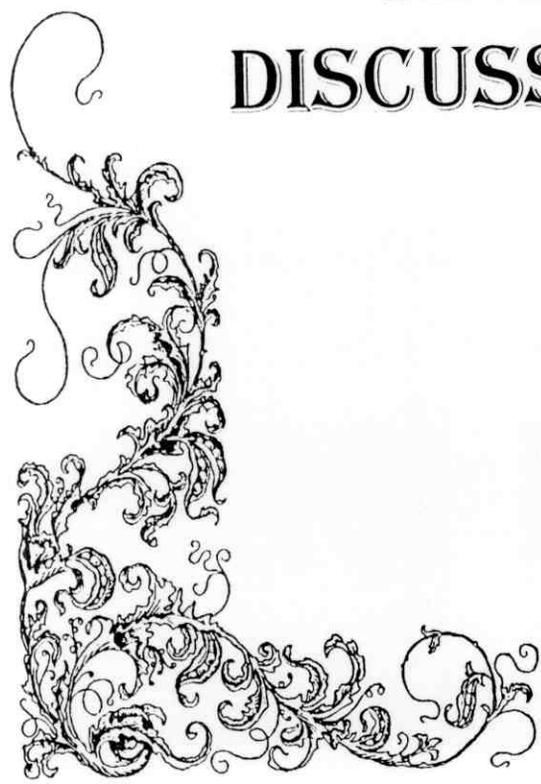


**RESULTS  
AND  
DISCUSSION**



## **RESULTS AND DISCUSSION**

### **First study (Wheat)**

#### **I- Growth characters :**

##### **1- Plant height :**

Results presented in Tables (4 and 5) and Fig. (1, 2, 3 and 4) show the effects of plant residue, irrigation regimes and N level as well as their interactions on plant height of wheat at 88 days from planting (DFA) and at harvest in 1997/98 and 1998/99 seasons.

##### **1-a- Effect of plant residues :**

Plant height of wheat at 88 days from planting and at harvest were significantly increased when plants cultivated in sandy soil treated with corn straw or casuarina leaves residues as compared to control treatment (without plant residues) in both seasons. The results in Tables (4 and 5) and Fig. (1, 2, 3 and 4) indicated clearly that the differences between the two plant residues (corn straw and casuarina ) treatments on plant height were significant at 88 days from planting at harvest date in the two successive seasons. The tallest plant was 67.2 and 73.3 cm, resulted from corn straw and casuarina residues respectively, at 88 days from planting and at harvest in the first and second season, respectively. On the other hand, the shortest plant was resulted without application of plant residues in both season. It could be concluded that the application of plant residues to sandy soil gave the highest values of plant height of wheat. These results may be due to organic fertilizer plays an important role in plant nutrition not only as a carrier and source of nutrients, but

Table ( 4 ) : Effect of plant residues, irrigation regimes, N-levels and their interactions on plant height (cm) at 88 DFP in 1997/1998 and 1998/1999 seasons.

Plant residues	N- Level KgN/fed	Plant height (cm) at 88 DFP					
		1 <sup>st</sup> season		Mean	2 <sup>nd</sup> season		Mean
		Irrigation regimes			Irrigation regimes		
		W1	W2	W1	W2		
Without	0	26.3	16.1	21.1	31.0	20	25.5
	60	55.0	40.0	47.5	63.0	48	55.5
	120	80.3	57.6	69.0	84.0	56	70.0
	Mean	53.8	37.8	45.8	59.3	41.3	50.3
Corn straw	0	67.0	45.0	56.0	72.0	48	60.0
	60	73.0	61.0	67.0	83.0	61	72.0
	120	88.0	69.3	78.6	89.0	64	76.0
	Mean	76.0	58.4	67.2	81.3	57.6	69.5
Casuarina leaves	0	64.3	42.0	53.1	75.0	52	63.5
	60	75.3	59.6	67.5	88.3	65	76.8
	120	84.0	66.6	75.3	91.0	68	79.5
	Mean	74.5	56.1	65.3	84.7	61.7	73.3
IxN	0	52.5	34.3	43.4	59.3	40.0	49.6
	60	67.7	53.5	60.6	78.1	58.1	68.1
	120	84.1	64.5	74.3	88.0	62.6	75.0
	Mean	68.1	50.8		75.1	53.6	

L.S.D at 0.05

R	0.95	1.12
I	1.60	0.99
N	0.60	1.39
RXI	3.02	1.59
RXN	2.46	2.41
IxN	2.01	1.97
RXIXN	3.48	3.42

**Table ( 5 ) : Effect of plant residues, irrigation regimes, N-levels and their interactions on plant height (cm) at harvest in 1997/1998 and 1998/1999 seasons.**

Plant residues	N- Level KgN/fed	Plant height (cm)at harvest					
		1 <sup>st</sup> season		Mean	2 <sup>nd</sup> season		Mean
		Irrigation regimes			Irrigation regimes		
		W1	W2		W1	W2	
<b>Without</b>	0	40	30	35	48	36	42
	60	69	54	61	81	58	69
	120	90	75	82	101	81	91
	<b>Mean</b>	66	53	59	76	58	67
<b>Corn straw</b>	0	79	63	71	96	67	81
	60	96	74	85	105	80	92
	120	101	81	91	108	83	95
	<b>Mean</b>	92	73	82	102	76	89
<b>Casuarina leaves</b>	0	81	62	71	94	66	80
	60	91	74	83	107	78	92
	120	99	76	88	110	80	95
	<b>Mean</b>	90	71	80	103	74	89
<b>IxN</b>	0	66	52	59	79	56	68
	60	85	67	76	97	72	84
	120	97	77	87	106	81	93
	<b>Mean</b>	83	65		94	70	

**L.S.D at 0.05**

R	3.30	1.28
I	3.96	1.04
N	2.20	0.87
RXI	1.43	1.81
RXN	2.49	1.52
IxN	2.03	1.24
RXIXN	4.37	2.15

W1 =50% soil moisture stress  
W2 =70% soil moisture stress

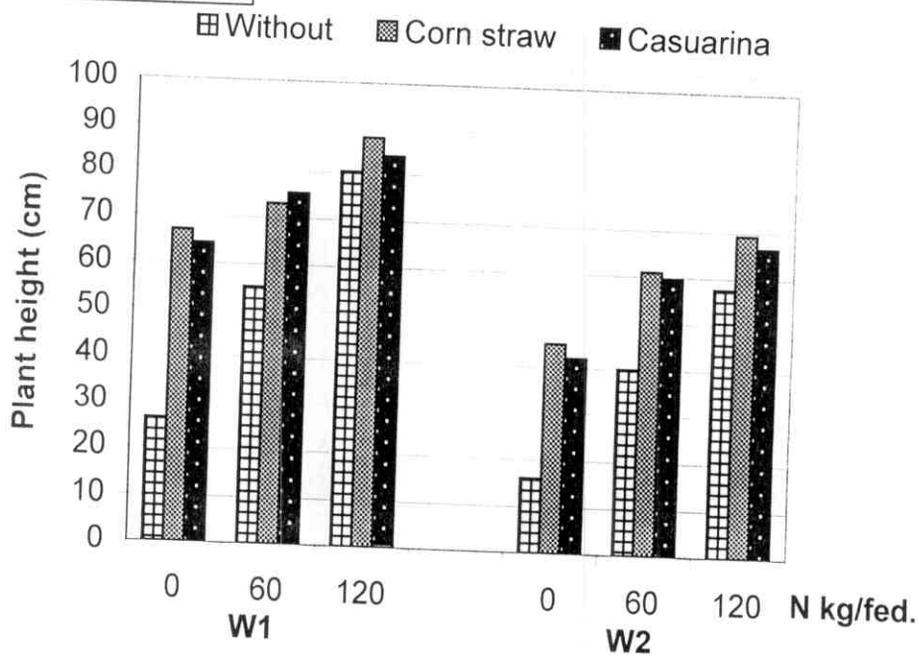


Fig (1): Plant height of wheat (cm) at 88 DFP during 1997/1998, growing season.

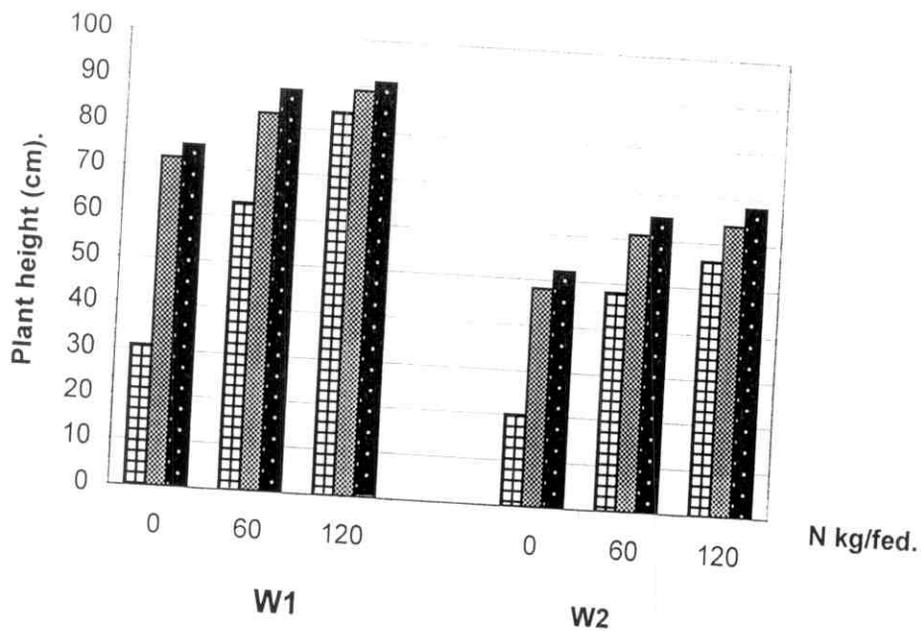


Fig (2): Plant height of wheat (cm) at 88 DFP during 1998/1999, growing season.

W1 =50% soil moisture stress  
W2 =70% soil moisture stress

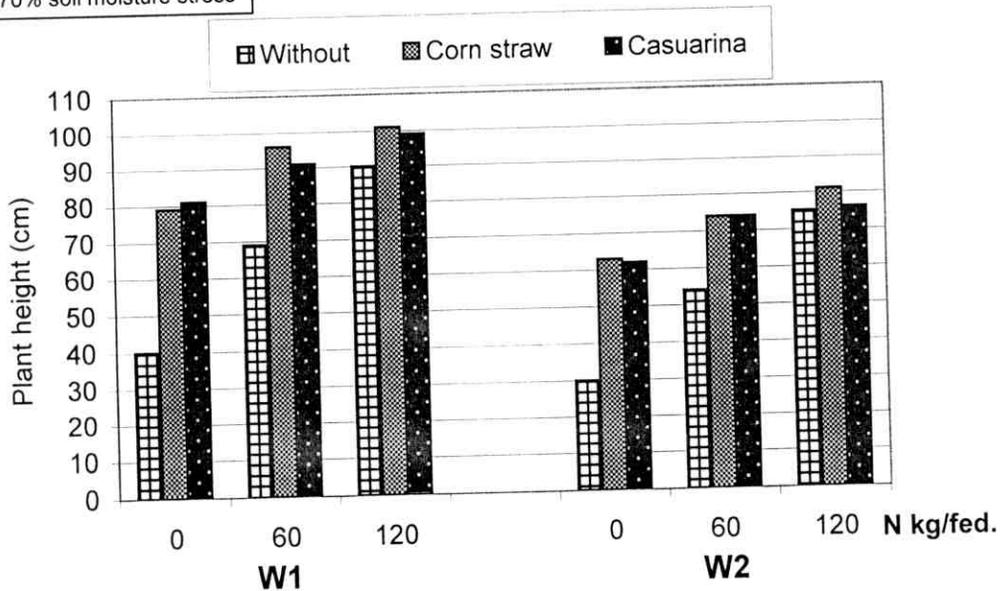


Fig (3): Plant height of wheat (cm) at harvest during 1997/1998, growing season.

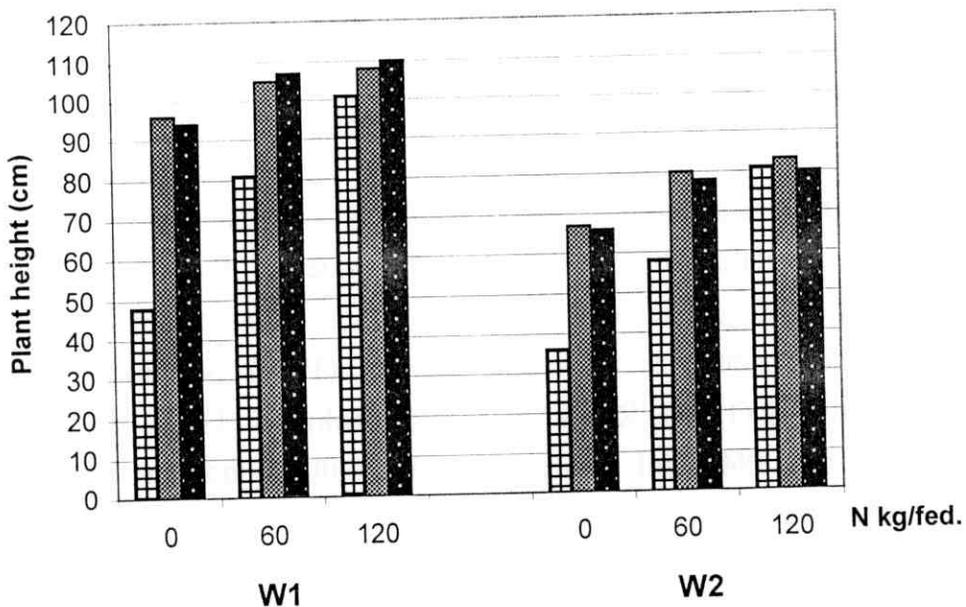


Fig (4): Plant height of wheat (cm) at harvest during 1998/1999, growing season.

also it is an excellent soil such as texture and aeration (Maramba *et al.*, 1978). Also, Abd El-Moez (1995) found that application of plant residues (lentil – Juave and sugar cane) to sand soil caused a significant increment in plant weight of wheat, nitrogen content in the soil and decreasing soil pH.

**1-b- Effect of irrigation regimes:**

The results in Tables (4 and 5) and Fig. (1, 2, 3 and 4) indicated that irrigation regimes had a significant effect on plant height of wheat at 88 days from planting and at harvesting time in the two growing seasons. Irrigation of wheat plants after 50% loss in water holding capacity gave the tallest plant, whereas irrigation at 70 % loss in water holding capacity gave the shortest plant in both season. The increment in plant height reached about 34.05 and 27.69 % at 88 days after planting and at harvest, respectively in the first season as well as 40.11 and 34.28 %, in the second season, respectively. These results are due to water stress decreased the activity of meristematic tissues responsible for elongation of plant. The decreasing in plant height due to the decrease in length of internodes as a result of the reduction in the number and size of the cells. Many investigators discussed the effect of soil moisture stress on the number and size of cells. Cooper (1980) Salwau (1981), Duwayri (1984), Rab *et al.* (1984) Mohamed (1992), El- Kalla *et al.* (1994) and Sharaan *et al* (2000) found that exposing wheat plants to water stress caused a significant decrement in plant height.

by 120 kg N/feddan gave the tallest plant at harvest time which equal 91 and 95 cm. in the first and second seasons, respectively. However no significant difference was obtained between corn straw and casuarina with applied 120 kg N/fedan on plant height at harvest in both season. Similar results were by **Freney and Simpson (1983)** who found that the addition of plant residues on the soil increased the available nutrients as a result of reducing pH mechanism.

There was significant effect of the interaction between plant residues, irrigation regimes and N levels on plant height at 88 days from planting and at harvest in the two growing seasons as shown in Tables (4 and 5). The highest plants of wheat was produced from addition of plant residues i.e corn straw or casuarina with irrigation at 50% loss in water holding capacity and applied 120 kg N/feddan at the two samples in both seasons.

Whereas the lowest plant height was obtained without both plant residues and nitrogen fertilizer with irrigation at 70% soil moisture depletion. It could be concluded that the application of plant residues and fertilization with nitrogen level at 120 kg/fed with irrigation at 50% loss in water holding capacity were more effective in significantly increasing plant height of wheat.

### **2-Number of tillers/m<sup>2</sup>**

Results in Table (6) show the effect of plant residues, irrigation regimes and N levels as well as their interactions on number of tillers/m<sup>2</sup> at 88 days from planting in 1997/98 and 1998/99 growing seasons .

Table (6): Effect of plant residues, irrigation regimes, N-levels and their interactions on number of tillers / m<sup>2</sup> at 88 DFP in 1997/1998 and 1998/1999 seasons.

Plant residues	N- Level KgN/fed	Number of tillers /m <sup>2</sup> at 88 DFP					
		1 <sup>st</sup> season		Mean	2 <sup>nd</sup> season		Mean
		Irrigation regimes			Irrigation regimes		
		W1	W2	W1	W2		
Without	0	156	93	125	217	198	205
	60	232	203	218	300	318	309
	120	288	236	262	309	292	301
Mean		225	177	201	275	267	271
Corn straw	0	262	202	232	284	251	267
	60	292	260	276	327	296	311
	120	314	293	303	370	310	340
Mean		289	252	270	327	285	306
Casuarina leaves	0	237	252	244	296	262	279
	60	301	271	286	362	306	333
	120	331	285	308	382	313	347
Mean		289	269	279	346	293	320
IxN	0	218	182	200	265	235	250
	60	275	245	260	329	306	318
	120	311	271	291	353	305	329
Mean		268	233		316	282	

L.S.D at 0.05

R	3.66	26.68
I	8.46	29.02
N	4.50	21.77
RXI	5.18	36.32
NxR	7.79	37.70
IxN	6.36	30.78
RXIXN	11.02	53.32

**2-a- Effect of plant residues :**

Plant residues had a significant effect on the number of tillers /m<sup>2</sup> at 88 days after planting in both seasons . The highest number of tillers / m<sup>2</sup> was 279 and 320, obtained from the soil treated with casuarina leaves in the first and second seasons, respectively. Whereas the lowest one was 201 and 271, produced from wheat planted in pure sandy soil. On the other hand, no significant difference was obtained between application of casuarina leaves and corn straw to sandy soil on the number of tillers /m<sup>2</sup> at 88 days from planting in the second season. It could be concluded that application of casuarina leaves and corn straw were more effective on increasing significantly tillers number /m<sup>2</sup> than with untreated of plant residues. These results may be due to organic fertilizer plays an important role in plant nutrition not only as a carrier and source of nutrients, but also it is an excellent soil conditioner, improving physical characters of soil such as and aeration (**Maramba et al, 1978**). On the other hand, **Mohamed (1994)** found that preceding crops had no significant effect on number of tillers of wheat /m<sup>2</sup>.

**2-b- Effect of irrigation regimes:**

Irrigation of wheat plants at 50% loss in water holding capacity significantly increase in number of tillers /m<sup>2</sup> at 88 days after planting as compared with irrigation at 70 % loss in water holding capacity in both seasons (Table, 6).The increment in number of tillers /m<sup>2</sup> by irrigation at 50% loss in water holding capacity was 20 and 53 tillers /m<sup>2</sup> over the treatment of irrigation at 70% loss in water holding capacity in the first and second seasons, respectively. These findings are in accordance

with Cooper (1980), Salwau (1981), Jadhve and Jadhve (1982), Duwayri (1984), Rab *et al.* (1984), Rickert *et al.* (1987), Mohamed (1992), El-Kalla *et al.* (1994) and Sharaan *et al.* (2000).

#### **2-c- Effect of nitrogen levels:**

The data reported in Table (6) show that the mean values tillers number / m<sup>2</sup> was significantly increased by increasing levels of nitrogen fertilizer in both seasons. Application of nitrogen fertilizer at the rate of 120 kg N / feddan produced the maximum number of tillers /m<sup>2</sup> at 88 days from planting which equal 291 and 329 tillers /m<sup>2</sup> in the first and second seasons, respectively. Whereas no significant difference on number of tillers/m<sup>2</sup> were obtained between 60 and 120 kg N/fed in the second season. These slight difference may be due to the sufficient level of soil fertility in the second season. Also, this increase clearly indicated that prominent role of N on vegetative growth and tillering in wheat grown in sandy soil . Similar results were also reported by Gab-Alla *et al.* (1985), Abd El-Maaboud (1991), El-Salhy (1991), Adam (1992), Mohamed (1994), Abd El-Fatah, Nagwa (1995), Yakout *et al.* (1998) and Mohamed (1999).

#### **2-d- Interaction effects:**

The interaction between plant residues and water regimes was significant on number of tillers /m<sup>2</sup> at 88 days from planting in the two growing seasons shown in Table (6). The maximum tillers number /m<sup>2</sup> was 289 and 346 tillers /m<sup>2</sup> produced from application corn straw and irrigation at 50% loss in water of holding capacity in the first and second seasons,

respectively. On the other hand, no significant difference between corn straw and casuarina leaves of plant residues with irrigation at 50% soil moisture stress in number of tillers /m<sup>2</sup> in both seasons. However, the minimum one was 117 and 267 tillers /m<sup>2</sup> respectively, obtained without application of plant residues with irrigation at 70% soil moisture stress.

Results in Table (6) indicated that the interaction between irrigation regimes and N levels affected significantly number of tillers /m<sup>2</sup> in both seasons. The highest value of number of tillers /m<sup>2</sup> was 311 and 353 tillers /m<sup>2</sup>, obtained from irrigation at 50% soil moisture stress with application of 120 kg N/feddan in the first and second seasons, respectively. On the contrary, the lowest one was 182 and 235 tillers /m<sup>2</sup>, respectively, produced from irrigation at 70% reduction in water of holding capacity without application of nitrogen fertilizer.

The illustrated in Table (6) show that number of tillers /m<sup>2</sup> was significantly affected by the interaction between N level and plant residues in both seasons. Wheat plants cultivated in sandy soil with application of corn straw or casuarina leaves and applied 120 kg N/feddan gave the highest number of tillers /m<sup>2</sup> in both seasons. The increment in number of tillers /m<sup>2</sup> produced 183 and 142 tillers /m<sup>2</sup> in the first and second seasons, respectively for application of casuarina leaves with applied 120 kg N/feddan over the control treatment (without plant residues and N fertilizer).

The effect of the interaction between plant residues, irrigation regimes and N level was significant on number of tillers /m<sup>2</sup> in both seasons, (Table, 6). Data obtained indicate

that the highest number was 331 and 382 tillers /m<sup>2</sup> in the first and second seasons, respectively, produced from applied casuarina leaves with irrigation after 50% soil moisture stress and applied 120 kg N/feddan. Whereas the lowest number was (93 and 198 tillers /m<sup>2</sup> in the first and second seasons, respectively), resulted from treatment without application of plant residues and irrigated at 70% soil moisture stress with zero N fertilizer.

It could be concluded that application of plant residues under study to sandy soil and irrigation at 50% loss in water of holding capacity with application 120 kg N/feddan gave the best results in number of tillers /m<sup>2</sup>.

### **3- Flag leaf area:**

The results of the effects of plant residues, irrigation regimes, N level and their interactions on flag leaf area at 88 days from planting in 1997/98 and 1998/99 seasons are presented in Table (7).

#### **3-a- Effect of plant residues:**

Data presented in Table in Table (7) reveal that plant residues had a significant effect on flag leaf area in both seasons. The application of corn straw or casuarina leaves increased flag leaf area over untreated plants by 62% and 58%, respectively in the first season. The corresponding increases were 62.74% and 62.09%, respectively in the second season. No significant difference in flag leaf area was obtained between corn straw and casuarina leaves in both seasons. This result may be due to the increasing nitrogen content in the soil by application of plant residues i.e casuarina leaves and corn straw in the sandy soil.

Table (7) : Effect of plant residues, irrigation regimes, N-levels and their interactions on flag leaf area (cm<sup>2</sup>) at 88 DFP in 1997/1998 and 1998/1999 seasons.

Plant residues	N- Level KgN/fed	Flag leaf area (cm <sup>2</sup> ) at 88 DFP					
		1 <sup>st</sup> season		Mean	2 <sup>nd</sup> season		Mean
		Irrigation regimes			Irrigation regimes		
		W1	W2		W1	W2	
Without	0	2.1	1.7	1.9	2.4	1.6	2.0
	60	20.3	11.6	16.0	20.1	13.4	16.8
	120	33.6	20.6	27.1	31.2	23.1	27.2
	Mean	18.7	11.3	15.0	17.9	12.7	15.3
Corn straw	0	15.3	10.5	12.9	15.9	12.8	14.4
	60	34.6	21.2	27.9	34.3	22.3	28.3
	120	37.6	26.8	32.2	38.7	25.3	32.0
	Mean	29.2	19.5	24.3	29.6	20.2	24.9
Casuarina leaves	0	14.6	9.6	12.1	13.5	11.4	12.4
	60	34.5	21.0	27.8	33.2	23.5	28.4
	120	37.9	24.8	31.3	40.9	26.0	33.5
	Mean	29.0	18.4	23.7	29.2	20.3	24.8
IxN	0	10.7	7.3	9.0	10.6	8.6	9.6
	60	29.8	17.3	23.9	29.2	19.7	24.5
	120	36.3	24.1	30.2	36.9	24.8	30.9
	Mean	25.6	16.4		25.1	17.8	

L.S.D at 0.05

R	0.95	1.45
I	1.60	3.42
N	0.60	1.34
RXI	1.34	2.05
RXN	1.05	2.33
IxN	0.86	1.90
RXIXN	1.49	3.29

These results were almost in agreement with those obtained by **Russell (1973)**, **Maramba *et al* (1978)**, **Gogoi and Sandhu (1984)**, **Velayudham and Seth (1986)**, **Fan and Yu (1987)**, **Mohamed (1994)**, **Abd El-Moez (1995)** and **Dev and Bhardwaj (1995)**.

### **3-b- Effect of irrigation regimes:**

With regard to irrigation regimes, results obtained in Table (7) showed clearly that the flag leaf area was significantly affected by irrigation treatments in both seasons (Table, 7). The highest mean values of flag leaf area at 88 days from planting was 25.6 and 25.1 cm<sup>2</sup>, produced from irrigation of wheat plant at 50% loss in water holding capacity in the first and second seasons, respectively. Whereas the lowest area was 16.4 and 17.8 cm<sup>2</sup>, obtained from irrigation at 70% loss in water holding capacity in the first and second seasons, respectively. The increase in the amount of water increased the mean values of leaf area because of the role of water in relation to the photosynthesis activity and the net assimilation rates which increases the merestimatic activity and the leaf growth. This result was expected since all enlargement is correlated to turgor pressure which is reduced as water deficits occur. These results are in harmony with those reported by **Cooper (1980)**, **Duwayri (1984)**, **Rab *et al.* (1984)** and **Mohamed (1992)**.

### **3-c- Effect of nitrogen levels:**

Results in Table (7) indicated that flag leaf area of wheat plant at 88 days after planting was significantly affected by increasing N level up to 120 kg N/feddan in the two growing seasons. The application of 60 and 120 kg N/feddan increased

flag leaf area by 165.55% and 235.55% over the check treatment in the first growing season, respectively. The corresponding increases were 155.21 and 221.87% in the second season, respectively. In general, N encourage growth of flag leaf as an essential element which plays a prominent role in building new merestemic cells, cell elongation and increasing photosynthesis activity of wheat plants . These are in accordance with those obtained by **Abd El-Maaboud (1991), Adam (1992), Abo-Warda (1993), Mohamed (1994) and Abd El-Fatah, Nagwa (1995).**

### **3-d- Interaction effects :**

Data in Table (7) shows that the mean values of flag leaf area was significantly affected by the interaction between the two factors and the three factors under study in both seasons. Wheat plants cultivated in sandy soil with applicated corn straw with irrigated at 50% soil moisture stress increased flag leaf area by 158.41 and 133.07 % over untreated plants with plant residues and irrigated at 70% soil moisture stress in the first and second seasons, respectively. However no significant difference was obtained between application of corn straw and casuarina leaves with irrigation after 50% moisture stress in flag leaf area in both seasons.

With regard the effect of the interaction between irrigation regimes and N levels, results indicate clearly that the highest value of flag leaf area was 36.3 and 36.9 cm<sup>2</sup>, produced from irrigation at 50% loss in water holding capacity with applied 120 kg N/feddan in the first and second seasons, respectively. Whereas, the lowest value was 7.3 and 8.6 cm<sup>2</sup>,

obtained from irrigation at 70% reduction in water of holding capacity and without nitrogen fertilizer in the first and second seasons, respectively. It could be concluded that application of 120 kg N/fed to sandy soil was irrigated at 50 % soil moisture stress gave the best result in flag leaf area of wheat plants.

The effect of the interaction between plant residues and N levels were significant on flag area in both seasons (Table 7), wheat plants cultivated in sandy soil with applicated corn straw or casuarina leaves and applied 120 kg N/fed gave the maximum area of flag leaf in both seasons. Whereas, no significant difference was obtained between corn straw and casuarina leaves with applied 120 kg N/feddan on flag leaf area at 88 days after planting. These results may be due to plant residues plays as important role in plant nutrition not only as a carrier and source of nutrient, but also it is an excellent soil conditioner, improving physical characters of soil such as texture moisture holding capacity and aeration (**Maramba *et al.*, 1978**).

The data illustrated in Table (7) show that flag leaf area was significantly affected by the interaction between the three factors under study in both seasons. The increment in flag leaf area Produced were 37.9 and 40.9 cm<sup>2</sup> in the first and second seasons, respectively for applicated casuarina leaves and applied 120 kg N / feddan. with irrigated at 50 % soil moisture stress over without applied of plant residues and N fertilizer with irrigated at 70 % soil moisture stress . It could be concluded that application of plant residues to sandy soil and irrigated at 50 % soil moisture stress with applied 120 kg N/ feddan . gave the highest values of flag leaf area of wheat plant.

#### **4- Dry weight of tillers / m<sup>2</sup>:**

The results presented in Table (8) show the effects of plant residues, irrigation regimes and N levels as well as their interactions on dry weight of tillers / m<sup>2</sup> at 88 days from planting in 1997/ 98 and 1998/ 99 growing seasons.

##### **4-a- Effect of plant residues :**

The results indicated that in both seasons, the plant residues significantly increased in dry weight of tillers / m<sup>2</sup> as compared with to the control treatment. The superiority of corn straw and casoarina leaves in dry weight of tillers /m<sup>2</sup> over the control treatment reached 78.50 and 80.13 % in the first season, respectively, corresponding in 78.60 and 81.05% in the second season, respectively. It could be concluded that the application of plant residues to sandy soil gave the highest dry weight of wheat plant may be due to the increases in plant height , number of tillers / m<sup>2</sup> and flag leaf area by application of corn straw and casuarina leaves. These findings are in agreement with those reported by **Maramba *et al.* (1978)**, **Fan and Yu (1987)**, **Abd El-Moez (1995)**, **Dev and Bhardwaj (1995)**, **Abd El-Sabour *et al.* (1997)**, and **Matwally *et al.* (1998)**.

##### **4-b- Effect of irrigation regimes:**

Concerning the effect of water regimes on dry weight of tillers/m<sup>2</sup> dry weight data in Table (8), it was obvious that decreasing the content of soil moisture before irrigation caused a significant decreasing dry weight of tillers / m<sup>2</sup> in both seasons. The highest dry weight of was obtained from irrigation at 50% loss in water holding capacity due to the increases in plant height, number of tillers / m<sup>2</sup> and flag leave area.

Table (8): Effect of plant residues, irrigation regimes, N-levels and their interactions on dry weight of tillers ( $\text{g/m}^2$ ) at 88 DFP in 1997/1998 and 1998/1999 seasons.

Plant residues	N- Level KgN/fed	Dry weight of tillers ( $\text{g/m}^2$ ) at 88 DFP					
		1 <sup>st</sup> season		Mean	2 <sup>nd</sup> season		Mean
		Irrigation regimes			Irrigation regimes		
		W1	W2		W1	W2	
Without	0	129	90	110	120	84	102
	60	396	292	344	362	277	320
	120	512	420	466	480	391	435
Mean		346	267	307	320	251	285
Corn straw	0	447	352	399	415	326	371
	60	625	490	557	580	455	517
	120	815	560	687	761	520	640
Mean		629	467	548	585	434	509
Casuarina leaves	0	374	343	359	340	320	334
	60	725	493	609	677	462	570
	120	813	571	692	757	431	644
Mean		637	469	553	594	437	516
IxN	0	317	262	289	294	243	269
	60	582	425	503	540	398	469
	120	713	517	615	666	480	573
Mean		537	401		500	374	

L.S.D at 0.05

R	22.79	23.36
I	52.12	37.33
N	21.18	18.45
RXI	32.23	33.04
RXN	36.68	31.95
IxN	29.95	26.09
RXIXN	51.88	45.18

These results are due to water stress decreased the activity of meristematic tissues responsible for elongation of plant. These results are in harmony with those obtained by **Cooper (1980)**, **Salwau (1981)**, **Duwayri (1984)**, **El- Kalla *et al* (1994)** and **Sharaan *et al* (2000)**.

#### **4-c- Effect of nitrogen levels:**

It was clear from Table (8) that dry weight of tillers / m<sup>2</sup> was significantly increased by increasing level of nitrogen fertilizer in the two growing seasons. The application of 60 and 120 kg N / feddan increased dry weight of tillers / m<sup>2</sup> by 112.80 and 113.01% over the check treatment in the first season, respectively. The corresponding increases were 74.35 and 113.01% in the second season, respectively. In general, N encouraged growth of plant height, flage leaf area and number of tillers / m<sup>2</sup> as an essential element in sandy soil which plays a prominent role in building new merestimatic cells, cell elongation and increasing photosynthesis activity of wheat plants. Results reported by **Abd El-Latif and El-Tuhamy (1986)**, **Adam (1992)**, **Abo-Warda (1993)**, **Mohamed (1994)**, **Abd El-Fatah, Nagwa (1995)**, **Yakout *et al.* (1998)**, **Mohamed (1999)** who showed that application of nitrogen levels up to 120 kg N/ feddan caused a significant increase on plant height, number of tillers / m<sup>2</sup>, flag leaf area and dry weight of tillers/ m<sup>2</sup>.

#### **4-d- Interaction effects :**

The interaction effects between plant residues and irrigation regimes, plant residues and N levels, irrigation regimes and N levels or among the three experimental factors were

significant on dry weight of tillers /m<sup>2</sup> in the two growing seasons as shown in Table (8).

Wheat plants cultivated in sandy soil with applied casuarina leaves and irrigated at 50% loss in water holding capacity gave the maximum dry weight of tillers / m<sup>2</sup> at 88 days from planting which equal 637 and 594 gm in the first and second seasons, respectively. On the other hand, the lowest one was 267 and 251 gm, produced from without applied of plant residues with irrigated at 70% loss in water holding capacity in the first and second seasons, respectively.

The data illustrated in Table (8) show the increment in dry weight of tillers / m<sup>2</sup> produced were 451 and 423 gm in the first and second seasons, respectively for irrigation at 50% loss in water holding capacity with applied 120 kg N / feddan over the interaction between irrigated at 70% soil moisture stress without applied of nitrogen fertilizer.

The results indicated that in both seasons the greatest dry weight of tillers / m<sup>2</sup> was 692 and 644 gm in the first and second seasons, respectively, produced from applied of 120 kg N / feddan and applied of casuarina leaves in sandy soil. Whereas the lowest one was obtained from without applied of plant residues and nitrogen fertilizer in both seasons. These results may be due to organic and nitrogen fertilizer plays important role in plant nutrition not only as a carrier and source of nutrients, but also it is an excellent soil conditioner, improving physical characters of soil (Maramba *et al.*, 1978).

The mean values of dry weight of tillers / m<sup>2</sup> was significantly affected by the interaction between the three factors

under study in both seasons. The application of plant residues to sandy soil and irrigated at 50 % soil moisture stress with applied 120 kg N / feddan gave the maximum dry weight of tillers / m<sup>2</sup> in the two growing seasons .

## **II- Yield and yield components**

### **1- Number of spikes /m<sup>2</sup> :**

The mean values of spikes number /m<sup>2</sup> as affected by plant residues, irrigation regimes and N levels as well as their interactions are presented in Table (9) .

#### **1-a- Effect of plant residues :**

The data illustrated in Table (9) show that number of spikes /m<sup>2</sup> was significantly increased under plant residues as compared with the control treatment in the both seasons. The highest means of spikes number/m<sup>2</sup> was 262 and 318, produced from application of casuarina leaves in the first and second seasons, respectively. On the contrary, untreated plants of wheat gave the lowest number of spikes / m<sup>2</sup> 185 and 240 in the first and second seasons, respectively. **Vyn and Sutton (1991)** found that wheat followed by wheat plant produced lowered population and spike number to wheat following another crop (soybean / wheat / wheat, maize / barley / wheat, maize / soybean / wheat and Medicago sativa / Medicago sativa / wheat). Also, **Smallfield (1992)** reported that fertile ear number of wheat was consistently reduced by retention of residues. On the other hand, **Mohamed (1994)** found that preceding crops had no significant effect on number of spikes / m<sup>2</sup> . Whereas **Metwally et al. (1998)** indicated that number of spikes / m<sup>2</sup> was markedly affected by

Table ( 9 ) : Effect of plant residues, irrigation regimes, N-levels and their interactions on number of wheat spikes/m<sup>2</sup> in 1997/1998 and 1998/1999 seasons.

Plant residues	N- Level KgN/fed	Number of wheat spikes/m <sup>2</sup>					
		1 <sup>st</sup> season		Mean	2 <sup>nd</sup> season		Mean
		Irrigation regimes			Irrigation regimes		
		W1	W2		W1	W2	
Without	0	137	94	116	200	126	163
	60	203	203	203	280	240	260
	120	252	225	238	305	291	298
Mean		197	174	185	261	219	240
Corn straw	0	245	215	230	280	248	264
	60	256	245	250	321	292	307
	120	283	254	268	362	306	334
Mean		261	238	249	321	282	301
Casuarina leaves	0	230	212	220	296	262	279
	60	273	267	270	367	300	333
	120	306	288	297	374	310	342
Mean		269	255	262	346	291	318
IxN	0	204	173	189	259	212	235
	60	244	238	241	322	277	300
	120	280	255	268	347	302	324
Mean		242	222		309	264	

L.S.D at 0.05

R	11.07	2.27
I	13.56	13.88
N	9.15	6.53
RXI	15.65	3.22
RXN	15.86	11.31
IxN	12.95	9.23
RXIXN	22.43	15.99

preceding summer crops and the highest values was grown after soybean. It could be concluded that application of plant residues on sandy soil were more effective on increasing spikes number / m<sup>2</sup> than with untreated treatment.

#### **1-b- Effect of irrigation regimes:**

Concerning to irrigation regimes, results indicated that number of spikes / m<sup>2</sup> was significantly affected by levels of irrigation in both seasons as shown in Table (9). The increment in number of spikes /m<sup>2</sup> by irrigation at 50% loss in water holding capacity was 20 and 45 spikes/m<sup>2</sup> over the treatment of irrigation at 70% loss in water holding capacity on 1997/98 and 1998 /99 seasons, respectively. These results are due to water stress decreased the activity of meristematic tissues responsible for increasing tillers number per plant. The same trend was obtained by **Cooper (1980), Salwau (1981), Jadhve and Jadhve (1982) , Rickert et al. (1987), Mohamed (1992), El-Kalla et al. (1994), and Sharaan et al (2000).**

#### **1-c- Effect of nitrogen levels:**

Nitrogen level significantly affected number of spikes/m<sup>2</sup> in the two growing seasons and the greatest value of spikes number /m<sup>2</sup> was recorded at the highest N level. Raising N level from zero to 120 kg N /fed. in sandy soil increased number of spikes/m<sup>2</sup> by 41.80 and 37.90% in the first and second seasons, respectively. It could be concluded that N encouraged tillering in wheat which was statistically evident in both seasons. Many investigators reported that the increase in N level markedly increased number of spikes /m<sup>2</sup> of wheat (**Hussein et al 1984; Yousef et al., 1984; Gab-Alla et al., 1985; Abdel-latif and El-**

Tuhamy, 1986; Abd el-Maaboud, 1991; El-Salhy, 1991; Fayed, 1992; Abo-Warda, 1993; Abd El-Ghani *et al.*, 1994; Mohamed, 1994; Abd El-Fatah, Nagwa, 1995; Metwally *et al.*, 1998; Yakout *et al.*, 1998; Mohamed, 1999 and El-Sawi, 2001).

#### **1-d- Interaction effects :**

The results in Table (9) show that irrigation regimes and plant residues significantly affected number of spikes  $m^2$  in both seasons. The greatest number of spikes  $/m^2$  was produced from irrigation at 50% loss in water holding capacity with application casuarina leaves in the sandy soil which recorded to 269 and 346 spikes  $/m^2$  in the first and second seasons, respectively. Whereas, the lowest one was 174 and 219 spikes  $/m^2$ , produced from untreated of plant residues with irrigation at 70% reduction in water of holding capacity.

The effect of interaction between irrigation regimes and N level were highly significant on number of spikes  $/m^2$  in both seasons (Table 9). The highest number of spikes  $/m^2$  was 280 and 347 in the first and second seasons, respectively, recorded by combining irrigation at 50% soil moisture stress with application of 120 kg N/feddan. On the contrary, the lowest one was 173 and 212 spikes  $/m^2$ , produced from irrigation at 70% loss in water holding capacity without nitrogen fertilizer in the first and second seasons, respectively.

There was a significant difference of the spikes number  $/m^2$  in both seasons due to the interaction between N level and plant residues as shown in Table (9). It was clear that the maximum number of spikes  $/m^2$  was 297 and 342, obtained from

adding 120 kg N/fed with application of casuarina leaves in the first and second seasons, respectively. It could be concluded that application of plant residues was more efficiency with increasing N level on number of spikes /m<sup>2</sup>.

Results presented in Table (9) show that the interaction effect between the three factors had significant effect on number of spikes /m<sup>2</sup> in both seasons. The interaction between application of casuarina leaves with 120 kg N /fed and irrigation at 50% loss in water of holding capacity gave the highest number of spikes /m<sup>2</sup> (306 and 374 spikes/m<sup>2</sup>) in the first and second seasons, respectively. Whereas, no significant difference was obtained on number of spikes /m<sup>2</sup> from the interaction between corn straw and casuarina leaves with applied 120 kg N /fed + irrigation at 50% reduction in water of holding capacity in the second season only.

It may be concluded that under sandy soil, the application of plant residues with 120 kg N /fed. and irrigation after 50% loss in water holding capacity gave the best result in number of spikes /m<sup>2</sup>.

## **2- Spike weight :**

Resulted in Table (10) show the mean values of spike weight as affected by plant residues, irrigation regimes and N levels as their well as interaction effects in 1997 /98 and 1998 / 99 growing seasons.

Table ( 10 ) : Effect of plant residues, irrigation regimes, N-levels and their interactions on spike weight (g) in 1997/1998 and 1998/1999 seasons.

Plant residues	N- Level KgN/fed	Spike weight (g)					
		1 <sup>st</sup> season		Mean	2 <sup>nd</sup> season		Mean
		Irrigation regimes			Irrigation regimes		
		W1	W2	W1	W2		
Without	0	0.29	0.23	0.29	0.35	0.29	0.32
	60	1.69	1.64	1.66	2.31	1.48	1.89
	120	2.15	1.71	1.93	2.75	1.49	2.12
Mean		1.40	1.19	1.29	1.80	1.09	1.44
Corn straw	0	1.35	0.63	0.99	1.42	0.84	1.13
	60	2.53	1.72	2.03	2.72	1.46	2.09
	120	2.40	1.86	2.13	2.97	1.77	2.39
Mean		2.03	1.40	1.72	2.38	1.36	1.87
Casuarina leaves	0	1.16	0.61	0.88	1.39	0.82	1.10
	60	2.23	1.59	1.91	2.67	1.35	2.01
	120	2.58	1.91	2.24	3.16	1.76	2.46
Mean		1.99	1.37	1.68	2.40	1.31	1.86
IxN	0	0.95	0.49	0.72	1.05	0.65	0.85
	60	2.09	1.65	1.87	2.56	1.43	2.00
	120	2.37	1.82	2.10	2.97	1.67	2.32
Mean		1.80	1.32		2.19	1.25	

L.S.D at 0.05

R	0.42	0.08
I	0.74	0.03
N	0.48	0.05
RXI	0.59	0.11
RXN	0.08	0.09
IxN	0.06	0.08
RXIXN	0.11	0.14

**2-a- Effect of plant residues:**

Table (10) indicates that the difference between plant residues treatments on the mean values of spike weight was significant in both seasons. Soil treated with corn straw gave the maximum weight of spike which equal 1.72 and 1.87 gm, in the first and second seasons, respectively. Whereas no significant difference was obtained between application of casuarina leaves and corn straw to sandy soil on spike weight in both seasons. The application of corn straw and casuarina leaves increased spike weight over untreated plants by 33.3 and 30.2%, respectively in the first season. The corresponding increases were 29.86 and 29.17%, respectively in the second season. This result may be due to the increase in number of grains /spike and 1000-grain weight by application of plant residues to sandy soil. Similar results were obtained by **Mohamed (1994) and Metwally *et al* (1998)**.

**2-b- Effect of irrigation regimes:**

The effect of irrigation regimes on spike weight was significant in both seasons (Table 10). The maximum weight of spike was 1.80 and 2.19 gm, produced from irrigation of wheat plants at 50% loss in water holding capacity in the first and second seasons, respectively. While the minimum one was 1.32 and 1.25 gm, obtained from irrigation at 70% loss in water holding capacity in the first and second seasons, respectively. This is to be expected since water plays an important role in plants moisture deficit can have a deleterious effect on most physiological process. Similer trend was reported by **Gill and Singh (1980), Salwau (1981) and Sharaan *et al.* (2000)** pointed out that water stress caused a reduction in spike weight of wheat.

**2-c- Effect of nitrogen levels:**

The obtained results in Table (10) obviously clear that the mean values of spike weight was significantly increased by increasing levels of nitrogen fertilizer in both seasons. In the first growing season, the application of 60 and 120 kg N/fed. increased spike weight by 191.67 and 159.72%, respectively compared with the control treatment. In the second season, the same two level caused an increase of 172.94 and 135.29%, in spike weight, respectively as compared to the control treatment. The present result is a quite clear manifestation for prominent role of spike weight in sandy soil. The increase in spike weight due to N application is an indication for the role of N in plant growth, development and production. These results are in harmony with those obtained by Hefni (1982), Hussein *et al.* (1984), Yousef *et al.* (1984), Gab-Alla *et al.* (1985), Gheith *et al.* (1989), Abd El-Maaboud (1991), El-Salhy (1991), Fayed (1992), Mohamed (1994), Salwau (1994), and El-Sawi (2001).

**2-d- Interaction effects :**

The results in Table (10) showed that the interaction between plant residues and irrigation regimes significantly affected spike weight in both seasons. The greatest spike weight was 2.03 and 2.38 gm , produced from wheat plants cultivated in sandy soil with applied corn straw with irrigation at 50% soil moisture stress in the first and second seasons, respectively. Whereas no significant difference was obtained between application of corn straw and casuarina leaves with irrigation at 50% soil moisture stress in spike weight in both seasons. It could be concluded that application of plant residues to sandy soil with

irrigation at 50% reduction in water of holding capacity gave the maximum weight of spike.

The data illustrated in Table (10) show that spike weight was significantly affected by the interaction between irrigation regimes and N level in both seasons. The increment in spike weight produced were 1.88 and 2.32 gm in the first and second seasons, respectively for applied 120 kg N /fed with irrigation at 50% soil moisture stress over without nitrogen fertilizer with irrigation at 70% reduction in water of holding capacity.

The interaction between N level and plant residues gave a significant effect on the mean values of spike weight in both seasons (Table 12). The maximum weight of spike was 2.24 and 2.46 gm, produced from application of casuarina leaves with 120 kg N /fed in the first and second seasons, respectively. This result indicates that wheat plants cultivated in sandy soil response to plant residues with increasing level of nitrogen fertilizer.

There was a significant difference between the mean values of spike weight due to the interaction between plant residues, irrigation regimes and N level in the two growing seasons as shown in Table (10). The maximum spike weight resulted from growing wheat plants in sandy soil with applied plant residues and irrigation at 50% reduction in water holding capacity and applied 120 kg N /fed. in both seasons.

It could be concluded that under sandy soil, the application of plant residues with 120 kg N /fed. and irrigation at 50% soil moisture stress gave the best result in spike weight of wheat.

### **3- Number of grains / spike :**

The effect of plant residues, irrigation regimes and N levels as well as their interaction effects on the mean values of grains number / spike in the two growing seasons as shown in Table (11).

#### **3-a- Effect of plant residues :**

The results in Table (11) showed that application of corn straw and casuarina leaves residues significantly increased the number of grain / spike over the untreated wheat plants by 52.94 and 64.70%, respectively in the first season. While the corresponding increase were 40.9 and 40.9% respectively in the second season. It was clear that, in significant difference was obtained between application of corn straw and casuarina leaves in the mean values of grains number / spike in the second season. The increase in number of grains / spike is naturally due to an increase in the number of fertile flowers per spike . This result may be due to the rise of organic matter in soil improved the soil structure and nutrient supply to plants (**Russell, 1973**). Similar results were obtained by **Mohamed (1994)** and **Metwally *et al.* (1998)** who indicated that number of grains / spike was markedly affected by preceding summer crops .

#### **3-b- Effect of irrigation regimes:**

Regarding to irrigation regimes, the obtained results indicated that number of grains /spike was significantly affected by the two levels of irrigation in the two growing seasons as shown in Table (11). Irrigation of wheat plants at 50% loss in water holding capacity gave the highest number of grains / spike which equal to 29 and 35 grain in the first and second seasons,

**Table (11) : Effect of plant residues, irrigation regimes, N-levels and their interactions on number of grains / spike in 1997/1998 and 1998/1999 seasons.**

Plant residues	N- Level KgN/fed	Number of grains / spike					
		1 <sup>st</sup> season		Mean	2 <sup>nd</sup> season		Mean
		Irrigation regimes			Irrigation regimes		
		W1	W2		W1	W2	
<b>Without</b>	0	6	3	4	6	4	5
	60	23	16	19	33	12	24
	120	36	22	29	46	28	37
	<b>Mean</b>			17	28	15	22
<b>Corn straw</b>	0	16	10	13	21	12	16
	60	39	23	31	46	28	37
	120	42	28	35	50	32	41
	<b>Mean</b>			26	39	24	31
<b>Casuarina leaves</b>	0	17	11	14	17	14	15
	60	40	26	33	45	28	36
	120	43	30	36	50	31	41
	<b>Mean</b>			28	37	24	31
<b>IxN</b>	0	13	8	10	14	10	12
	60	34	21	27	41	23	32
	120	40	27	33	48	31	39
	<b>Mean</b>				35	21	

**L.S.D at 0.05**

R	0.99	1.37
I	1.81	1.24
N	1.36	0.94
RXI	1.40	1.94
RXN	2.36	1.62
IxN	1.93	1.33
RXIXN	3.35	2.30

respectively. Whereas, the minimum one was 18 and 21 grain / spike, produced from irrigation at 70% loss in water holding capacity in the first and second seasons, respectively. The increase in number of grains / spike is naturally due to the increase in fertility of flowers per spike. The reduction in number of grains / spike by increasing water stress probably resulted from the complete development of some grains of the spike because of lack of water . These results are in harmony with those obtained by **Gill and Singh (1980)**, **Salwau (1981)**, **Rickert *et al.* (1987)**, **Talukder (1987)**, **El- Kalla *et al.* (1994)**, **Sadek *et al* (1997)** and **Sharaan *et al* (2000)**.

### **3-c- Effect of nitrogen levels:**

It was clear of Table (11) that number of grains / spike was significantly increased by increasing N- level up to 120 kg N /fed in both seasons. The application of 60 and 120 kg N/feddan increased number of grains / spike by 17 and 23 grains, respectively over the control treatment in the first season, by 22 and 27 grains, respectively, in the second season. The favorable effect of nitrogen on the number of grains / spike may be due to its effect on photosynthesis and the other essential metabolic activities which affect the plant growth and development. These results are in line with those obtained by **Hussein *et al.* (1984)**, **Yousef *et al.* (1984)**, **Abd El-Latif and El-Tuhamy (1986)**, **Abo-Warda (1993)**, **Abdel-Ghani *et al.* (1994)**, **Salwau (1994)**, **Metwally *et al.* (1998)**, **Yakout *et al.* (1998)**, **Mohamed (1999)** and **El-Sawi (2001)**.

**3-d- Interaction effects :**

The results in Table (11) show that the interaction between irrigation regimes and plant residues significantly affected number of grains / spike in the two growing seasons. The greatest number of grains / spike was produced from irrigation at 50% loss in water holding capacity with application of plant residues i.e. casuarina leaves and corn straw in the first and second seasons, respectively. While the lowest one was 13 and 15 grains / spike, obtained from irrigation at 70% reduction in water of holding capacity with untreated of plant residues in the first and second seasons, respectively. It could be concluded that irrigation at 50% soil moisture stress with application of plant residues i.e. casuarina leaves or corn straw gave the best result in number of grains / spike.

There was a significant difference in number of grains / spike due to the interaction between irrigation regimes and N-level in both seasons as shown in Table (11). Irrigation of wheat plants at 50% soil moisture stress with 120 kg N /fed. produced the highest number of grains / feddan (40 and 48 grains) in the first and second seasons, respectively. Whereas, the lowest one was 8 and 10 grains / spike, produced from irrigation at 70% reduction in water of holding capacity without nitrogen application in the first and second seasons, respectively

Results in Table (11) showed that the interaction between N level and plant residues significantly affected number of grains / spike in both seasons. The increment in number of grains / spike produced were 32 and 36 grains in the first and second seasons, respectively for applied casuarina leaves with 120kg N/

feddan over the control treatment (without application of plant residues and N-level). On the other hand, no significant difference was obtained between the interaction of corn straw and casuarina leaves with applied 120 kg N /feddan in number of grains / spike in both seasons.

The effect of the interaction between the three factors were significant on number of grains / spike in both seasons (Table 11). The application of plant residues i.e corn straw or casuarina leaves to sandy soil and irrigated at 50% soil moisture stress with applied 120 kg N/ feddan gave the greatest number of grains / spike which equal to 43 and 50 grains in the first and second seasons, respectively. Whereas the lowest number was 3 and 4 grains, produced from without application of plant residues and nitrogen fertilizer with irrigation at 70% soil moisture stress in the first and second seasons, respectively.

It could be concluded that application of plant residues and 120 kg N /feddan with irrigation at 50% loss in water of holding capacity gave the best results in number of grains / spike.

#### **4- 1000-grain weight :**

The results presented in Table (12) show the effects of plant residues, irrigation, regimes, N-levels and their interactions on 1000-grain weight in 1997 / 98 seasons.

##### **4-a- Effect of plant residues:**

The results indicate that plant residues had a significant effect on the mean values of 1000-grain weight in both seasons. The application of corn straw increased 1000-grain weight over

**Table (12) : Effect of plant residues, irrigation regimes, N-levels and their interactions on 1000-grain weight (g) in 1997/1998 and 1998/1999 seasons.**

Plant residues	N- Level KgN/fed	1000 - grain weight (g)					
		1 <sup>st</sup> season		Mean	2 <sup>nd</sup> season		Mean
		Irrigation regimes			Irrigation regimes		
		W1	W2		W1	W2	
Without	0	34.4	32.5	33.4	40.1	39.9	40.0
	60	34.8	32.6	33.7	38.6	37.9	38.2
	120	39.9	36.3	38.1	42.3	38.6	40.4
<b>Mean</b>		36.3	33.8	35.0	40.3	38.8	39.5
Corn straw	0	35.9	33.8	34.8	39.2	34.3	36.7
	60	43.1	36.5	39.8	46.2	38.3	42.2
	120	44.0	38.6	41.3	49.3	40.8	44.7
<b>Mean</b>		41.0	36.3	38.6	44.9	37.6	41.2
Casuarina leaves	0	36.2	30.3	33.2	35.1	35.2	35.1
	60	42.1	35.2	38.6	45.6	38.1	41.8
	120	44.9	36.6	40.7	48.2	10.4	44.1
<b>Mean</b>		41.0	34.0	37.5	42.9	37.8	40.3
IxN	0	35.5	32.2	33.8	38.1	36.4	37.3
	60	40.0	34.7	37.3	43.4	38.1	40.7
	120	42.9	37.1	40.0	46.6	39.6	43.1
<b>Mean</b>		39.4	34.7		42.7	38.0	

**L.S.D at 0.05**

R	1.56	0.84
I	1.94	1.16
N	1.43	1.20
RXI	2.21	1.19
RXN	2.48	2.08
IxN	2.02	1.70
RXIXN	3.51	2.94

untreated plants 3.6 and 1.7 gm, in the first and second seasons, respectively. Whereas, no significant difference was obtained between application of corn straw and casuarina leaves in sandy soil on the mean values of thousand grain weight in the first season . It could be concluded that corn straw or casuarina leaves are the best of plant residues for producing heavy grains. There results may be due to organic fertilizer plays an important role in plant nutrition not only as a carrier and source of nutrients, but also it is an excellent soil conditioner improving physical characters of soil such as texture moisture holding capacity and aeration (**Maramba *et al.* (1978)**). Similar results were obtained by **Mohamed (1994)** and **Metwally *et al.* (1998)** found that 1000-grain weight was markedly by preceding summer crops.

#### **4-b- Effect of irrigation regimes:**

Results in Table (12) observed that 1000-grain weight was significantly affected by levels of irrigation in both seasons. The increment in 1000-grain weight by irrigation at 50% loss in water holding capacity was 4.7 and 4.7 gm over the treatment when irrigation at 70% loss in water holding capacity in the first and second seasons, respectively. This was expected since drought stress during grain filling may be affected greatly on the amount of photosynthesis in the grains. This result was in harmony with those obtained by **Farahat (1978)**, **Gill and Singh (1980)**, **Salwau (1981)**, **Rickert *et al.* (1987)**, **Mohamed (1992)** and **El-Kalla *et al.* (1994)**.

#### **4-c- Effect of nitrogen levels:**

Concerning to N-level, the mean values of 1000-grain weight was significantly increased by increasing N-levels up to

120 kg / feddan in both seasons as shown in Table (12). The application of 60 and 120 kg N/feddan increased 1000-grain weight by 10.35 and 18.34% over untreated plants of nitrogen fertilizer in the first season. The corresponding increases were 9.11 and 15.55% in the second season, respectively. Nitrogen application level showed a similar effect as that obtained on grain weight / spike. These results are in line with those obtained by Yousef *et al.* (1984), Gab-Alla *et al.* (1985), Abdel-Latif and El-Tuhamy (1986), Fayed(1992), Abo-Warda (1993), Mohamed (1994), Metwally *et al.* (1998), Yakout *et al.* (1998) and Mohamed (1999).

#### **4-d- Interaction effects :**

Data in Table (12) shows that the mean values of 1000-grain weight was significantly affected by the interaction between plant residues and irrigation regimes. Wheat plants cultivated in sandy soil with applicated corn straw and irrigated at 50% soil moisture stress increased 1000-grain weight produced the maximum weight of 1000-grain (41 and 44.9) gm in the first and second seasons, respectively). However no significant difference was obtained between application of corn straw and casuarina leaves with irrigation at 50% soil moisture stress in 1000-grain weight . Also irrigation at 70% soil moisture stress with application of plant residues gave the lower values of 1000-grain weight in the second season. It could be concluded that application of plant residues was not efficiency with increasing soil moisture stress in sandy soil.

There was a significant difference of 1000-grain weight due to the interaction between irrigation regimes and N levels in

both seasons (Table 12). The highest value of 1000-grain weight was 42.9 and 46.6 gm, obtained from application of 120 kg N / feddan with irrigated at 50 % loss in water of holding capacity in the first and second seasons, respectively. While, the lowest one was 32.2 and 36.4 gm , produced from irrigation at 70 % soil moisture stress without application of nitrogen fertilizer in the first and second seasons, respectively. It could be concluded that application of 120 kg N / feddan with increasing available soil moisture gave the best treatment in 1000 – grain weight.

The effect of the interaction between N- level and plant residues were highly significant on 1000-grain weight in both seasons (Table 12). It was clear that the maximum 1000- grain weight was 41.3 and 44.7 gm, produced from adding 120 kg N / feddan with application of corn straw in the first and second seasons, respectively. Whereas, the minimum one was 33.2 and 35.1 gm, respectively, obtained from applied casuarina leaves without nitrogen fertilizer. It could be concluded that application of corn straw was more efficiency with increasing N level on 1000-grain weight.

The results in Table (12) showed that 1000-grain weight was significantly affected by the interaction between plant residues irrigation regimes and N-level in both seasons. In the first season, the highest weight of 1000-grain was 44.9 gm, produced from appreciated casourine leaves with irrigated at 50 % soil moisture stress and applied 120 kg N - / feddan, whereas the lowest one was 32.5 gm, obtained from irrigated at 70 % soil moisture stress without application of plant residues and nitrogen fertilizer. On the contrary, the maximum weight of thousand

grain was 49.3 gm, produced from applied corn straw and 120 kg N / feddan with irrigated at 50 % soil moisture stress, while the minimum one was 34.3 gm, obtained from application of corn straw without nitrogen fertilizer and irrigation at 70 % soil moisture stress.

It could be concluded that application of plant residues to sandy soil with increasing N levels up to 120 kg N /feddan and irrigation at 50 % soil moisture stress gave the best result in 1000- grain weight.

### **5- Grain yield ( kg / feddan):**

The average values of grain yield / feddan as affected by plant residues, irrigation regimes, N- levels and their interactions in the two growing seasons (1997/ 98 and 1998/ 99 seasons) are presented in Table (13) and Fig. (5 and 6).

#### **5-a- Effect of plant residues :**

Wheat grain yield / feddan significantly increased as a result of plant residues were incorporated to sandy soil in both seasons (Table 13 and Fig. 5 and 6). The application of corn straw and casuarina leaves in sandy soil increased the grain yield/ feddan over the untreated wheat plants by 71.06 and 72.70 %, respectively in the first season, while the corresponding increase were 58.74 and 59.37 %, respectively in the second season. Whereas no significant difference in grain yield / feddan was obtained between application of corn straw and casuarina leaves in the mean values of grain yield / feddan in both seasons. Grain yield was affected by other characters of yield components such as number of spikes/m<sup>2</sup>, spike weight, number of grains/spike and 1000-grain weight which increased by using application of plant

Table (13): Effect of plant residues, irrigation regimes, N-levels and their interactions on grain yield (Kg/feddan) in 1997/1998 and 1998/1999 seasons.

Plant residues	N- Level KgN/fed	Grain yield (Kg/feddan)					
		1 <sup>st</sup> season		Mean	2 <sup>nd</sup> season		Mean
		Irrigation regimes			Irrigation regimes		
		W1	W2	W1	W2		
Without	0	135	87	111	189	113	151
	60	969	563	766	1260	994	1102
	120	1824	799	1312	2060	1138	1599
	Mean	976	483	729	1169	732	950
Corn straw	0	775	595	685	1010	563	786
	60	1951	957	1454	2251	1152	1701
	120	2118	1084	1601	2653	1420	2036
	Mean	1615	879	1247	1971	1045	1508
Casuarina leaves	0	778	557	667	1112	572	842
	60	2029	977	1503	2351	1081	1716
	120	2137	1075	1606	2514	1455	1984
	Mean	1648	870	1259	1992	1036	1514
IxN	0	563	413	488	770	416	593
	60	1650	832	1241	1954	1059	1506
	120	2026	986	1506	2409	1338	1873
	Mean	1413	744		1711	937	

**L.S.D at 0.05**

R	32.55	28.09
I	33.56	13.39
N	50.54	22.6
RXI	46.04	39.72
RXN	87.54	39.05
IxN	71.48	32.05
RXIXN	123.8	55.51

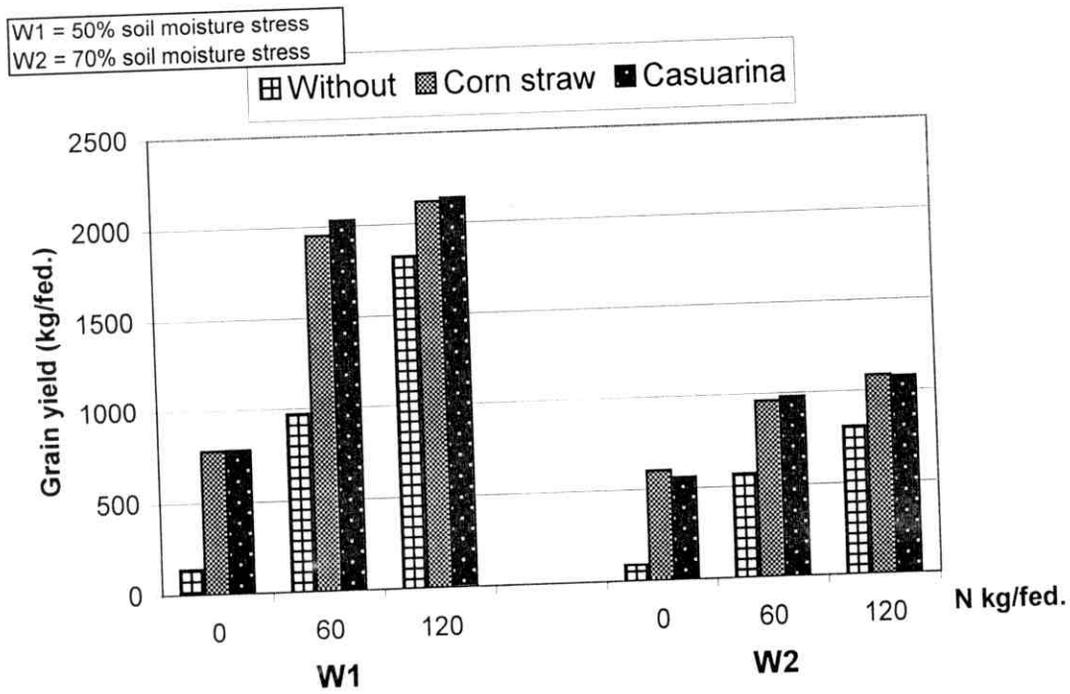


Fig (5): Grain yield of wheat (kg/feddan) during 1997/1998, growing season.

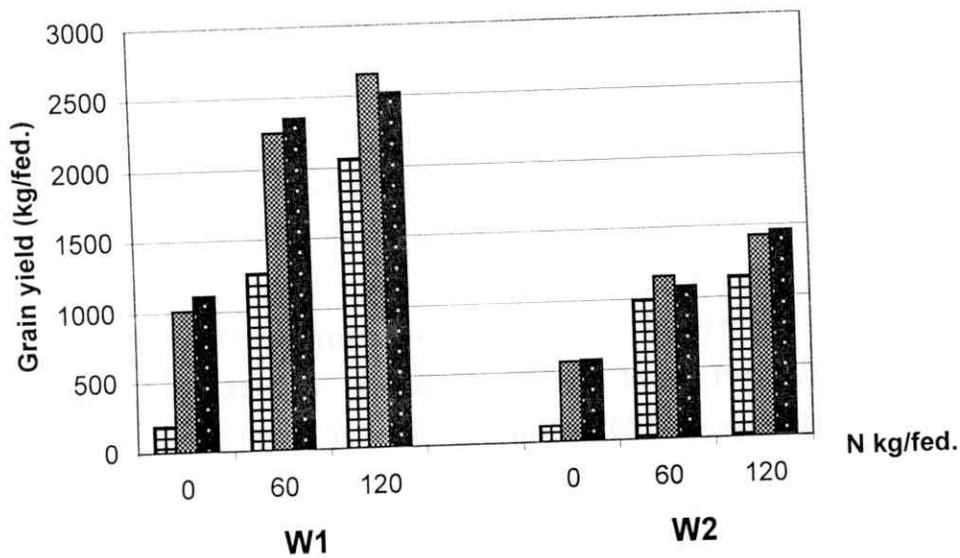


Fig (6): Grain yield of wheat (kg/feddan) during 1998/1999, growing season.

residues, These results are in accordance with those obtained by **Badr (1971)**, **Gogoi and Sandhu (1984)**, **Sidhu and Beri (1989)**, **Vyn and Sutton (1991)**, **Gomaa (1991)**, **Mohamed (1994)**, **Abd El-Magid *et al.* (1995)** and **Metwally *et al.* (1998)**.

#### **5-b- Effect of irrigation regimes:**

With regard to irrigation regimes, the results showed that the grain yield / feddan was significantly affected by irrigation regimes in both seasons (Table 13) and (Fig. 5 and 6). It was observed that irrigation of wheat plant at 50 % loss in water holding capacity significantly surpassed the irrigation at 70 % soil moisture stress in grain yield / feddan by 89.91 and 82.60% in the first and second seasons, respectively. This is to be expected since the mean values of spikes / number, spike weight, number of grains / spike and 1000-grain weight decreased by increasing soil moisture depletion up to 70%. Moreover, drought stress might reduce translocation of assimilates from leaves and as drought hasten maturation, this response in addition to reduced photosynthesis in the grains itself contribute to lower grain yield. Water shortage causes stimulate closure and this in turn prevents CO<sub>2</sub> diffusion into the air inside the tissue of the plants and consequently the photosynthetic efficiency become low (**Vasic and Videnovic, 1980**). These results are in harmony with those obtained by **Misra and Pant (1981)**, **Duwayri (1984)**, **Rickert *et al.* (1987)**, **Talukder (1987)**, **Sud *et al.* (1990)**, **Mohamed (1992)**, **Eid and Yousef (1994)**, **El-Kalla *et al.* (1994)**, **Abo Shetaia and Abd El-Gawad (1995)** and **Sharaan *et al.* (2000)**.

**5-c- Effect of nitrogen levels:**

The effect of nitrogen levels on grain yield / feddan was significant in both seasons (Table 13) and Fig. (7 and 8). The increase in N level significantly increased grain yield / feddan in both seasons and the highest grain yield was 1506 and 1873 kg / feddan, produced by using the highest N level i.e 120 kg / feddan in the first and second seasons, respectively. The application of 60 and 120 kg N / feddan significantly increased grain yield / feddan over control treatment by 154.3 and 208.6%, respectively in the first season. The corresponding significant increases in grain yield in the second season were 154.6 and 221.6%, respectively. This is clear illustration for the prominent role of N in increasing grain yield under the sandy soil conditions. The increase in grain yield due to the increase in N level is a result of the effect of N in increasing number of spikes / m<sup>2</sup>, spike weight, number of grains / spike and 1000-grain weight. Similar results were indicated by Hefni (1982), Hussein et al (1984), Yousef et al (1984), Gab -Alla et al (1985), Abd El-Gawad et al.(1986), Abdel-Latif and El- Tuhamy (1986), Gheith et al. (1989), Abd El-Maaboud (1991), El-Salhy (1991), Adam (1992), Fayed (1992), Abo-Warda (1993), Abdel-Ghani et al. (1994), Mohamed (1994), Abd El-Fatah, Nagwa (1995), Metwally et al. (1998), Yakout et al. (1998) and Mohamed (1999).

**5-d- Interaction effects :**

The results in Table (13) showed that plant residues x irrigation regimes significantly affected grain yield / feddan in the two growing seasons. The highest grain yield was 1648 and 1992 kg / feddan, produced from irrigation at 50 % soil moisture

stress with application casuarina leaves in sandy soil in the first and second seasons, respectively, However, the lowest one was 483 and 732 kg / feddan, obtained from irrigation at 70% soil moisture stress without application of plant residues in the first and second seasons, respectively. It could be concluded that plant residues was more efficiency with decreasing soil moisture depletion in grain yield .

The effect of the interaction between irrigation regimes and N levels were highly significant on grain yield / feddan in both seasons (Table 13). The maximum grain yield / feddan was 2026 and 2409 kg / feddan, produced by combining irrigation at 50% soil moisture stress +120 kg N/feddan in the first and second seasons, respectively. Whereas the minimum one was 413 and 416 kg / feddan, respectively, obtained from irrigation at 70% soil moisture stress without application of nitrogen fertilizer, It could be concluded that increasing N level up to 120 kg N / feddan was more efficiency with increasing available of soil moisture to gave the highest grain yield.

There was a significant difference of grain yield / feddan due to the interaction between plant residues and N-levels in the two growing seasons as shown in Table (13). The highest grain yield / feddan was produced combining casuarina leaves + 120 kg feddan being 1606 kg / feddan in 1997 /98 season, whereas in 1998/99 season, the combination between corn straw +120 kg N/feddan produced the highest grain yield / feddan (2036 kg / fed). No significant difference was obtained between application of corn straw and casuarina leaves with applied 120 kg N/feddan in both seasons. On the contrary, without application

of plant residues and untreated plant of nitrogen fertilizer gave the lowest grain yield / feddan which equal 111 and 151 kg /feddan in the first and second seasons, respectively. It could be concluded that application of plant residues gave the highest grain yield with increasing N-level up to 120 kg N/feddan in sandy soil.

Data illustrated in Table (13) show that the mean values of grain yield / feddan was significantly affected by the interaction between plant residues, irrigation regimes and N-levels in 1997/98 and 1998/99 seasons . It was clear that, the highest mean values of grain yield / feddan was 2137 and 2514 kg / feddan, produced from treated wheat plant of casuarina leaves with irrigated at 50% soil moisture stress and applied of 120 kg N/ feddan in the first and second seasons, respectively . Whereas the differences between casuarina leaves and corn straw with irrigation at 50% soil moisture stress +120 kg N/ feddan were not significant in both seasons. Also no significant difference was obtained between applied 60 and 120 kg N/ fed with irrigated at 50% soil moisture stress and treated plants of casourine leaves in the first season. The lowest mean values of grain yield / feddan was 87 and 113 kg / feddan, obtained from untreated wheat plants of plant residues and without application of nitrogen fertilizer with irrigation at 70% soil moisture stress.

It could be concluded that application of plant residues with decreasing soil moisture stress and increasing N level up to 120 kg N/feddan gave the maximum grain yield / feddan in sandy soil.

### **6- Straw yield kg / feddan :**

Data in Table (14) indicates that the differences between the mean values of straw yield /feddan was significantly affected by plant residues, irrigation regimes and N levels as well as their interactions in the two growing seasons (1997/98 and 1998/99 seasons).

#### **6-a- Effect of plant residues :**

The effect of plant residues on straw yield / feddan was significant in both seasons (Table 14) and (Fig. 7 and 8). The application of corn straw and casuarina leaves increased straw yield by 80.48 and 84.66%, in the first season and by 48.04 and 58.96% in the second one over untreated treatment respectively. Whereas, no significant difference was obtained between application of corn straw and casuarina leaves on straw yield / feddan, **Russell (1973)** mentioned that the application of organic residues, green manure, crop residues, compost are widely practiced by farmers for improvement in soil productivity. Also he found that the rise of organic matter in soil improved the soil structure and nutrient supply to plants. Straw yield was affected by other characters i.e. plant height, number of tillers / m<sup>2</sup> which increased by using application of plant residues. These results reported by **Abd El-Sabour et al. (1997)**.

#### **6-b- Effect of irrigation regimes:**

Irrigation of wheat plants at 50% loss in water holding capacity significantly surpassed the irrigation at 70% soil moisture stress in straw yield/feddan by 82.57 and 69.44% in the first and second seasons, respectively. This result may be expected because the dry weight of tillers/m<sup>2</sup>, number of tillers/m<sup>2</sup>, leaves area and

**Table (14): Effect of plant residues, irrigation regimes, N-levels and their interactions on straw yield (kg/feddan) in 1997/1998 and 1998/1999 seasons.**

Plant residues	N- Level KgN/fed	Straw yield (kg/feddan)					
		1 <sup>st</sup> season		Mean	2 <sup>nd</sup> season		Mean
		Irrigation regimes			Irrigation regimes		
		W1	W2		W1	W2	
<b>Without</b>	0	345	210	277	460	289	374
	60	2100	1301	1700	2599	2150	2375
	120	3516	1719	2618	3899	2419	3159
	<b>Mean</b>		1987	1076	1532	2319	1619
<b>Corn straw</b>	0	1720	1360	1540	2202	1232	1717
	60	4117	2114	3115	4301	2421	3361
	120	4782	2449	3640	4979	2850	3915
	<b>Mean</b>		3539	1991	2765	3827	2168
<b>Casuarina leaves</b>	0	1782	1302	1543	2541	1290	1915
	60	4460	2199	3329	4681	2401	3541
	120	4802	2424	3613	4889	2976	3933
	<b>Mean</b>		3682	1975	2829	4037	2222
<b>IxN</b>	0	1283	957	1120	1734	937	1335
	60	3559	1871	2715	3860	2324	3092
	120	4367	2214	3290	4589	2748	3669
	<b>Mean</b>		3069	1681		3394	2003

**L.S.D at 0.05**

R	103.8	14.7
I	56.5	212.4
N	78.6	79.4
RXI	146.8	20.8
RXN	136.3	137.6
IxN	111.3	112.4
RXIXN	192.7	194.6

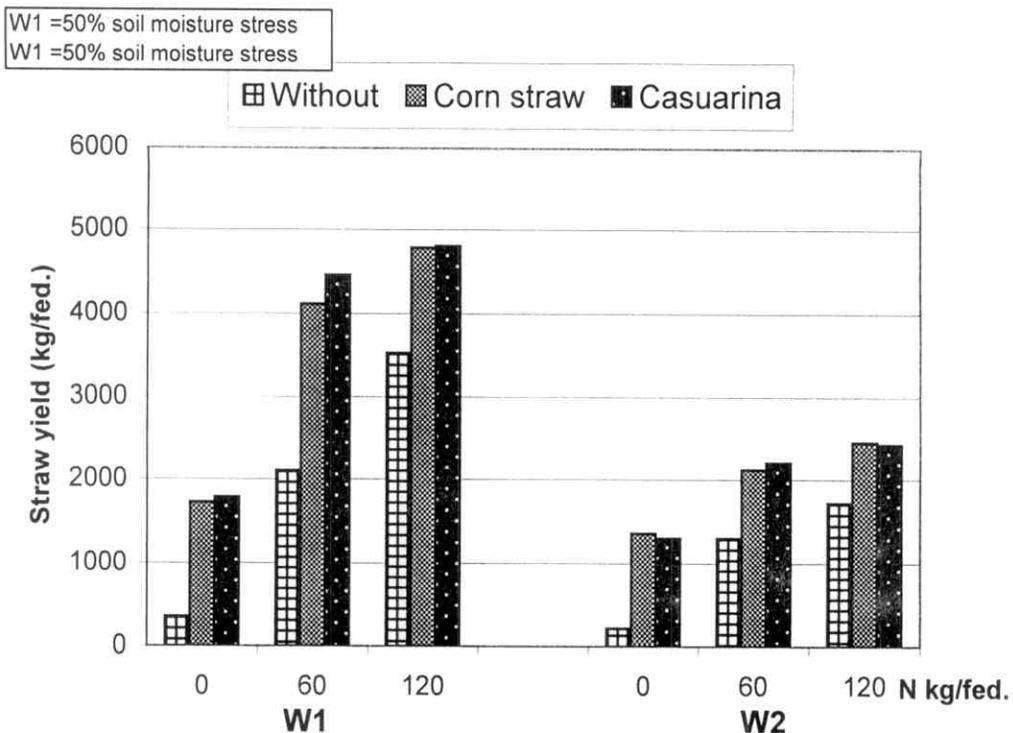


Fig (7): Straw yield of wheat (kg/feddan) during 1997/1998, growing season.

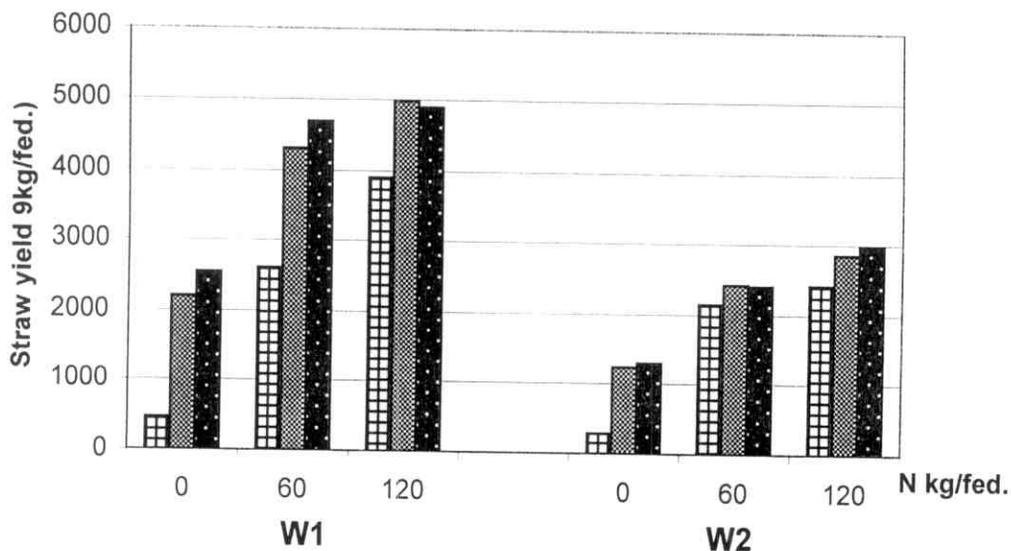


Fig (8): Straw yield of wheat (kg/feddan) during 1998/1999, growing season.

plant height were decreased by increasing soil moisture depletion up to 70%. The same trend was obtained by **Farahat (1978)**, **Misra and Pant (1981)**, **Duwayri (1984)**, **Mohamed (1992)**, **El-Kalla *et al.* (1994)** and **Sadek and Mitkees (1997)**.

#### **6-c- Effect of nitrogen levels:**

With regarding to N level, results showed that straw yield / feddan was significantly increased with increasing N level up to 120 kg N / feddan in both seasons (Table 14) and (Fig. 7 and 8). The application of 60 and 120 kg N/ feddan increased straw yield / feddan by 142.4 and 193.7% respectively over the check treatment in the first season . The corresponding increases were 131.6 and 174.8%, respectively in the second season. The response of straw yield to N levels is nearly similar to that grain yield and reflect the effect of nitrogen fertilizer on stimulating the vegetative growth of wheat i.e plant height, number of tillers / m<sup>2</sup> and dry weight of tillers / m<sup>2</sup>. It concluded that the optimum N levels for producing the highest straw yield under sandy soil conditions is 120 kg N/ feddan. Similar conclusion was obtained by **Hussein *et al.* (1984)**, **Yousef *et al.* (1984)**, **Gab-Alla *et al.* (1985)**, **Abdel-Latif and El-Tuhamy (1986)**, **Abd El-Maaboud (1991)**, **Adam (1992)**, **Fayed (1992)**, **Abo-Warda (1993)**, **Mohamed (1994)**, **Abd El-Fatah, Nagwa (1995)**, **Yakout *et al.* (1998)** and **El-Sawi (2001)**.

#### **6-d- Interaction effects :**

There was a significant difference of the mean values of straw yield / feddan as affected by the interaction between plant residues and irrigation regimes in both seasons as shown in Table (14). The highest values of straw yield / feddan was 3682 and 4037

kg in the first and second seasons, respectively, produced from application of casuarina leaves to sandy soil with irrigation at 50% soil moisture stress. However, the lowest one was 1076 and 1619kg / feddan, respectively, obtained from without application of plant residues with irrigation at 70% soil moisture stress.

Results in Table (14) indicated that the interaction between irrigation regimes and N levels affected significantly straw yield / feddan in both seasons. The highest value of straw yield / feddan was 4367 and 4589 kg / feddan , produced from irrigation at 50% soil moisture stress with adding 120 kg N/ feddan in the first and second seasons, respectively. The increment in straw yield / feddan produced were 3410 and 3652 kg / feddan in the first and second seasons, respectively for applied 120 kg N/ feddan with irrigated at 50% soil moisture stress over without application of nitrogen fertilizer and irrigation at 70% soil moisture stress.

Table (14) obviously clear that the mean values of straw yield / feddan was significantly affected by the interaction between plant residues and N levels in the two growing seasons. In the first season, the application of corn straw with adding 120 kg N/ feddan gave the maximum yield of straw per feddan (3640 kg / feddan) . Whereas the highest straw yield / feddan was 3933 kg , produced from application of casourine leaves with applying 120 kg N/ feddan in the second season . On the other hand , no significant difference was obtained between application of corn straw and casuarina leaves with 120 kg N/ feddan on straw yield in both seasons. On the contrary, without application of plant residues and nitrogen levels gave the lowest mean values of

straw yield / feddan which equal to 277 and 374 kg in the first and second seasons, respectively.

The data illustrated in Table (14) show that straw yield / feddan was significantly affected by the interaction between the three factors in the two growing seasons. The increment in straw yield / feddan produced was 4592 kg / feddan in the first season for applicated casuarina leaves and applied 120 kg N/ feddan with irrigated at 50% soil moisture stress over without applied of plant residues and N fertilizer with irrigated at 70% soil moisture stress (control treatment). Whereas, in the second season, the increment in straw yield per feddan was 4690 kg / feddan for applicated corn straw and applied 120 kg N/ feddan with irrigated at 50% soil moisture stress over the control treatment. On the other hand, no significant difference was obtained between application of corn straw and casuarina leaves with adding 120 kg N/ feddan and irrigation at 50% soil moisture stress on straw yield / feddan in the two growing seasons.

It could be concluded that application of plant residues i.e corn straw or casuarina leaves to sandy soil and irrigation at 50% soil moisture stress with adding 120 kg N/ feddan gave the highest mean values of straw yield / feddan.

### **III- Chemical analysis:**

#### **1- Protein content :**

The percentage of wheat grain protein as influenced by plant residues, irrigation regimes, N-levels and their interactions in the two growing seasons (1997/98 and 1998/99) are shown in Table (15).

Table (15): Effect of plant residues, irrigation regimes, N-levels and their interactions on Wheat grain protein content (%) in 1997/1998 and 1998/1999 seasons.

Plant residues	N- Level KgN/fed	Wheat grain protein content (%)					
		1 <sup>st</sup> season		Mean	2 <sup>nd</sup> season		Mean
		Irrigation regimes			Irrigation regimes		
		W1	W2	W1	W2		
Without	0	9.17	9.87	9.52	8.98	9.28	9.13
	60	9.44	10.06	9.75	9.68	10.27	9.98
	120	10.05	10.69	10.37	10.22	10.46	10.34
Mean		9.55	10.21	9.29	9.63	10.00	9.82
Corn straw	0	9.32	9.51	9.42	9.44	9.74	9.59
	60	10.25	10.21	10.23	10.31	10.50	10.40
	120	10.82	11.60	11.21	10.76	11.64	11.20
Mean		10.13	10.44	9.88 b	10.17	10.63	10.40
Casuarina leaves	0	9.78	9.34	9.56	9.40	9.63	9.51
	60	10.06	10.50	10.28	10.37	10.20	10.28
	120	10.52	11.26	10.89	10.97	11.03	11.00
Mean		10.12	10.37	10.24	10.24	10.29	10.26
IxN	0	9.42	9.57	9.50	9.27	9.55	9.41
	60	9.92	10.26	10.09	10.12	10.32	10.22
	120	9.57	11.18	10.42	10.65	11.04	10.84
Mean		9.93	10.34		10.01	10.31	

L.S.D at 0.05

R	0.199	0.181
I	0.196	NS
N	0.139	0.130
RXI	0.281	0.257
RXN	0.241	0.226
IxN	0.197	0.184
RXIXN	0.341	0.319

**1-a- Effect of plant residues:**

The results showed clearly that application of plant residues surpassed significantly untreated soil on the percentage of protein in wheat grains in both seasons. The increment in protein content reached about 0.40 and 0.36%, produced by application of corn straw and casuarina leaves, respectively over untreated soil in the first season. The corresponding increases were 0.58 and 0.44%, respectively in the second season. Whereas no significant difference was obtained between application of corn straw and casuarina leaves on the percentage of protein in both seasons. This result may be due to the addition of plant residues in the soil increased the available nutrients as a result of reducing pH mechanism, **Freney and Simpson (1983)**. Similar results were obtained by **Mohamed (1994)**, **Abd El-Magid et al. (1995)** and **Dev and Bhardwaj (1995)**.

**1-b- Effect of irrigation regimes:**

The results also revealed that in the first season, irrigation regimes significantly affected protein content. Irrigation of wheat at 70% loss in water holding capacity gave the highest protein content (10.34%), while irrigation at 50% soil moisture stress gave the lowest protein content (9.93 %) in the first season. The above mentioned results can be explained by the report of **Kramer (1978)** who concluded that in stressed plants there was rapid drop in water content and a small increase in protein possibly due to the continued synthesis of RNA. During stress there was a hydrolysis of protein. Finally, an apparent increase in protein occurred, although this may have been an increase in peptides rather than protein. These results are in harmony with

those obtained by *Hefni et al. (1983)*, *Moursi et al. (1983)*, *Sud et al. (1990)*, *Mohamed (1992)*.

#### **1-c- Effect of nitrogen levels:**

The obtained results in Table (15) indicated that protein content in wheat grains was significantly increased by increasing N- level up to 120 kg N / feddan in both seasons.

The application of 60 and 120 kg N / feddan increased protein content by 0.59 and 0.92 %, respectively over the check treatment in the first season. The corresponding increases were 0.81 and 1.43%, respectively, in the second season. This result proved the great response of wheat grown in sandy soil to N fertilization. These results are similar to those obtained by *Yousef et al. (1984)*, *Abd El-Maaboud (1991)*, *Dourgham, Elham (1991)*, *El-Salhy (1991)*, *Sabrah et al. (1992)*, *Abo-Warda (1993)*, *Mohamed (1994)*, *Salwau (1994)* and *Yakout et al. (1998)* whom found that grain protein content were increased significantly and consistently with increasing rates of N fertilizer.

#### **1-d- Interaction effects :**

Data in Table (15) indicated that there were significant differences in protein content as affected by the interaction between plant residues x irrigation regimes, plant residues x N level, irrigation regimes x N-level and between the three factors in the two growing seasons.

It was observed that the highest percentage of protein in wheat grains was 10.44 and 10.63%, produced from wheat plants cultivated in sandy soil with applicated of corn straw and irrigated at 50% soil moisture stress in the first and second

seasons, respectively. Whereas the interaction between without treated of plant residues with irrigation at 50% soil moisture stress gave the lowest percentage of protein content in wheat grains (9.55 and 9.63%) in the first and second seasons, respectively.

The results in Table (15) showed that the interaction between irrigation regimes and N level had a significant effect on protein content in both seasons. The increment in protein content by irrigation at 70% loss in water holding capacity with adding 120 kg N/ feddan was 1.76% and 1.77%, over the interaction between irrigation after 50% soil moisture stress without application of nitrogen fertilizer in the first and second seasons, respectively.

Data presented in Table (15) reveal that protein content in wheat grain was significantly increased by increasing N level up to 120 kg N/ feddan with application of plant residues to sandy soil in the two growing seasons. The greatest values of protein content was 11.21 and 11.20%, produced from treated plants with corn straw and applied 120 kg N/ feddan in the first and second seasons, respectively.

The effect of the interaction between plant residues irrigation regimes and N level were significant on protein content in wheat grains in both seasons as shown in Table (15). The highest values of protein content was 11.60 and 11.64% in the first and second seasons, respectively, produced from applied corn straw with irrigated after 70% soil moisture stress and applied 120 kg N /feddan. However the lowest one was 9.17 and 8.98%, respectively, obtained from without

applied of plant residues and irrigated at 50% soil moisture stress with zero N fertilizer. It could be concluded that application of corn straw to sandy soil and irrigated at 70% loss in water of holding capacity with adding 120 kg N/feddan gave the greatest content of protein in wheat grains.

## **2- Nitrogen use efficiency :**

Nitrogen use efficiency in wheat plants as affected by plant residues, irrigation regimes and N-levels as well as their interactions effects in 1997/98 and 1998/99 seasons are presented in Table (16).

### **2-a- Effect of plant residues :**

It was clear that addition of plant residues i.e corn straw or casuarina leaves to sandy soil significantly increased N-utilized in wheat plants in both seasons as compared to untreated soil of plant residues. Application of casuarina leaves to sandy soil gave the highest percentage of N-use efficiency (28.38 and 26.13% in the first and second seasons, respectively), followed by the application of corn straw (26.52 and 22.66%, respectively). Whereas the lowest percentage was 8.09 and 7.68%, respectively, produced from without applied of plant residues. Organic plays an important role in plant nutrition not only as a carrier and source of nutrients, but also it is an excellent soil conditioner, improving physical characters of soil such as texture, moisture holding capacity and aeration, **Maramba et al. (1978)**, Also, **Strel'nikova et al. (1989)** found that liming substantially increased N utilization by plants and improved the N balance on poorer sandy soil, also liming improved the plants utilization of immobilized fertilizer N, thus

**Table (16): Effect of plant residues, irrigation regimes, N-levels and their interactions on N-utilized (%) in 1997/1998 and 1998/1999 seasons.**

Plant residues	N- Level KgN/fed	N-utilized (%)					
		1 <sup>st</sup> season		Mean	2 <sup>nd</sup> season		Mean
		Irrigation regimes			Irrigation regimes		
		W1	W2		W1	W2	
Without	0						
	60	7.20	6.25	6.73	6.26	6.87	6.52
	120	10.02	8.90	9.64	8.23	8.35	8.78
	<b>Mean</b>	8.61	7.58	8.09	7.25	8.11	7.68
Corn straw	0						
	60	31.26	21.66	26.46	25.69	19.08	22.39
	120	30.90	22.26	26.58	26.98	17.86	22.42
	<b>Mean</b>	31.08	21.26	26.52	26.84	18.47	22.66
Casuarina leaves	0						
	60	32.38	24.10	28.24	28.92	20.98	24.95
	120	31.74	25.30	28.52	33.03	21.57	27.30
	<b>Mean</b>	32.00	24.7	28.38	30.98	21.28	26.13
IxN	0						
	60	23.61	17.34	20.47	20.29	15.63	17.96
	120	24.33	18.82	21.57	22.86	16.26	19.56
	<b>Mean</b>	23.97	18.08		21.69	15.94	

**L.S.D at 0.05**

<b>R</b>	0.51	0.17
<b>I</b>	1.56	0.40
<b>N</b>	0.52	0.15
<b>RXI</b>	0.24	0.73
<b>RXN</b>	0.26	0.91
<b>IxN</b>	0.21	0.74
<b>RXIXN</b>	0.38	1.29

reducing the quantity of N fixation in comparison with non limed soil. Similar results were obtained by **Mohamed (1994)**, **Abdel-Magid et al. (1995)**, **Abdel-Moez (1995)**, **Dev and Bhardwaj (1995)** and **Abd El-Sabour and Abo El-Seoud (1996)**.

#### **2-d- Effect of irrigation regimes:**

With regarding to irrigation regimes, irrigation to early i.e at 50% loss in water holding capacity improved nitrogen utilization compared to which irrigated to late i.e at 70% loss in water holding capacity as shown in Table (16). Irrigation to early produced an increment reached about 32.58 and 36.07% in the first and second seasons, respectively, as compared to late irrigation. Nitrogen losses under prolonged intervals of irrigation due to nitrogen transformation may be the reason behind the utilization efficiency reduction. It might be attributed to the reduction in the dry matter content as well as photosynthetic efficiency. The same trend was obtained by **Sharama et al. (1990)** who found that utilization of nitrogen at high soil moisture levels. Whereas, **Sowers et al. (1994)** indicated that nitrogen use efficiency was decreased by increasing water supply.

#### **2-c- Effect of nitrogen levels :**

It was clear that from Table (16) N use efficiency was significantly increased with increasing N level up to 120 kg / feddan in both seasons which gave the highest increase of 21.57 and 19.56% in the first and second seasons, respectively for nitrogen use efficiency. The same trend was obtained by **Mahgoub et al. (1991)** and **Ortiz-Monasterio et al. (1997)** found that nitrogen use efficiency (N.U.E) was increased by increasing levels of nitrogen fertilizer. While **Mohamed (1999)**

found that N U E was significantly decreased by increasing nitrogen level.

#### **2-d- Interaction effects :**

Table (16) shows that the interaction between plant residues and irrigation regimes significantly affected nitrogen use efficiency in the two growing seasons. Nitrogen- utilization in wheat plants was the highest for each plant residues with the highest amount of water not more than 50% loss in water holding capacity, whereas the increases in N- utilized were higher as casuarina leaves applied than corn straw was added to sandy soil with irrigated at 50% loss in water holding capacity in both seasons.

The effect of the interaction between irrigation regimes and N levels were highly significant on nitrogen use efficiency in the two growing seasons (Table 16). The greatest N.U.E was 24.33 and 22.86%, produced from irrigated at 50% soil moisture stress with applied 120 kg N/ feddan in the first and second seasons, respectively. On the other hand, the lowest one was 17.34 and 15.6%, respectively obtained from irrigation at 70% soil moisture stress with adding 60 kg N / fed. The same trend was not obtained by **Sowers *et al.* (1994)** indicated that nitrogen use efficiency was decreased by increasing water supply and over fertilization of nitrogen which led to nitrogen losses by identification and immobilization.

There was a significant difference of nitrogen use efficiency due to the interaction between plant residues and N-level in 1997/98 and 1998/99 seasons as shown in Table (16). The combination between casuarina leaves + 120 kg N/ feddan produced the maximum nitrogen use efficiency which equal to

28.52 and 27.30% in the first and second seasons, respectively. Whereas the minimum one was 6.73 and 6.52%, respectively, produced from adding 60 kg N/feddan without application of plant residues. Also no significant difference was obtained between 60 and 120 kg N/ feddan with applied casourine leaves on nitrogen use efficiency in the first season.

The best nitrogen use efficiency has been resulted from planting wheat in sandy soil incorporated with casuarina leaves and irrigated not more that 50% loss in water holding capacity with fertilized at 120 kg N/ feddan which equal 31.74 and 33.03% in the first and second seasons, respectively.

It could be concluded that nitrogen use efficiency was positively with application of plant residues and irrigation at 50% soil moisture stress with applied 60 or 120 kg N / feddan.

#### **V- Water use efficiency (kg / m<sup>3</sup>):**

Water use efficiency (W.U.E) has been used to evaluate various agronomic practices with respect to water consumptive use. Water use efficiency can be increased by increasing crop production and or by decreasing evapotranspiration. Crop production can be upgrade by the best high yielding cultivars, adaptation to the environment as well as by effective water management, air and nutrients supply to the roots and of both light and CO<sub>2</sub> to the foliage. The water use efficiency is expressed as kg grains / m<sup>3</sup> of water consumed. The average values of W.U.E by wheat as influenced by plant residues, irrigation regimes and N-level as well as their interactions during the two growing seasons are presented in Table (17).

**Table (17): Effect of plant residues, irrigation regimes, N-levels and their interactions on water use efficiency based on grain yield (kg/m<sup>3</sup>) in 1997/1998 and 1998/1999 seasons.**

Plant residues	N- Level KgN/fed	Water use efficiency based on grain yield (kg/m <sup>3</sup> )					
		1 <sup>st</sup> season		Mean	2 <sup>nd</sup> season		Mean
		Irrigation regimes			Irrigation regimes		
		W1	W2		W1	W2	
Without	0	0.070	0.057	0.064	0.098	0.074	0.086
	60	0.502	0.366	0.434	0.652	0.614	0.633
	120	0.945	0.519	0.732	1.067	0.740	0.903
	<b>Mean</b>	0.506	0.314	0.410	0.606	0.476	0.541
Corn straw	0	0.474	0.566	0.520	0.618	0.536	0.577
	60	1.193	0.911	1.052	1.377	1.096	1.236
	120	1.296	1.031	1.164	1.623	1.351	1.487
	<b>Mean</b>	0.988	0.836	0.912	1.206	0.994	1.100
Casuarina leaves	0	0.476	0.530	0.503	0.685	0.544	0.612
	60	1.242	0.929	1.086	1.438	1.029	1.233
	120	1.307	1.026	1.167	1.538	1.384	1.461
	<b>Mean</b>	1.008	0.828	0.918	1.219	0.986	1.102
IxN	0	0.340	0.384	0.362	0.465	0.384	0.465
	60	0.979	0.735	0.857	1.156	0.913	1.034
	120	1.183	0.859	1.021	1.409	1.158	1.284
	<b>Mean</b>	0.834	0.660		1.010	0.818	

**L.S.D at 0.05**

<b>R</b>	0.024	0.024
<b>I</b>	0.037	0.037
<b>N</b>	0.053	0.021
<b>RXI</b>	0.037	0.043
<b>RXN</b>	0.065	0.037
<b>IxN</b>	0.053	0.030
<b>RXIXN</b>	0.092	0.053

**V-a- Effect of plant residues :**

Table (17) indicated that water use efficiency significantly increased by application of corn straw and casuarina leaves residues to sandy soil in 1997/ 98 and 1998/ 99 seasons. The height water use efficiency value was 0.918 and 1.102 kg grains / m<sup>3</sup> of water consumed for application of casuarina leaves in the first and second seasons, respectively. Whereas no significant difference was obtained between application of corn straw and casuarina leaves on water use efficiency in both seasons. The increment in W.U.E reached about 0.502 and 0.508 kg grain / m<sup>3</sup> water consumed for the same plant residues over untreated plant residues in the first season as well as 0.599 and 0.561 kg grains / m<sup>3</sup> of water consumed, respectively in the second season. It can be concluded that application of plant residues to sandy soil is more efficient in water consumption than untreated of plant residues. In this connection, **Maramba et al. (1978)** stated that organic fertilizer is an excellent soil conditioner, improving physical characters of soil such as texture, moisture holding capacity.

**V-b- Effect of irrigation regimes:**

Regarding the effect of irrigation regimes on the mean values of water use efficiency by wheat, the data presented in Table (17) pointed out that irrigation regimes had a great effect on W.U.E by wheat in 1997/ 98 and 1998/ 99 seasons. The highest water use efficiency value was 0.834 and 1.010 kg grains / m<sup>3</sup> of consumed water scored from irrigated at 50 % soil moisture depletion in the first and second seasons, respectively. Whereas the lowest one was 0.660 and 0.818 kg grains / m<sup>3</sup> of

water consumed, respectively produced from irrigated at 70% loss in water holding capacity. These results could be attributed to the highly significant differences among the wheat grain yield values as well as differences between the consumptive use. In this connection, **Rickert *et al.* (1987)** found that water efficiency of about 10 kg grains / ha per mm of water were similar to those for winter rainfall areas in South eastern, Australia. whereas, **Sadek and Mitkees (1997)** under reclaimed regions condition at Western Coast in Egypt, mentioned that excess water of irrigation led to reduction in water use efficiency.

#### **V-c- Effect of nitrogen levels:**

The mean values of water use efficiency for nitrogen applied i.e. 0,60 and 120 kg N / feddan were 0.362, 0.857 and 1.021 kg / m<sup>3</sup> of consumed water, respectively in the first season. Whereas W.U.E for the same levels of nitrogen were 0.465, 1.034 and 1.284 kg / m<sup>3</sup> of consumed water in the second season. It is evident that applying nitrogen fertilizer at 120 kg / feddan resulted in producing the highest water use efficiency than other level of nitrogen due to high yield production. The previous results are in accordance with those reported by **Rickert *et al.* (1987)**, **Morgan (1988)** and **Sabrah *et al.* (1992)**.

#### **V-d- Interaction effects :**

Table (17) shows that the effect of the interaction between plant residues and irrigation regimes was significant for water use efficiency in both seasons. Application of casuarina leaves to sandy soil with irrigation at 50 % soil moisture stress gave the greatest value of W.U.E. which equal to 1.008 and 1.219 kg / m<sup>3</sup> of consumed water in the first and second seasons, respectively,

However the lowest one was 0.057 and 0.074 kg / m<sup>3</sup> water consumed, respectively, produced from without application of plant residues with irrigation at 70 % soil moisture stress.

On the other side, the interaction between irrigation regimes and N level on water use efficiency (W.U.E) was highly significant in the two growing seasons (Table 17). The highest mean values of water use efficiency was 1.183 and 1.409 kg / m<sup>3</sup> of water consumed in the first and second seasons, respectively, obtained from irrigation after 50 % soil moisture with adding 120 kg N/ feddan .

The data presented in Table (17) shows that a significant effects in W.U.E were detected by the interaction between plant residues and N levels in the two growing seasons. Application of casuarina leaves to sandy soil with adding 120 kg N / feddan gave the maximum mean values of W.U.E (1.167 and 1.461 kg / m<sup>3</sup> of water consumed in the first and second seasons, respectively). Whereas the minimum one was 0.064 and 0.086 kg / m<sup>3</sup> of water consumed, respectively produced from without applied of plant residues and N -level.

Finally the effect between plant residues, irrigation regimes and N- levels showed higher significant and considerable values of water use efficiency in wheat plants. The best combination occurred were the combination between high rate of nitrogen (120 kg N / feddan) to wheat plants cultivated in sandy soil received corn straw or casuarina leaves and irrigated at 50 % soil moisture stress in the first and second seasons, respectively.

The increment in water use efficiency could be explained that the plant residues to sandy soil play a role in preventing water loss and that leads to high rate absorption and release of nutrients by plants as well as the indirect role of water for absorbed nutrients by easily mobilization in soil towards the roots. Also crop residues applied is a useful guide to the prediction of nitrogen mineralization. (**Khalleel *et al.*, 1981; Rynk and Rechcgl, 1995**).

## **Second study (sesame)**

### **I- Growth characters:**

#### **1- Plant height:**

Data presented in Tables (18 and 19) show that the effect of plant residues, irrigation regimes and N-levels as well as their interactions on the mean values of plant height of sesame at 75 days from planting (D.F.P) and at harvest time in 1998 and 1999 seasons.

#### **1-a- Effect of the plant residues:**

Sesame plant height at 75 days from planting and at harvest time were significantly increased when plants grown in sandy soil residual of with casuarina and corn straw residues as compared to which grown in sandy soil untreated with plant residues in both growing seasons Table (18 and 19) and Fig. (9, 10, 11 and 12). In the first season, the tallest plant was 124 and 135 cm, obtained from planting in sandy soil with residual of casuarina leaves at 75 DAP and at harvest, respectively, followed by planting in corn straw residues (123 and 131 cm, respectively). The shortest plants was 62 and 72 cm, respectively, obtained from without applying any plant residues in the first season. The same trend was obtained in the second. It could be concluded that the addition of plant residues to sandy soil before the previous crop (wheat) gave the highest values of plant height of sesame. This result may be due to that plant residues plays an important role in plant nutrition not only as a carrier and source of mineral, but also it is plays as a soil conditioner, imptoving physical and chemical characters of soil

**Table (18): Effect of plant residues, irrigation regimes, N-levels and their interactions on Plant height (cm) at 75 DFP in 1998 and 1999 seasons.**

Plant residues	N- Level KgN/fed	Plant height ( cm ) at 75 DFP					
		1 <sup>st</sup> season		Mean	2 <sup>nd</sup> season		Mean
		Irrigation regimes			Irrigation regimes		
		W1	W2		W1	W2	
Without	0	70	55	62	66	48	57
	30	122	69	96	112	75	93
	60	128	98	113	113	95	114
	Mean	107	74	90	103	73	88
Corn straw	0	105	66	85	100	67	83
	30	150	110	130	149	113	131
	60	164	123	144	158	120	139
	Mean	140	100	120	136	100	118
Casuarina leaves	0	108	73	90	104	71	88
	30	152	116	134	154	121	137
	60	168	128	148	166	125	145
	Mean	143	105	124	141	105	123
IxN	0	94	65	79	90	62	76
	30	141	98	120	138	103	120
	60	153	116	135	152	113	133
	Mean	130	93		157	93	

**L.S.D at 0.05**

R	2.040	1.555
I	1.569	2.662
N	1.295	1.473
RxI	2.886	2.199
RxN	2.244	2.559
IxN	1.832	2.083
RxIxN	3.173	3.608

Table (19): Effect of plant residues, irrigation regimes, N-levels and their interactions on Plant height (cm) at harvest in 1998 and 1999 seasons.

Plant residues	N- Level KgN/fed	Plant height (cm) at harvest					
		1 <sup>st</sup> season		Mean	2 <sup>nd</sup> season		Mean
		Irrigation regimes			Irrigation regimes		
		W1	W2		W1	W2	
Without	0	82	62	72	76	53	65
	30	130	86	108	122	81	101
	60	139	107	123	144	102	123
	Mean		117	85	101	114	79
Corn straw	0	113	78	96	110	72	91
	30	166	119	142	160	119	139
	60	179	132	155	171	127	149
	Mean		152	109	131	147	106
Casuarina leaves	0	117	81	99	112	77	95
	30	168	123	146	162	127	145
	60	184	136	160	176	131	153
	Mean		156	113	135	150	112
IxN	0	104	73	89	99	67	83
	30	155	109	132	148	109	128
	60	167	125	146	164	120	142
	Mean		142	102		137	99

L.S.D at 0.05

R	1.792	2.452
I	2.652	1.645
N	0.995	2.019
RxI	2.534	3.468
RxN	1.724	3.497
IxN	1.408	2.855
RxIxN	2.438	4.945

W1 =50% soil moisture stress  
W2 =70% soil moisture stress

Without Corn straw Casuarina

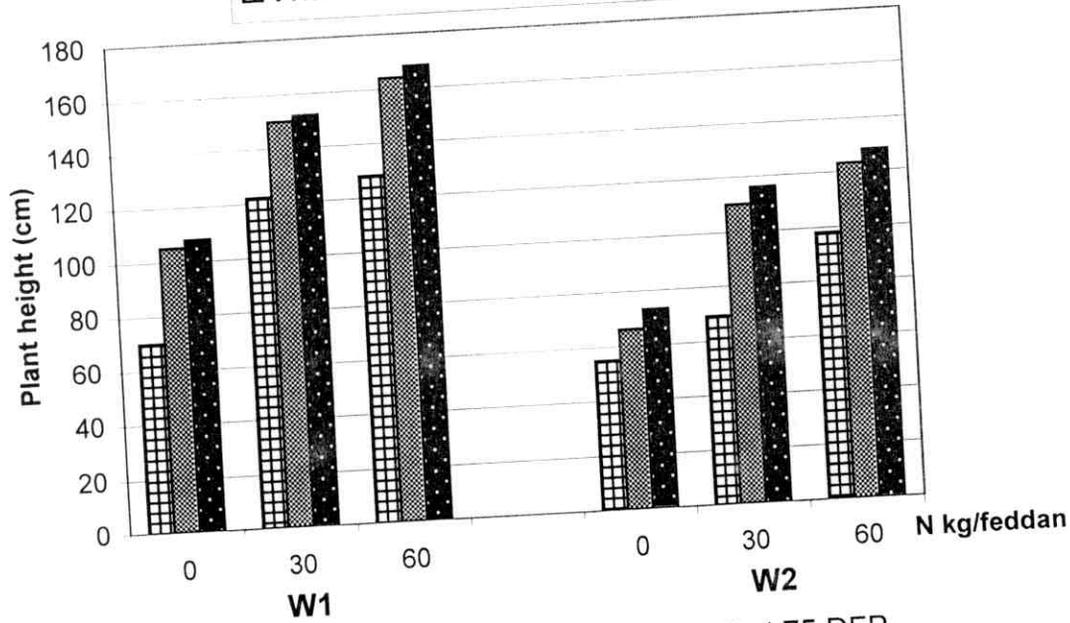


Fig (9): Plant height of sesame (cm) at 75 DFP during 1998, growing season.

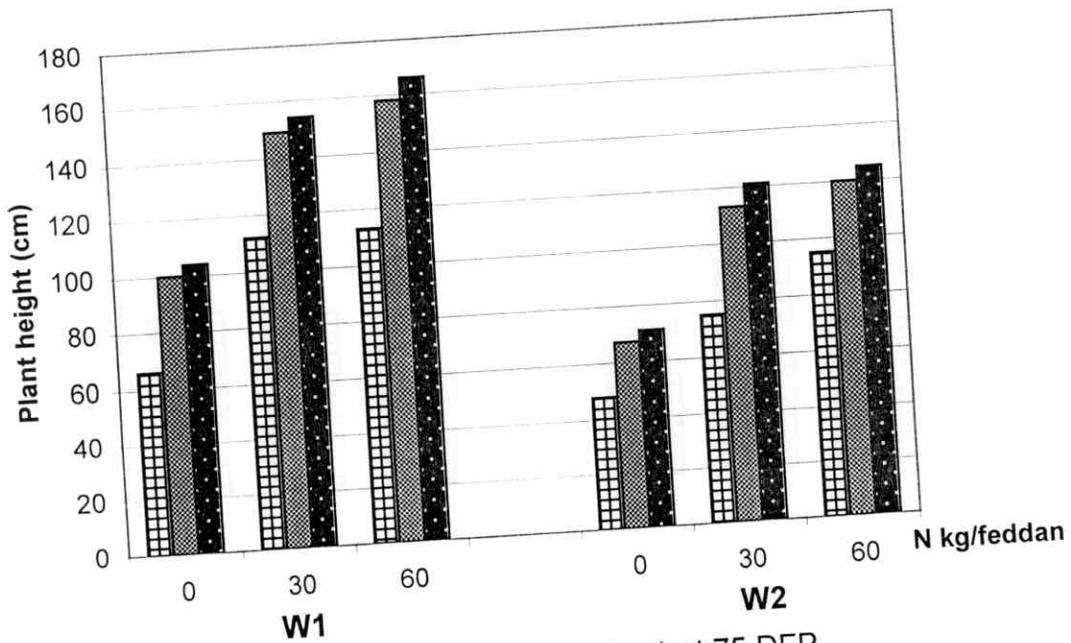


Fig (10): Plant height of sesame (cm) at 75 DFP during 1999, growing season.

W1 = 50% soil moisture stress  
W2 = 70% soil moisture stress

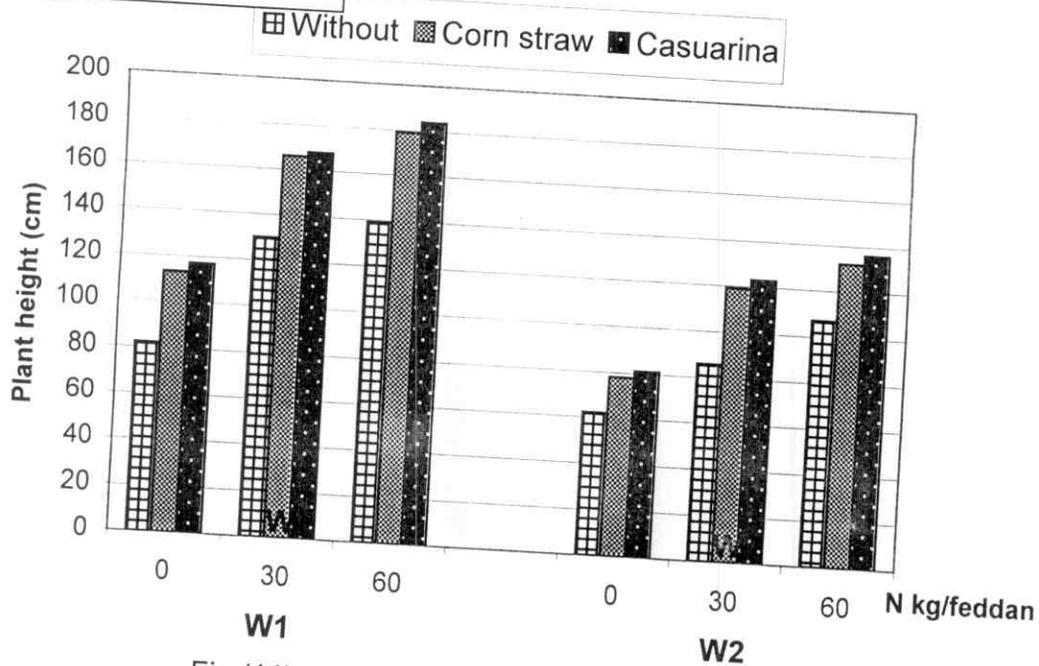


Fig (11): Plant height of sesame (cm) at harvest during 1998, growing season.

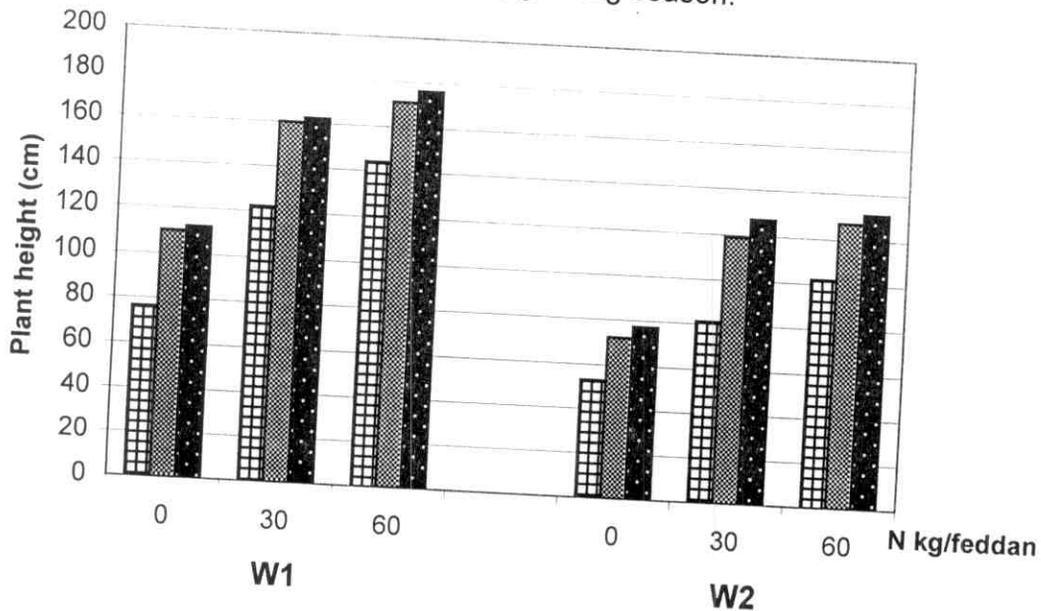


Fig (12): Plant height of sesame (cm) at harvest during 1999, growing season.

as moisture holding capacity and aeration (**Maramba et al., 1978**). Also, **Abd El-Moez (1995)** mentioned that the addition of plant residues to sandy soil caused a significant increment of lentil plant weight by decreasing pH. Whereas, **Gaber (1998)** found that preceding winter crops (berseem and barley) before sesame had no significant effect on plant height.

#### **1-b- Effect of irrigation regimes:**

The results presented in Tables (18 and 19) and Fig. (9, 10, 11 and 12) indicate that irrigation regimes had a significant effect on sesame plant height at 75 days after planting and at harvest time in both seasons. Irrigation of sesame at 50% loss in water holding capacity gave the tallest plant at 75 DFP (130 and 157 cm) and at harvest (142 and 102 cm) in the first and second seasons, respectively. While irrigation at 70% soil moisture stress gave the shortest one (93 and 93 cm at 75 DAP) and (102 and 99 cm at harvest) in both seasons, respectively. The increment in plant height reached about 39.8 and 68.8% at 75 DFP in the first and second seasons, respectively and about 39.2 and 38.4%, respectively at harvest. These results may be due to that water stress decreased the activity of meristematic tissues responsible to elongation and then decreased internodes length as a result of reduction in cell number and size. The previous results are in full agreement with those obtained by **Atta (1980)**, **El-Wakil (1983)** and **Yadav and Srivastava (1997)**.

#### **1-c- Effect of nitrogen levels:**

With regard to N-levels, the mean values of sesame plant height at 75 days from planting and at harvest time were significantly increased by increasing N-level up to 60 kg N /

feddan in the two growing seasons as shown in Tables (18 and 19) and Fig. (9, 10, 11 and 12). The maximum values of plant height was 116 and 133 cm, obtained from adding 60 kg N / feddan in the first and second seasons, respectively. While the minimum one was 65 and 76 cm, produced from unfertilized of nitrogen in both seasons, respectively. Also, the application of 30 and 60 kg N / feddan increased plant height by 49.3 and 71.2% over the check treatment at harvest in the first season, respectively, the corresponding increases were 54.2 and 71.1% in the second season, respectively (Table 19) and (Fig. 11 and 12). The increments in sesame plant height may be due to enhancement of meristematic growth and then cell elongation as a result of auxin production in fresh cells. Similar results were obtained by **Mohamed (1976)**, **Atta (1980)**, **Khalil (1980)**, **Abu-Hagaza (1981)**, **El-Wakil (1983)**, **Ghosh and Patra (1993)**, **Osman (1993)**, **Ramakrishnan et al. (1994)**, **Awad et al. (1997)** and **Mondal et al. (1997)**.

#### 1-d- Interaction effects:

The results in Tables (18 and 19) showed that the interaction between plant residues and irrigation regimens significantly affected plant height at 75 days after planting and at harvest time in the two growing seasons. Sesame plant height developed and gave the tallest from sandy soil with residual of casuarina leaves and irrigation at 50% loss in water holding capacity (w1) as compared without application of plant residues and irrigation at 70% soil moisture stress (w2). The addition of plant residues increased available water and nutrients (**Freney and Simpson, 1983**). Also, irrigation after 60% loss in water

holding capacity is essential for high nitrogen recovery by limiting water infiltration as indicated by **Duwayri (1984)**.

Data in Tables (18 and 19) showed that there were significant differences plant height as affected by the interaction between irrigation regimess and N-levels at 75 DAP and at harvest in the two growing seasons. At 75 days from planting, the tallest plant was 153 and 152 cm in the first and second seasons, respectively, produced from irrigated at 50% soil moisture stress with applied 60 kg N / feddan. On the contrary, the shortest one was 65 and 62 cm, respectively, obtained from irrigated at 70% soil moisture depletion without nitrogen fertilizer. Also, the difference between the mean values of plant height at harvest gave the same trend at 75 days from planting as affected by the interaction between irrigation regimes and N-level in both seasons. It could be concluded that the tallest plant of sesame produced from applied 60 and 30 kg N/feddan whean irrigated at 50% loss in water holding capacity as compared to irrigation at 70% soil moisture stress.

It was clear from Tables (18 and 19) that the interaction between plant residues and N-level had a significant effect on plant height at the two samples in both seasons. Sesame plants cultivated in sandy soil with a residual effect of casuarina and applied 60 kg N / feddan gave the tallest plant at 75 DFP (148 and 145 cm) and at harvest (160 and 153 cm) in the first and second seasons, respectively. Similar result was obtained by **Freny and Simpson (1983)** found that the addition of plant residues on the soil increased the available nutrients as a result of reducing pH mechanism.

There was significant effect of the interaction between the three factors on plant height of sesame at 75 days from planting and at harvest in both season as shown in Tables (18 and 19). The highest plants of sesame at 75 days from planting and at harvest were produced from residual of casuarina leaves with irrigation at 50% loss on water holding capacity and adding 60 kg N / feddan in both seasons. Whereas the lowest ones were obtained without plant residues and nitrogen fertilizer with irrigation at 70% soil moisture depletion.

It could be concluded that the residual of corn straw or casuarina leaves fertilization with nitrogen level 60 kg N / feddan with irrigation at 50% loss in water holding capacity were more effective in increasing significantly plant height of sesame.

## **2- Dry weight of plants / m<sup>2</sup>:**

The effect of plant residues, irrigation regimes, N-levels and their interactions on the mean values of plants dry weight / m<sup>2</sup> at 75 days from planting in 1998 and 1999 seasons are presented in Table (20).

### **2-a- Effect of plant residues:**

The main values of sesame plants dry weight/m<sup>2</sup> at 75 days from planting was significantly increased by residual of corn straw and casuarina as compared without application of plant residues in the two growing seasons. Application of corn straw and casuarina leaves before wheat significantly increased dry weight of sesame plant / m<sup>2</sup> by 126.7 and 135.3% over untreated with plant residues, respectively in the first season. The corresponding increases in the second season were 95.3 and

**Table (20): Effect of plant residues, irrigation regimes, N-levels and their interactions on Dry weight of plants (g/m<sup>2</sup>) at DFP in 1998 and 1999 seasons.**

Plant residues	N- Level KgN/fed	Dry weight of plants (g/m <sup>2</sup> ) at DFP					
		1 <sup>st</sup> season		Mean	2 <sup>nd</sup> season		Mean
		Irrigation regimes			Irrigation regimes		
		W1	W2		W1	W2	
<b>Without</b>	0	37	12	25	33	13	23
	30	219	75	147	187	66	126
	60	405	151	278	439	149	294
	<b>Mean</b>	220	79	150	219	76	148
<b>Corn straw</b>	0	334	58	196	243	59	151
	30	566	224	395	481	199	340
	60	595	262	429	518	235	376
	<b>Mean</b>	498	181	340	414	164	289
<b>Casuarina leaves</b>	0	362	60	211	250	52	151
	30	518	281	399	467	216	341
	60	603	293	448	548	268	408
	<b>Mean</b>	494	211	353	422	178	300
<b>IxN</b>	0	244	43	144	175	41	108
	30	434	193	314	378	160	269
	60	534	235	385	502	217	359
	<b>Mean</b>	404	157		352	139	

**L.S.D at 0.05**

<b>R</b>	10.79	3.78
<b>I</b>	5.71	1.41
<b>N</b>	10.62	4.35
<b>RxI</b>	15.26	5.35
<b>RxN</b>	18.39	8.01
<b>IxN</b>	15.02	6.54
<b>RxIxN</b>	26.01	11.34

102.7% respectively. The same trend was obtained by **Abd El-Sabour and Abo El-Seoud (1996)** found that organic waste compost addition on sesame caused significantly increment in dry matter.

#### **2-b- Effect of irrigation regimes:**

The data presented in Table (20) indicate that irrigation at 50% loss in water holding capacity significantly surpassed the irrigation at 70% soil moisture stress in dry weight of plants / m<sup>2</sup> in the two growing seasons. The increases reached 157.3 and 153.2% as a result of irrigation at 50% loss in water holding capacity in the first and second seasons, respectively. These results are due to water stress decreased the activity of meristematic tissue responsible for elongation of plant. These results are in accordance with those reported by **Mahmoud (1969), El-Wakil (1983) and Yadav and Srivastava (1997)**.

#### **2-c- Effect of nitrogen levels:**

The results showed that N application significantly increased dry weight of sesame plant /m<sup>2</sup> at 75 days from planting in both seasons. The application of 30 and 60 kg N / feddan increased dry weight of plants/m<sup>2</sup> by 167.4 and 118.0% over unfertilized plants in the first season, respectively. The corresponding increases were 149.1 and 232.4% respectively, in the second season. These results may be due to nitrogen as essential element in sandy soil which plays a prominent role in building new meristematic cells, cell elongation and increasing photosynthesis activity of sesame plants. The same trend was obtained by **Atta (1980), Abu-Hagaza (1981), El-Wakil (1983)**,

**Ghosh and Patra (1993), Awad *et al.* (1997) and Mondal *et al.* (1997).**

**2-d- Interaction effects:**

Table (20) shows that the differences between the mean values of dry weight of plants/m<sup>2</sup> was highly significantly influenced by the interaction between plants residues and irrigation regimes in the two seasons. The higher dry weight of plants / m<sup>2</sup> produced from sandy soil received casuarina and corn straw to the previous crop and irrigated at 50% loss in water holding capacity than which produced when irrigated at 70% loss in water holding capacity. The addition of corn straw to sandy soil with irrigation at 50% soil moisture depletion gave the maximum dry weight of plants/m<sup>2</sup> (498 g) in the first season, whereas no significant difference was obtained between corn straw and casuarina leaves with irrigated at 50% soil moisture stress on dry weight of plants/m<sup>2</sup>. In the second season, the highest value was 422 g, produced from residual of casuarina leaves with irrigated at 50% soil moisture stress. On the contrary, without application of plant residues with irrigation at 70% soil moisture stress gave the minimum dry weight of plants/m<sup>2</sup> which equal to 79 and 76 g in the first and second seasons, respectively.

The interaction between irrigation regimes and N-level had a significant effect on dry weight of plants/m<sup>2</sup> in 1998 and 1999 seasons, as shown in Table (20). The increment in dry matter reached about 491 and 461 g/m<sup>2</sup> in the first and second season, respectively, produced from irrigated at 50% soil moisture stress with applied 60 kg N/feddan as compared to irrigation at 70% soil moisture stress without application of

nitrogen fertilizer. It could be concluded that early irrigation (at 50% soil moisture stress) with the highest level of nitrogen (60 kg N / feddan) gave the best result of dry weight of sesame plants / m<sup>2</sup>.

It was observed from Table (20) that dry weight of sesame plants/m<sup>2</sup> was significantly increased by application of plant residues with increasing level of nitrogen fertilizer in both seasons. Casuarina residues was more effective in increasing plants dry matter by fertilization with 60 kg N / feddan than which received 30 kg N / feddan. The results could be show that the addition of corn straw was similar to addition of casuarina leaves with adding 60 kg N/feddan in dry weight of plants/m<sup>2</sup> in the first seasons. The highest values was 448 and 408 g/m<sup>2</sup>, produce from residual of casuarina leaves with adding 60 kg N/feddan in the first and second seasons, respectively.

Data presented in Table (20) reveal that dry weight of sesame plants was significantly affected by the interaction between the three factors in the two growing seasons. The highest mean values of dry matter was 603 and 548 g / m<sup>2</sup>, obtained from residual of casuarina with irrigated at 50% loss in water holding capacity and applied 60kg N / feddan in the first and second seasons, respectively. However the lowest one was 12 and 13 g/m<sup>2</sup>, respectively, produced from without applicated of plant residues and irrigated at 70% soil moisture stress without nitrogen fertilizer.

## II- Yield and yield components

### 1- Number of capsules per plant and per unit area ( $m^2$ ):

Results in Tables (21 and 22) indicated the effect of plant residues, irrigation regimes and N-levels as well as their interaction on the mean values of capsules number / plant and per  $m^2$  through 1998 and 1999 growing seasons.

#### 1-a- Effect of plant residues:

Data concerned capsules number/plant and per  $m^2$  showed a considerable difference and significant increased as a result of planting sesame in sandy soil with residual effect of corn straw and casuarina leaves as compared to the plants in pure sandy soil in the two growing seasons as shown in Table (21). The increment in sesame capsules number/plant reached 70.2 and 76.7% in the first season and 41.6 and 56.2% in the second season for corn straw and casuarina leaves residues as compared without treated of plant residues, respectively. On the other side, the increment in capsules number/ $m^2$  has been reflected on the capsules number/ $m^2$  which reached about 69.7 and 84.3% in the first season as well as 42.9 and 46.8% for the corn straw and casuarina residues over the check treatment, respectively as shown in Table (22). It could be concluded that the application of casuarina residues to sandy soil was more effective relatively on increasing number of capsules/plant and per  $m^2$  than the application of corn straw in the two growing seasons. The application of organic residues, green manure, crop residues, compost are widely practiced by farmers for improvement in soil productivity and the rise of organic matter in soil improved the soil structure and nutrient supply to plants (Russell, 1973).

Table (21): Effect of plant residues, irrigation regimes, N-levels and their interactions on Capsules number / plant in 1998 and 1999 seasons.

Plant residues	N- Level KgN/fed	Capsules number plant					
		1 <sup>st</sup> season		Mean	2 <sup>nd</sup> season		Mean
		Irrigation regimes			Irrigation regimes		
		W1	W2	W1	W2		
Without	0	7	4	5.8	4	3	3.5
	30	34	21	27.8	21	15	21.5
	60	37	24	30.8	40	17	28.5
	Mean	26.4	16.5	21.5	24	11.6	17.8
Corn straw	0	23	12	17.8	16	6.0	11.0
	30	57	31	44.5	40	21	30.6
	60	61	33	47.5	45	23	34.0
	Mean	47.4	25.7	36.6	33.6	16.6	25.2
Casuarina leaves	0	23	12	18.1	18	7	12.5
	30	59	33	46.3	45	23	34.0
	60	63	35	49.5	47	27	37.0
	Mean	48.8	27.1	38.0	36.6	19	27.8
IxN	0	18.1	9	13.9	12.6	5.3	9.0
	30	50.5	28	39.5	37.6	19.7	28.7
	60	54.1	31	42.6	44.0	22.3	33.1
	Mean	40.9	23.1		31.4	15.4	

L.S.D at 0.05

R	1.539	0.437
I	2.259	1.027
N	0.880	0.789
RxI	2.177	0.618
RxN	1.526	0.966
IxN	1.246	0.789
RxIxN	2.157	1.366

**Table (22): Effect of plant residues, irrigation regimes, N-levels and their interactions on Capsules number / m<sup>2</sup> in 1998 and 1999 seasons.**

Plant residues	N- Level KgN/fed	Capsules number/m <sup>2</sup>					
		1 <sup>st</sup> season		Mean	2 <sup>nd</sup> season		Mean
		Irrigation regimes			Irrigation regimes		
		W1	W2		W1	W2	
<b>Without</b>	0	155	79	117	88	60	74
	30	760	445	602	614	321	467
	60	854	501	677	909	357	633
	<b>Mean</b>			465	537	246	391
<b>Corn straw</b>	0	514	260	387	357	212	239
	30	1286	641	963	8.72	487	679
	60	1327	707	1017	1005	517	761
	<b>Mean</b>			789	744	375	559
<b>Casuarina leaves</b>	0	529	267	398	396	140	268
	30	1376	699	1037	924	460	692
	60	1476	800	1136	1024	506	763
	<b>Mean</b>			857	780	369	574
<b>IxN</b>	0	399	202	301	280	107	193
	30	1140	595	867	803	422	613
	60	1217	669	943	978	460	719
	<b>Mean</b>				687	330	

**L.S.D at 0.05**

<b>R</b>	31.08	13.36
<b>I</b>	42.41	21.71
<b>N</b>	25.76	11.00
<b>RxI</b>	43.95	18.90
<b>RxN</b>	44.61	19.05
<b>IxN</b>	36.61	15.56
<b>RxIxN</b>	63.09	26.94

The same trend was obtained by **Gaber (1998)** found that preceding winter crops before sesame had significant effects on number of capsules/plant.

#### **1-b- Effect of irrigation regimes:**

Number of capsules/plant and per m<sup>2</sup> were significantly affected by irrigation regimess in both seasons (Tables 21 and 22). In the first season, the increment in capsules number/plant and per m<sup>2</sup> were 77.1 and 87.9% respectively for irrigation at 50% loss in water holding capacity as compared to the irrigation at 70% loss in water holding capacity. Also, the increment in the above characters were 103.9 and 108.2%, respectively for irrigation at 50% soil moisture stress over the irrigation at 70% soil moisture stress in the second season. The increments in sesame capsules number due to the early irrigation must be attributed to the availability of water to reach near the root zone of the plants and then developed healthy plants. These results are in good agreement with those obtained by **Mahmoud (1969)**, **Atta (1980)** and **El-Wakil (1983)**.

#### **1-c- Effect of nitrogen levels:**

The data in Tables (21 and 22) indicated that number of capsules per plant and per m<sup>2</sup> were significantly increased by increasing N level up to 60 kg N/feddan in both seasons. Application of 60 kg N/feddan gave the highest capsules number /plant (42.6 and 33.1) and highest capsules number/m<sup>2</sup> (943 and 719) in the first and second seasons, respectively. Whereas the lowest number of capsules/plant and capsules number/m<sup>2</sup> were 9.0 and 5.3 capsules / plant as well as 301 and 193 capsule/m<sup>2</sup> in

the first and second seasons, respectively, produced from without application of nitrogen fertilizer. The observed data emphasized that sesame plants utilized significantly from high rate of nitrogen than low rate. These results are in harmony with those obtained by **Mahmoud (1976)**, **Atta (1980)**, **Khalil (1980)**, **Abu-Hagaza (1981)**, **El-Wakil (1983)**, **Ghosh and Parta (1993)**, **Ramakrishnan et al. (1994)**, **Awad et al. (1997)** and **Mondal et al. (1997)**.

#### **1-d- Interaction effects:**

The interaction between plant residues and irrigation levels demonstrate a considerable and significant improvement in both capsules number/plant which in turn reflected on capsules number/m<sup>2</sup> as shown in Tables (21 and 22). Casuarina residues was effective with irrigation at 50% soil moisture stress and higher in its effect than corn straw residues as well as the two plant residues in capsules number / plant and per m<sup>2</sup> specially with irrigation at 50% loss in water holding capacity as compared to 70% loss in water holding capacity.

There were a significant differences of capsules number / plant and per m<sup>2</sup> due to the interaction between irrigation regimes and N-levels in both seasons as shown in Tables (21 and 22). The fertilization with 60 kg N / feddan was more effective in increasing capsules number / plant (54.1 and 44.0) and capsules number / m<sup>2</sup> (1217 and 978) when irrigated at 50% soil moisture stress in the first and second seasons, respectively. It could be concluded that increasing N level up to 60 kg N / feddan was more efficiency with increasing available of soil

moisture in sandy soil to gave the highest mean values of capsules number / plant and per m<sup>2</sup>.

The differences between the mean values of above characters were significantly affected due to the interaction between N-levels and plant residues in the two growing seasons (Tables 21 and 22). The highest value of capsules number / plant (49.5 and 37.0) and highest capsules number / m<sup>2</sup> (1136 and 763) were produced from residual of casuarina leaves with applied 60 kg N / feddan in the first and second seasons, respectively.

The effect of the interaction between the three factors under study were highly significant on capsules number / plant and per m<sup>2</sup> in both seasons (Tables 21 and 22). It was clear that, the highest values were produced from sandy soil received casuarina leaves followed by corn straw to the previous wheat crop and irrigated at 50% loss in water holding capacity with applied 60 kg N / feddan in the two growing seasons.

## **2- 1000-Seed weight :**

Date presented in Table (23) shows the effect of plant residues, irrigation regimes and N-levels as well as their interaction on seed sesame index (1000-seed weight) of sesame at harvest time during 1998 and 1999 growing seasons.

### **2-a- Effect of plant residues :**

The mean values of seed index was significantly increased by application of plant residues before wheat planting (as a residual effect of planting wheat before sesame) compared to planting sesame in pure sandy soil (control ) in one seasons out of two are shown in Table (23). The increments reached 6.23

**Table (23): Effect of plant residues, irrigation regimes, N-levels and their interactions on sesame 1000-seed weight (g) in/1998 and 1999 seasons.**

Plant residues	N- Level KgN/fed	1000- seed weight (g)					
		1 <sup>st</sup> season		Mean	2 <sup>nd</sup> season		Mean
		Irrigation regimes			Irrigation regimes		
		W1	W2		W1	W2	
Without	0	2.84	2.43	2.63	2.73	2.53	2.63
	30	3.12	2.86	2.99	3.04	2.69	2.68
	60	3.21	2.89	3.05	3.21	2.88	3.05
<b>Mean</b>		3.05	2.72	2.89	2.99	2.70	2.85
Corn straw	0	2.92	2.74	2.83	3.07	2.60	2.80
	30	3.40	2.92	3.16	3.62	2.83	3.22
	60	3.50	2.95	3.22	3.69	2.90	3.29
<b>Mean</b>		3.27	2.87	3.07	3.44	2.78	3.11
Casuarina leaves	0	3.03	2.84	2.94	3.35	2.63	2.99
	30	3.51	2.91	3.21	3.60	2.97	3.28
	60	3.60	2.94	3.27	3.70	3.00	3.35
<b>Mean</b>		3.38	2.89	3.14	3.55	2.86	3.21
IxN	0	2.93	2.67	2.80	3.03	2.59	2.81
	30	3.34	2.90	3.12	3.42	2.83	3.12
	60	3.43	2.93	3.18	3.53	2.93	3.23
<b>Mean</b>		3.23	2.83		3.33	2.78	

**L.S.D at 0.05**

<b>R</b>	0.034	0.102
<b>I</b>	0.074	0.196
<b>N</b>	0.030	0.031
<b>RxI</b>	0.048	0.141
<b>RxN</b>	0.059	0.053
<b>IxN</b>	0.042	0.044
<b>RxIxN</b>	0.075	0.078

and 8.65% for corn straw and casuarina leaves, respectively in the first season as well as 9.12 and 12.63% for the same treatments, respectively, in the second seasons. This result may be due to application of plant residues to sandy soil caused a significant increment in nitrogen content in the soil and decreasing soil pH.

#### **2-b- Effect of irrigation regimes:**

Table (23) indicated that irrigation regimes had a significant effect on 1000-seed weight of sesame in the two growing seasons. Irrigation of sesame plants in sandy soil at 50% loss in water holding capacity increased 1000-seed weight by 14.1 and 19.8% in the first and second seasons, respectively compared to which irrigated to late (at 70% loss in water holding capacity). This is to be expected since water plays an important role in plants and moisture deficit can have a deleterious on most physiological process. Similar trend were reported by **Atta (1980) El-Wakil (1983) and Yadav and Srivastava (1997)**.

#### **2-c- Effect of nitrogen levels:**

The data reported in Table (23) show that nitrogen application to sesame plants significantly increased the mean values of 1000-seed weight at harvest in both seasons. Application of 30 and 60 kg N/faddan increased 1000-seed weight over the check treatment by 11.43 and 13.59%, respectively in the first season. The corresponding increases were 11.03 and 14.95% in the second season, respectively. The increase in seed index due to N application is an indication for the role of N in plant growth, development and production. These results are in agreement with those obtained by **Abdel-**

Rahman *et al.* (1980), Atta (1980), El-Wakil (1983), Ghosh and Patra (1993), Ramakrishnan *et al.* (1994) and Mondal *et al.* (1997).

**2-d- Interaction effects :**

Table (23) show that the mean values of seed index was significantly affected by the interaction between irrigation regimes and plant residues in 1998 and 1999 seasons. Sesame plants grown in soil treated with casuarina and corn straw before wheat with continuously irrigation at 50% loss in water holding capacity produced the higher weight of thousand seeds compared to which development from irrigation at 70% soil moisture stress. The highest mean values of seed index was 3.38 and 3.55 gm, obtained from residual of casuarina with irrigation at 50% loss in water holding capacity in the first and second seasons, respectively.

The effect of irrigation regimes and N-levels interaction was significant on 1000-seed weight in both season (Table 23). The maximum mean values of seed index was 3.43 and 3.53 gm, produced from irrigated after 50% loss in water holding capacity with applied 60 kg N / feddan in the first and second seasons, respectively. The increasing in seed index as a result of applying 60 kg N/feddan was 28.5% and 36.3% higher when the plants irrigated early in the first and second seasons, respectively compared to without application of nitrogen fertilizer with irrigated late.

It was clear that there was a significant difference of seed index due to the interaction between plant residues and N level in the two growing seasons as shown in Table (23). The

combination between plant residues i.e corn straw or casuarina residues with 60 kg N / feddan gave the highest values of 1000-seed weight of sesame in both seasons. Whereas no significant difference was obtained between the interaction of corn straw and casuarina residues with applied 60 kg N/feddan on 1000-seed weight in the two growing seasons.

Finally the effect between plant residues, irrigation regimes and N levels showed higher significant and considerable values of seed index in both seasons (Table 23). The best combination between high rate of nitrogen (60 kg N/ feddan) to sesame plants cultivated in sandy soil received corn straw or casuarina residues and irrigated at 50% loss in water holding capacity in both seasons. The maximum weight of thousand seed was 3.60 and 3.70 gm, produced from residual of casuarina with irrigated at 50% soil moisture stress and applied 60 kg N / feddan in the first and second seasons, respectively.

### **3- Seed yield per plant (g)**

The data illustrated in Table (24) show that the mean values of seed yield / plant as affected by plant residues, irrigation regimes and N-levels as well as their interaction in 1998 and 1999 seasons.

#### **3-a- Effect of plant residues :**

The results showed that seed yield / plant was significantly increased after cultivating sesame plants in sandy soil received casuarina residues and corn straw pre planting (as a residual effects of planting wheat before sesame) compared to pure sandy soil in the two growing seasons. The residual of corn

**Table (24): Effect of plant residues, irrigation regimes, N-levels and their interactions on Seeds yield / plant (g) in 1998 and 1999 seasons.**

Plant residues	N- Level KgN/fed	Seeds yield plant (g)					
		1 <sup>st</sup> seasons		Mean	2 <sup>nd</sup> seasons		Mean
		Irrigation regimes			Irrigation regimes		
		W1	W2		W1	W2	
Without	0	0.257	0.327	0.257	0.250	0.237	0.243
	30	2.733	1.923	2.328	2.180	1.400	1.790
	60	4.433	2.983	3.708	5.047	2.697	3.872
	<b>Mean</b>	2.474	1.744	2.109	2.492	1.444	1.968
Corn straw	0	2.483	1.350	1.917	2.040	1.027	1.533
	30	6.457	3.960	5.208	5.520	3.047	4.283
	60	8.357	4.623	6.490	7.227	3.643	5.435
	<b>Mean</b>	5.766	3.311	4.538	4.929	2.572	3.751
Casuarina leaves	0	2.533	1.517	2.025	2.213	1.103	1.658
	30	7.033	4.133	5.583	5.720	3.153	4.437
	60	8.877	4.900	6.888	7.910	3.783	5.847
	<b>Mean</b>	6.766	3.517	4.832	5.281	2.680	3.981
IxN	0	1.758	1.064	1.411	1.501	0.789	1.145
	30	5.408	3.339	4.373	4.473	2.533	3.503
	60	7.222	4.169	5.696	6.728	3.374	5.051
	<b>Mean</b>	4.796	2.856		4.234	2.232	

**L.S.D at 0.05**

R	0.121	0.087
I	0.181	0.037
N	0.139	0.057
RxI	0.172	0.123
IxN	0.197	0.081
RxN	0.241	0.099
RxIxN	0.341	0.141

straw and casuarina leaves increased seed yield / plant over in pure sandy soil by 115.2 and 129.1%, respectively in the first season, while the corresponding increase were 90.6 and 102.3% respectively in the second seasons. It was clear that application of casuarina residues before planting wheat gave the maximum sesame yield of seeds per plant which equal to 4.832 and 3.981 g in the first and second seasons, respectively, the increments in seed yield / plant as a result of the application of residues as on organic matter could be explained by the raising of nutrients and improving soil structure such as nitrogen, **Khaleel *et al.* (1981)**. Similar trend was obtained by **Gaber (1998)**.

### **3-b- Effect of irrigation regimes:**

Concerning to irrigation regimes, results indicated that seed yield/ plant was significantly affected by levels of irrigation in both seasons as shown in Table (24). The increment in seed yield / plant by irrigation at 50% soil moisture stress was 1.940 and 2.002 g, over the treatment of at 70% loss in water holding capacity in the first and second seasons, respectively. This was expected since drought stress during seed filling may be affected greatly on the amount of photosynthesis in the seeds. These results are in line with those obtained by **Mohmoud (1969)**, **Atta (1980)** and **Yadav and Srivastava (1997)**.

### **3-c- Effect of nitrogen levels:**

The effect of N-levels on seed yield / plant was significant increase in both seasons (Table 24). The application of 30 and 60 kg N/feddan increased seed yield /plant over without application of nitrogen fertilizer by 209.8 and 309.7%, respectively in the first season. Whereas, the second season were 206.0 and 341.1%,

respectively. This is clear illustration for the prominent role of N in increasing seed yield under the sandy soil conditions. These results are in accordance with those obtained by **Atta (1980)**, **Khalil (1980)**, **Abu-Hagaza (1981)**, **El-Wakil (1983)**, **Ramakrishnan et al. (1994)** and **Awad et al (1997)**.

### **3-d- Interaction effects :**

The interaction between plant residues and irrigation regimes showed a significant effect on seed yield / plant in the two growing seasons (Table 24). The maximum seed yield / plant was 6.77 and 5.28 g, produced from planting sesame in sandy soil with a residual casuarina and irrigated at 50% loss in water holding capacity in the first and second seasons, respectively. whereas the increase reached 92.3, 79.1 and 42.5% for casuarina , corn straw and pure sandy soil with irrigated after 50% loss in WHC, respectively in the first season and 97.0, 91.8 and 72.9% in the second season at the same treatments, respectively compared to which irrigated at 70% loss in water holding capacity (WHC).

There was a significant effect of the interaction between irrigation regimes and N-level on seed yield / plant in both seasons (Table 24). Irrigation at 50% soil moisture stress with applied 60 kg N/ feddan to sesame plants in sandy soil gave the highest mean values of seed yield / plant (7.22 and 6.73 g) the first and second season, respectively. On the other hand, the lowest one was 1.06 and 0.79 g, respectively, produced from irrigation at 70% soil moisture stress without application of nitrogen fertilizer. It could be noticed that the early irrigation (at

50% loss in water holding capacity) was more effective with the application of 60 kg N/feddan in seed yield / plant

The data in Table (24) showed that seed yield / plant was significantly increased by application of plant residues with increasing N-level up to 60 kg N/feddan in the two growing seasons. Application of casuarina residues before wheat with application of 60 kg N / feddan gave the maximum seed yield / sesame plant which equal to 6.89 and 5.85 g in the first and second seasons, respectively. Whereas, the minimum one was 0.26 and 24 g, produced from without application of plant residues and nitrogen fertilizer in 1998 and 1999 seasons, respectively.

The resulted interaction between plant residues, irrigation regimes and nitrogen applied induced a significant improvement in sesame seeds yield per plant. The best interaction produced from the interaction between casuarina residues, irrigation at 50% loss in water holding capacity and fertilization with 60 kg N / feddan (8.88 and 7.91 g) in the two growing seasons, respectively compared to the other interaction.

The increases in plant seeds yield as a result of the incorporation of plant residues on soil charaters (**Pannamperume, 1984**). Thus could be reffected to be more effective as a nutrients sources to sesame plants which in turn increased seed weight per plant.

#### **4- Seeds yield (kg / feddan) :**

Data recorded in Table (25) and Fig. (13 and 14) show the effect of plant residues, irrigation regimes and N-level as well as their interaction on the mean values of sesame seed yield (kg)per feddan in 1998 and 1999 seasons.

**Table (25): Effect of plant residues, irrigation regimes, N-levels and their interactions on Seeds yield (kg/feddan) in 1998 and 1999 seasons.**

Plant residues	N- Level KgN/fed	Seed yield (kg/feddan)					
		1 <sup>st</sup> season		Mean	2 <sup>nd</sup> season		Mean
		Irrigation regimes			Irrigation regimes		
		W1	W2		W1	W2	
<b>Without</b>	0	26	16	21	22	16	19
	30	218	154	186	189	112	151
	60	334	221	278	436	205	320
	<b>Mean</b>	193	130	161	216	111	163
<b>Corn straw</b>	0	215	89	152	174	80	127
	30	574	318	446	455	245	350
	60	739	328	534	630	277	453
	<b>Mean</b>	509	245	377	419	200	310
<b>Casuarina leaves</b>	0	244	121	173	198	75	137
	30	586	318	452	480	255	367
	60	779	360	569	668	282	475
	<b>Mean</b>	530	266	398	448	204	326
<b>IxN</b>	0	155	75	115	131	57	94
	30	459	263	361	375	204	289
	60	617	303	460	578	254	416
	<b>Mean</b>	410	214		361	172	

**L.S.D at 0.05**

<b>R</b>	16.93	1.87
<b>I</b>	18.18	1.46
<b>N</b>	10.08	1.91
<b>RxI</b>	23.95	2.64
<b>RxN</b>	17.45	3.31
<b>IxN</b>	14.25	2.70
<b>RxIxN</b>	24.68	4.69

W1 = 50% soil moisture stress  
W2 = 70% soil moisture stress

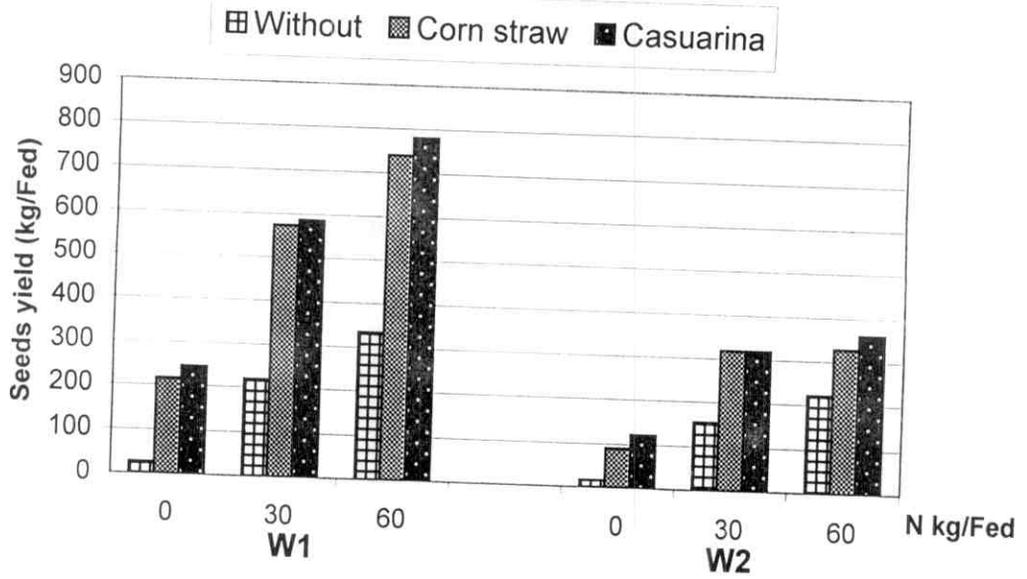


Fig (13): Seeds yield of sesame (kg/Fed) during 1998, growing season.

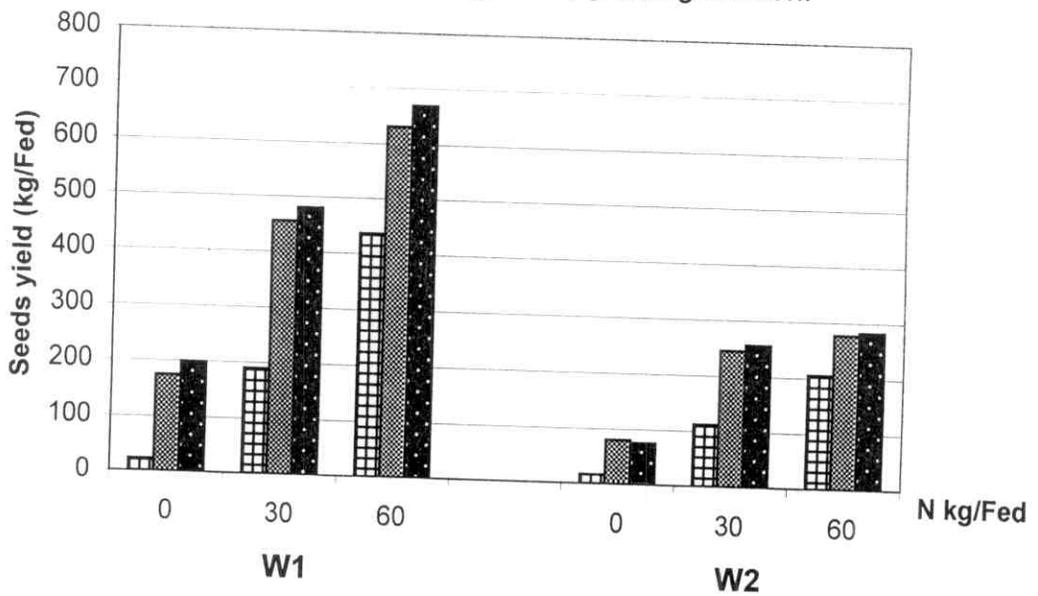


Fig (14): Seeds yield of sesame (kg/Fed) during 1999, growing season.

**4-a- Effect of plant residues :**

The application of corn straw and casuarina residues significantly increased sesame seed yield per feddan over untreated sandy soil by 134.16 and 147.28%, respectively in the first seasons, whereas the corresponding increases were 90.18 and 100.0%, respectively in the second seasons (Table 25) and Fig. (13 and 14). This is to be expected since the main values of number of capsules per plant and per unit area ( $m^2$ ), seed yield / plant and 1000-seed weight were increased by application of plant residues before wheat . The increases in sesame seeds yield as a result of corn and casuarina residual effect in nitrogen content in sandy soil, **Abd El-Moez (1995)** which reflected on the efficiency photosynthesis and net assimilation rate and the increasing of economic seeds yield has been done. Similar trend was obtained by **Abdel-Sabour and Abo El-Seoud (1996)** **Abdel-Sabour *et al.* (1997)** and **Gaber (1998)**.

**4-b- Effect of irrigation regimes:**

As shown in Table (25) and Fig. (13 and 14) irrigation of sesame plants early at 50% in water holding capacity induced high significant increased in seed yield / feddan as compared to plants which irrigated at 70% loss in water holding capacity. The increment in seed yield was 91.6 and 109.9% for the irrigation to early in the first and second seasons, respectively, Exposing plants to water stress caused a significant reduction in physiological growth which reflected on seed yield of sesame per feddan. Many investigators were obtained the same results (**El- Wakil, 1983; El-Wakil and Gaafar, 1988; Mohamed and Abdel-Monem, 1994; Yadav and Srivastava, 1997**).

**4-c- Effect of nitrogen levels :**

It was clear from Table (25) and Fig. (13 and 14) that the mean values of sesame seed yield / feddan was significantly increased by increasing N level up to 60 kg N/feddan in the two growing seasons. The application of 30 and 60 kg N/feddan increased seed yield by 213.9 and 300% , respectively over the control treatment (zero N) in the first season. The corresponding increases were 207.4 and 342.5%, respectively in the second season. The increase in N-level is a result of the effect of N increasing number of capsules / plant and per m<sup>2</sup> , seed yield / plant and 1000-seed weight. These results are in harmony with those obtained by **Abd El-Rahman *et al.* (1980), Atta (1980), Abu-Hagaza (1981), El-Wakil (1983), Ghosh and Patra (1993), Ishwar *et al.* (1994), Awad *et al.* (1997) and Mondal *et al.* (1997).**

**4-d- Interaction effects:**

The results in Table (25) showed that the interaction between plant residues and irrigation regimes significantly affected seed yield / feddan in the two growing seasons, The combination of corn straw or casuarina residues with irrigation at 50% soil moisture stress gave the best results in seed yield /feddan compared to irrigation at 70% soil moisture stress in both seasons. The highest values was 530 and 448 kg / feddan, produced from residual of casuarina with irrigated at 50% loss water holding capacity in the first and second seasons, respectively.

Data in Table (25) revealed that there were a significant differences in seed yield / feddan as affected by the interaction

between irrigation regimens and N- levels in both seasons, The maximum seed yield was 617 and 578 kg/ feddan, obtained from irrigation at 50% soil moisture stress with applied 60 kg N/feddan in the first and second seasons, respectively. On the contrary, the minimum one was 75 and 57 kg / feddan, respectively, produced from without application of nitrogen and irrigated at 70% soil moisture stress. It could be with said that the irrigation to early is more efficiency with 60 kg N/feddan in seed yield compared to irrigation to late without application of nitrogen .

The interaction effect between plant residues and N-levels was significant on seed yield (kg) /feddan in the two growing seasons Table (25). The higher values of seed yield/feddan was observed by the combination between casuarina residues or corn straw with the application of 60 kg N/feddan. The increments percentage ranged between 92.1 and 104.7% in the first season as well as between 41.6 and 48.4% in the second season for corn straw and casuarina residues treatments, respectively received 60 kg N/feddan compared to sesame plants which grown in pure sandy soil and fertilized without N fertilizer with 60 kg N/feddan

The data illustrated in Table (25) show that seed yield / feddan was significantly affected by the interaction between the three factors under study in both seasons. Sesame plants cultivated in sandy soil with a residual effect of casuarina with irrigation at 50% soil moisture stress and applied 60 kg N / feddan gave the greatest seed yield / feddan which equal to 779 and 668 kg/feddan in the first and second seasons, respectively.

It could be concluded that the seed yield of sesame was the highest for each plant residues with high level of nitrogen (60 kg N /feddan) and with irrigation at 50% loss in water holding capacity.

### **5- Straw yield (kg / feddan):**

The values of straw yield /feddan as affected by plant residues, irrigation regimes and N-levels as well as their interactions in 1998 and 1999 seasons are presented in Table (26) and Fig. (15 and 16).

#### **5-a- Effect of plant residues :**

The mean values of straw yield /feddan was significantly increased by residual effect of corn straw and casuarina leaves in sandy soil as compared to which grown in sandy soil untreated with plant residues in the two growing seasons (Table 26) and Fig. (15 and 16). The highest mean values of straw yield /feddan was 2405 and 2103 kg in the first and second seasons, respectively produced from residual of casuarina leaves. Also, the soil treated with corn straw and casuarina residues showed a significant increased reached about 112.9 and 132.6% compared to which planted in pure sandy soil in the first season as well as 87.2 and 110.5% in the second season , respectively. Straw yield was affected by the other characters i.e plant height and dry weight of plants / m<sup>2</sup> which increased by residual of plant residues.

**Table (26): Effect of plant residues, irrigation regimes, N-levels and their interactions on Straw yield (kg/feddan) in 1998 and 1999 seasons.**

Plant residues	N- Level KgN/fed	Straw yield (kg/feddan)					
		1 <sup>st</sup> season		Mean	2 <sup>nd</sup> season		Mean
		Irrigation regimes			Irrigation regimes		
		W1	W2		W1	W2	
Without	0	197	117	157	155	112	133
	30	1420	942	1181	1157	660	9.9
	60	2180	1350	1765	2680	1231	1955
	<b>Mean</b>		1266	803	1034	1331	668
Corn straw	0	1361	561	961	1121	459	790
	30	3263	1790	2527	2890	1414	2152
	60	4280	1951	3115	3703	1633	2668
	<b>Mean</b>		2968	1434	2201	2572	1290
Casuarina leaves	0	1439	730	1085	1312	478	895
	30	3480	1887	2684	3149	1585	2367
	60	4694	2199	3449	4288	1808	3048
	<b>Mean</b>		3204	1605	2405	2917	1290
IxN	0	999	469	734	863	350	606
	30	2721	1540	2130	2399	1220	1809
	60	3718	1833	2775	3557	1557	2557
	<b>Mean</b>		2479	1281		2273	1042

**L.S.D at 0.05**

<b>R</b>	53.62	16.52
<b>I</b>	58.85	21.78
<b>N</b>	35.04	25.31
<b>RxI</b>	75.83	23.37
<b>RxN</b>	60.69	43.83
<b>IxN</b>	49.04	35.79
<b>RxIxN</b>	85.82	61.99

W1 = 50% soil moisture stress  
W2 = 70% soil moisture stress

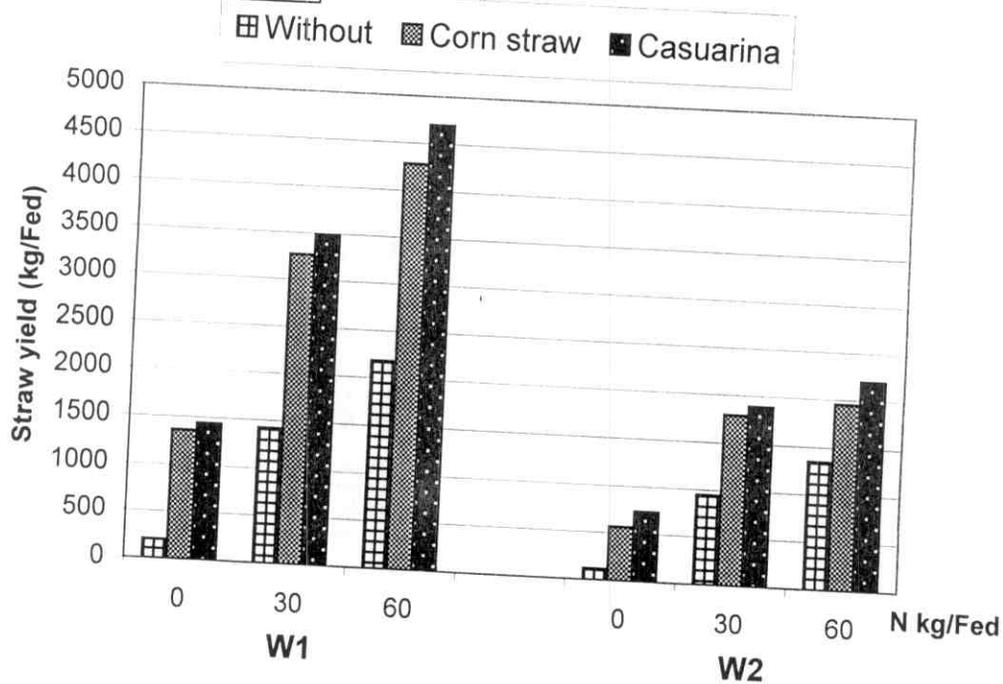


Fig (15): Straw yield of sesme (kg/Fed) during 1998, growing season.

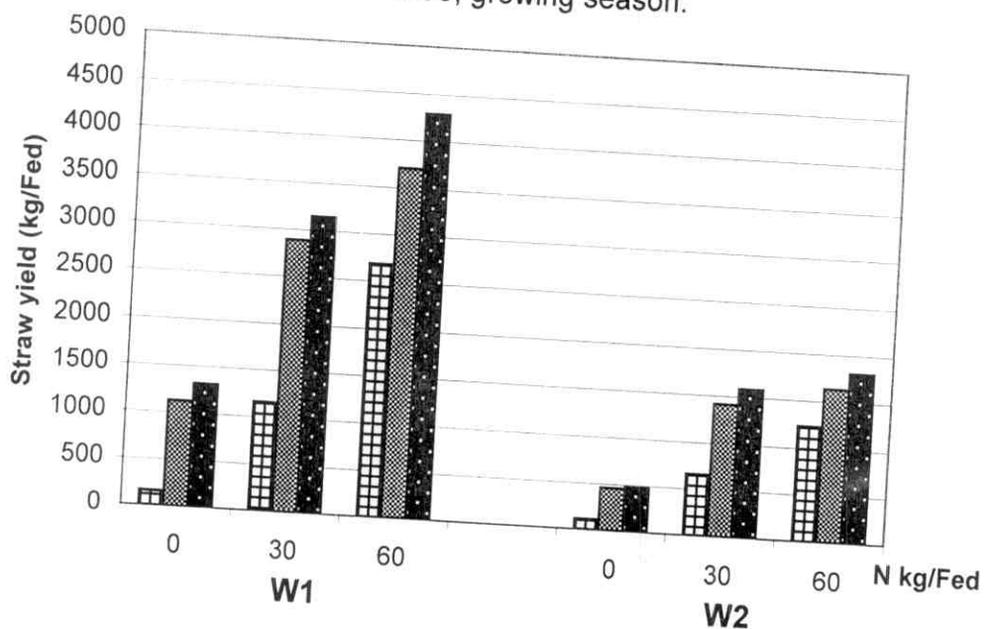


Fig (16): Straw yield of sesame (kg/Fed) during 1999, growing season.

**5-b- Effect of irrigation regimes:**

Irrigation regimes had a significant effect on straw yield of sesame per feddan in both seasons. Irrigation of sesame plants at 50% loss in water holding capacity significantly surpassed the irrigation at 70% soil moisture stress by 93.52 and 118.14% in the first and second seasons, respectively. This result may be expected because plant height and dry weight of plants / m<sup>2</sup> were decreased by increasing soil moisture depletion up to 70%. Similar conclusion was obtained by **El-Wakil (1983)** and **Mohamed and Abdel-Monem (1994)**.

**5-c- Effect of nitrogen levels:**

The data illustrated in Table (26) and Fig. (15 and 16) show that straw yield / feddan was significantly increased by increasing N level up to 60 kg N/feddan in the two growing seasons. Raising N level from zero to 60 kg N / feddan in sandy soil increased straw yield / feddan by 290.83 and 321.95 % in the first and second seasons, respectively. The response of straw yield to N level is nearly similar to that seed yield and reflect of nitrogen fertilizer on stimulating the vegetative growth of sesame i.e plant height and dry weight of plants / m<sup>2</sup>. It could be concluded that the optimum N level for producing the highest seed and straw yields of sesame under sandy soil conditions is 60 kg N/ feddan. These results are in accordance with those obtained by **Abdel-Rahman et al. (1980)**, **Abu-Hagaza (1981)**, **El-Wakil (1983)**, **Ghosh and Patra (1993)** and **Mondal et al. (1997)**.

**5-d- Interaction effects :**

Data in Table (26) shows that the average values of straw yield / feddan was significantly affected by all the interactions between the two factors and the three factors under study in both seasons. Sesame plants cultivated in sandy soil with residual of casuarina leaves and irrigated at 50% soil moisture stress increased straw yield by 299.00 and 336.68% over untreated plants with plant residues and irrigated at 70% soil moisture stress in the first and second seasons, respectively.

The highest mean values of straw yield / feddan was 3718 and 3557 kg / feddan produced from irrigation at 50 % loss in water holding capacity with applied 60 kg N/feddan in the first and second seasons, respectively , However the lowest one was 469 and 350 kg / feddan, obtained from irrigation at 70% soil moisture stress without nitrogen fertilizer in the first and second seasons, respectively.

The effect of the interaction between plant residues and N level were significant on straw yield / feddan in both seasons (Table 26). Sesame plants cultivated in sandy soil with residual of casuarina leaves and applied 60 kg N/feddan gave the maximum yield of straw per feddan which equal to 3449 and 3048 kg / feddan in the first and second seasons, respectively.

Results in Table (26) show that straw yield per feddan was significantly affected by the interaction between plant residues, irrigation regimes and N-level in both seasons. The increment in straw yield was 4577 and 4176 kg / feddan in the first and second seasons, respectively, produced from residual of casuarina and applied 60 kg N/feddan with irrigated at 50% loss

in water holding capacity over without applied of plant residues and nitrogen fertilizer with irrigated at 70% soil moisture stress. It could be concluded that residual of corn straw or casuarina leaves to sandy soil and irrigated at 50% soil moisture stress with applied 60 kg N/feddan gave the best result of straw yield / feddan.

### **III- Chemical analysis**

#### **1- Seed oil content :**

Table (27) show the effect of plant residues, irrigation regimes and N-level as well as their interaction on seed oil content in 1998 and 1999 seasons.

#### **1-a- Effect of plant residues :**

Seed oil percentage was significantly increased when sesame plants grown in sandy soil treated with casuarina and corn straw as compared to which grown in sandy soil untreated with plant residues in both the first season only. The increases in seed oil content as a result of plant residues applicated in sandy soil were 1.15 and 1.23% in the first season as well as 1.13 and 0.87% in the second season for casuarina and corn straw as compared to untreated with plant residues, respectively. Residual of casuarina was more effective in seed oil content in the first season and residual of corn straw was more effective and increased seed oil content higher than using casuarina residues in the second season. The increment in seed oil content as a result of the application of plant residues as an organic matter could be explained by the raising of improving soil structure **Khalil et al. (1981).**

Table (27): Effect of plant residues, irrigation regimes, N-levels and their interactions on Seed oil content (%) in 1998 and 1999 seasons.

Plant residues	N- Level KgN/fed	Seed oil content (%)					
		1 <sup>st</sup> season		Mean	2 <sup>nd</sup> season		Mean
		Irrigation regimes			Irrigation regimes		
		W1	W2	W1	W2		
Without	0	52.15	50.32	51.23	53.47	52.57	53.02
	30	53.90	50.98	52.44	54.93	53.75	54.34
	60	53.98	51.66	52.82	55.13	53.68	54.41
Mean		53.34	50.99	52.16	54.51	53.33	53.92
Corn straw	0	53.41	50.87	52.14	54.20	52.92	53.56
	30	54.85	51.56	53.21	56.17	53.89	55.03
	60	54.49	51.35	52.92	55.84	54.16	55.00
Mean		54.25	51.26	52.76	55.40	53.66	54.53
Casuarina leaves	0	53.62	50.98	52.30	53.92	53.01	53.46
	30	54.86	51.69	53.27	56.42	53.82	55.12
	60	54.31	51.31	52.81	55.48	53.69	54.58
Mean		54.26	51.33	52.80	55.27	53.50	54.39
IxN	0	53.06	50.72	51.89	53.86	52.82	53.35
	30	54.54	51.41	52.97	55.84	53.82	54.83
	60	54.26	51.44	52.85	55.48	53.84	54.66
Mean		53.92	51.19		55.06	53.50	

**L.S.D at 0.05**

R	0.10	N.S.
I	1.43	0.05
N	0.16	0.06
RxI	0.14	0.09
RxN	0.29	0.11
IxN	0.24	0.09
RxIxN	0.41	0.15

Similar results were obtained by **Abd El-Sabour and Abo El-Seoud (1996)**, **Abd El-Sabour *et al.* (1997)** and **Gaber (1998)**.

#### **1-b- Effect of irrigation regimes:**

Irrigation of sesame at 50% and 70% loss in water holding capacity had a significant effect on seed oil % in the two growing seasons (Table 27). Irrigation of sesame plants at 50% loss in water holding capacity produced the highest content of seed oil, whereas the increment occurred were 5.33 and 2.91% in the first and second seasons, respectively as compared with irrigation at 70% loss in water holding capacity. It is apparent that seed oil content decreased with increasing loss in water holding capacity in the two growing seasons. The above mentioned results could be explained by the fact that the accumulation of fats takes place during the development of storage tissue. Fat increases in the quantity and in concentration during the development of the seed. This accumulation is probably due to the transformation of sugar to fat in the seed itself and it is actually sugar rather than fat which is translocated into seeds from leaves of plants. Moreover, reducing irrigation interval enhanced carbohydrate accumulation, which in turn increases seed oil percentage. These results are in agreement with those obtained **El-Serogy *et al.* (1977)**, **Hassan *et al.* (1977)**, **Atta (1980)** and **El-Wakil (1983)**.

#### **1-c- Effect of nitrogen levels:**

The results in table (27) indicated that seed oil content of sesame was significantly affected by increasing level of nitrogen in the two growing seasons. The application of 30 and 60 kg N/feddan increased oil content by 2.08 and 1.85%, respectively

over the check treatment in the first season. The corresponding increases were 2.77 and 2.45%, respectively, in the second season. Also, the increases were not significantly between 30 and 60 kg / feddan in the first season. The highest value of seed oil percentage was produced from applied 30 kg N/ feddan in the second season. The present finding generally is in harmony with those obtained by **Atta (1980), Khalil (1980), El-Wakil (1983), Ramakrishnan et al. (1994), Ashok et al. (1996) and Awad et al. (1997).**

#### **1-d- Interaction effects :**

Data in Table (27) showed that there were significant difference in seed oil content as affected by the interaction between plant residues and irrigation regimes in 1998 and 1999 growing seasons. Residual of corn straw in the first season and residual of casuarina in the second season with irrigation at 50% soil moisture stress gave the highest value of seed oil content whereas no significant difference was obtained between corn straw and cosourina leaves with early irrigation on seed oil content in the first season.

Also, the interaction between irrigation regimes and N levels significantly affected seed oil content in both seasons as shown in Table (27). The highest value of seed oil content was 54.54 and 55.84% produced from applied 30 kg N/feddan with irrigated at 50% loss in water holding capacity in the first and second seasons, respectively. On the other hand, irrigation at 70% loss in water holding capacity without applied of nitrogen fertilizer gave the lowest one (50.72 and 52.82%, respectively). Whereas, seed oil content was decreased by increasing level of

nitrogen from 30 to 60 kg N/ feddan with two levels of irrigation in both seasons.

Results in Table (27) indicated that seed oil content was significantly increased by increasing level of nitrogen up to 30 kg N / feddan with residual of casuarina leaves which equal to 53.27 and 55.12% in the first and second seasons, respectively. On the contrary, without application of plant residues and nitrogen fertilizer gave the minimum percentage of seed oil (51.23 and 53.02 %, respectively). It could be concluded that residual of corn straw and casuarina leaves with fertilization both 30 and 60 kg N/feddan increased seed oil percentage significantly higher than which planted in pure sandy soil and received the same level of nitrogen fertilizer .

The effect of the interaction between plant residues, irrigation regimes and N levels were significant on seed oil content in the two growing seasons. The greatest seed oil content produced from the interaction between residual of casuarina leaves with irrigation at 50% loss in water holding capacity and fertilization with 30 kg N/ feddan to the other interaction between the three factors in the two growing seasons.

## **2- Oil yield (kg / feddan):**

The average values of oil yield of sesame per feddan as affected by plant residues, irrigation regimes and N-levels as well as their interactions in 1998 and 1999 seasons as shown in Table (28).

Table (28): Effect of plant residues, irrigation regimes, N-levels and their interactions on Seed oil (kg/feddan) in 1998 and 1999 seasons.

Plant residues	N- Level KgN/fed	Oil yield (kg/feddan)					
		1 <sup>st</sup> season		Mean	2 <sup>nd</sup> season		Mean
		Irrigation regimes			Irrigation regimes		
		W1	W2	W1	W2		
Without	0	13	8	10.5	11	8.4	9.7
	30	117	78	98	104	60	82
	60	180	114	147	240	110	175
Mean		104	67	85.5	118	59	89.3
Corn straw	0	114	45	80	95	42	68
	30	315	165	240	255	132	193
	60	403	168	285	351	150	250
Mean		277	126	202	234	108	171
Casuarina leaves	0	120	62	91	106	40	73
	30	312	164	242	271	137	204
	60	423	184	303	370	151	261
Mean		288	137	212	249	109	179
IxN	0	83	38	60	71	30	50
	30	251	136	193	210	109	160
	60	335	155	288	320	137	229
Mean		223	110		200	92	

L.S.D at 0.05

R	9.446	
I	9.654	1.092
N	5.552	1.324
RxI	13.36	1.158
RxN	9.616	1.545
IxN	7.851	2.005
RxIxN	13.60	1.637
		2.836

**2-a- Effect of plant residues :**

The results in Table (28) showed clearly that residual of corn straw and casuarina leaves surpassed significantly untreated plants on oil yield of sesame per feddan in both seasons. The increment in oil yield reached about 166.5 and 147.95%, produced from residual of corn straw and casuarina leaves, respectively over in pure sandy soil in the first season. The corresponding increases were 91.49 and 100.45 %, respectively in the second season. It could be concluded that the addition of plant residues in the sandy soil increased the available nutrients as a result of reducing pH mechanism, **Freney and Simpson (1983)**.

**2-b- Effect of irrigation regimes:**

Concerning, irrigation regimess, it could be noticed a significant increment on oil yield of sesame induced by increasing quantity of irrigation to sandy soil in both seasons (Table 28). It was observed that irrigation of sesame plants at 50% loss of water holding capacity significantly surpassed the irrigation at 70% soil moisture stress in oil yield / feddan by 117.39and 102.73 % in the first and second seasons, respectively. This result may be due to increased seed yield / feddan and oil content in sesame seeds by early irrigation. Also, exposing plants to water stress caused a significant reduction in physiological growth and these effects reflected on seed yield as a relation between source and sink (**El-Kalla et al., 1994 and Sharaan et al., 2000**). Similar results were obtained by **Atta (1980)**, **El-Wakil (1983)**, **El-Wakil and Gaafar (1988)** and **El-Sorogy et al. (1997)**.

**2-c- Effect of nitrogen levels:**

The data in Table (28) showed that N-levels significantly affected oil yield / feddan in both seasons and greatest value of oil yield / feddan was recorded at the highest N level. Raising N level from zero to 60 kg N/feddan in sandy soil increased oil yield / feddan by 380 and 358% in the first and second seasons, respectively. The increase in oil yield due to the increase in N-level is a result of the effect of N in increasing seed yield and seed oil content. These results are in harmony with those obtained by, **Abd El-Rahman *et al* (1980), El-Wakil (1983), Awad *et al.* (1997) and Mondal *et al* (1997).**

**2-d- Interaction effects :**

The effect of the interaction between plant residues and irrigation regimes were highly significant on seed oil yield per feddan in the two growing seasons (Table 28). The maximum oil yield / feddan was 288 and 249 kg produced from combining irrigation at 50% soil moisture stress with residual of casuarina leaves in sandy soil in the first and second seasons, respectively. However the lowest one was 67 and 59 kg oil yield / feddan, obtained from irrigation at 70% soil moisture stress without application of plant residues in the first and second seasons, respectively. It could be concluded that plant residues was more efficiency with early, irrigation in oil yield of sesame per feddan.

The results in Table (28) showed that the interaction between irrigation regimes and N levels significantly affected seed oil yield per feddan in both seasons. The increment in seed oil yield as a results of irrigation at 50% loss in water holding capacity with applied 60 kg N /feddan was 297 and 290 kg oil

yield / feddan in the first and second seasons, respectively as compared to without application of nitrogen fertilizer with irrigation at 70% soil moisture stress.

Also, the interaction between plant residues and N-levels induced significant increases in seed oil yield per feddan in 1998 and 1999 seasons. Residual of casuarina leaves in sandy soil with applied 60 kg N/ feddan gave the maximum yield of seed oil which equal 303 and 261 kg / feddan in the first and second seasons, respectively. Whereas, the minimum one was 10.5 and 9.7 kg/ feddan produced from pure sandy soil and unfertilized sesame plants in both seasons, respectively. It could be concluded that residual of casuarina leaves with increasing N-level up to 60 kg / feddan in sandy soil were more efficiency on oil yield / feddan.

Data illustrated in Table (28) indicate that the mean values of oil yield of sesame per feddan was significantly affected by the interaction between the three factors under study in both seasons. It was clear that, the highest mean values of seed oil yield/feddan was 423 and 370 kg/feddan, produced from residual of casuarina leaves with irrigated at 50% soil moisture stress and applied of 60 kg/feddan in the first and second seasons, respectively. Whereas, the lowest mean values of oil yield/feddan was 8 and 8.4 kg/feddan, obtained from untreated sesame plants of plant residues with irrigation at 70% soil moisture stress without application of nitrogen fertilizer. It could be concluded that residual of casuarina leaves or corn straw with decreasing soil moisture stress and increasing in N-level up to 60 kg N/feddan gave the highest seed oil yield of sesame in sandy soil.

### **3- Seed protein content :**

Data presented in Table (29) show the effect of plant residues, irrigation regimes and nitrogen levels and their interactions on seed protein content in 1998 and 1999 seasons.

#### **3-a- Effect of plant residues :**

Plant residues had a significant effect on seed protein content in both seasons as shown in Table (29). Residual of corn straw in sandy soil gave the highest percentage of protein (21.59%) in the first season, while residual of casuarina leaves gave the highest one (21.60%) in the second season. On the other hand, no significant difference was obtained between residual of corn straw and casuarina leaves on seed protein content as a result of the application of plant residues as an organic matter could be explained by the raising of nutrients and improving soil structure such as nitrogen. (**Khaleel et al., 1981**). Similar result was obtained by **Abd El-Sabour et al. (1997)** found that organic waste compost addition on sesame caused significantly increment in nitrogen content .

#### **3-b- Effect of irrigation regimes:**

The results presented in Table (29) show that seed protein content was significantly increased by increasing soil moisture stress in both seasons. In contrast to seed oil content, irrigation at 70% loss in water holding capacity gave the highest percentage of seed protein (21.37 and 21.20% in the first and second seasons, respectively. The increment in seed protein content reached about 5.95 and 3.92%, respectively. The above mentioned results can be explained by the report of **Kramer (1978)** who found that in stressed plants there was rapid drop in

Table (29): Effect of plant residues, irrigation regimes, N-levels and their interactions on Seed protein content (%) in 1998 and 1999 seasons.

Plant residues	N- Level KgN/fed	Seed protein content (%)					
		1 <sup>st</sup> season		Mean	2 <sup>nd</sup> season		Mean
		Irrigation regimes			Irrigation regimes		
		W1	W2		W1	W2	
Without	0	17.14	19.41	18.28	16.94	18.93	17.93
	30	19.34	19.83	19.58	19.69	19.60	19.64
	60	20.39	21.08	20.73	20.16	21.05	20.61
	Mean	18.95	20.11	19.53	18.93	19.86	19.39
Corn straw	0	17.99	19.41	18.70	17.27	18.87	18.07
	30	22.51	21.45	21.98	22.39	21.27	21.83
	60	24.52	23.67	24.09	24.22	23.21	23.71
	Mean	21.67	21.51	21.59	21.29	21.17	21.20
Casuarina leaves	0	18.71	19.25	19.00	18.41	19.02	18.71
	30	19.83	23.31	21.57	21.68	23.08	22.38
	60	21.08	24.89	22.98	22.87	24.54	23.71
	Mean	19.87	22.48	21.17	20.99	22.21	21.60
IxN	0	17.95	19.36	18.65	17.54	18.94	18.24
	30	20.56	21.53	21.04	21.25	21.31	21.28
	60	21.99	23.21	22.60	22.42	22.93	22.68
	Mean	20.17	21.37		20.40	21.20	

L.S.D at 0.05

R	0.494	0.357
I	0.509	0.854
N	0.388	0.529
RxI	0.698	0.505
RxN	0.672	0.917
IxN	0.548	0.749
RxIxN	0.950	1.298

water content and a small increase in protein, possibly due to the continued synthesis of RNA. During stress there was a hydrolysis of protein, finally, an apparent increase in protein occurred, although this may have been an increase in peptides rather than protein. These results are in harmony with those obtained by **Atta (1980), El-Wakil (1983) and Mohamed and Abdel-Monem (1994)**.

### **3-c- Effect of nitrogen levels:**

Table (29) indicated that seed protein was significantly increased by increasing N-level up to 60 kg / feddan in both seasons. The application of 30 and 60kg N / feddan increased protein content by 12.81 and 21.18%, respectively over unfertilized treatment in the first season.. The corresponding increases were 16.67 and 24.34%, respectively in the second season. These results are in agreement with those obtained by **Atta (1980), Khalil (1980), El-Wakil (1983) and Mondal et al. (1997)**.

### **3-d- Interaction effects :**

There was a significant difference of protein content in sesame seeds due to the interaction between plant residues and irrigation regimes in the two growing seasons as shown in Table (29). Seed protein percentage developed from sandy soil applied with casuarina and corn straw were higher than without application of plant residues when irrigation at 70% loss in water holding capacity in both seasons. The highest percentage of seed protein was 22.48 and 22.21%, produced from residual of casuarina leaves with irrigation at 70% soil moisture stress in the first and second seasons, respectively.

While the lowest one was 18.95 and 18.93%, respectively, produced from without application of plant residues with irrigation at 50% soil moisture stress.

Also, the interaction between irrigation regimes and N-levels induced significant effect in seed protein. The greatest protein content was 23.21 and 22.93%, produced by combining irrigation at 70% soil moisture stress + 60 kg N/ feddan in the first and second seasons, respectively. Whereas, the minimum one was 17.95 and 17.54%, respectively, obtained from irrigation at 50% soil moisture stress without application of nitrogen fertilizer. It could be concluded that increasing N level up to 60 kg N/ feddan was more efficiency with increasing depletion of soil moisture to give the highest seed protein content .

Table (29) obviously clear that seed protein content was significantly increased by increasing N-level up to 60 kg N/ feddan with residual of corn straw or casuarina leaves in the two growing seasons. Residual of corn straw in sandy soil with applied of 60 kg N/ feddan gave the maximum percentage of seed protein (24.09 and 23.71% in the first and second season, respectively. It could be concluded residual of corn straw or casuarina leaves in sandy soil with increasing N level up to 60 kg N/ feddan gave the greatest seed protein content.

Finally, the interaction between plant residues, irrigation regimes and N- level showed a significant effect in seed protein content. Planting sesame in sandy soil treated with casuarina and corn straw and irrigation at 70% loss in water holding capacity developed seed protein content than that irrigated at

50% loss in water holding capacity with applied 60 kg N/ feddan in the two growing seasons. Whereas, no significant difference was obtained between the interaction corn straw + irrigation at 50% soil moisture stress+ 60 kg N / feddan and casuarina leaves + irrigation at 70% soil moisture stress + 60 kg N /feddan on seed protein content in the two growing seasons.

#### **4- Nitrogen use efficiency :**

Nitrogen use efficiency in sesame plants as a result of planting in sandy soil treated with plant residues , irrigation regimes and N- levels as well as their interaction in 1998 and 1999 seasons are presented in Table (30) as a result of using N-15 labelled in fertilization.

##### **4-a- Effect of plant residues :**

It could be noticed that sesame plants cultivated in sandy soil with residual plants of casuarina and corn proved to be high efficient in its fertilizer use efficiency expressed in the form of percentage of N-utilized as compared to without plant residues in both seasons. The highest percentage of N- use efficiency was 33.49 and 31.51%, produced from residual of corn straw in sandy soil in the first and second seasons, respectively. Whereas no significant difference was obtained between residual or casuarina leaves and corn straw on N-use efficiency in the first season. It was clear that residual of corn straw was more efficiency on the percentage of N- utilized as compared to residual of casuarina in sandy soil. Organic fertilizer plays an important role in plant nutrition not only as a carrier and source of nutrients, but also it is an excellent soil conditions, improving physical characters of soil such as texture, moisture holding

Table (30): Effect of plant residues, irrigation regimes, N-levels and their interactions on N-utilization (%) in 1998 and 1999 seasons.

Plant residues	N- Level KgN/fed	N-utilization ( % )					
		1 <sup>st</sup> season		Mean	2 <sup>nd</sup> season		Mean
		Irrigation regimes			Irrigation regimes		
		W1	W2		W1	W2	
Without	0			5.83	6.54	3.04	4.79
	30	8.11	3.56	8.11	10.71	4.08	7.39
	60	11.30	4.93	8.11	8.62	3.56	6.09
Mean		9.70	4.24	6.97	8.62	3.56	6.09
Corn straw	0			32.79	39.30	22.84	31.07
	30	41.69	23.90	43.03	40.43	23.50	31.69
	60	44.35	23.71	43.03	39.86	23.17	31.51
Mean		43.02	23.80	33.49	39.86	23.17	31.51
Casuarina leaves	0			31.19	37.01	21.60	29.30
	30	38.6	23.78	34.78	39.71	23.50	31.45
	60	45.50	24.06	34.78	38.21	22.55	30.38
Mean		42.05	23.92	32.98	38.21	22.55	30.38
IxN	0			23.27	27.61	15.82	21.72
	30	29.47	17.08	25.87	30.29	17.02	23.66
	60	34.08	17.67	25.87	28.95	16.42	
Mean		31.77	17.32		28.95	16.42	

L.S.D at 0.05

R	4.24	0.94
I	6.77	3.43
N	2.10	1.05
RxI	0.39	0.64
RxN	0.43	0.89
IxN	0.35	0.56
RxIxN	0.61	1.26

capacity and aeration, **Maramba et al. (1978)**. Also, **Strel'nikva and Kochkarev (1989)** found that liming substantially increased N-utilization by plants and improved the N balance on poorer sandy soil. Similar results were obtained by **Abd El-Sabour and Abo El-Seoud (1996)**.

#### **4-b- Effect of irrigation regimes :**

The effect of irrigation regimes could be considered a major role in effecting N-utilized of sesame. The results in Table (30) showed markedly increases in N- utilized due to early irrigation compared to late irrigation in both seasons. The increases in N- utilized reached 83.42 and 76.31 % in the first and second seasons, respectively compared to irrigation at 70% loss in water holding. Nitrogen losses under prolonged intervals of irrigation due to nitrogen transformation may be the reason behind the utilization efficiency reduction. It might be attributed to the reduction in the dry matter content as well as photosynthetic efficiency. In this condition, **Mohamed and Abdel-Monem (1994)**, **Askok et al. (1996)** and **Yadav and Srivastava (1997)** showed N-use efficiency was increased with increasing number irrigations.

#### **4-c- Effect of nitrogen levels:**

It was clear that from Table (30) N-use efficiency was significantly increased by increasing N level up to 60 kg N /feddan as compared to unfertilized plants in the two growing seasons which gave the highest increase of 25.87% and 23.66% in the first and second seasons, respectively. The same trend was obtained by **El-Wakil (1983)**, **Atta and Cleemput (1988)** found that N- use efficiency was increased by increasing N- level.

#### **4-d- Interaction effects :**

Table (30) showed that nitrogen utilization in sesame plants was the higher for each residual of corn straw and casuarina leaves with the highest amount of water application not more than 50% loss in water holding capacity . Residual of corn straw in sandy soil was more efficiency on N- use efficiency (43.02 and 39.86%) than residual of casuarina leaves (42.05 and 38.21%) in the first and second seasons, respectively. Application of corn straw and casuarina leaves with irrigation at 50% soil moisture stress increased N- use efficiency over untreated of plant residues with the same level of irrigation by 343.5 and 333.5%, respectively, in the first season as well as by 362.4 and 343.27%, respectively in the second season.

The effect of the interaction between irrigation regimes and N-levels were highly significant on nitrogen use efficiency in both seasons (Table 30). The greatest N-use efficiency was 34.08 and 30.29% produced from irrigated at 50% loss in water holding capacity with applied 60 kg N /feddan in the first and second seasons, respectively. On the contrary, the lowest one was 17.08 and 15.82%, respectively, obtained from irrigation at 70% soil moisture stress with adding 30 kg N/feddan. It could be concluded that increasing water supply was more efficiency on N- utilized by sesame plants with increasing N-level up to 60 kg N /feddan .

There was a significant difference of nitrogen use efficiency due to the interaction between plant residues and N-levels in 1998 and 1999 seasons as shown in Table (30). The combination between residual of corn straw with 60 kg N/feddan

gave the highest N-utilized by sesame plants which equal to 43.03 and 31.69% in the first and second seasons, respectively. Also, no significant difference was obtained between applied 30 and 60 kg N/feddan with residual of corn straw on N- use efficiency in the second season.

Table (30) indicated that the greatest nitrogen use efficiency has been resulted from planting sesame in sandy soil with residual of casuarina leaves and irrigated not more than 50% loss in water holding capacity with fertilized at 60 kg N/feddan in the first season. Whereas, The highest N-use efficiency was produced from residual of corn straw + irrigation at 50% soil moisture stress + 60 kg N /feddan in the second season. The improvement in nutrients particularly nitrogen use efficiency resulted as a plant residues applied to sandy soil could be due to the improvements resulted in soil properties such as chemical and biological environment and nitrogen transformation and then crop uptake.

### **V- Water use efficiency (kg /m<sup>3</sup>)**

It is considered a real index for improving sesame seed yield, expressed as a water use efficiency the average values of water use efficiency by sesame as influenced by plant residues, irrigation regimes and N levels as well as their interactions during 1998 and 1999 seasons are presented in Table (31).

#### **V-a- Effect of plant residues :**

The results in Table (31) indicated that water use efficiency increased significantly by applying casuarina and corn straw residues to sandy soil in both seasons. The maximum

**Table (31): Effect of plant residues, irrigation regimes, N-levels and their interactions on W.U.E based on seed yield (kg/m<sup>3</sup>) in 1998 and 1999 seasons.**

Plant residues	N- Level KgN/fed	W.U.E based on seed yield (kg/m <sup>3</sup> )					
		1 <sup>st</sup> season		Mean	2 <sup>nd</sup> season		Mean
		Irrigation regimes			Irrigation regimes		
		W1	W2		W1	W2	
Without	0	0.011	0.009	0.010	0.009	0.009	0.009
	30	0.092	0.087	0.090	0.080	0.063	0.072
	60	0.141	0.125	0.133	0.185	0.116	0.151
	<b>Mean</b>	0.082	0.074	0.078	0.0191	0.063	0.077
Corn straw	0	0.127	0.076	0.101	0.106	0.068	0.087
	30	0.337	0.273	0.305	0.276	0.210	0.243
	60	0.433	0.282	0.358	0.382	0.238	0.310
	<b>Mean</b>	0.299	0.210	0.255	0.254	0.172	0.213
Casuarina leaves	0	0.127	0.105	0.116	0.120	0.065	0.093
	30	0.347	0.273	0.310	0.291	0.219	0.255
	60	0.457	0.309	0.383	0.405	0.241	0.323
	<b>Mean</b>	0.310	0.229	0.269	0.272	0.175	0.223
IxN	0	0.088	0.063	0.076	0.078	0.047	0.063
	30	0.258	0.211	0.235	0.216	0.164	0.190
	60	0.344	0.239	0.291	0.324	0.198	0.261
	<b>Mean</b>	0.230	0.171		0.206	0.136	

**L.S.D at 0.05**

R	0.024	0.035
I	0.037	0.041
N	0.021	0.022
RxI	0.034	0.040
RxN	0.037	0.038
IxN	0.031	0.030
RxIxN	0.053	0.056

water use efficiency value was 0.269 and 0.223 kg seeds / m<sup>3</sup> of water consumed for residual of casuarina leaves in sandy soil in the first and second seasons, respectively. On the other hand no significant difference was obtained between residual of corn straw and casuarina leaves on water use efficiency in both seasons. The increment in W.U.E. reached about 0.177 and 0.191 kg seeds/m<sup>3</sup> of water consumed for the same plant residues over untreated plant residues in the first season as well as 0.136 and 0.146 kg seeds/m<sup>3</sup> of water consumed, respectively in the second season. In this connection, **Mandl and Gosh (1984)** found that increasing straw mulch and irrigation caused a significant increment in seed yield and water use efficiency in sesame.

#### **V-b- Effect of irrigation regimes:**

It could be noticed that early irrigation of sesame plants (at 50% loss in water holding capacity) increased significantly water use efficiency as compared to late irrigation (at 70% loss in water holding capacity in the two growing seasons (Table 31). The increment in water use efficiency as a result of early irrigation reached 34.5 and 51.5% in the first and second seasons, respectively. Similar results were obtained by **El-Wakil and Gaafar (1988)** and **Ashok et al. (1996)**.

#### **V-b- Effect of nitrogen levels :**

The effect of N-level on water use efficiency was significant increase in both seasons (Table 31). The application of 30 and 60 kg N/feddan increased water use efficiency by 0.159 and 0.215 kg seeds /m<sup>3</sup> of water consumed, respectively over unfertilized plants in the first season. The corresponding increases were 0.127 and 0.198 kg seeds/m<sup>3</sup> of water consumed,

respectively in the second season. It is evident that increasing N-level up to 60 kg/feddan resulted in producing the highest water use efficiency due to high seeds production of sesame. These findings are in accordance with this reported by **El-Wakil (1983)** concluded that application of 45 and 60 kg /N feddan gave the highest values of water use efficiency .

#### **V-d- Interaction effects :**

Table (31) shows that the effect of the interaction between plant residues and irrigation regimes was significant for water use efficiency (W.U.E) in both seasons. The greatest mean values of water efficiency was 0.310 and 0.272 kg/m<sup>3</sup> of consumed water produced from residual casuarina leaves in sandy soil with irrigation at 50% soil moisture stress in the first and second seasons, respectively. Whereas no significant difference was obtained between the interaction between residual of corn straw and casuarina leaves with irrigation at 50% loss in water holding capacity on water use efficiency in both seasons. However the lowest one was 0.078 and 0.077 kg seeds/m<sup>3</sup> of water consumed, respectively, produced from without application of plant residues with irrigation at 70% soil moisture stress. The same trend was obtained by **Mandl and Gosh (1984)** who found that increasing straw mulch and irrigation caused a significant increment in seed yield of sesame and water use efficiency.

On the other side, the interaction between irrigation regimes and N-levels on water use efficiency was highly significant in the two growing seasons as presented in Table (31). Irrigation of sesame plants at 50% soil moisture stress with application 60 kg N/ feddan gave the highest mean values of

water use efficiency. The increment in W.U.E as a result of irrigation at 50% soil moisture stress with applied 60 kg N/feddan was 446 and 589.45, in the first and second seasons, respectively, as compared to irrigation at 70% soil moisture stress without application of nitrogen fertilizer.

The data presented in Table (31) shows that a significant effect in W.U.E were detected by the interaction between plant residues and N-levels in both seasons. Residual of casuarina leaves in sandy soil with adding 60 kg n/feddan gave the greatest mean values of W.U.E (0.383 and 0.323 kg seeds / m<sup>3</sup> of water consumed) in the first and second seasons respectively. Whereas, no significant difference between residual of corn straw and casuarina leaves with the same level of nitrogen fertilizer on W.U.E in both seasons.

Finally the effect between plant residues, irrigation regimes and N-level showed higher significant and considerable values of water use efficiency in sesame plants. The best combination occurred were the interaction between high rate of nitrogen (60 kg N/feddan) to sesame plants cultivated in sandy soil received casuarina residues and then irrigated not more 50% loss in water holding capacity compared to the other combination. The increments in W.U.E could be explained that the plant residues applied to sandy soil play a role in preventing water loss and that leads to a high rate absorption and release of nutrients by plant as well as the indirect role of water for absorbed nutrients by easily mobilization in soil towards the roots. Also, crop residues applied is a useful guide to the prediction of nitrogen mineralization (**Khaleel *et al.*, 1981; Rynk, 1992 and Rechgal, 1995**).