4			0.4			0.8			0.09			0.06		

Table 7: Means of Flag leaf area, no. of panicles,1000-grain weight and grain yield as affected by the interaction between irrigation intervals and humic & ascorbic acids.

Char.	Flag leaf area (cm²)						No. of panicles/m²			1000-grain weight (g)			Grain yield (t/fad)		
Seasons.	2005			2006			2005			2006			2005		
B C	Control	Humic acid	Ascorbic acid.	Control	Humic acid	Ascorbic acid.	Control	Humic acid	Ascorbic acid.	Control	Humic acid	Ascorbic acid.	Control	Humic acid	Ascorbic acid.
4 days	20.2	22.2	23.3	21.2	23.6	25.2	381.6	395.9	403.9	30.3	33.1	35.3	3.67	3.79	3.97
6 days	21.2	22.9	24.3	22.4	24.6	26.3	389.2	402.4	409.2	30.1	33.9	36.1	3.82	4.12	4.19
8 days	14.3	15.1	17.1	15.3	16.7	18.4	347.0	362.1	372.2	24.2	26.9	29.2	3.00	3.20	3.42
LSD 5%	0.4			0.4			3.9			0.4			0.17		

Table 8: Means of Flag leaf area and grain yield/fad as affected by the interaction between preceding crops, irrigation intervals and humic & ascorbic acids.

Char.		Flag leaf area(cm^2)						Grain yield (t /fad)					
Seas.		2005			2006			2005			2006		
A	C B	Control	Humic acid	Ascorbic acid	Control	Humic acid	Ascorbic acid	Control	Humic acid	Ascorbic acid	Control	Humic acid	Ascorbic acid
Flax	4	18.3	21.3	22.3	19.3	22.7	24	3.40	3.63	3.77	3.70	3.93	4.03
	6	18	19.3	19.7	19	19.7	21	3.30	3.60	3.70	3.50	3.70	3.87
	8	13	13.7	15.7	13.7	15	16.7	2.73	2.93	3.33	2.87	3.00	3.13
Sugar beet	4	19.3	21.3	22.3	20.7	23	25	3.57	3.43	3.67	3.60	3.83	4.03
	6	20.3	22.3	24.3	21.7	25	27	3.76	4.10	4.00	3.87	4.10	4.40
	8	14	15	17	15	16.3	18	3.03	3.27	3.37	3.07	3.33	4.47
Faba bean	4	23	24	25.3	23.7	25	26.7	4.03	4.30	4.47	4.33	4.63	4.80
	6	25.3	27	29	26.7	29	31	4.40	4.67	4.87	4.50	4.80	4.97
	8	16	16.7	19.7	17.3	18.7	20.7	3.23	3.40	3.53	3.30	3.47	3.63
LSD 5%		0.77			0.83			0.31			0.11		

Table 9: Simple correlation coefficient among rice characters (average of two seasons, 2005 and 2006).

	X1	X2	X3	X4	X5	X6	X7	X8	X9
X 1-Plant height (cm)									
X2- Flag leaf area (cm^2)	0.68*								
X3-No. of panicle/m^2	0.74 **	0.92**							
X4-Panicle length (cm)	0.71**	0.97**	0.93**						
X5-No. of grains/panicle	0.70 *	0.97**	0.92**	0.95**					
X6-Grains weight/panicle (g)	0.73**	0.95**	0.92**	0.95**	0.95**				
X7-Filled grains/panicle%	0.73**	0.97**	0.94**	0.96**	0.98**	0.95**			
X8-1000-grain weight (g)	0.72**	0.95**	0.93**	0.97**	0.94**	0.96**	0.96**		
X9-Straw yield (t/fad)	0.67*	0.84**	0.78**	0.85**	0.82**	0.82**	0.83**	0.84**	
X10- Grain yield (t/fad)	0.66*	0.94**	0.87**	0.93**	0.93**	0.92**	0.92**	0 .93**	0.81**

The relationship between grain yield and its attributing variables:

The relationships between grain yield and its attributing variables were done. Three tatistical procedures, Viz; simple correlation, multiple linear regression and stepwise regression were used in this study.

1-Correlation coefficient :

The result of correlation coefficient (r) among grain yield/fad and each of its attributing variables Table (9) shows that grain yield/fad was positively and high significantly associated with plant height, flag leaf are, no. of panicle/m^2, panicle length, no. of grains /panicle, grain weight/panicle, filled grains/panicle, 1000-grain weight and straw yield. Also cleared that there was highly significant positive correlation among all characters that were studied and each of other.

2- Multiple regression:

Results of multiple regression analysis recorded in Table 10, cleared that the relative contribution R^2 for all variables in the total variation of grain yield 91.67%. On the other hand, the residual value was 8.43% which indicates that the most characters were included in this study.

Table 10: Multiple regression and stepwise regression analysis for grain yield t/fad (Y) as affected by all studied characters in rice.

Prediction equation according to multiple regressions.	
Y= a+ bx1 + bx2 + bx3 + bx4 + bx5 + bx6 + bx7 + bx8 + bx9 Y= 3.238 + 0.001 x1 + 0.088 x2 -.022 x3 + 0.001 x4 + 0.021 x5 + 0.044 x6 - 0.052 x7 + 0.059 x8 +0.003 x9	
Relative contribution (R^2) for all variables according to full model regression	91.67%
Prediction equation according to stepwise	
Y= a + bx2 + bx8+ bx7 + bx5 Y= 2.860 + 0.086 x2 +0.059 x8 - 0.056 x7 + 0.022 x5	
Relative contribution (R^2) for each of accepted variables according to stepwise regression	
X2 flag leaf area (cm^2)	89.27%
X8 1000-grain weight (g)	1.15%
X7 filled grains%	0.40%
X5 no. of grains/panicles	0.73%
The total relative contribution (R^2) for all accepted variables according to stepwise regression	91.55%
The relative contribution (R^2) for all removed variables according to stepwise regression	0.12
The relative contribution (R^2) for residual variables according to stepwise regression	8.33%
Total effect (accepted, removed and residual)	100%

3-Stepwise regression analysis:

Data in Table 10 show that 4 variables out of the nine were accepted as significantly contributing variables to variation in rice grain yield . These accepted variables were flag leaf area, 1000-grain weight, failed grains% and number of grain/panicle with R^2 being 89.27%, 1.15% , 0.40% and 73%

according stepwise analysis, respectively. The results indicated that stepwise analysis develops a sequence of multiple regression equation by removing 5 from the full model equation with relative contribution of 0.12%. In conclusion, it can be stated that flag leaf area, 1000-grain weight, no,of filled grains and no. of grains/panicles the most important characters, Since did not have only highly significant positively associated with grain yield/fad, but also had highly relative contributing towards grain yield/fad in the prediction equation. Therefore, maximum effort should be given to these characters for the improvement of rice grain yield by selection through breeding programs.

REFERENCES

Abd- Allah, A.A. (2004). A breeding study on drought tolerance in rice (*Oryza sativa L.*). gyptian J. of Agric. Res. 82 (1): 149-165.

Abd El-Rahman, A.A.; A.A, Leilah; M.A. Badawi and Zayed (2004). Effect of irrigation intervals and methods of nitrogen application on yield of some rice cultivars under saline soil conditions. Egypt. J. Agric. Res., 82 (1): 197- 207.

Abo-Soliman, M.S.A.; S.A. Ghanem; S.A. Abd El- Hafez and N. El-Mowelhi (1990). Effect of irrigation regimes and nitrogen levels on rice production and nitrogen losses under tile drainage. Ministry of Agric. and land reclamation, Agric,Res. 1: 14-15.

Bama, K.S. (2009). Foliar application of humic acid for rice yield and nutrition. J. of Ecobiology, 25 (3): 241- 244.

Bama, K.S. and G. Selvakumari (2009). Optimizing of lignite humic acid in rice grain yield and its effect on soil properties. Advanced in plant Science, 22(2): 507-509.

Bassal, s.a.a.; Abd El- All; I.O.E. Metwally and K.E. El-Habbak (1996).Growth and yield of rice in rotation to winter preceding crops and N fertilizer levels. J.Agric.Sci. Mansoura Univ., 21(1): 79- 88.

Chatterjee, B.N.and S.Maiti (1983). Principles and practices of rice growing. Oxford and IBHpublishing Co. New Delhi.

CRRI (Central Rice Research instate) (1978). Annual report of 1978. Cent. Rice Res. Inst., Cuttack, India.

Demiral, T. and I. Turkan (2005) comparative lipid per oxidation, antioxidant defense system and praline content in root of two rice cultivars differing in salt tolerance. Environmental and Experimental Botany 53 (2005) 247- 257.

Draper, N.R. and H. Smith (1987). Applied Regression Analysis. John Wiley and Sons, Inc. New York pp. 171- 172, 397-402.

Ebaid, R.A. and S.A. Ghanem (2000). Productivity of Giza 177 rice variety growth after different winter crops and fertilized with different nitrogen levels.Egypt J.Agric. Res., (78):717-731.

EL-Hawary, M.A. (2000). Effect of irrigation intervals on yield and yield components of some rice varieties in newly reclaimed soils

El-Kalla, S.E.; El-A. M. Said; A.A.M. Abd El-Rahman and A.M.S. Kishk (2006). Response of rice cultivars to irrigation intervals and some organic fertilizer treatments in newly reclaimed soils. J. Agric. Mansoura Univ., 31 (9): 5547-5555.

El-Wehaishy, M.M. (1998). Effect of legume and non-legume preceding crops on nitrogen requirements and productivity of rice. J.Agric.Res.Tanta Univ., 24(1): 45-59.

El-Wehaishy, M.M. and S.S. Ghanem ((1996). Behavior of Giza 176 rice cultivar as affected by water management , N- forms and nitrification inhibitor (DCD): Proc. 7th Conf. Agronomy 9-10 Sept., Mansoura Univ., 93-104. fiya Uni., Egypt.

Fadzilla, N. M.; R.P.Finch; H.B. Roy, (1997) Salinity, oxidative stress and anti oxidant response in shoot cultures of rice, J. Exp. Bot. 48 (1997) 325-331.

Fragbenro, J.A.and A.A.Agboola (1993). Effect of different levels of humic acid on the growth and nutrient uptake of teak seedling. J.plant Nutrition, 16: 1465-1483.

Gomez, K.A. and A.A. Gomez (1984): Statistical procedures for agricultural research 2 nd (ed.). JonWilly, USA.

Gouranga, K.V.; H.N.R. Singh (2006). Effect of winter crop and supplemental irrigtion on crop yield , water use efficiency and proeastern india. Agricultural water management, 79 (3): 280-292.

Halliwell, B. (1974). Superoxide dismutase, cataloes and glutathione perooxidase: Solution to the problems of living with oxygen. New phytol. 73: 1075-1086.

Ibrahim, E.M. (2002). Effect of preceding winter crops and biological fertilization on growth and yield of rice under different levels of nitrogen fertilization. J.Agric.Sci. Mansoura Univ., 27(12): 8021- 8032.

Jackson, M.I. (1958). Soil chemical analysis pretict Hall, Inc. Engelwood Cliffe, N.J.

Lin, C.C.; C. H. Kao (2001). Cell wall peroxides activity, hydrogen peroxide level and NaCl- inhibited root growth of rice seedlings. Plant Soil 230, 135-143.

Mc Donnell, R.., N.M. Holden,; S. M. Ward; J.F.Collins; E.P.Farrell and M.H. Hays (2001). Characteristics of humic substances in health land and forested peat soils of the wickiow mountains. Biology and Environment, 10 (3): 187-197.

Metwally, I.O.E.; A. M. Abd El-All and E.M.A. Gabr (1994). Growth and yield of rice as affected by fertilizer treatment and preceding winter crop. J.Agric.Sci. Mansoura Univ., 19(3): 891-901.

Moiller, J.W. (2001). Irrigation ,agriculture and poverty reduction: general relationships and specific needs. In: Hussain, I, biltonen, E.(Eds.), Managing water for the poor: Proceedings of the regional Workshop on Pro- poor Intervention strategies in Irrigated agriculture in Asia: Bangladesh, China, India, Indonesia, Bakistan and Vietnam , International Water management Institute, Colombo, Srilanka. (C.F. computer search).

Nour, M.A. and F N. Mahrous (1994). Effect of varying irrigation intervals during tillering , reproductive and ripening stages on rice yield and is components. Egypt.J. Appl. Sci., 9 (7)/; 869-879.

Nour, M.A.; A.E. Abd El-Wahab and F N. Mahrous (1994). Effect of water stress at different growth stages on rice yield and contributing variables G. Agric. Sci. Mansoura Univ., 19(2): 403-412.

Olsen, S.R.; G.V. Sole; F.S. Watanabe and L.A. Dean (1954). Estimation of available phosphorus in soils by extraction with sodium bicarbonate. U.S. Dept., Agric. Sci., 939.

Ozaki T.,A.; A. B. E. Tomoko and Arokia samy (2003).Effect of humic acid on the biovailability of radio nuclides to rice plants. Analytical and bio analytical chemistry. 1618- 1642.

Pastori G.M.; G. Kiddle; J. Antoniw; S. Bernard; J.S. Veljovic; B.J. Verrier; G. nictor and C.H. Foyer (2003). Leaf vitamin C contents modulate plant defense transcripts and regulate genes the control development through hormone signaiing plant cell 15: 939- 951.

Palamiswamy, K.M. and K. A. Gomez (1974). Length –width method for estimating leaf area of rice. Agron. J. 66: 430-433.

Richards, L.A. (1945). Diagnosis and improvement of saline and alkali soils USDA "Hodbook" No. 60.

Sakr, M.T.; A.E. Abdel- Wahab; M.M. Darweesh; Z.A. Mohamed and Omnia M Abdel-Fattah (2010). Effect of some applied antioxidants on phytohormones content of two rice (Oryza sativa l.) cultivars under draught stress conditions. J. of Plant production, Vol. 1 (1): 101-1120

Snedecor, G.W. and W. G. Cochoran (1989). Statistical Methods. 8th Edition. Lowa State University Press. Ames, Iowa, USA.

Ulukan, H. (2008). Effect of soil applied humic acid at different sowing times on some yield components in wheat hybrids. Int.J.Bot., 4: 164-175.

Vaidyanathan. H.; P.Sivakumar; R. Chakrabarty and G. Thomas (2003) Scavening of reactive oxygen species in Naclo- stressed rice (Oryza sativa L.) differential response in salt-tolerant and sensitive varities. Plant Science 165: 1411-1418.

Wang,W.H.; Bray C.M. and Jones M.N. (1999). The rate C^{14} labelled humic substancein rice

Wang L.Z.; Z.Y.Guangli; X.X. Zhang and F.H. Yuegao (2009). Effect of winter crops on soil microbial biomass, C and Nin the rice growth season. Plant nutration and fertilizer science, 15 (2): 381-285.

Xunzhong Z. and E.H. Ervin (2004). Cyto kinin contaning seaweed and humic acid extracts associated with Creeping Bentgrass leaf cytokinin and drought resistance. Crop Sci., Society of America. 44: 1737-17450

Zayed,B.A. (2005). The effect of different farmyard manures levels and different modes of urea application on rice productivity under salt affected soil. Egypt.J. Agric.Res. , 2(2): 631-642.

تأثيرالمحاصيل الشتوية السابقة و فترات الرى على الارزالمعامل بحمض الهيوميك والاسكوربيك في شمال الدلتا

الغريب محمد ابراهيم
قسم بحوث التكثيف المحصولى – معهد بحوث المحاصيل الحقلية – مركز البحوث الزراعية– الجيزة – مصر

أقيمت تجربتان حقليتان بمحطة البحوث الزراعية بتاج العز بمحافظة الدقهلية خلال الموسمين ٢٠٠٥ و٢٠٠٦ لدراسة مدى تأثر محصول الارز صنف سخا ١٠١ بالمحاصيل الشتوية السابقة (كتان – بنجر سكر و فول بلدى) وفترات رى مختلفة (كل ٤ و ٦ و ٨ ايام) مع المعاملة باحماض الهيوميك والأسكوربيك. حيث نفذت التجربة باقامة تجربة مستقلة لكل محصول سابق وصممت كل تجربة مستقلة بنظام القطع المنشقة مرة واحدة في ثلاث مكررات وتتلخص أهم النتائج فيمايلى:

أثرت المحاصيل السابقة معنويا على كل الصفات المدروسة خلال موسمى الدراسة واوضحت النتائج تفوق الارز المنزرع بعد الفول البلدى فى كل الصفات المدروسة خلال عامى الدراسة بالمقارنة بالارز المنزرع بعد الكتان وبنجر السكر حيث حقق زيادة فى انتاجية المحصول بلغت ١٧.٤ و ١٣% كمتوسط لموسمى الزراعة على الترتيب.

أظهرت النتائج التاثير المعنوى لفترات الرى على جميع صفات الارز المدروسة خلال موسمى الدراسة واوضحت النتائج تفوق فترة الرى كل ٦ ايام لمحصول الارز فى كل الصفات المدروسة خلال عامى الدراسة عدا محصول القش الذى تفوق مع الفترة كل ٤ أيام. سجلت فترة الرى كل ٦ أيام زيادة بلغت ٤.٤ و ٢١.٤% كمتوسط لموسمى الزراعة فى انتاجية المحصول بالمقارنة بفترتى الرى كل ٤ و٨ أيام على الترتيب.

أوضحت النتائج أن اضافة احماض الهيوميك والأسكوربيك كان لها تاثير معنوى على كل الصفات المدروسة خلال موسمى الزراعة. تفوقت جميع الصفات الدروسة والمعاملة بحمض الاسكوربيك حيث بلغت الزيادة فى انتاجية المحصول ٩.٣ و ٣.٨% كمتوسط لموسمى الزراعة بالمقارنة بالكنترول وهيومك اسيد على الترتيب.

أشارت نتائج الفاعل بين عوامل الدراسة الختلفة أن اعلى محصول من حبوب الارزبلغ ٤.٨٧ و٤.٩٧ طن للفدان فى السنة الاولى والثانية على الترتيب تم الحصول عليه بزراعة الارز بعد الفول البلدى والرى كل ٦ ايام مع اضافة حمض الاسكوربيك كمضاد للاكسدة.

أظهرت النتائج المتحصل عليها وجود ارتباطا موجبا عالى المعنوية بين المحصول و جميع الصفات المدروسة وايضا جميع الصفات فيما بينها. كما اظهرت نتيجة تحليل الانحدار المتعدد ان المساهمة النسبية لكل الصفات كمتغيرات مستقلة مجتمعة هو٩١.٦٧% فى تباين المحصول طن/ فدان. كما اظهرت نتيجة تحليل الانحدار المتعدد المرحلى ان ٤ عوامل من ٩ عوامل تساهم بنسبة ٩١.٥٥% فى التباين الكلى للمحصول طن/فدان وهذه العوامل هى مساحة ورقة العلم و وزن ١٠٠٠ حبة و عدد الحبوب الممتلئة بالدالية و عدد الحبوب بالدالية بنسبة اسهام ٨٩.٧٢% و٥ ١.١% و٠.٤٠% و٠.٧٣ % على الترتيب

مما يوضح ان هذه الصفات الاربعة لها ارتباطا موجبا عالى المعنوية بينها وبين المحصول وساهمت بنسبية عالية فى التباين الكلى للمحصول ٩١.٥٥ % مما يجعل هذه الصفات تساهم مساهمة مباشرة وعالية فى برامج التربية لزيادة انتاجية محصول الارز.

قام بتحكيم البحث

أ.د / احمد نادر السيد عطيه	كلية الزراعة – جامعة المنصورة
أ.د / أبراهيم عثمان السيد	مركز البحوث الزراعية