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Durum Wheat As Affected by Water Stress Conditions In The Presence of Added Compost For Increasing The Productivity

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ABSTRACT

Two pot experiments were carried out in a matting house under natural environmental conditions of Al- Haram area , Giza, Governorate during 2009/2010 and 2010/2011 seasons to study the effect of water stress (70, 80 and 90%) of evapotranspiration (ET) and 3 rates of compost (2, 4 and 6%) of soil weight (16kg in each pot) on some growth parameters , yield and yield components of durum wheat varieties Banysweif -1 and Banysweif-4 .

The complete randomized design with six repetitions and factorial arrangements were used . The obtained results revealed that , increasing water irrigation level from 70 up to 90% of ET increased , leaf area/plant , plant height and dry weight/plant. Yield and yield components followed the same manner , such as No. of spikes/plant and No. of grains /spikes. Application of 6% compost had a positive and significant effect on the studied parameters either related to plant growth stage or yield The difference between the two durum wheat varieties reached the level of significance and Banysweif -4(V_2) ranked first for all characters under study i.e. growth or yield .

All the studied characters were affected significantly by the first and second order interactions , in both seasons. Subjected Banysweif 4 to water irrigation at 90% of ET and fed with 6% of compost gave the greatest values for all parameters under study.

INTRODUCTION

Durum wheat is one of the cereals most cultivated in the Mediterranean basin, essentially for pasta making. Tetraploid durum wheat (T. Durum) or hard wheat mainly are used to produce semolina flour used in the food industries , especially the pasta the spaghetti . However , he cultivated area of this crop is less than other

hexaploid wheat, but their resistance against diseases and environment stress such as common consistencies, is more an remarkable in drought conditions (**Arzani,2000**).

Drought effect on plant growth and field crops production more than any other environmental stresses (**Zheng et al., 2010 and Almeselmani et al., 2006**). Its remains an ever growing problem that severely limits crop production worldwide and causes important agricultural losses particularly in arid and semiarid areas (**Boyer , 1982**) . Drought stress is a decrease of soil water potential so plant reduce their osmotic potential for water absorption by congestion of some nutrient i.e. soluble carbohydrates and proline, (**Martin et al., 1993**). Therefore osmotic regulation will help to cell development and plant growth in water stress(**Pessarkli, 1999**) . Moderate to severe water stress drastically affects various morph physiological traits in wheat such as water use sufficiency and dry matter yield ,(**Ehdaie et al., 1991**). Since genotypic differences for these traits have been reported for wheat and others, These traits have been used to identify drought tolerant genotypes in various crops. Therefore, there is a link between various physiological responses of crop plant to drought and high relative water content and water potential.(**Shamsi Keyvan 2010 and Datta et al., 2011**)

Using of compost or organic fertilizer is one of the scientific methods to avoid the harmful effect of mineral one on environment and improves the mechanical and chemical properties of soil especially sandy nature; **Entry et al., 1997** cleared that, organic matter improves physical properties i.e. water retention capacity and reduced the volume of water needed for irrigation. Added to that, **Sawar et al., 200** reported that wheat grain yield and yield components (plant height, number of titters and 1000 grain weight) were significantly increased with the application of organic material in the form of compost.

The target of this investigation, is to study the impact of drought stress or water irrigation levels from evapotranspiration (ET_c) and compost at different rates on some growth parameters, yield and yield component of the two durum wheat varieties.

. MATERIALS AND METHODS

Pot experimental study was conducted in a matting house under natural environmental condition of Al-Haram area, Giza governorate during the winter \spring of 2009\2010 and 2010\2011 seasons.

The objective of this investigation was, study the effect of some water irrigation levels(70,80 and 90% of evapotranspiration) and three compost rates (2,4 and 6% of 16Kg of soil / pot) on some growth characteristics, yield and yield components of two durum wheat varieties

Experimental treatments:-

A. Durum wheat varieties (V) :.

1-Banyswief -1 (V1) 2-Banyswief-4 (V2)

B. Water irrigation levels (W):.

The following water irrigation levels ,were depended on the evapotranspiration rate for that crop under the condition of the experimental site (1500m^3\fed) , which computed according IRR – CLAC program supplied by the central lab of climate - ARC.

1- 70% of (ET) 2- 80% of (ET) 3-90% of (ET)

C. compost fertilizer rates:.

The amounts of compost fertilizer were related to the soil weight in each pot (16 kg\pot) as follows:-

1- 2% equal (320g\pot) 2- 4% equal (640g\pot)

3- 6% equal (960 g\pot)

Before sowing chemical and mechanical analysis of the experimental soil were carried out according to **(A.O.A.C, 1970)**. That tabulated in table1.

Chemical and mechanical analysis of the experimental soil .

seasons	Chemical analysis Sample Soil	PH (1 : 2.5)	EC (ppm)	Total N (ppm)	Organic Matter (%)
2009/2010	Compost 0%	8.02	0.25	3.22	0.100
	Compost 2%	7.68	0.13	37.00	0.323
	Compost 4%	7.75	0.15	42.60	0.582
	Compost 6%	7.80	0.18	48.30	0.820
2010/2011	Compost 0%	8.00	0.27	3.19	0.103
	Compost 2%	7.60	0.13	43.80	0.395
	Compost 4%	7.69	0.16	46.13	0.783
	Compost 6%	7.11	0.21	51.20	0.962

Seasons	Mechanical analysis Sample soil	Clay%	Sand%	Silt%	Texture
2009/2010	Compost soil 0%	5.40	93.25	1.35	Sand
	Compost soil 2%	6.50	90.50	3.00	Sand
	Compost soil 4%	6.20	88.00	5.80	Sand
	Compost soil 6%	7.00	85.50	7.50	Loamy sand
2010/2011	Compost soil 0%	5.50	93.50	1. 00	Sand
	Compost soil 2%	5.80	90.2	4.00	Sand
	Compost soil 4%	6.50	88.50	5.00	Sand
	Compost soil 6%	6.80	85.50	7.70	Loamy sand

Whereas Table 2 cleared the chemical analyses for compost fertilizer sample.

Table (2)

Chemical analyses for compost fertilizer sample.

Micronutrients(ppm)				Macronutrients (%)		
Fe	Mn	Zn	Cu	N	P	K
776	534	52	18	0.76	0.11	1.14

O.C%	O.M%	C/N
9.7	16.7	12.76

Growth characteristics:

Each pot was harvested carefully to determine the following characteristics :

Studied attributes:

I Growth attributes:

At adage 90 day after planting (before booting),the five wheat plants in each pot were harvested carefully by the immerse each polyethylene pot in plastic bucket filled by water and the plants were washed carefully and dried by paper towel ,

then the green stem and its tillers were cut from the roots to determine the average plant height (cm), leaf area per plant (cm^2) according to **Voldeng and Simposn (1967)**, and dry weight per plant (g).

Π Yield and its components :-

At harvesting time, five plants were collected carefully from each pot to estimate No of spikes/ plant, No of grains /spike,1000 grain/weight and grain yield / plant (g).

3.1.3. Statistical analysis:

Pot experiments included eighteen treatments which were the combination of three levels of water irrigation quantity, three rates of compost fertilizer and two durum wheat varieties. A factorial experiment by using completely randomize design with three replicates was used, the statistical analysis for all data of 2009/2010 and 2010/2011were exposed to the proper statistical analysis according to **Snedecor and Cochran (1982),** The mean values were compared at 5% level of significance using least significant differences **(L.S.D)** test.

Results and discussion

I. Growth characters :

Data recorded in tables (3) illustrated the significant effects of water irrigation levels, compost rates under study on plant height (cm), leaf area /plant (cm^2) and dry weight / plant (g) for the two durum wheat varieties i.e. Banysweif-1 (V_1) and Banysweif-4 (V_2), as well as the first and second order interactions between the experimental factors during the growing seasons 2009/2010 and 2010/2011, respectively.

With regard to water irrigation levels as percent from evapotranspiration (ET) ,(taple 1) results that plant growth characters were significantly increased with increasing water level from 70 up to 90% of ET, during the two successive seasons, i.e. these increases equal 13.96, 51,35 and 16.60% for plant height, leaf area /plant and dry weight/ plant, respectively, in the first season.

These findings could be explicated by **(Mankin and Danny , 1998).** They reported that crop evapotranspiration (ET) changes depending on canopy cover, crop types, variety and plant maturity. On the same line, **Abo-Shetaia and Abd-El Gawad, (1995) and Porras et al., (2010)** pointed out that plant height was increased with increasing evaporation pan coefficient. **(Khan et al. ,2007).** Explicated the greatest values of dry weight /plant to the greater no. of tillers, that was resulted under the condition of more moisture, beside that **Mahgoub and Sayed (2001),** found that the reduction of dry weight / plant may be attributed to the decrease in leaf area under

water stress condition that reflects on photosynthetic production.

With respect to, the significant impact of the studied compost rates on the above traits. All of them were enhanced as increasing the added compost from 2 up to 6% Tables(3), in both seasons. For example, plant height, leaf area / plant and dry weight / plant were aggrandized by 3.48, 18.23 and 21.42%, respectively, in the second season. These results are in harmony with those obtained by **(Entry et al., 1997).**They concluded that organic matter improves soil physical properties, i.e. water retention capacity that reflects on plant growth. On the same line, **(Zahir et al., 2007).** Demonstrated that, organic materials contain significant amounts of macro-nutrients (i.e. N,P and K), beside that organic matter which has a remarkable value comparing with its nutrition content, because of its beneficial effect on soil physical properties.

Concerning the significant difference between the two studied varieties in the studied plant growth characters,in Banysweif-4 var. pronounced its superiority in the all studied traits, in both seasons. For example. In the first season , plant height was exceeded by 2.95%, while the increase leaf area / plant was 12.58% as well as dry weight /plant was enhanced by 4.16% as compared with Banysweif -1 (V_1). These results are advocated by **(Rhouma Sayar et al., 2010)** who stated that although sowing durum wheat varieties under the same drought stress conditions but the two genotypes displayed distinct responses to it . In this sense, genetic variability within a species offers a valuable tool for studying mechanisms of drought tolerance . **(Gergorio et al.,2002)** .

(Atefeh Nouri et al., 2011). Suggested that the magnitude of difference in durum wheat genotypes was sufficient to provide some scope for selecting genotypes to improve drought tolerance that reflects markedly on plant growth characters .

It is interesting to note that , in both successive seasons all the studied interactions had significant effects on that growth parameters , i.e subjected Banysweif 4 (V_2) to water irrigation at 90% ET(WxV) gave the tallest plants, the greatest leaf area/plant and the maximum value of dry weight/plant as enduring with the other treatments (Table 3). The results of the second order interaction (WxCxV) revealed that , treating Banysweif - 4 (V_2) to water irrigation at 90 % ET and feeding with compost at 6% of 16 kg / pot awarded the highest values for all the above traits.

II . Yield and yield components:

Results tabulated in (Tables, 4 and 5) , exhibited the significant impact of water irrigation at different percent of ET, various rates of added compost on no. of spikes /plant , no. of grains/spikes , 1000/ grain weight and grain yield / plant for the

two investigated durum wheat varieties , as well as the first and second order interactions ,in both growing seasons.

Similar directions had been achieved for the significant effect of water irrigation at various percent of ET . to those gained in plant growth parameters (Tables , 4and5) . All the studied characters related to yield were increased as increasing water irrigation level from 70 up to 90% ET. These results may be ought to drought stress may be reduce the number of fertile spikes /unit area and the number of grains/spike **(Simane et al., 1993 and Abayomi and Wright, 1999) . (Talebi , 2009)** observed that visible syndromes of wheat plant exposure to drought in the vegetative phase are leaf wilting , a decrease in plant height , number and area of leaves and delay in accuracy of buds and flowers . On the same line , all the studied parameters of yield and yield components were significant enhanced with increasing the compost rates from 2 up to 6% , it was similar to those obtained during the growth stage(Table, 4 and 5) .These results are in agreement with those obtained from **(Mohamed Solima Ibrahim,2008)**who reported that the partial replacement of N fertilizers by additional of equivalent level of organic fertilizers to wheat production could be a useful way to save the amount of irrigation water used in wheat production by prolonging the irrigation interval and enhancement of plant growth and increasing nutrients uptake by plants to avoid nitrate leaching especially under sandy soils. So, it could be seem that, the gradual N release from organic matter or compost over the growth season appeared to benefit plants more than soluble N fertilizer where the organic fertilizer provides growth factors in addition to nutrients**(Badaruddin et al., 1999**). Significant difference had been achieved between Banysweif -1 (V_1) and Banysweif - 4 (V_2) in studied yield parameters , in both successive seasons , as shown in(Tables , 4 and 5) In general , drought and water stress are major a biotic constraints on crop production and food security , and adversely impact the socio-economic fabric of many developing countries . The significant difference between the two studied wheat varieties may be ought to the genetic variability within varieties offers a valuable tool for studying mechanisms of drought tolerance . One of these mechanisms depends on the capacity for osmotic adjustment, which allows growth to continue under water stress conditions . Under these circumstance, it is achieved by synthesis and accumulation of organic compatible solutes (**Alian et al., 2000**)

All the first and second order interactions had significant impact on all studied yield parameters, in both growing season. The results and maturate that , the addition of 6% compost for Banysweif – 4 var.(C x V) attained the greatest values for grain yield/plant (7.05 and 7.45g/plant) . On the other hand, subjected Banysweif 4 (V_2) to irrigate at the level of 90% of ET and received 6% compost gave the highest value for no. of spikes/plant and grain/spikes, 1000/grain weight and grain yield/plant.

تأثير الأجهاد المائى على قمح الديورم فى وجود الكمبوست لزياده الأنتاجيه

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الملخص العربى

أجريت تجربتان أصص فى صوب زجاجيه وتحت الظروف الطبيعيه بمنطقه الهرم بمحافظه الجيزة خلال موسمى ٢٠٠٩/٢٠١٠ ، ٢٠١٠/٢٠١١ لدراسة تأثير الإجهاد المائى (٧٠، ٨٠، ٩٠%) من البخر نتح (ET) وثلاثة مستويات من الكمبوست (٢ ، ٤ ، ٦ %) من وزن التربه المضافة ١٦ كجم لكل أصيص على بعض صفات النمو والمحصول ومكوناته لصنفى القمح بنى سويف ١ وبنى سويف ٤ ، وقد استخدمت القطاعات الكاملة العشوائية فى ٦ تكرارات كتجربة عامليه . وأوضحت النتائج أن زيادة النسب المئوية لكميات المياه المضافة من ٧٠ ، ٩٠% من البخر نتح أدت الى زيادة معنوية فى صفات النمو لكل من مساحه الورقة / سم^{2} وطول النبات سم والوزن الجاف للنبات/ جم وقد سلكت صفات المحصول ومكوناته نفس السلوك مثل عدد السنابل للنبات الواحد وعدد الحبوب للسنبلة.

ولقد وجد أن أضافه الكمبوست بمستوى ٦ % كانت له نتائج ايجابيه ومعنوية على القياسات السابق ذكرها سواء كانت تتعلق بصفات النمو أو صفات المحصول(عدد السنابل للنبات ،عدد الحبوب للسنبلة ،ووزن ١٠٠٠ حبة ومحصول الحبوب للنبات .

وأوضحت نتائج هذا البحث أن هناك اختلاف معنوي فى ما بين الصنفين قيد الدراسة، فاحتل الصنف بنى سويف ٤ المرتبه الأولى فى كل الصفات السابق ذكرها.

وفى كل الموسمين كان للتفاعل الأول والثانى تأثيرا معنويا على كل القياسات تحت الدراسة وفى النهاية يمكن القول أنه بتعرض الصنف بنى سويف٤ لمستوى ٩٠ % من البخر نتح مع تسميد التربه بمعدل ٦% كمبوسيت قد أعطت أعلى النتائج للصفات قيد الدراسة.

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Table (4): Quantity of water irrigation and compost rates affectiug number of spikes / plant and number of grains /spike of durum wheat varieties Banysweif-1 (V1) and Banysweif-4 (V2) wheat varieties in 2009/2010 and 2010/2011 seasons.

Treatments		Number of spikes / plant						Number of grains /spike					
		First season 2009/2010 varieties (V			Second seasou 2010/2011 varieties(V)			First season 2009/2010 varieties (V)			Second season 2010/2011 varieties(V)		
Water*ET Level (W)	Compost Rate (C)	V1	V2	Mean	V1	V2	Mean	V1	V2	Mean	V1	V2	Mean
	2 %	3.66	4.00	3.83	4.13	4.46	4.30	36.30	38.00	37.15	38.66	40.33	40.91
90%	4 %	4.26	4.46	4.36	4.53	4.60	4.56	41.33	42.66	42.00	42.00	44.33	43.16
	6 %	4.80	5.00	4.90	4.93	5.00	4.96	44.66	47.00	45.83	46.00	50.33	48.16
Mean		4.24	4.48	4.36	4.53	4.68	4.61	40.76	42.55	41.66	42.22	44.99	43.60
	2 %	2.66	2.86	2.76	2.86	3.00	2.93	32.33	35.66	34.00	35.66	36.66	36.16
80%	4 %	3.00	3.13	3.06	4.33	3.60	3.56	36.33	40.00	38.17	38.66	40.66	39.66
	6 %	3.53	4.06	3.80	4.33	4.53	4.43	41.66	44.33	43.00	40.66	44.33	42.49
Mean		3.06	3.35	3.21	3.57	3.71	3.64	36.77	40.00	38.39	38.32	40.55	39.43
	2 %	2.53	2.66	2.60	2.46	2.60	2.53	27.33	31.00	29.17	28.33	32.66	30.49
70%	4 %	2.66	2.93	2.80	2.86	3.20	3.03	34.66	35.33	35.00	35.66	37.33	36.49
	6 %	2.93	3.13	3.03	3.46	3.73	3.60	38.00	40.33	39.17	38.66	41.66	40.16
Mean		2.71	2.91	2.81	2.93	3.17	3.05	33.33	35.55	34.44	34.21	37.21	35.71
G.M. V.		3.34	3.58	3.46	3.68	3.85	3.77	36.96	39.37	38.16	38.25	40.91	39.58
Over all C x V													
	2 %	2.95	3.17	3.06	3.15	3.35	3.25	31.99	34.89	33.44	34.22	36.55	39.88
	4 %	3.31	3.51	3.41	3.64	3.80	3.72	37.44	39.33	38.39	38.77	42.00	40.38
	6 %	3.75	4.06	3.91	4.24	4.42	4.33	41.44	43.89	42.66	41.77	45.44	43.60
LSD at 5%	W	0.21			0.22			1.07			1.11		
	C	0.18			0.18			0.91			0.94		
	V	0.14			0.14			0.71			0.74		
	W x C	0.31			0.32			1.57			1.63		
	W x V	0.24			0.25			1.24			1.28		
	C x V	0.24			0.25			1.24			1.28		
	W x C x V	0.42			0.44			2.14			2.22		

Table (4): Quantity of water irrigation and compost rates affecting number of spikes / plant and number of grains /spike of durum wheat varieties Banysweif-1 (V1) and Banysweif-4 (V2) wheat varieties in 2009/2010 and 2010/2011 seasons.

Treatments		Number of spikes / plant						Number of grains /spike					
		First season 2009/2010 varieties (V			Second season 2010/2011 varieties(V)			First season 2009/2010 varieties (V)			Second season 2010/2011 varieties(V)		
Water*ET Level (W)	Compost Rate (C)	V1	V2	Mean	V1	V2	Mean	V1	V2	Mean	V1	V2	Mean
	2 %	3.66	4.00	3.83	4.13	4.46	4.30	36.30	38.00	37.15	38.66	40.33	40.91
90%	4 %	4.26	4.46	4.36	4.53	4.60	4.56	41.33	42.66	42.00	42.00	44.33	43.16
	6 %	4.80	5.00	4.90	4.93	5.00	4.96	44.66	47.00	45.83	46.00	50.33	48.16
Mean		4.24	4.48	4.36	4.53	4.68	4.61	40.76	42.55	41.66	42.22	44.99	43.60
	2 %	2.66	2.86	2.76	2.86	3.00	2.93	32.33	35.66	34.00	35.66	36.66	36.16
80%	4 %	3.00	3.13	3.06	4.33	3.60	3.56	36.33	40.00	38.17	38.66	40.66	39.66
	6 %	3.53	4.06	3.80	4.33	4.53	4.43	41.66	44.33	43.00	40.66	44.33	42.49
Mean		3.06	3.35	3.21	3.57	3.71	3.64	36.77	40.00	38.39	38.32	40.55	39.43
	2 %	2.53	2.66	2.60	2.46	2.60	2.53	27.33	31.00	29.17	28.33	32.66	30.49
70%	4 %	2.66	2.93	2.80	2.86	3.20	3.03	34.66	35.33	35.00	35.66	37.33	36.49
	6 %	2.93	3.13	3.03	3.46	3.73	3.60	38.00	40.33	39.17	38.66	41.66	40.16
Mean		2.71	2.91	2.81	2.93	3.17	3.05	33.33	35.55	34.44	34.21	37.21	35.71
G.M. V.		3.34	3.58	3.46	3.68	3.85	3.77	36.96	39.37	38.16	38.25	40.91	39.58
Over all C x V													
	2 %	2.95	3.17	3.06	3.15	3.35	3.25	31.99	34.89	33.44	34.22	36.55	39.88
	4 %	3.31	3.51	3.41	3.64	3.80	3.72	37.44	39.33	38.39	38.77	42.00	40.38
	6 %	3.75	4.06	3.91	4.24	4.42	4.33	41.44	43.89	42.66	41.77	45.44	43.60
LSD at 5%	W	0.21			0.22			1.07			1.11		
	C	0.18			0.18			0.91			0.94		
	V	0.14			0.14			0.71			0.74		
	W x C	0.31			0.32			1.57			1.63		
	W x V	0.24			0.25			1.24			1.28		
	C x V	0.24			0.25			1.24			1.28		
	W x C x V	0.42			0.44			2.14			2.22		

Table (5): Quantity of water irrigation and compost rates affecting 1000-grain weight (g) and grain yield per plant (g) of durum wheat varieties Banysweif-1 (V1) and Banysweif-4 (V2) wheat varieties in 2009/2010 and 2010/2011 seasons.

Treatments		1000-grain weight (g)						grain yield per plant (g)					
		First season 2009/2010 varieties (V)			Second season 2010/2011 varieties(V)			First season 2009/2010 varieties (V)			Second season 2010/2011 varieties(V)		
Water*ET Level (W)	Compost Rate (C)	V1	V2	Mean	V1	V2	Mean	V1	V2	Mean	V1	V2	Mean
	2 %	42.18	44.71	43.45	42.83	45.16	44.00	7.27	7.57	7.42	7.37	7.55	7.46
90%	4 %	48.08	49.36	48.72	47.03	50.10	48.57	7.61	7.82	7.72	8.25	8.42	8.34
	6 %	53.08	55.51	54.30	52.50	55.30	53.90	8.08	8.42	8.25	8.40	9.14	8.77
Mean		47.78	49.86	48.82	47.45	50.19	48.82	7.65	7.94	7.80	8.01	8.37	8.19
	2 %	38.68	41.53	40.11	43.56	46.16	44.86	4.93	5.19	5.06	4.89	5.16	5.03
80%	4 %	44.18	45.25	44.72	45.91	47.13	46.52	5.32	5.73	5.53	5.32	5.71	5.52
	6 %	48.31	51.08	49.70	48.65	51.75	50.20	6.44	7.18	6.81	7.14	7.60	7.37
Mean		43.72	45.95	44.84	46.04	48.35	47.19	5.56	6.03	5.80	5.78	6.16	5.97
	2 %	38.31	41.63	39.97	39.95	40.63	40.29	4.55	4.73	4.64	4.61	4.79	4.70
70%	4 %	41.36	43.05	42.21	41.05	43.75	42.40	4.74	5.02	4.88	4.90	5.20	5.05
	6 %	44.10	47.30	45.70	46.25	48.20	47.23	5.37	5.55	5.46	5.48	5.62	5.55
Mean		41.26	43.99	42.63	42.42	44.19	43.31	4.89	5.10	4.99	5.00	5.20	5.10
G.M. V.		44.25	46.60	45.43	45.30	47.58	46.44	6.47	6.36	6.20	6.26	6.58	6.42
Over all C x V													
	2 %	39.72	42.62	41.17	42.11	43.98	43.05	5.58	5.83	5.71	5.62	5.83	5.73
	4 %	44.54	45.89	45.21	44.66	46.99	45.83	5.89	6.19	6.04	6.16	6.44	6.30
	6 %	48.50	51.30	49.90	49.13	51.75	50.44	6.63	7.05	6.84	7.01	7.45	7.23
LSD at 5%	W			1.14			1.29			0.36			0.41
	C			0.96			1.05			0.31			0.35
	V			0.76			0.86			0.24			0.28
	W x C			1.67			1.90			0.53			0.61
	W x V			1.32			1.50			0.42			0.48
	C x V			1.32			1.50			0.42			0.48
	W x C x V			2.28			2.49			0.72			0.83