J. Plant Production, Mansoura Univ., Vol. 2 (3): 413 - 424, 2011

EFFECT OF IRRIGATION LEVELS AND RICE STRAW COMPOST RATES ON YIELD, CHEMICAL COMPOSITION AND WATER USE EFFICIENCY OF CABBAGE (*Brassica oleraceae* var. *Capitata* L.)

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ABSTRACT

Organic fertilizer and water management are essential factors for achieving adequate cabbage development and productivity. Two field experiments were conducted in a clay loam soil at a private farm located at Aga district, Dakahlia governorate, Egypt, during the two successive seasons of 2009 and 2010. The effect of three irrigation levels (35, 45 and 55% depletion from the available soil moisture), three rice straw compost rates (0, 5 and 10 ton/fed.) and their interactions were studied on yield, chemical composition and water use efficiency of cabbage cv. Balady Mohassan. Results indicated that the water deficit treatment (irrigation at 55% depletion from the available soil moisture throughout growing season) had significant decreases in outer leaves weight, edible head weight, edible head diameter, marketable yield, N, P and K accumulation in head leaves and seasonal applied water, and had significant increases in nitrate accumulation in inner leaves and water use efficiency in both seasons. On the other hand, all studied characters except seasonal applied water were significantly increased with increasing rice straw compost rates in both seasons. The interaction between the two studied factors had significant effects on all the studied parameters in both seasons. Generally, it could be concluded that the treatment of 45% depletion from the available soil moisture within 10 ton rice straw compost per fedden was the best combination and it is recommended for cabbage cv. Balady Mohassan grown under similar field conditions in order to get higher economical yield and to save irrigation water.

Keywords: *Brassica oleraceae* var. *Capitata*, cabbage, irrigation, rice straw compost

INTRODUCTION

Cabbage is one of the most important leafy vegetables in Egypt. Cabbage production is affected by different factors such as irrigation and soil fertility. Cabbage is a vegetable that requires high N input and frequent irrigation to enhance yield. Cabbage has a shallow root system, which limits its ability to take up water and nutrients from the deeper soil profile (Wien and Wurr, 1997).

Increasing concern over the effects of climate change on water resources requires that water should be used more effectively in irrigated agriculture to increase and sustain productivity. In crop production, instead of achieving maximum yield from a unit area by full irrigation, water productivity can be optimized within the concept of deficit irrigation (Fereres and Soriano, 2007; Geerts and Raes, 2009).

Irrigation should be managed concurrently to maximize yield, quality and irrigation efficiency for cabbage (McKeown *et al*., 2010). Increasing the water application increased significantly cabbage head diameter, head weight, leaf weight and marketable yield (Sammis *et al*., 1988; Sammis and Wu, 1989; Abdel Rahman *et al*., 1994; Parmar *et al*., 1999; AL-Rawahy *et al*. 2004; McKeown *et al*., 2010).

Maintenance of sufficient levels of organic matter in soil is prerequisite for sustainable and high yield of cabbage (Yamazaki and Roppongi, 1998). Addition of mineral NPK fertilizers into compost could further increase the Chinese cabbage yield (Wei and Liu, 2005).

Depletion of nutrients and poor organic matter contents of Egyptian soils can be replenished by applying rice straw compost to these soils (Esawy *et al*., 2009). Use of rice straw compost as an organic fertilizer, might be play a vital role not only in improving soil physical condition and water holding capacity but also in improving the plant nutrients (Ali *et al.*, 2006; Hellal, 2007; Esawy *et al*., 2009).

Application of rice straw compost has been reported to improve soil structure, fertility and consequently development and productivity of cabbage plants (Yoshida *et al*., 2004).

While traditional composting procedures take as long as 4-6 months to produce finished compost, with the aid of decomposing microorganisms (*Actinomycetes*), decomposition of rice straw is accelerated to just 1-3 months (El-Hammady *et al.*, 2003; El-Shatoury, 2006; Abdulla, 2007). Composting with effective microorganisms (EM) inoculation is encouraged in organic farming practice in many countries. Effective microorganisms solution contains a mixture of five genera of organisms, namely *Actinomycetes*, ray fungi, photosynthetic bacteria, yeasts and lactic acid bacteria (Higa, 1994).

There is little information available on the effectiveness on improving cabbage yield with rice straw compost applied at different irrigation rates. Thus, the present study was undertaken for further understanding of the response of cabbage, in terms of yield, chemical composition and water use efficiency, to different rates of rice straw compost under different regimes of applied water and their interactions.

MATERIALS AND METHODS

Two field experiments were carried out at a private farm located at Aga district, Dakahlia governorate, Egypt, during the two successive seasons of 2009 and 2010 on cabbage cv. Balady Mohassan.

Some physical and chemical properties of the experimental field soil at the depth of 0-30 cm were determined as described by Page (1982) and Klute (1986) and are shown in Tables (1 and 2).

Seeds of cv. Balady Mohassan were sown on 1 April in both seasons and transplanted on 15 and 17 May in both seasons, respectively.

A split plot design with three replicates was followed. The main plots were assigned to three irrigation levels (35, 45 and 55% depletion from the available soil moisture (DASM), equal 12, 8 and 5 irrigations throughout growing season, respectively). Sub plots were devoted to the three rice straw compost rates (0, 5 and 10 ton/fed.). Each sub plot area was 12.8 m^2. Each plot consisted of 4 ridges; each row was 80 cm wide and 4 m long. The transplants were spaced at 50 cm apart on one side of the ridge. A guard ridge was left between the treatments.

Table 1: Some physical and chemical properties of the experimental soil surface layer (at the depth of 0-30) before planting during 2009 and 2010 seasons

Properties	Values		Properties	Values	
	2009	2010		2009	2010
Sand (%)	27.3	26.9	pH* values	7.8	7.7
Silt (%)	31.4	31.6	EC (dSm^{-1})	0.9	0.8
Clay (%)	41.3	41.5	Total N (%)	0.13	0.12
Texture class	Clay-loam	Clay-loam	Available P (ppm)	11.4	11.2
$CaCO_3$	3.4	3.3	Exchangeable K (ppm)	316	305
OM (%)	2.3	2.1			

*** pH: (1:2.5 soil extract).**

Table 2: The soil moisture constants (% by weight) and bulk density of the experimental soil during summer 2009 and 2010 seasons

Constants depth(cm)	Field capacity (%)		Wilting point (%)		Available water (%)		Bulk density (g/cm^3)	
	2009	2010	2009	2010	2009	2010	2009	2010
0 – 15	42.86	43.06	22.84	23.22	20.02	19.84	1.20	1.22
15 – 30	40.12	40.79	21.81	22.67	18.31	18.12	1.24	1.26
30 - 45	38.87	38.72	21.23	21.16	17.64	17.56	1.33	1.35

The straw was chopped into 5 cm long pieces, piled, moistened with water and composted in association with a chemical accelerator (7 kg superphosphate and 40 kg ammonium sulphate per ton dry matter), 100 kg fertile soil per ton dry matter and10% Farmyard manure. At the initial stage of composting, the EM suspension was sprayed on the raw material amounted 10 litres per ton dry matter. During composting (3 months), materials were manually mixed at a week intervals to provide aeration. The moisture content during the composting course was kept at a proper level (60 % by weight) throughout irrigation (El-Hammady *et al*., 2003; El-Shatoury, 2006; Abdulla, 2007). Some properties of the used compost were determined by using standard methods described by AOAC (1990) (Table, 3). Rice straw compost was added to the soil and left two weeks before transplanting.

Irrigation treatments were applied after the first irrigation which was 10 days after transplanting.

All plots were fertilized with ammonium sulphate (20.6% N) at the rate of 80 kg N/fed., calcium super phosphate (15.5% P_2O_5) at the rate of 48 Kg P_2O_5/fed. and potassium sulphate (48% K_2O) at the rate of 48 kg K_2O/fed.. The mineral fertilizers were applied in two equal doses, at the fourth week after seedling transplanting and at the eighth week after seedling transplanting. The other cultural practices were carried out as recommended.

At harvesting time, sample of 6 plants from each experimental plot was randomly taken at 100 days after transplanting to measure the outer leaves weight, edible head weight and diameter, N, P and K accumulation in head leaves and nitrate accumulation in inner leaves. Samples of leaves (outer and inner leaves) were weighed and then oven-dried at 60 ^{0}C for 72 hours. Thereafter their dry weights were recorded to calculate their dry matter percentages. Total nitrogen was determined with micro-kjeldahl method according to Chapman and Pratt (1961). Phosphorus was colorimetrically determined following Jackson (1973). Potassium was determined using a flame photometer as described by Jackson (1973). NO^{-}_{3} was extracted using 2% acetic acid and determined according to Singh (1988). Element content was estimated based on leaves dry weight and element percentage in leaves. Also, marketable heads yield was determine in kg/plot, then it was converted to estimate marketable yield in ton/fed..

Table 3: Some properties of rice straw compost used in 2009 and 2010 seasons.

Properties	Values		Properties	Values	
	2009	2010		2009	2010
N (%)	1.78	1.81	**OM (%)**	25.7	24.4
P (%)	0.18	0.16	**C / N**	21.7	22.3
K (%)	0.86	0.81	**pH**	6.9	7.2
			EC (mmhos/cm)	2.6	2.8

Water consumptive use computed as the difference in the soil moisture content before and after irrigation according to the following equation by Israelson and Hansen (1962): $Cu = D \times Bd \times 4200 \times (\theta_2 - \theta_1)/100$, where Cu is the water consumptive use m^3/fed., D is the soil depth, Bd is the soil bulk density (g/cm^{-3}), θ_1 is the soil moisture content before irrigation (% by weight), θ_2 is the soil moisture content after irrigation or after 48 hours (% by weight). Seasonal applied water is the sum of the figures computed for each irrigation application. Water use efficiency was computed for the different treatments by dividing the marketable yield (ton/fed.) by seasonal applied water (m^3/fed.) (Stanhill, 1986).

Data obtained were subjected to statistical analysis by the technique of analysis of variance (ANOVA) for split block design according to Snedecor and Cochran (1982). Comparisons among means of treatments were tested using LSD values at 5% level.

RESULTS AND DISCUSSION

1. Head characteristics and marketable yield:

Data presented in Table (4) illustrate that outer leaves weight, edible head weight, edible head diameter and marketable yield were significantly increased by increasing available soil water in both seasons. These increases can be due to the fact that available more water enhances nutrient availability which improves nitrogen and other macro- and micro-elements absorption as well as enhancing the production and translocation of the dry matter content from source to edible head (Sammis and Wu, 1989). Similar results were reported by Sammis *et al*. (1988), Sammis and Wu (1989), Abdel Rahman *et al*. (1994), Parmar *et al*. (1999), AL-Rawahy *et al*. (2004) and McKeown *et al*. (2010).

Table 4: Effect of irrigation levels, rice straw compost (RSC) rates and their interactions on head characteristics and marketable cabbage yield during 2009 and 2010 seasons

Treatments		Outer leaves weight (kg/plant)		Edible head weight (kg/plant)		Edible head diameter (cm)		Marketable yield (ton/fed.)	
Irrigation levels (%DASM)	RSC rates (ton/fed.)	2009	2010	2009	2010	2009	2010	2009	2010
35		1170	1118	5473	5113	39.0	37.4	52.651	49.158
45		1087	1051	4859	4581	35.7	34.0	47.306	43.525
55		905	885	3802	3580	30.6	29.1	36.842	34.097
LSD (5%)		28	21	127	221	1.4	1.5	2.451	2.416
	0	963	936	4104	3809	32.3	30.9	39.603	36.428
	5	1061	1026	4754	4460	35.1	33.5	46.022	42.601
	10	1137	1092	5276	5006	38.0	36.2	51.174	47.752
LSD (5%)		52	34	405	302	1.6	1.4	3.015	3.259
35	0	1093	1048	5011	4682	36.4	34.7	48.104	45.086
	5	1177	1120	5506	5147	38.9	37.5	53.008	49.031
	10	1240	1185	5902	5511	41.8	40.0	56.839	53.357
45	0	996	972	4198	3943	32.7	31.2	40.790	37.109
	5	1092	1056	4906	4624	35.8	34.1	47.742	43.952
	10	1174	1124	5473	5177	38.6	36.8	53.386	49.515
55	0	801	788	3102	2801	27.8	26.7	29.915	27.088
	5	915	901	3851	3609	30.5	28.9	37.316	34.820
	10	998	967	4453	4331	33.5	31.8	43.295	40.384
LSD (5%)		90	59	675	524	2.7	2.4	5.222	5.644

DASM: depletion from the available soil moisture

Moreover, it is evident from the data in Table (4) that the outer leaves weight, edible head weight, edible head diameter and marketable yield of cabbage plants were significantly increased with increasing rice straw compost rates in both seasons. The beneficial effect of rice straw compost on head characteristics and marketable yield may be due to improving the soil structure conditions, which encouraged the plant to have a good root development by improving soil water holding capacity and this permitted favourable plant supply with water and nutrients which in turn, increases the amount of plant biomass produced (Ali *et al*., 2006; Hellal, 2007; Esawy *et al*., 2009). These results are in accordance with those reported by Warman and Harvard (1996), Yoshida *et al.* (2004) and El-Shabrawy *et al*. (2005) on cabbage, Wei and Liu (2005) and Bahadur *et al.* (2006) on Chinese cabbage and Kandil and Gad (2009) on broccoli.

Concerning the interaction between both studied factors, results in Table (4) indicate that 10 t/fed. rice straw compost under irrigation at 35 and 45 % DASM recorded the highest values of head characteristics and marketable yield, while, the lowest values were recorded under irrigation at 55% DASM where no rice straw compost was added in comparison with other treatments. Results were similar in both seasons. Such results may be explained that head characteristics and marketable yield are generally decided by the amount of water and nitrogen applied to the crop. In this respect, McKeown *et al.* (2010) found that more N is required as the water supply increases.

2. N, P, K and NO_3 accumulation:

Data in Table (5) show that N, P and K accumulation in head leaves and nitrate accumulation in inner leaves were significantly affected under different irrigation water regimes. Irrigation at 45% of DASM gave slight increases of N, P and K accumulation in leaves followed by irrigation at 35% and 55% DASM. However, No significant differences between 35 and 45 % of DASM were observed for K accumulation. Results were true and similar in the two seasons of the experiment. In this respect, Frank and Viets (1967) stated that growing plants in fertile soil can meet its needs for more nutrients when water conditions are more favourable. Therefore, the decreasing of nutrients content in cabbage plant at 65% DASM may be due to redacting the solubility of mineral in the soil; hence movement of cations to root is reduced (Frank and Viets, 1967). The same trend was found by Karam *et al.* (2002) who found that the highest nitrogen uptake was observed in lettuce plants of the well-irrigated treatment and it decreased with increasing water stress level. As regard to nitrate accumulation, the results show that there is a general significant negative effect on the nitrate content in inner leaves due to increasing each of available soil water in root zone (Table, 5). This trend was detected in the first and second seasons. These results were in good agreement with the findings reported by Aggelidis *et al.* (1999) who found that the nitrate content in lettuce leaves was increased with increasing soil water potential.

Table 5: Effect of irrigation levels, rice straw compost (RSC) rates and their interactions on N, P and K accumulation in head leaves and nitrate accumulation in cabbage inner leaves during 2009 and 2010 seasons

Treatments		N accumulation (mg/head)		P accumulation (mg/head)		K accumulation (mg/head)		NO_3 (mg/kg dry wt.)	
Irrigation levels (%DASM)	RSC rates (ton/fed.)	2009	2010	2009	2010	2009	2010	2009	2010
35		14110	17197	1688	2031	16779	18226	119	127
45		16367	13683	1795	1791	17110	18682	140	161
55		9156	9250	1223	1323	12845	14222	177	184
LSD (5%)		848	1068	149	128	518	454	11	7
	0	11177	11534	1271	1403	13577	14978	130	137
	5	13208	13364	1578	1727	15656	17157	136	157
	10	15247	15232	1855	2015	17501	18995	170	178
LSD (5%)		1716	1545	100	89	437	397	13	9
35	0	12365	15750	1460	1796	15267	16547	104	112
	5	13944	17500	1643	2059	16820	18260	119	126
	10	16021	18340	1960	2237	18252	19869	135	142
45	0	14126	11560	1494	1468	15342	16789	130	137
	5	16898	13671	1861	1779	17124	18667	111	161
	10	18077	15818	2030	2125	18863	20591	178	185
55	0	7041	7291	861	946	10123	11597	155	162
	5	8781	8922	1232	1342	13024	14543	177	184
	10	11645	11538	1575	1682	15389	16526	198	207
LSD (5%)		2855	2676	195	154	915	687	18	15

DASM: depletion from the available soil moisture

The results in Table (5) also reveal that increasing application of rice straw compost increased N, P and K accumulation in cabbage head leaves and nitrate accumulation in inner leaves compared with mineral fertilizer alone in both seasons. Organic fertilizers contain not only the various nutrients that crops need, but also release these nutrients gradually in step with the changing demand of developing crop. The compost ratio affected the total and available N, P, and K content and the mineralization rates in the substrate. In general, as more compost was included in the substrate, the quantity of available N, P, and K increased along with the mineralization rate (Yoshida *et al*., 2004; Hellal, 2007; Jianming *et al,* 2008; Esawy *et al*., 2009; Kandil and Gad, 2009). In the same line, Yamazaki and Roppongi (1998) and El-Shabrawy *et al.* (2005) reported that organic manure increased N, P and K contents in head cabbage. However, Zahradník and Petříková (2007) found that application of compost had no significant effect on K content in cabbage leaves. As regard to nitrate accumulation, these data are in harmony with those obtained by Rubeiz *et al.* (1993) who reported that organic produced cabbage contained a high concentration of NO_3.

Concerning to the interaction between the two studied factors, the results in Table (5) show that there is a general significant positive effect on the content of N, P and K in cabbage head leaves due to increasing available soil water and application rates of rice straw compost. Application of 10 ton/fed. rice straw compost for plants irrigated at 35 and 45 % DASM gave the highest significant values of N, P and K content in head leaves. Meanwhile, the lowest values were found when no rice straw compost was applied for plants irrigated at 65% DASM in comparison with other treatments. Results were similar in both seasons. Such results may be explain that N, P and K uptake are generally decided by the amount of water and nutrients applied to the crop. Reduction in N, P and K uptake with 65% DASM at no rice straw compost can be due to the inability of the roots to absorb and translate them to the plant top under low soil water (Frank and Viets, 1967) and depletion of nutrients (Hellal, 2007; Esawy *et al.*, 2009).

Also, the results in Table (5) show that the interaction between the two studied factors had significant effects on nitrate accumulation in inner leaves in both seasons. Increasing the rate of water stress enhances nitrate accumulation in response to rice straw compost fertilization, especially when high compost rates are applied. These results may be due to the role of organic fertilizers and soil water in availability and uptake of nitrate from soil by cabbage plants. In this respect, Tarkalson *et al.* (2006) found that increasing manure applied under deficit irrigation resulted in greater NO_3^--N mass in the soil.

3. Seasonal applied water (SAW):

Data presented in Table (6) indicate that SAW to cabbage plants was significantly increased by increasing available soil water in both seasons. This may be due to the fact that frequently watered plants used more water because they found it much more easily without suffering from water deficit. Israelson and Hansen (1962) stated that if other conditions were equal, roots of plants in wet soil will extract more water than the roots of plants growing in dried soil.

Data presented in Table (6) also indicate that there was a tendency for the SAW to be lowest when fertilized with compost and highest when the compost was not supplied. The plants with the highest compost treatment (10 ton fed.$^{-1}$) gave significantly lowest SAW in both seasons. This can be explained by the fact that the organic matter in compost reduces evaporation from the soil surface and increases the soil's water holding ability so that irrigation water are held in the root zone for plant use (Ali *et al.*, 2006; Esawy *et al*., 2009). According to Duane (2004), this can significantly lower the irrigation requirements. In this respect, Jaza Folefack (2008) found that compost use tended to decrease the Lettuce's irrigation requirements.

Table 6: Effect of irrigation levels, rice straw compost (RSC) rates and their interactions on seasonal applied water and water use efficiency of cabbage during 2009 and 2010 seasons

Treatments		Seasonal applied water (m^3/fed.)		Water use efficiency (kg edible head / m^3 water)	
Irrigation levels (%DASM)	RSC rates (ton/fed.)	2009	2010	2009	2010
35		1776	1807	29.79	27.31
45		1513	1520	31.50	28.86
55		1131	1143	33.08	30.24
LSD (5%)		29	25	1.41	1.34
	0	1563	1574	25.22	23.01
	5	1476	1488	31.41	28.87
	10	1381	1408	37.73	34.53
LSD (5%)		44	38	1.88	2.35
35	0	1861	1883	25.83	23.93
	5	1779	1800	29.83	27.27
	10	1689	1738	33.70	30.74
45	0	1603	1605	25.43	23.15
	5	1514	1521	31.52	28.93
	10	1421	1435	37.55	34.50
55	0	1226	1233	24.40	21.95
	5	1134	1144	32.89	30.42
	10	1033	1052	41.93	38.37
LSD (5%)		76	66	3.26	4.07

DASM: depletion from the available soil moisture

The interaction between irrigation regime and rice straw compost was significant for SAW in both seasons (Table, 6). The highest values in this respect were detected when no rice straw compost was added to soil irrigated at 35% DASM. On the other hand, the lowest significant values of SAW were detected by plants fertilized by rice straw compost at 10 ton/fed. under severe water stress (65% DASM) in comparison with other treatments. These mainly were due to higher capacity of the rice straw compost for water holding capacity which gave rise to good aeration and drainage (Ali *et al.*, 2006) that may be decrease the irrigation requirements (Jaza Folefack, 2008).

4. Water use efficiency (WUE):

The results showed significant differences for WUE among the irrigation treatments in both seasons (Table, 6). The WUE values found in this experiment showed that the lower the amount of irrigation water applied, the higher the irrigation water use efficiency obtained. The same trend was found by Imtiyaz *et al.* (2000) and Tiwari *et al.* (2003) who found that the yield per unit quantity of water used increased by increasing water deficit.

Regarding the effect of rice straw compost application rates on water use efficiency, the plants with the highest compost treatment (10 ton/fed.) gave significantly highest WUE in both seasons (Table, 6). This could be due to the role of rice straw compost as organic fertilizer on better holding the water in the root zone (Ali *et al.*, 2006). In this respect, Ali *et al.* (2006) also found that the application of rice straw compost for tomatoes increased water use efficiency.

As for the effect of the interaction between the two studied factors on WUE, it is obviously clear that plants grown under severe water stress and fertilized by rice straw compost at 10 ton/fed. gave the highest significant values of WUE. While, the lowest values were recorded under three irrigation levels where no rice straw compost was added in comparison with other treatments (Table, 6). Results were similar in both seasons. The same trend was found by Pasakdee *et al.* (2006) on broccoli.

Conclusions:

The previous findings emphasize the importance of determining the interaction effects between irrigation regimes and rice straw compost rates to find out the optimum combinations for maximum marketable yield accompanied by high water use efficiency. The treatment of 45% depletion from the available soil moisture within 10 ton rice straw compost per fedden was the best combination and it is recommended for cabbage cv. Balady Mohassan grown under similar field conditions in order to get higher economical yield and to save irrigation water.

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تأثير مستويات الري ومعدلات كمبوست قش الأرز على محصول الكرنب وتركيبه الكيماوي وكفاءة استخدامه لماء الري

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يعتبر التسميد العضوي والري من أهم العوامل التي تؤثر على نمو وانتاجية الكرنب. لذلك نفذت تجربتان حقليتان في تربة طينية طمبية بمزرعة خاصة بمركز أجا بمحافظة الدقهلية خلال الموسمين الصيفيين 2009، 2010م، لدراسة تأثير ثلاث مستويات للري وهي الري عند استنفاذ 35، 45 ، 55% من الماء الميسر في التربة)، وثلاثة معدلات من كمبوست قش الأرز (صفر، 5 ،10 طن للفدان)، وكذلك التفاعل بينهما على المحصول والمكونات الكيميائية وكفاءة استخدام الماء في الكرنب صنف "بلدي محسن". أوضحت النتائج أن الري بالمستوى المنخفض من الماء (عند استنفاذ 55 % من الماء الميسر في التربة) خلال موسم النمو أدى إلى خفض كل من وزن الأوراق الخاجية، ووزن الرأس وقطرها، والمحصول الصالح للتسويق، والنيتروجين والفسفور والبوتاسيوم المتراكم في كل من الأوراق الخارجية والداخية، والماء الكلي المضاف للفدان خلال موسم الزراعة، ولكنها أدت إلى حدوث زيادة معنوية في كل من تراكم النترات في الأوراق الداخلية، وكفاءة استخدام الماء في كلا الموسمين. ومن ناحية أخرى أدت زيادة معدلات كمبوست قش الأرز المضافة إلى حدوث زيادة معنوية في جميع الصفات المدروسة فيما عدا صفة الماء الكلي المضاف للفدان خلال موسم الزراعة، والتي انخفضت بزيادة معدلات الكمبوست في كلا الموسمين. كما أثر التفاعل بين عاملي الدراسة (مستويات الري ومعدلات الكمبوست) معنويا على جميع الصفات المدروسة في كلا الموسمين.

وخلصت الدراسة إلى أن ري نباتات الكرنب صنف "بلدي محسن" عند استنفاذ 45% من الماء الميسر في التربة خلال موسم النمو، مع إضافة كمبوست قش الأرز بمعدل 10 طن للفدان، يمكن أن يحسن من كمية ونوعية المحصول مع زيادة كفاءة استخدام ماء الري، وبالتالي توفير مياه الري، بخاصة تحت الظروف المماثلة لظروف هذه الدراسة.

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