Indian Journal of Fundamental and Applied Life Sciences ISSN: 2231– 6345 (Online)
An Open Access, Online International Journal Available at www.cibtech.org/sp.ed/jls/2014/04/jls.htm
2014 Vol. 4 (S4), pp. 2998-3004/Rad and Amiri
Research Article

EFFECTS OF IRRIGATION MANAGEMENT ON YIELD AND YIELD COMPONENTS OF IRAN RICE GENOTYPES

Saeed Vakili Rad and *Ebrahim Amiri
Department of Agriculture, Lahijan Branch, Islamic Azad University, Lahijan, Iran
**Author for Correspondence*

ABSTRACT
An experiment was conducted in 2012 in Iran to evaluate the effects of irrigation management on yield and yield components of rice genotypes. Split plot test was conducted in three replications in the form of Randomized Complete Block design (RCBD). The main factor consists of three irrigation managements of permanent flooding (I1), irrigation 4 days after the disappearance of water from land surface (I2) and irrigation 8 days after the disappearance of water from land surface (I3). Sub-factor consists of 10 different genotypes, including Hashemi (V1), hybrid NO 7 (V2), Gohar (V3), Ali Kazemi (V4), Nemat (V5), Hasan Sarayi (V6), Kadus (V7), Tarom Daylamani (V8), Fajr (V9) and Bahar (V10). The irrigation intervals had a significant effect on grain yield, total biomass, height, tiller number, total grains, number of days to full maturity, panicle weight, cluster weight, cluster length and harvest index. The experiment results showed that the highest grain yield of rice was obtained from flooding treatment and Gohar genotype with value of 6470 kg.

Keywords**:** *Irrigation Management, Yield, Yield Components, Rice Genotypes*

INTRODUCTION
Rice is the main food of all people around the world. Rice consumes the largest amount of water among all the other crops. Conventional system of rice irrigation is flooding and maintenance free water on the land surface. First of all, flooding provides suitable conditions for land preparation and rapid formation of the product through transplant and weed removal. Second of all, (permanent) flooding provides adequate water and nutrients under anaerobic conditions. However, the conventional system loses a large amount of water through evaporation and infiltration (Nguyen *et al.*, 2009).
Rice is one of the products facing with a severe limitation of cultivated area (Silva *et al.*, 2007). Drought is the main factor restricting rice production in 40 million hectares of cultivated lands of rice in Asia (Venobrasado *et al.*, 2007). Rice needs about 8 to 11 thousand cubic meters of water per hectare until its full maturity, while 700 liters of water is needed for the production of a dry matter (Amiri and Nahvi, 2007). Emphasizing the positive role of intermittent irrigation on reduction of water consumption, Bouman and Tuong (2001) believe that intermittent irrigation reduces water use and increases water efficiency and productivity until cracks are appeared on the soil surface. Therefore, it is recommended not to prolong the dry period in order to avoid high water consumption (Rezaei and Nahvi, 2007; Zubaer *et al.*, 2007). The water stress caused by non-flooded (NF) irrigation not only affects water consumption, but also reduces tiller number, leaf area, dry matter accumulation, the number of grains in the cluster, grain weight and ultimately yield by preventing the transfer of minerals and nutrients to the plant and reduction of photosynthesis (Amiri, 2006; Rezaei and Nahvi, 2007; Nahvi, 2006). In the current situation, Yazdani and Parsi (2008) introduce the use of intermittent irrigation method as their best solution to deal with the phenomenon of aridity in paddies of Iran. Applying the proper water depth and irrigation interval, intermittent irrigation increases water productivity in paddies while preventing water loss, and it can also be a suitable solution to deal with the aridity crisis. Amiri and Rezaei (2009) claimed that the irrigation management change from (2004) traditional flooded method to non-flooded method will improve the efficiency of irrigation water, because grain yield will reduce with decrease of irrigation water. However, grain yield will reduce by 0.3times as a result of one time reduction of irrigation. In a study on the effect of different irrigation intervals on the efficiency of water consumption and yield of Khazar genotype of rice, Nahvi *et al.,* (2004) claimed that water stress reduced tiller number and plant height and affects the

© Copyright 2014 | Centre for Info Bio Technology (CIBTech)

number of full pellets. They also mentioned that there is a direct relationship between the increases of irrigation intervals with increase of number of empty pellets.
The purpose of this study was to identify drought tolerant genotypes with highest value of yield and yield components.

MATERIALS AND METHODS

This experiment was conducted in 2012 Reza Mahalleh village in Roodsar, located at the geographical coordinates of 37 degrees 7 minutes north latitude and 50 degrees 19 minutes east longitude, and height of 22 meters above open sea level, east Gilan province, Iran.

In April of crop year, according procedures in the area, the nursery was prepared and then graining was performed. Following the drainage and plow and other preparation steps on May 12, healthy grain lings were transferred from the nursery to the field. Grain lings of 10 genotypes used in the split plot design were planted in the form of randomized complete block design in three replications.

In this experiment consisted of main factor including three irrigation managements of permanent flooding, irrigation 4 days after the disappearance of water from land surface and irrigation 8 days after the disappearance of water from land surface.

Sub-factor in this experiment consists of 10 different genotypes, including Hashemi, Hybrid NO 7, Gohar, Kazemi, Nemat, Hasan Sarayi, Kadus, Daylamani, Fajr and Bahar. Plots were 1.5x4 and each replication consisted of 30 plots. Transplanting spacing is 30cm and the spacing between plants in each row is 20cm. All agricultural operations such as fertilization, and control of pests, diseases and weeds were conducted conventionally.

At the time of maturity, 8 plants per plot were selected to calculate grain yield. After harvesting by Combine machine, rice grains were separated and grains were weighed and measured in kg/ha with 14% moisture.

Total biomass of the dry weight of the plant, except for the root, was measured after drying it in the oven at 72° C until the final weight is stabilized.

3 plants were randomly harvested from each plot and measured. To calculate the height of the gap between the collars on the soil surface to the end of the highest cluster, the main stem was measured in centimeter and recorded regardless of awn, and it was randomly measured and recorded in 5plantsper plot at the grain maturity stage.

Tiller number in 5 plants were calculated and recorded randomly in each plot.

The length of main clusters of 5 plants was randomly measured and recorded selected for each plot at the harvest time, and then the distance between the cluster nodes to its tip was measured in centimeters, regardless of awn.

Cluster’s weight, main clusters of 5 plants each plot were randomly harvested from the cluster node, and then it was measured and recorded in grams by an accurate balance.

The number of grains per cluster were counted and recorded for the main cluster which was randomly harvested from each plot after full maturity. Also for grain weight, 1000 grains randomly harvested from 8 plants per plot, were selected and then measured and recorded in grams by an accurate balance.
Harvest index was calculated through dividing the grain yield on biological yield and MSTATC software was used for analysis of variance and Comparison of Means. Also Excel software was used to draw diagrams.

RESULTS AND DISCUSSION

Analysis of variance showed that treatment of different irrigation managements and various genotypes on grain yield and total biomass and total number of grains in cluster and grain weight and harvest index was significant (Table 1).

© Copyright 2014 | Centre for Info Bio Technology (CIBTech)

Table 1: Analysis of variance

	df	grain yield	Total biomass	Harvest index	Cluster weight	Weight1000 grains	Number of grains cluster	Length cluster	Tiller number	height
							MS			
Rep	2	394040.34	17439227.87	81.63	0.004	20.86	168.81	5.02	1226.87	63.87
Irrigatin	2	48068389.54**	21056435.37*	2428.30**	9.63**	1418.41**	7462.54**	223.16**	20163.54**	240.54*
Error 1	4	242437.11	2188415.61	63.93	0.149	3.97	57.54	3.69	1053.77	28.37
Genotype	9	2139040.84**	6919517.77**	53.09*	0.195 n.s	11.25**	1142.98**	52.96**	7904.67**	107.40**
I*G	18	2139040.84**	1306738.40**	42.12*	0.108n.s	4.25**	132.32**	11.13n.s	924.47n.s	183.5n.s
Error 2	54	163576.04	562758.63	20.78	0.142	1.09	133.81	6.25	1037.83	132.07
(٪) CV		10.58	10.98	13.64	21.88	5.86	11.62	8.63	12.50	10.22

Table 2: Comparison of the interactions between the total number of grains per cluster in irrigation conditions and genotype

	I1	I2	I3
Hashemi	116(ABCDE)	90(GHI)	79 (HIj)
n07	115(ABCDEF)	94(DEFGHI)	86 (GHIj)
Gohar	117.3(ABC)	97(CDEFGHI)	80.67(GHIj)
Ali Kazemi	124.7 (A)	94.67 (DEFGHI)	75 (Ij)
Nemat	131.7 (A)	125 (A)	102 (BCDEFG)
Hasansarayi	119.3(ABC)	102.3 (BCDEFG)	79 (HIj)
Kadus	121.3 (AB)	113.3 (ABCDEF)	97 (CDEFGHI)
Tarom Deilamany	81.33 (GHIj)	77.33 (HIj)	67.67 (j)
Fajr	117.7 (ABC)	93.33 (FGHI)	81.67 (GHIj)
Bahar	116.3(ABCD)	93.67 (EFGHI)	98.33 (CDEFGH)

Research Article

The comparison of means showed that the highest grain yield in flooding treatment and Gohar genotype was***** 6470 kg/ha and the lowest grain yield was related to the irrigation treatment 8 days after the disappearance of water from land surface and genotype of Ali Kazemi, with the value of 1733 kg/ha

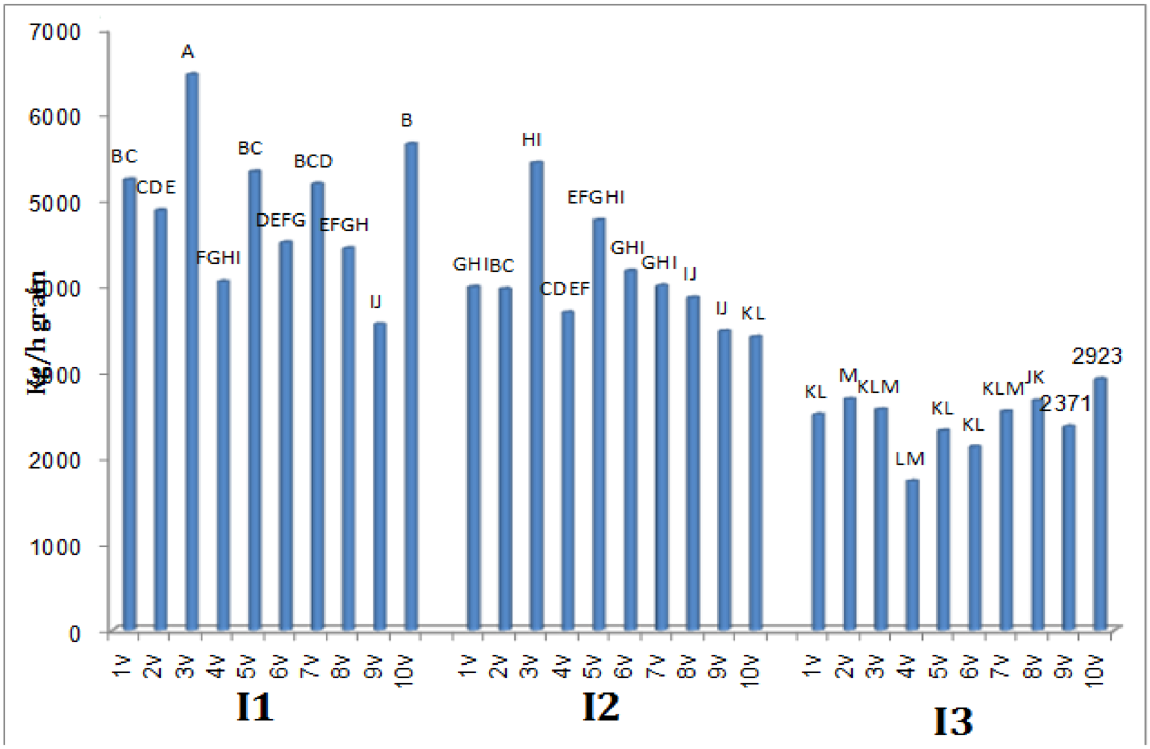

Figure 1: Mean comparison of grain yield in irrigation conditions and genotype

Having calculated the photosynthetic correlation coefficients between traits in 187 rice varieties, Zhu *et al.*, (2003) showed that grain yield is significantly correlated with traits of cluster length, flag leaf length, number of filled grains in the cluster, the number of grains per cluster and number of clusters per plant that was consistent with the study results. Lafiteh *et al.*, (2006) also reported that the rice grain yield under drought stress conditions has a high photosynthetic correlation with the number of clusters per plant, number of clusters and relative water of leaf, which was totally consistent with the study results. Regarding to the comparison of means, the highest amount of total biomass was related to the flooded treatment and Gohar genotype with value of 14,950 kg/ha and the lowest total biomass (biological function) was related to the irrigation treatment 8 days after the disappearance of water from land surface and Ali Kazemi genotype with value of 8987 kg/ha (Figure 2). Katouzi *et al.*, (2007) also reported that with change of irrigation method from the flooding method tointermittent irrigation, biological yield of rice decreased significantly. Bolder *et al.*, (2004) also showed that irrigation has a positive effect on rice dry matter production. The height mean comparison results affected by irrigation factor showed that flooded irrigation regime with mean of 115.6 cm had the highest height and irrigation of 8 days after the disappearance of water from the land surface with 110.2 cm had the lowest height. Height trait affected by the genotype factor indicated that Hashemi genotype with mean of 124.1cm had the highest height and Bahar genotype with mean of 96.33 cm had the lowest height (Table 5). The study results showed that water loss reduces flexibility of stem cell wall and decrease of water absorption is barrier to stem elongation (Neumann, 1993) and (Acevedoetal, 1971). Ghorbanpor *et al.*, (2004) showed that rice height under intermittent irrigation conditions is significantly less than under flooding conditions. The results of mean comparison of the numbers of tillers affected by irrigation factor showed that, flooded irrigation treatment with mean of 287.6tillers per square meter had the highest and irrigation 4 days after

© Copyright 2014 | Centre for Info Bio Technology (CIBTech)

disappearance of water from land surface with mean of 241.9 tillers per square meter had the lowest tiller number.

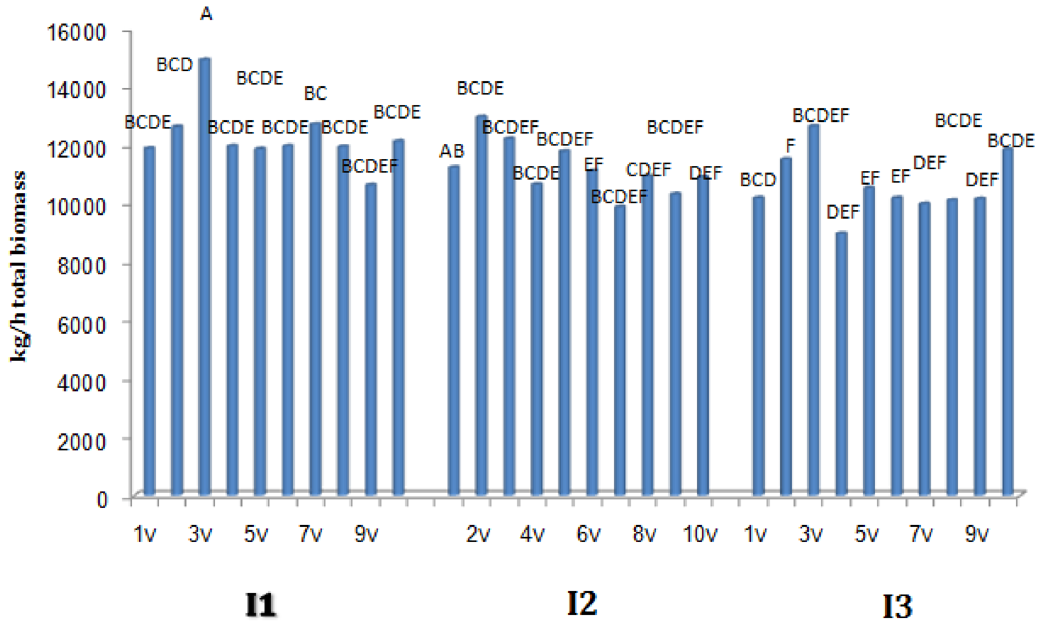

Figure 2: Mean comparison of total biomass in irrigation conditions and genotype

Also the trait of tiller number affected by genotype factor in Bahar genotype with mean of 318 tillers per square meter had the highest and Hashemi genotype with mean of 230.1 tillers per square meter had the lowest number of tillers (Table 5). The table of mean comparison of total grain per cluster showed the highest value in flooded irrigation treatment and Ali Kazemi and Nemat genotypes with value of 131.7 and 119.3, respectively and the lowest grain per cluster is related to irrigation regimes 8 days after the disappearance of water from the land surface Tarom Daylamani genotype with value of 67.67 (Table 2). The results of mean comparison for cluster length affected by irrigation showed the highest cluster length in flooded irrigation treatment with mean of31.74cm and the lowest cluster length in irrigation treatment 8 days after disappearance of water from land surface with mean of 26.28cm.Also, mean comparison of cluster length affected by genotype factor showed the highest cluster lengthin Gohar genotype with mean of 32.46cm and the lowest cluster length in Tarom Daylamani genotype with mean of 25.8cm (Table 5).
The highest grain weight in the experiment was related to flooded irrigation treatment and Cadus genotype weighting 24.70g and the lowest grain weight was related to irrigation treatment 8 days after disappearance of water from land surface and Fajr genotype weighting 7.8 g (Table 3).

Table 3: Mean comparison of grain weight in irrigation conditions and genotype

	I1	I2	I3
Hashemi	25.80 (AB)	19.13(DE)	11.80 (KL)
no7	23.73 (C)	16.83 (FGH)	12.50 (K)
Gohar	25.23 (ABC)	19.73 (D)	14.53 (Ij)
Ali Kazemi	24.37 (BC)	15.57 (GHI)	11.40(KLM)
Nemat	25.57 (ABC)	16.37 (GHI)	10 (LM)
Hasansaraye	24.27 (BC)	16.27 (GHI)	9.633 (M)
Kadus	26.50 (A)	18.57 (DEF)	11.33(KLM)
Tarom Deilamany	24.70 (ABC)	17.47 (EFG)	10.47 (LM)
Fajr	30.25 (ABC)	15.37 (HI)	7.8 (N)
Bahar	24.33 (ABC)	17.37 (EFG)	13.17 (JK)

© Copyright 2014 | Centre for Info Bio Technology (CIBTech)

Saadati (1996) stated that water stress during stem elongation stage reduces grain weight, which is consistent with the study results.
The highest harvest index was related to flooded irrigation treatment and hybrid 1 genotype with value of 46.33 and the lowest harvest index was related to in irrigation regime 8 days after disappearance of water from land surface and Gohar, Nemat and Hasan Sarayi genotypes, with values of 20, 21.67 and 21, respectively (Table 4).

Table 4: Mean comparison of harvest index in irrigation conditions and genotype

	I1	I2	I3
Hashemi	44 (ABC)	35.33 (CDEF)	24.33 (HIj)
no7	38.33 (ABCDEF)	30.67 (FGHI)	23.33 (Ij)
Gohar	43.33 (ABCD)	45.67 (AB)	20 (j)
Ali Kazemi	33.67 (EFG)	34.67 (DEF)	23 (Ij)
Nemat	45.33 (AB)	40.33 (ABCDE)	21.67 (j)
Hasansaraye	37.67 (ABCDEF)	37.33 (BCDEF)	21 (j)
Kadus	43.67 (ABC)	40.67 (ABCDE)	25.33 (HIj)
Tarom Deilamany	37.33 (BCDEF)	35.67 (CDEF)	26 (GHIj)
Fajr	34 (EFG)	34 (EFG)	23.33 (Ij)
Bahar	46.33 (A)	32.33 (EFGH)	24.67 (HIj)

The results of mean comparison of cluster affected by irrigation factor showed the highest cluster weight in flooding conditions with mean of 2.35and the lowest cluster weight in irrigation 8 days after the disappearance of water from land surface with mean of 1.24 gr (Table 5).

Table 5: Simple mean comparison

	Height	tiller number	length cluster	cluster weight
Flooding	115	287	32	2.35
I2	111	241	29	1.57
I3	110	243	26	1.24
Hashemi	124	230	31	1.79
No7	112	271	27	1.34
Gohar	104	293	32	1.81
Alikazemi	119	245	31	1.74
Nemat	106	234	29	1.7
Hasansaraye	122	231	27	1.9
Kadus	107	243	28	1.77
Tarom deilamany	114	240	26	1.72
Fajr	116	268	32	1.79
Bahar	96	318	26	1.68

Conclusion

The analysis of variance of this test showed a significant difference between the yield of genotypes in 3 different irrigation managements and interaction between irrigation management and the studied genotypes, which indicates substantial and significant genetic variation among the studied genotypes. The mean comparison of traits showed the highest value of grain yield, total biomass, number of grains per panicle, grain weight and harvest index under flooded irrigation conditions. These results showed that the highest grain yield was related to Gohar genotype in all three conditions of flooded irrigation and irrigation, 4 and 8 days after the disappearance of water from land surface and the lowest grain yield was

© Copyright 2014 | Centre for Info Bio Technology (CIBTech)

related to Fajr genotype in flooded irrigation and irrigation 4 days after the disappearance of water from land surface and Ali Kazemi genotype in the irrigation regime 8 days after the disappearance of water from land surface.

REFERENCES

Acevedo E, Hsiao THC and Henderson DW (1971). Immediate and Subsequent growth responses of maize leaves to change in water status. *Journal of Plant Physiology* **48** 631-63.

Amiri E (2006). Studying water balance in different irrigation methods in paddy fields. Phd dissertation in irrigation and drainage Islamic Azad University.

Asadi R and Rezaei MKS (2004). A simple solution to deal with drought in Mazandaran Paddies, *Journal of Drought and Famine* (14) 87-91.

Belder P, Bouman BAM, Cabangon R, Guoan LU, Quilang EJP, Yuanhua LI, Spiertz JHJ and Tuong TP (2004). Effect of water-saving irrigation on rice yield and water use in typical lowland conditions in Asia. *Agricultural Water Management* **65** 193-210.

Bouman BAM and Tuong TP (2001). Field water management to save water and increase its productivitg in irrigated Lowland rice. *Agricultural water Management* **49**(1) 11-30.

Ghorbanpur MD, Mazaheri F, Alinia MR, Naghavi and Nahvi M (2004). Effect of different irrigation management on the physiology and morphologg characteristics of rice. *Journal of Construction Research* **17**(65) 27-32.

Javaher Dashti M and Esfahani M (2002). *Dry Land Rice*. Written by Mitchell Zhako and Brigitte Courteau (Agricultural Sciences Publications) 128.

Lafitte HR, Price AH and Courtois B (2004). Yield response to water deficit in an upland rice mapping population: Associations among traits and genetic markers. *Field Crops Research* **6** 1237-1246.

Nahvi M (2006). Determination the best irrigation internal based on grouth indices. MSc dissertation. Azad University 85.

Nahvi M, Yazdani MR, Allah Gholi Poor M and Hosseini M (2004). Survey of effect of irrigation intervals on water use efficiency and yield of Khazar genotype of rice, *Journal of Agricultural Science* **6**(2) 53-60.

Neumann PM (1993). Rapid and reversible modification of extension capacity of cell walls in elongating maize leaf tissues responding to root addition and removal of NaCl. Plant cell

Rezaei M (2007). Environment protection using irrigation and herbical management in paddy field. Presented in the 10th national conference on irrigation and drainage 26-28 Jun 2007, Tehran.

Rezaei M and Nahvi M (2007). Effect of different irrigation management methods on water use efficiency and rice yield. *Agricultural Science* **1**(9) 15-25.

Rezaei M and Nahvi M (2007). Survey of effect of irrigation interval in clay soil on water use efficiency and some traits of two genotypes of local rice in Guilan province, *Journal of Agricultural Sciences* (9) 16-24, *Environment* **16** 1107-14.

Silva MA, Jifon JL, Da Silva JAG and Sharma V (2007). Use of physiological parameters as fast tools to screen for drought talerance in sugarcane. *Brazilian Journal of Plant Physiology* **19** 193-201.

Venuprasad R, Lafitte HR and Atlin GN (2007). Response to direct selection for grian yield under drought stress in rice. *Crop Science* **47** 285-293.

Yazdani MR (2004). Evaluation of different irrigation regime in rice cultivation in Guilan drainage 26-28 Jun 2007, Tehran, Iran.

Zhou GS, Jin DM and Mei FZ (2003). Effects of drought on rice grain indices at booting stage. *Journal of Huazhong Agricultural University* **3** 219-222.

Zubaer MA, Chowdhury AKMMB, Ialam MZ, Amad T and Hasan MA (2007). Effects of water stress on growth and yield attributes of aman rice genotypes. *International Journal of Sustainable Crop Production* **2**(6) 25-30.

© Copyright 2014 | Centre for Info Bio Technology (CIBTech)