# RESULTS AND DISCUSSION

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## I- Growth measurements:

Results presented in Table (3) show the effect of irrigation treatments, ascorbic acid concentrations and N-rate on plant height number of tillers/ $m^2$, dry weight of tillers/ $m^2$ and Total chlorophyll at 80 days after planting in the two growing seasons (2004/2005 and 2005/2006 seasons).

### 1- Effect of irrigation treatments:

#### 1.1. Plant height:

Plant height of wheat at 80 days from planting was significantly affected by exposing wheat plants to soil moisture stress in both seasons. Irrigation of wheat plants at 40 % available soil moisture depletion (Table 3) gave the tallest plant (66.7 and 70.4 cm) in the first and second seasons, respectively. Whereas, irrigation after 80 % ASMD gave the shortest plant 49.4 and 52.1 cm. in the first and second seasons, respectively. These results may be due to that water stress decreased the activity of merstimatic tissues responsible for elongation of plant. The decreasing in plant height due to the decrease in the number and size of cells. **Abdel-Fatah (1982), Abu-Elela (1996), El-Sherbeny (2003), Hussein (2005), El-Afandy (2006) and Fang *et al.* (2006) reported similar results.**

#### 1.2 Number of tillers/ $m^2$:

Results in Table (3) indicate that irrigation treatments had a significant effect on number of tillers / $m^2$ in the two growing seasons. Increasing soil moisture depletion from 40 to 80% caused subsequent decrease in number of tillers / $m^2$. The increment in number of tillers / $m^2$ by irrigation at 40 % ASMD was 104 and 123 tillers/ $m^2$ over the treatment of irrigation at 80 % ASMD in the first and second seasons, respectively. These results due to water stress decreased the activity of merstimatic tissues responsible for increasing tillers number per plant. The same trend was obtained by **Abdel-Fatah (1982), Abd-El-Aal (1991), Mohamed (1992), El-Sherbeny (2003) , Hussein (2005) and El-Afandy (2006) .**

## 1. 3. Dry weight of tillers/ $m^2$ (g):

It was obvious said that decreasing the content of soil moisture before irrigation (at 80 % ASMD) caused a significant decrease in dry weight of tillers /$m^2$ in both seasons as shown in Table (3). The maximum dry weight of tillers was 763 and 825 g/$m^2$, obtained from irrigation at 60 % ASMD in the first and second seasons, respectively. Whereas, the minimum dry weight were 478 and 509 g/$m^2$ respectively, produced from irrigation at 80 % ASMD. These results are due to that water stress which decreased the activity of merstimatic tissues responsible for elongation of plant and tillers/ $m^2$. These results are harmony with those obtained by **El-Sherbeny (2003) and Kassab and El- Zeiny (2005).**

## 1.4 Flag leaf area ($cm^2$):

Table (3) show clearly that the flag leaf area was significantly affected by irrigation treatments in both seasons.

The highest mean values of flag leaf area at 80 days from planting was 36.57 cm in the first season and 35.95 in the second season produced from irrigation of wheat plants at 60 and 40 % ASMD, respectively. Whereas, the lowest area was 24.44 and 22.91 cm, obtained from irrigation at 80 % ASMD in the first and second seasons, respectively. The increase in the amount of water resulted in increasing the mean values of leaf area because of the role of water in relation to the photosynthesis activity, which increases the merstimatic activity and the leaf growth. This result was expected since all elongation is correlated to tug or pressure which is reduced as water deficits occur. These results are in agreement with those obtained by **Abdel-Fatah(1982), Abd-El-Aal (1991), Abu-Elela(1996) and El-Sherbeny (2003).**

## 1.5 Total chlorophyll:

The results reported in Table (3) indicate that total chlorophyll in leaves of wheat plant was significantly increased by increasing available soil moisture depletion in the two growing seasons. Irrigation at 80 % available soil moisture depletion gave the maximum mean values of Total chlorophyll which equal to 16.7 and 15.80 mg/g d.w.in the first and second seasons, respectively. Whereas, the minimum one was 13.05 and 14.86 mg/g. respectively, produced from irrigation at 40 % ASMD. These results may be due to photosynthesis rate continuing in height with low leaf water potential in addition, photosynthesis rate decreased in old leaves before young leaves **(Crafts, 1968).** Also, **Gupta and berkowitz,1988, and Gupta**

***et al.,* 1989**,they found that photosynthesis of wheat plants improved with increasing water stress as a result of increase in potassium ion concentration in the soil. On the contrary, **Abo El-Kheir (2000)** reported that decreasing water supply caused significant reduction in total chlorophyll.

## 2-Effect of ascorbic acid concentrations:

### 2.1 Plant height:

Results in Table (3) show that plant height of wheat at 80 days after planting was significantly increased by increasing concentration of ascorbic acid up to 1000 mg/L. as foliar application in the two seasons. The application of ascorbic acid at 500 and 1000 mg/ L. increased plant height over the untreated wheat plants by 7.80 and 12.88 % respectively, in the first season. While, the corresponding increase were by 7.51 and 16.38% respectively, in the second season. In this respect, the obtained increase of this trait may be due to the stimulating effect of vit. C on vegetative growth and regarded in attract amount to maintain normal vegetative growth to increase plant growth including increase plant height. Also, **Oertil (1987)** reported that functions of vitamin C are reversal at stress effects (temperature and poisons), antioxidant, protection of chloroplast and electron transport system. It also stimulates respiration activates, cell division and many enzymes activities. These results are in line with those obtained by **Zhang and Stanley (1994), Wang *et al.* (1995), Negm (1998), Anton *et al.* (1999), Hamed and Hamada (20002), Abd- El-Hameed *et al.* (2004), Irfan *et al.* (2006) and Zewail (2007).**

## 2.2. Number of tillers/ $m^2$:

Results presented in Table (3) show that application of ascorbic acid had significant effect on number of tillers/ $m^2$ in the two growing seasons. The highest number of tillers/ $m^2$ was 352 and 402, produced from spraying of ascorbic acid at 1000 mg/ L. in the first and second seasons, respectively. On the contrary, no significant difference was obtained between application of ascorbic acid at 500 and 1000 mg/ L. in the first season. The obtained increase of this trait could be attributed to induce many stimulating effects on plant growth and some physiological processes and cytokinines synthesis and enhancing cell division to increase plant growth leading to an increase of tillering plants. The obtained results are in accordance with those of **Oertil (1987), De Gara *et al.* (1991), Hamed and Hamada (2002) and Zewail (2007).**

## 2. 3. Dry weight of tillers/ $m^2$:

The men values of dry weight of tillers/ $m^2$ were significantly increased by application of ascorbic acid to wheat plants when compared with the untreated wheat plants in both seasons. The increments reached 16.16 and 13.13 % for application of ascorbic acid at 500 and 1000 mg/ L. in the first season as well as 19.59 and 16.40 % in the second season respectively. This result may be attributed to the increase in dry matter to the increment in plant height, number of tillers/ $m^2$ and leaf area of wheat plant as well as a result of influencing physiological processes such as synthesis of enzymes .The results mentioned above are in good agreement with those obtained by **De Gara** ***et al.*** **(1991), Wang** ***et al.*** **(1995), Adarouze, Dalia (1997), Anton** ***et al.*** **(1999), Hamed and Hamada (2002), Irfan** ***et al.*** **(2006) and Zewail (2007).**

## 2.4. Flag leaf area ($cm^2$):

The effect of ascorbic acid on flag leaf area ($cm^2$) was significant when compared with the control treatment (zero ascorbic acid) in the two growing seasons as shown in Table (3). Application of ascorbic acid at 1000 mg/ L. gave the maximum mean values of flag leaf area, which equal 33.13 and 31.87 $cm^2$ in the first and second season, respectively. Whereas, there is not a significant effect between 500 and 1000 mg/ L. in the two growing seasons. On the contrary, the minimum mean values of flag leaf area was 31.43 and 30.37 $cm^2$, produced from untreated wheat plants in the first and second seasons, respectively. In this respect, vit. C one of the most important vitamin having stimulation effects on plant growth, cell division in different plants. **Anton** ***et al.*** **(1999), Abd-El-Hameed** ***et al.*** **(2004), Irfan** ***et al.*** **(2006) and Zewail (2007)** obtained the same trend.

## 2.5. Total chlorophyll:

The application of ascorbic acid at 500 and 1000 mg/L. significantly increased total chlorophyll in leaves of wheat plants over untreated by 4.17 and 8.0 %, respectively in the first season, whereas, the corresponding increases were 1.66 and 1.86 %, respectively in the second season (Table 3). On the other hand no significant difference was obtained from application ascorbic acid at 500 and 1000 mg/ L. in the second season. The simulative of photosynthetic pigments formation could be attributed to the obtained vigorous growth that stimulate total chlorophyll formation hence enhanced photosynthesis efficiency. Other studies nearly got similar results by **Bhat *et al.* (1990), Zhang and Stanley (1994), Inskbaski and Iwaya (2006) Irfan *et al.* (2006) and Zewail (2007).**

## 3- Effect of nitrogen rates:

### 3.1. Plant height:

Plant height of wheat at 80 days after planting was significantly and consistently increased by increasing N rate from 60 to 100 Kg N/faddan in 2004/2005 and 2005/ 2006 growing seasons as shown in Table (3). The tallest plants recorded 62.7 and 65.7 cm by adding 100 Kg N/ faddan in the first and second seasons, respectively. On the contrary, the shortest one recorded 53.5 and 57.2 cm, by adding 60 Kg N/ faddan, respectively. The increase in plant height may be due the increase in merstimatic activity in wheat plant and cell elongation because nitrogen encourages both merstimatic activity and auxin production in plants. These results are in harmony with those obtained by **Darwishe (1994), Dawood and Kheiralla (1994), Salwau (1994), Abd-El-Fatah (1995), Abd-El-Hakem (1996), Zaher (1996), El-Douby (1997), Metwally *et al.* (1998), Zohary *et al.* (1998), Dardiry (1999), Abou-Salama *et al.* (2000), Toaima *et al.* (2000), Abou-El-Ela, Soliman (2006) and Zewail (2007).**

## 3.2. Number of tillers/ $m^2$:

Results in Table (3) show that number of tillers/ $m^2$ were significantly increased by increasing N- rate up to 100 Kg N /faddan in the two growing seasons. Application at 80 and 100 Kg N / faddan resulted in increasing the number of tillers/ $m^2$ by 4.09 and 7.81 over adding 60 Kg N / faddan, respectively in the first season. Whereas raising N-rate from 60 to 80 and 100 Kg N/ faddan increased number of tillers/ $m^2$ 9.27 and 14.04 %, respectively in the second season. This increase clearly indicated that there are a prominent role of N on vegetative growth and tillering in wheat grown in sandy soil. These findings are in accordance with **Zaher (1996), El-Douby (1997), Dardiry (1999), Abou-El-Ela (2001), El-Sherbeny (2003) and Zewail (2007).**

## 3. 3. Dry weight of tillers/ $m^2$:

The results in Table (3) indicate that nitrogen fertilizer had a significant effect on dry weight of tillers/ $m^2$ at 80 days after planting in the two growing seasons. The application of 80 and 100 Kg N / faddan increased the dry weight of tillers/ $m^2$ by 12.48 and 17.54 % respectively, over the check treatment (60 Kg N/ faddan) in the first season. The corresponding increases were 11.61 and 15.02 % respectively in the second season. In general, N encouraged growth of plant height, flag leaf area and number of tillers/ $m^2$ as an essential element in sandy soil, which plays a prominent role in building new merstimatic cells, cell elongation and increasing photosynthesis activity of wheat plants. Similar trend was reported by **Darwiche (1994), Dardiry (1999), El-Sherbeny (2003) and Zewail (2007)**.

## 3.4. Flag leaf area ($cm^2$):

Results presented in Table (3) reveal that flag leaf area ($cm^2$) of wheat plant at 80 days after planting was significantly affected by increasing N- rate up to 100 Kg N / faddan in both seasons. The highest flag leaf area was 33.49 and 32.45 $cm^2$, produced from application 100 Kg N / faddan in the first and second seasons, respectively. Whereas, the lowest one was 30.90 and 29.61 cm, respectively when adding 60 Kg N / faddan. In general, N encourage growth of flag leaf area as an essential element which plays a prominent role in building new merstimatic cells, cell elongation and increasing photosynthesis activity of wheat plants. These results were almost in agreement with those obtained by **Darwiche (1994), Abou-El-Ela (2001), El-Sherbeny (2003) and Zewail (2007)**.

## 3.5. Total chlorophyll:

It was clear from Table (3) that total chlorophyll in wheat leaves was significantly increased by increasing rate of nitrogen fertilizer in the two growing seasons. Application of nitrogen fertilizer up to 100 Kg N / faddan gave the highest content of chlorophyll, which equal to 17.09 and 15.51 mg /g. d.w. in the first and second seasons, respectively. These results may be due to the nitrogen as essential element in sandy soil, which plays a prominent role in increasing photosynthesis activity of wheat plants, and stimulate chlorophyll formation. Results reported by

**Table (3): Effect of irrigation treatments, ascorbic acid concentrations and nitrogen rates on growth characteristics at 80 DAP of wheat in 2004/2005 and 2005/2006 seasons.**

| Characters | | Plant height (cm). | | No. of tillers/$m^2$ | | Dry weight of tillers ($g/m^2$). | | Flag leaf area ($cm^2$). | | Total chlorophyll (mg/g. D.W). | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | season | | | | | | | | | |
| Treatments | | 1st | 2nd | 1st | 2nd | 1st | 2nd | 1st | 2nd | 1st | 2nd |
| Irrigation | $I_1$ | 66.7 a | 70.4 a | 384 a | 429 a | 715 b | 774 b | 36.52 a | 35.95 a | 13.05 c | 14.86 c |
| | $I_2$ | 60.4 b | 64.0 b | 364 b | 417 b | 763 a | 825 a | 36.57 a | 35.08 b | 14.37 b | 15.12 b |
| | $I_3$ | 49.4 c | 52.1 c | 280 c | 306 c | 478 c | 509 c | 24.44 c | 22.91 c | 16.70 a | 15.80 a |
| F-test | | * * | * * | * * | * * | * * | * * | * * | * * | * * | * * |
| Ascorbic acid | $S_1$ | 55.1 c | 58.6 c | 330 b | 363 c | 594 c | 628 c | 31.43 b | 30.37 b | 14.13 c | 15.08 b |
| | $S_2$ | 59.4 b | 63.0 b | 345 a | 368 b | 672 b | 731 b | 32.98 a | 31.69 a | 14.72 b | 15.33 a |
| | $S_3$ | 62.2 a | 68.2 a | 352 a | 402 a | 690 a | 751 a | 33.13 a | 31.87 a | 15.26 a | 15.36 a |
| F-test | | * * | * * | * * | ** | * * | * * | * * | * * | * * | * * |
| Nitrogen | $N_1$ | 53.5 c | 57.2 c | 269 c | 356 c | 593 c | 646 c | 30.90 c | 29.61 c | 16.31 c | 14.87 c |
| | $N_2$ | 60.3 b | 63.7 b | 280 b | 389 b | 667 b | 721 b | 33.14 b | 31.87 b | 16.69 b | 15.39 b |
| | $N_3$ | 62.7 a | 65.7 a | 290 a | 406 a | 697 a | 743 a | 33.49 a | 32.45 a | 17.09 a | 15.51 a |
| F-test | | * | * * | * * | * | * * | * * | * * | * * | * * | * * |

$I_1$ = Irrigation at lose 40% A.S.M.D
$I_2$ = Irrigation at lose 60% A.S.M.D
$I_3$ = Irrigation at lose 80% A.S.M.D

$S_1$ = Zero ascorbic acid
$S_2$ = 500 mg/L ascorbic acid
$S_3$ = 1000 mg/L ascorbic acid

$N_1$ = 60 kg N / faddan
$N_2$ = 80 kg /N / faddan
$N_3$ = 100 kg N / faddan

**Abd-El-Fatah (1995) and Zewail (2007)** who showed that total chlorophyll was significantly increased by increasing N- rate up to 105 and 100 Kg N / faddan, respectively.

## 4- Interactions effect:

### 4.1.Interaction effect between irrigation treatments and ascorbic acid concentrations:

The effect of the interaction between irrigation and ascorbic acid treatment was significant on plant height, number of tillers / $m^2$ and dry weight of tillers / $m^2$ in both seasons and total chlorophyll in the second season only as shown in Table (4). Irrigation at 40 % ASMD with application of ascorbic acid at 1000 mg/L. gave the greatest mean values of plant height and number of tillers /$m^2$. While, irrigation at 60% ASMD with application 1000 mg/L. ascorbic acid concentration gave the best value of dry weight of tillers/$m^2$ and irrigation at 80% ASMD with application 1000 mg/L. ascorbic acid concentration resulted in the highest mean value of total chlorophyll. No significant differences were obtained between application of ascorbic acid at 500 and 1000 mg/ L. with irrigation at 40 % ASMD on plant height, number of tillers / $m^2$. On the contrary, the lowest ones were obtained from without ascorbic acid and irrigating at 80 % ASMD respect to plant height, number of tillers/$m^2$ and dry weight of tillers /$m^2$ whereas irrigation at 40% available soil moisture depletion respect to Total chlorophyll. It could be concluded that irrigation of wheat at 40 % ASMD with application of ascorbic acid at different concentrations gave the

**Table (4): The interaction significantly effects of irrigation treatments with ascorbic acid concentrations on growth characteristics.**

| Characters | | Plant height (cm) | | No. of tillers/m$^2$ | | Dry weight of tillers (g/m$^2$) | | Total chlorophyll (mg/g. D.W). |
|---|---|---|---|---|---|---|---|---|
| Treatments | | Season | | | | | | |
| | | 1st | 2nd | 1st | 2nd | 1st | 2nd | 2nd |
| $I_1$ | $S_1$ | 61.8 | 65.7 | 368 | 401 | 644 | 667 | 12.51 |
| | $S_2$ | 68.1 | 71.8 | 385 | 433 | 736 | 815 | 13.09 |
| | $S_3$ | 70.3 | 73.8 | 399 | 452 | 765 | 841 | 13.56 |
| $I_2$ | $S_1$ | 57.1 | 61.0 | 351 | 390 | 700 | 755 | 13.40 |
| | $S_2$ | 57.2 | 64.9 | 370 | 420 | 789 | 854 | 14.58 |
| | $S_3$ | 63.2 | 66.9 | 370 | 440 | 800 | 870 | 15.12 |
| $I_3$ | $S_1$ | 45.7 | 49.6 | 273 | 299 | 465 | 462 | 16.49 |
| | $S_2$ | 49.1 | 52.2 | 280 | 305 | 492 | 523 | 16.51 |
| | $S_3$ | 52.9 | 54.6 | 285 | 315 | 505 | 542 | 17.11 |
| L.S.D. at 0.05 | | 3.29 | 2.05 | 22.73 | 26.37 | 17.16 | 14.25 | 0.162 |

$I_1$ = Irrigation at lose 40% A.S.M.D
$I_2$ = Irrigation at lose 60% A.S.M.D
$I_3$ = Irrigation at lose 80% A.S.M.D

$S_1$ = Zero ascorbic acid
$S_2$ =500 mg/L ascorbic acid
$S_3$ = 1000 mg/L ascorbic acid

best results of growth characters of wheat plants except Total chlorophyll.

## 4.2. Interaction effect between irrigation treatments and N-rates:

The results in Table (5) show that the interaction between irrigation treatments and N-rates significantly affected plant height in the first season, number of tillers / $m^2$ , dry weight of tillers / $m^2$ ,total chlorophyll in the two growing seasons as well as flag leaf area in the second season only. The greatest mean values of plant height and number of tillers/$m^2$ and flag leaf area were produced from irrigation at 40 % ASMD and 100 Kg N / faddan, and irrigation at 60% ASMD with adding 100 kg N/faddan respect to dry weight of tillers /$m^2$, and irrigation at 80% ASMD with adding 100 kg N/faddan respect to total chlorophyll. Whereas, the lowest mean values of plant height, number of tillers / $m^2$dry weight of tillers / $m^2$ and flag leaf area produced from adding 60 Kg N/faddan with irrigation at 80 % available soil moisture depletion (ASMD), while, the lowest mean value of total chlorophyll was obtained from irrigation at 40 % available soil moisture depletion with 60 Kg N / faddan application. No significant difference was obtained between adding 80 and 100 Kg N / faddan with irrigation at 40 % ASMD in plant height, number of tillers / $m^2$ at 80 days after planting.

Table (5): The interaction significantly effects of irrigation treatments with nitrogen rates on growth characteristics.

| Characters | | Plant height (cm) | No. of tillers/$m^2$ | | Dry weight of tillers ($g/m^2$) | | Flag leaf area (cm2) | Total chlorophyll (mg/g. D.W). | |
|---|---|---|---|---|---|---|---|---|---|
| Treatments | | Season | | | | | | | |
| | | 1st | 1st | 2nd | 1st | 2nd | 2nd | 1st | 2nd |
| $I_1$ | $N_1$ | 61.4 | 363 | 391 | 635 | 700 | 34.13 | 12.32 | 14.49 |
| | $N_2$ | 68.4 | 388 | 437 | 729 | 800 | 36.69 | 13.15 | 14.98 |
| | $N_3$ | 70.2 | 400 | 459 | 781 | 823 | 37.04 | 13.70 | 15.12 |
| $I_2$ | $N_1$ | 54.4 | 347 | 388 | 693 | 759 | 33.29 | 13.30 | 14.85 |
| | $N_2$ | 61.8 | 368 | 423 | 787 | 847 | 35.69 | 14.80 | 15.21 |
| | $N_3$ | 64.9 | 377 | 440 | 809 | 872 | 36.25 | 15.00 | 15.29 |
| $I_3$ | $N_1$ | 44.7 | 269 | 291 | 451 | 478 | 21.40 | 16.31 | 14.87 |
| | $N_2$ | 50.7 | 280 | 309 | 484 | 515 | 23.25 | 16.69 | 15.39 |
| | $N_3$ | 52.9 | 290 | 319 | 501 | 534 | 24.07 | 17.09 | 15.51 |
| L.S.D. at 0.05 | | 3.96 | 18.14 | 22.02 | 19.41 | 10.01 | 0.33 | 0.189 | 0.139 |

$I_1$= Irrigation at lose 40% A.S.M.D
$I_2$= Irrigation at lose 60% A.S.M.D
$I_3$= Irrigation at lose 80% A.S.M.D

$N_1$ = 60 kg N / faddan
$N_2$ = 80 kg /N / faddan
$N_3$=100 kg N / faddan

## 4.3.Interaction effect between ascorbic acid concentrations and N-rates:

There was a significant deference in plant height, number of tillers / $m^2$, dry weight of tillers / $m^2$ and Total chlorophyll in both seasons and flag leaf area in the second season due to the interaction between ascorbic acid and N –rates as shown in Table (6) . Application of ascorbic acid at 1000 mg / L. with adding 100 Kg N / faddan gave the maximum mean values of growth wheat characters under study as compared with the control treatment (without application of ascorbic and 60 kg nitrogen fertilizer per faddan). However, no significant difference was obtained between application of ascorbic acid at 500 and 1000 mg/L. with adding 80 and 100 Kg N / faddan, respectively, in all growth characters of wheat.

## 4.4 Interaction effect between the three factors:

The interaction effect of the three applied factors was significant on number of tillers / $m^2$ , dry weight of tillers / $m^2$ in the second season and total chlorophyll in the first season at 80 days after planting in one season out of two (Table 7). Whereas, the other characters of growth were not significantly affected by the interaction between irrigation treatments, ascorbic acid and N – rates in both seasons. The highest mean value of number of tillers / $m^2$ was produced from adding 100 kg N/ faddan with sprayed 1000 mg/L. ascorbic acid concentration and irrigation at 40 % available soil moisture depletion ASMD and irrigation at 60% for dry weight of tileres/$m^2$ , and irrigation at 80% for total chlorophyll in one season out of two.

Table (6): The interaction significantly effects of ascorbic acid concentrations with nitrogen rates on growth characteristics.

| Characters | | Plant height (cm). | | No. of tillers/m$^2$ | | Dry weight of tillers (g/m$^2$) | | Flag leaf area (cm$^2$) | Total chlorophyll (mg/g. D.W). | |
|---|---|---|---|---|---|---|---|---|---|---|
| Treatments | | Season | | | | | | | | |
| | | 1st | 2nd | 1st | 2nd | 1st | 2nd | 2nd | 1st | 2nd |
| $S_1$ | $N_1$ | 49.8 | 52.9 | 315 | 341 | 549 | 582 | 28.35 | 13.26 | 14.73 |
| | $N_2$ | 56.7 | 59.6 | 331 | 362 | 596 | 629 | 30.60 | 14.22 | 15.11 |
| | $N_3$ | 59.7 | 63.2 | 364 | 386 | 638 | 673 | 32.15 | 14.93 | 15.41 |
| $S_2$ | $N_1$ | 54.5 | 58.2 | 331 | 361 | 610 | 674 | 30.24 | 14.07 | 14.95 |
| | $N_2$ | 61.2 | 65.0 | 348 | 392 | 690 | 751 | 32.36 | 14.87 | 15.51 |
| | $N_3$ | 62.4 | 65.7 | 357 | 406 | 718 | 767 | 32.48 | 15.23 | 15.54 |
| $S_3$ | $N_1$ | 56.2 | 60.4 | 334 | 367 | 620 | 681 | 30.23 | 14.60 | 14.94 |
| | $N_2$ | 64.0 | 66.6 | 356 | 414 | 714 | 781 | 32.67 | 15.55 | 15.56 |
| | $N_3$ | 66.1 | 68.2 | 365 | 425 | 735 | 791 | 32.73 | 15.63 | 15.58 |
| L.S.D. at 0.05 | | 3.96 | 1.97 | 18.14 | 22.02 | 19.41 | 10.01 | 0.33 | 0.189 | 0.139 |

$S_1$ = Zero ascorbic acid
$S_2$ =500 mg/L ascorbic acid
$S_3$ = 1000 mg/L ascorbic acid

$N_1$ = 60 kg N / faddan
$N_2$ = 80 kg N / faddan
$N_3$=100 k N / faddan

**Table (7): The interaction significantly effects of irrigation treatments and ascorbic acid concentrations with nitrogen rates on growth characteristics.**

| Characters | | | No. of tillers/m² | Dry weight of tillers (g/m²) | Total chlorophyll (mg/g. D.W). |
|---|---|---|---|---|---|
| Treatments | | | Season | | |
| | | | 1st | 2nd | 1st |
| $I_1$ | $S_1$ | $N_1$ | 347 | 633 | 11.55 |
| | | $N_2$ | 370 | 665 | 12.40 |
| | | $N_3$ | 358 | 703 | 13.59 |
| | $S_2$ | $N_1$ | 371 | 739 | 12.46 |
| | | $N_2$ | 389 | 840 | 13.19 |
| | | $N_3$ | 397 | 865 | 13.62 |
| | $S_3$ | $N_1$ | 373 | 728 | 12.94 |
| | | $N_2$ | 405 | 893 | 13.86 |
| | | $N_3$ | 418 | 903 | 13.89 |
| $I_2$ | $S_1$ | $N_1$ | 337 | 699 | 12.23 |
| | | $N_2$ | 350 | 754 | 13.23 |
| | | $N_3$ | 366 | 811 | 13.79 |
| | $S_2$ | $N_1$ | 350 | 780 | 13.61 |
| | | $N_2$ | 377 | 886 | 14.18 |
| | | $N_3$ | 384 | 897 | 15.12 |
| | $S_3$ | $N_1$ | 353 | 799 | 14.07 |
| | | $N_2$ | 377 | 902 | 15.58 |
| | | $N_3$ | 382 | 910 | 15.71 |
| $I_3$ | $S_1$ | $N_1$ | 261 | 415 | 16.01 |
| | | $N_2$ | 274 | 468 | 16.67 |
| | | $N_3$ | 285 | 504 | 17.01 |
| | $S_2$ | $N_1$ | 272 | 503 | 16.14 |
| | | $N_2$ | 279 | 528 | 16.93 |
| | | $N_3$ | 289 | 539 | 16.96 |
| | $S_3$ | $N_1$ | 274 | 516 | 16.80 |
| | | $N_2$ | 286 | 549 | 17.22 |
| | | $N_3$ | 296 | 561 | 17.31 |
| L.S.D. at 0.05 | | | 31.43 | 17.34 | 0.527 |

## II- Yield and its components.

The effect of irrigation treatments, ascorbic acid concentrations and N-rates on plant height at harvest, number of spikes / $m^2$ , spike characters, 1000 grain weight, grain and straw yields / faddan in 2004 / 2005 and 2005 / 2006 seasons as shown in Table (8).

### 1- Effect of irrigation treatments:

### 1-1 Plant height at harvest:

The results show that increasing soil moisture depletion significantly decreased wheat plant height at harvest in the two growing seasons (Table 8). Irrigation of wheat plants at 40 % available soil moisture depletion increased plant height by 48.75 and 45.51 % over the treatment of irrigation at 80 % ASMD in the first and second seasons, respectively. This result may charily that water stress decreased the activity of merstimatic tissues responsible to elongation and then decreased internodes length because of the reduction in cell division size. **Kramer and Boyer (1995)** have carefully discussed this effect of water stress on cell division and enlargement. Similar observations were recorded by **Abd-El-Fatah (1982), Mohamed (1992), Dawood and Kheiralla (1994), El-Kalla *et al.* (1994), Abu-Elela (1996), Sharaan *et al.,* (2000), El-Sherbeny (2003) and El-Afandy (2006).**

## 1.2. Number of spikes / m$^2$:

The data illustrated in Table (8) show that the number of spikes / m$^2$ were significantly affected by rates of irrigation in both seasons. The highest number of spikes / m$^2$ were 351 and 362, produced from irrigation of wheat plant at 40 % available soil moisture depletion in the first and second seasons, respectively. Whereas, the lowest ones were 253 and 259, respectively, obtained from irrigation at 80 % (ASMD). The increase in number of spikes / m$^2$ is to be expected since the mean values of tillers/ m$^2$ increased by decreasing soil moisture depletion up to 40 %. Also, water stress decreased the activity of merstimatic tissues responsible for increasing tillers number per plant. These are in accordance with those obtained by **Abd-El-Fatah (1982), El-Kalla *et al.* (1994), Dawood and Kheiralla (1994), Abu-Elela (1996), El-Hawary (2000), Munir *et al.* (2000), El-Sherbeny (2003) and El-Afandy (2006).**

## 1.3. Spike characters:

Results in Table (8) indicate that the effect of irrigation treatment on spike characters i.e. spike length, spike weight, number of grain / spike and weight of grains / spike were significant in both seasons. Irrigation of wheat plants at 40 % available soil moisture depletion gave the maximum mean values of the above characters of spike in the two seasons. Whereas, the lowest ones were produced from irrigation at 80 % ASMD. This was expected since water plays an important role in plants moisture deficit can have a deleterious effect on most physiological process and the decrease in number of grains /

spike by increasing soil moisture stress, which might be attributed to decrease in spike length. These results are in harmony with those obtained by **Abd-El-Fatah (1982), Abu-Elela (1996), Sadek and Mitkees (1997), Munir *et al.* (2000), Sharaan *et al.* (2000), El-Sherbeny (2003), Hefnawy and Wahba (2003), Salem (2005) and El-Afandy (2006).**

## 1.4. 1000 – grain weight:

The results in Table (8) show that the average value of thousand-grain weight was significantly decreased by increasing soil moisture depletion in both seasons. Irrigation at 40 % available soil moisture depletion surpassed the irrigation at 80 % ASMD in 1000-grain weight by 26.97 and 24.91 % in the first and second seasons, respectively. The decrease in seed index owing to increasing the soil moisture depletion could be exposing wheat plants to the soil moisture stress during grain filling stage, resulting in a reduction in photosynthesis ability, which led to decreased in metabolites quantity translocated and stored in grains. These results are in good agreement with those reported by **Abd-El-Fatah (1982), Dawood and Kheiralla (1994), El-Kalla *et al.* (1994), Abu-Elela (1996), El-Hawary (2000), El-Sherbeny (2003), Ozturk and Aydin (2004) and El-Afandy (2006).**

## 1.5. Grain and straw yields (Kg / faddan):

Table (8) and Figs. (1-4) indicate that irrigation treatments had a significant effect on grain and straw yields of wheat per faddan in the two growing seasons. It was observed that irrigation of wheat plants at 40 % available soil moisture depletion surpassed the irrigation at 80 % ASMD in grain yield / faddan by 47.33 and 52.90 % in the first and second seasons, respectively. The reduction in grain yield / faddan by increasing soil moisture stress probably resulted from decreasing in number of spikes / $m^2$, number of grains / spike, weight of grains / spike and 1000 – grain weight. 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.

Concerning to straw yield / faddan, it was clear from Table (8) that irrigation of wheat plants at 40 % available soil moisture depletion significantly surpassed the irrigation at 80 % ASMD in straw yield / faddan by 72.90 and 74.14 % in the first and second seasons, respectively. This result may be expected because the dry weight of tillers / $m^2$, leaves area and plant height were decreased by increasing soil moisture depletion up to 80 %. These results are in line with those obtained by **Abd-El-Fatah (1982), Sud *et al.* (1990), Abd-El-Aal (1991),Dawood and Kheiralla (1994), Abu-Elela (1996), Sadek and Mitkees (1997), El-Hawary (2000), Munir *et al.* (2000), Moussa and Abdel-Maksoud (2004), Ozturk and Aydin (2004), Salem (2005), El-Afandy (2006) and Fang *et al.* (2006).**

## 2- Effect of ascorbic acid concentrations:

### 2.1. Plant height at harvest:

Data in Table (8) show that effect of application of ascorbic acid on plant height of wheat plants at harvest which gave significant effect in 2004/2005 and 2005/2006 growing seasons. The highest values were 86.8 and 89.9 cm, existed with application of ascorbic acid at 1000 mg / L. in the first and second seasons, respectively. Whereas, the lowest ones were 78.5 and 81.2 cm, produced from unsprayed wheat plant by ascorbic acid, respectively. In this respect, the increase in plant height may be due to the stimulating effect of Vit. C on vegetative growth and regarded in attract amount to maintain normal growth to increase plant height. The same trend was obtained by **Zhang and Stanley (1994), Wang *et al.* (1995), Negm (1998), Anton *et al.* (1999), Hamed and Hamada (2002), Abd-El-Hamed *et al.* (2004), Irfan *et al.* (2006) and Zewail (2007).**

## 2.2. Number of spikes / $m^2$:

The mean values of spikes number / $m^2$ was significantly increased by application of ascorbic acid on wheat plants in the two growing seasons as shown in Table (8). The application of ascorbic acid at 500 and 1000 mg / L. increased the number of spikes / $m^2$ over the untreated wheat plants by 11.07 and 14.53 %, respectively in the first season. While, the corresponding increase were 9.63 and 14.29 %, respectively in the second season. The increase in the number of spikes / $m^2$ as affected by application of ascorbic acid may be attributed to the increase in number of tillers / $m^2$ at 80 days after planting. Also, the obtained means of this trait could be attributed to the induction many stimulating effects on plant growth and some physiological process and cytokinines synthesis and enhancing cell division which resulted in increasing plant growth leading to an increase the tillering plants. These findings are similar to those reported by **Shorning *et al.* (1999), Hamed and Hamada (2002) and Zewail (2007).**

## 2.3. Spike characters:

Results in Table (8) show that the application of ascorbic acid significantly resulted in increasing the spike characters i.e. spike length, spike weight, number of grain / spike and weight of grains / spike in both seasons as presented in Table (8). The heights mean values of the above characters of spike were produced from application of ascorbic acid at 1000 mg / L. in both seasons. On the contrary, no significant differences were obtained between application of ascorbic acid at 500 and 1000 mg / L. on spike characters in the first season. The lowest ones were produced from untreated wheat plants of ascorbic acid. The obtained increase of this trait, it could be attributed to that role of Vit. C. on fertility and increasing photosynthetic rate and photosynthesis production and their translocation into grains thereby increased grains characters. These results are in harmony with those reported by **Zhang and Stanley (1994), Zade *et al.* (1995), Negm (1998), Shorning *et al.* (1999), and Abd-El-Hameed *et al.* (1999) and Zewail (2007).**

## 2.4. 1000 – grain weight:

Results in Table (8) indicate that weight of thousand grains were significantly increased with application of ascorbic acid on wheat plants when compared with untreated plants in the two growing seasons. The application of ascorbic acid at 1000 mg / L. gave the maximum weight of thousand grains, which equal to 42.34 and 41.67 g. in the first and second seasons, respectively. Whereas, the minimum one was 37.44 and 36.38 g. respectively, produced from the control treatment. On the contrary, the application of ascorbic acid at 500 and 1000 mg / L. did not reach the rate of significant in the second season. The obtained increase of this trait could be attributed to the increase of grain weight / spike thereby could increase the weight of 1000 –grains. Similar results were indicated by **Zhang and Stanley (1994), Wang *et al.* (1995) Zade *et al.* (1995), Negm (1998), Abd-El-Hameed *et al.* (1999) and Zewail (2007).**

## 2.5. Grain and straw yields (Kg/ faddan):

It could be noticed that a significant results has been observed because of spraying ascorbic acid on wheat plants expressed as grain and straw yields per faddan (Table 8) and Figs. (1-4). The application of ascorbic acid at 1000 mg / L. increased grain and straw yields by 15.35 and 14.91% respectively in the first season as compared with unsprayed of ascorbic acid whereas, there is not a significant effect between 500 and 1000 mg / L. On the other hand, the corresponding significant increases in grain and straw yields were 15.65 and 15.14 % respectively, in the second season. The positive response of wheat plants may be due to ascorbic activates some enzymes, which are important in regulation of photosynthetic carbon reduction **(Helsper *et al.*, 1982).** That gave more photosynthesis products, which translocated to the grains and increased the number and weight of grains as well as increased number of spikes / $m^2$ thereby which in turn resulted in increasing the total grain and straw yields. These results are closed with those reported by **Bhat *et al.* (1990), Rabie and Negm (1992), Mousa *et al.* (1994), Zhang and Stanley (1994), Zade *et al.* (1995), Wang *et al.*(1996), Anton *et al.*(1999), Sharning *et al.* (1999) Abd-El-Hamed *et al.* (2004), Inskbaski and Iwaya (2006) and Zewail (2007).**

## 3- Effect of nitrogen rates:

### 3.1. Plant height at harvest:

The results in Table (8) show that the plant height of wheat at harvest was significantly increased by increasing nitrogen fertilizer rate up to 100 Kg N / faddan in the two growing seasons. The application of 80 and 100 Kg N / faddan increased plant height at harvest by 8.48 and 11.44 % over the application of 60 Kg N / faddan in the first season, respectively. The corresponding increases were 6.76 and 8.71 % in the second season, respectively. The increase in plant height may be due to the increase in merstimatic activity in wheat plant and cell elongation as affected by nitrogen fertilizer. These results are in accordance with those obtained by **Darwiche (1994), Dawood and Kheiralla (1994), Salwau (1994), Abd-El-Fatah (1995), Abd-El-Hakem (1996), Zaher (1996), El-Douby (1997), Metwally *et al.* (1998), Zohary *et al.* (1998), Dardiry (1999), Abou-Salama *et al.* (2000) , Abou-El-Ela,Sabah (2001), Soliman (2006) and Zewail (2007).**

## 3.2. Number of spikes / $m^2$:

The nitrogen fertilizer rate significantly affected the number of spikes / $m^2$ in the two growing seasons as shown in Table (8). The greatest mean value of number of spikes / $m^2$ was recorded at the highest N-rate ( 100 Kg N / faddan). Raising N-rate from 60 to 100 Kg N / faddan in sandy soil, which resulted in increasing the number of spikes / $m^2$ by 12.29 and 14.29 % in the first and second seasons, respectively. It could be concluded that N encouraged tillering and fertility in wheat, which was statistically evident in wheat grown in sandy soil. These results are in line with those obtained by **Darwiche (1994), Dawood and Kheiralla (1994), Salwau (1994), Abd-El-Fatah (1995), Abd-El-Hakem (1996), Zaher (1996), Metwally *et al.* (1998), Abou-Salama *et al.* (2000) , Abd-El-Hady *et al.* (2006), Soliman (2006) and Zewail (2007).**

## 3. 3. Spike characters:

The results in Table (8) indicated that the average values of spike length, spike weight, number of grain / spike and weight of grains / spike were significantly increased by increasing rate of nitrogen fertilizer up to 100 Kg N / faddan in both seasons. Application of nitrogen fertilizer at 100 Kg N /faddan gave the longest spike (11.37 and 11.93 cm), the highest spike weight (2.84 and 2.79 g), the largest number of grains / spike (34.6 and 36.7) and maximum weight of grain / spike (1.73 and 1.89 g.) in the first and second seasons, respectively. The favorable effect of nitrogen on spike characters may be due to its effect on photosynthesis and the other essential metabolic activities, which affect the plant growth, development and production. These results are in harmony with those indicated by **Darwiche (1994), Dawood and Kheiralla (1994), Abd-El-Fatah (1995), Abou-El-Ela (2001), Salem (2005), Soliman (2006) and Zewail (2007).**

### 3.4. 1000-grain weight:

Results In Table (8) show that the nitrogen rates had a significant effect on 1000 –grain weight in both seasons. The application of 80 and 100 Kg N / faddan increased 1000-grain weight by 7.38 and 9.75 % over adding 60 Kg N / faddan, respectively in the first season, corresponding to 6.66 and 9.41 %, respectively in the second season. Nitrogen application rate showed a similar effect as that obtained on grain weight / spike. The same trend was obtained by **Dawood and Kheiralla (1994), Zaher (1996), Metwally *et al.* (1998), Zohary *et al.* (1998), Toaima *et al.* (2000), Salem (2005), Soliman (2006) and Zewail (2007).**

### 3.5. Grain and straw yields (Kg/ faddan):

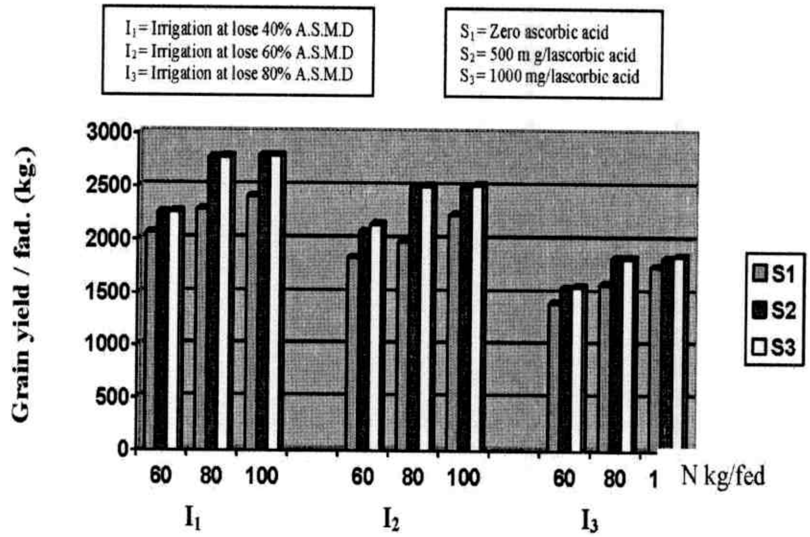
Table (8) and Figs. (1-4) illustrate that nitrogen fertilization of wheat with 60, 80 and 100 Kg N / faddan gave a significant increment at the second and third rate when compared with the first rate in grain and straw yields / faddan in 2004/2005 and 2005/2006 growing seasons. The increment due to nitrogen fertilization with 100 Kg N / faddan over the check treatment reached 20.60 and 16.79 % in grain yield / faddan, 14.66 and 17.11 % in straw yield / faddan in the first and second seasons, Table (8): Effect of irrigation treatments, ascorbic acid concentrations and nitrogen rates on yield and yield components of wheat in 2004/2005 and 2005/2006 seasons.

| Characters | | Plant height (cm) at harvest | | No. of spikes/ $m^2$ | | Spike characters | | | | | | | | 1000-grain weight (g) | | Grain yield (kg/fad.) | | Straw yield (kg/fad.) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Spike length (cm) | | Spike weight (g) | | No. of grains/spike | | Weight of grains/ spike (g) | | | | | | | |
| Treatments | | season | | | | | | | | | | | | | | | | | |
| | | $1^{st}$ | $2^{nd}$ | $1^{st}$ | $2^{nd}$ | $1^{st}$ | $2^{nd}$ | $1^{st}$ | $2^{nd}$ | $1^{st}$ | $2^{nd}$ | $1^{st}$ | $2^{nd}$ | $1^{st}$ | $2^{nd}$ | $1^{st}$ | $2^{nd}$ | $1^{st}$ | $2^{nd}$ |
| Irrigation | $I_1$ | 95.2a | 97.8a | 351a | 362a | 12.08a | 12.99a | 3.13a | 2.97a | 37.3a | 39.6a | 1.91a | 2.05a | 45.29a | 43.72a | 2487a | 2587a | 4179a | 4270a |
| | $I_2$ | 89.7b | 93.4b | 337b | 354a | 11.25b | 11.92b | 2.79b | 2.78b | 34.8b | 37.3b | 1.69b | 1.90b | 41.01b | 39.90b | 2250b | 2332b | 3803b | 3869b |
| | $I_3$ | 64.0c | 66.3c | 253c | 259b | 8.45 c | 8.69 c | 1.92c | 1.81c | 27.1c | 26.5c | 1.13c | 1.24c | 35.67c | 35.00c | 1688c | 1692c | 2417c | 2452c |
| F-test | | ** | * | ** | * | ** | ** | ** | ** | ** | ** | ** | * | ** | ** | ** | ** | ** | ** |
| Ascorbic acid | $S_1$ | 78.5c | 81.2c | 289c | 309b | 9.86 b | 10.28c | 2.30b | 2.27c | 31.7b | 32.7c | 1.49b | 1.57c | 37.44b | 36.38c | 1948b | 2013c | 3158b | 3223c |
| | $S_2$ | 83.6b | 86.6b | 321b | 341a | 10.89a | 11.50b | 2.74a | 2.54b | 33.6a | 34.8b | 1.61a | 1.74b | 42.17a | 40.57b | 2231a | 2269b | 3613a | 3658b |
| | $S_3$ | 86.8a | 89.9a | 331a | 346a | 11.03a | 11.82a | 2.80a | 2.85a | 33.9a | 36.8a | 1.64a | 1.87a | 42.34a | 41.67a | 2247a | 2328a | 3629a | 3711a |
| F-test | | * | ** | ** | ** | ** | ** | * | ** | * | ** | ** | ** | ** | ** | ** | ** | ** | ** |
| Nitrogen | $N_1$ | 77.8c | 81.4c | 293c | 301c | 9.46 c | 10.25c | 2.29c | 2.17c | 30.5c | 31.9c | 1.35c | 1.49c | 38.46c | 37.53c | 1903c | 2001c | 3192c | 3202c |
| | $N_2$ | 84.4b | 86.9b | 318b | 330b | 10.94b | 11.43b | 2.71b | 2.60b | 33.9b | 35.2b | 1.66b | 1.81b | 41.30b | 40.03b | 2227b | 2273b | 3548b | 3640b |
| | $N_3$ | 86.7a | 89.3a | 329a | 344a | 11.37a | 11.93a | 2.84a | 2.79a | 34.6a | 36.7a | 1.73a | 1.89a | 42.21a | 41.06a | 2295a | 2337a | 3660a | 3750a |
| F-test | | ** | * | ** | * | ** | ** | ** | ** | * | ** | ** | ** | ** | ** | ** | ** | ** | ** |

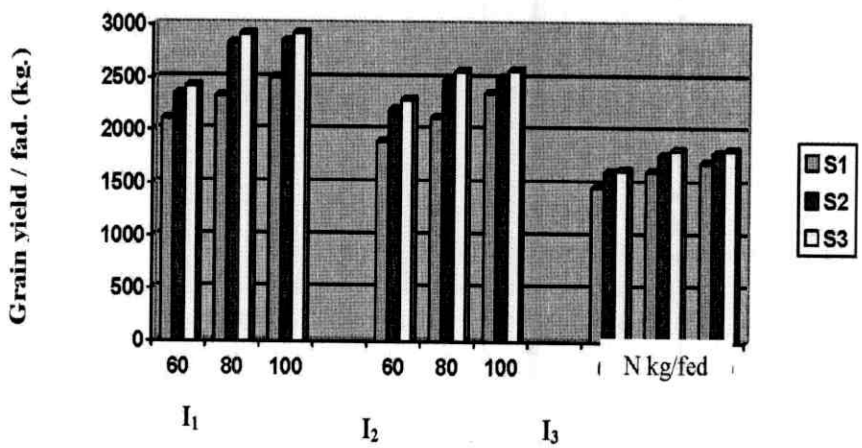
$I_1$ = Irrigation at lose 40% A.S.M.D
$I_2$ = Irrigation at lose 60% A.S.M.D
$I_3$ = Irrigation at lose 80% A.S.M.D

$S_1$ = Zero ascorbic acid
$S_2$ =500 mg/L ascorbic acid
$S_3$ = 1000 mg/L ascorbic acid

$N_1$ = 60 kg N / faddan
$N_2$ = 80 kg N / faddan
$N_3$ = 100 kg /N / faddan




**Fig(1):Show the effect of irrigation treatments, ascorbic acid and nitrogen rates on grain yield kg/faddan (Kg.) in the 1st season.**




**Fig(2):Show the effect of irrigation treatments, ascorbic acid and nitrogen rates on grain yield kg/faddan (Kg.) in the 2nd season.**

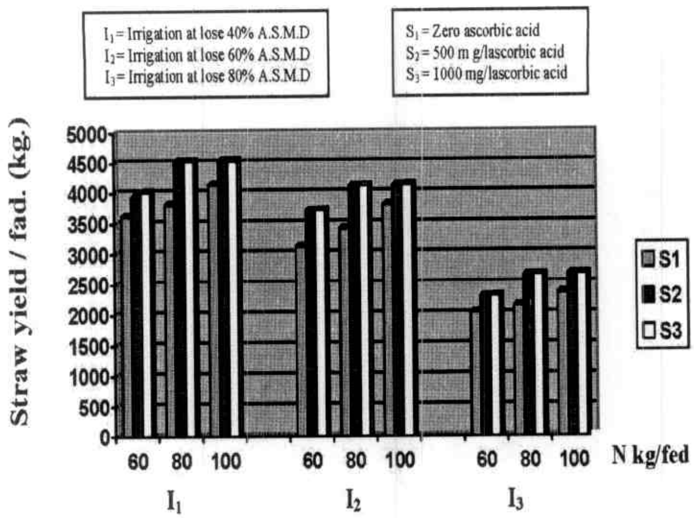



**Fig (3): Show the effect of irrigation treatments, ascorbic acid and nitrogen rates on straw yield/faddan (Kg.) in the 1st season.**

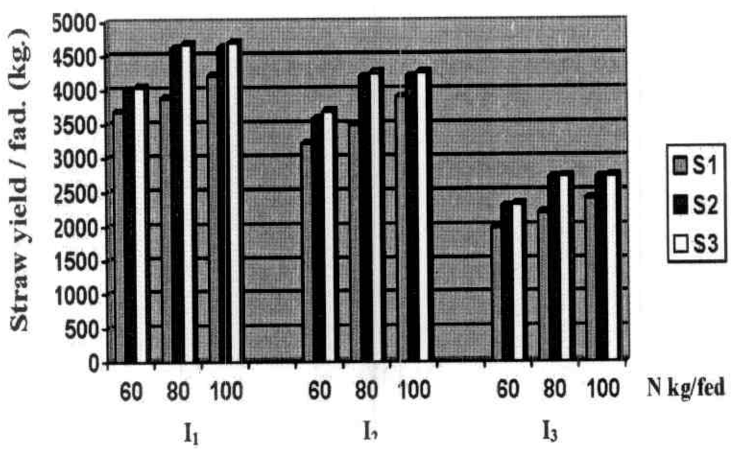



**Fig (4): Show the effect of irrigation treatments, ascorbic acid and nitrogen rates straw yield/faddan (Kg.) in the 2nd season.**

respectively. The increase in grain yield due to the increase in N-rate is a result of the effect of nitrogen in increasing the number of spikes / $m^2$, the spike weight, the number of grain / spike and 1000-grain weight. Also, the response of straw yield to N-rates is nearly similar to that grain yield and reflect the effect of nitrogen fertilizer on stimulating the vegetative growth of wheat i.e. the plant height, the number of tillers / $m^2$, and the dry weight of tillers / $m^2$ . Similar conclusion was obtained by **Darwiche (1994), Dawood and Kheiralla (1994), Salwau (1994), Abd-El-Fatah 1995), Abd-El-Hakem (1996), Zaher (1996), Zohary *et al.* (1996), Salem (2005), Soliman (2006) and Zewail (2007).**

## 4- Interactions effect:

### 4.1.Interaction effect between irrigation treatments and ascorbic acid concentrations:

There was a significant difference in plant height, number of spikes / $m^2$, spike weight, weight of grains / spike, 1000-grain weight, grain and straw yields of wheat per faddan in both seasons as well as spike length, and number of grains / spike in the first season due to the interaction between irrigation treatment and ascorbic acid concentrations as shown in Table (9). The greatest values of the above characters of yield and yield components were produced from irrigation at 40 % available soil moisture depletion with application of ascorbic acid at 500 and 1000 mg / L. Whereas, no significant difference was obtained between application of ascorbic acid at 500 and 1000 mg / L. with irrigation at 40 % ASMD on plant height, spike length, number of grains / spike, weight of grains / spike, 1000- grain

Table (9): The interaction significantly effects of irrigation treatments with ascorbic acid concentrations on yield and yield components.

| Characters | | Plant height (cm) at harvest | | No. of spikes/ $m^2$ | | Spike length (cm) | Spike weight (g) | | No. of grains/ spike | Weight of grains/ spike (g) | | 1000-grain weight (g) | | Grain yield (kg/fad.) | | Straw yield (kg/fad.) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Treatments | | Season | | | | | | | | | | | | | | | |
| | | 1st | 2nd | 1st | 2nd | 1st | 1st | 2nd | 1st | 1st | 2nd | 1st | 2nd | 1st | 2nd | 1st | 2nd |
| $I_1$ | $S_1$ | 89.3 | 91.2 | 322 | 355 | 11.41 | 2.57 | 2.55 | 35.4 | 1.78 | 1.84 | 41.81 | 40.78 | 2249 | 2318 | 3852 | 3929 |
| | $S_2$ | 95.4 | 99.9 | 358 | 368 | 12.34 | 3.36 | 3.05 | 38.1 | 1.94 | 2.07 | 47.05 | 44.80 | 2604 | 2687 | 4328 | 4412 |
| | $S_3$ | 100.1 | 102.8 | 373 | 385 | 12.48 | 3.46 | 3.57 | 38.4 | 2.01 | 2.23 | 47.01 | 45.59 | 2609 | 2755 | 4357 | 4468 |
| $I_2$ | $S_1$ | 84.4 | 88.0 | 310 | 317 | 10.79 | 2.53 | 2.58 | 34.0 | 1.63 | 1.80 | 37.32 | 36.36 | 2013 | 2124 | 3447 | 3543 |
| | $S_2$ | 91.2 | 94.8 | 346 | 364 | 11.41 | 2.91 | 2.77 | 35.1 | 1.73 | 1.93 | 42.78 | 41.20 | 2350 | 2396 | 3976 | 3993 |
| | $S_3$ | 93.6 | 101.7 | 353 | 381 | 11.56 | 2.93 | 3.01 | 35.4 | 1.74 | 1.97 | 42.93 | 42.13 | 2511 | 2477 | 3986 | 4070 |
| $I_3$ | $S_1$ | 62.0 | 64.3 | 234 | 252 | 7.38 | 1.78 | 1.68 | 25.8 | 1.05 | 1.09 | 33.18 | 32.00 | 1580 | 1598 | 2175 | 2196 |
| | $S_2$ | 64.2 | 65.3 | 260 | 260 | 8.92 | 1.97 | 1.81 | 27.6 | 1.15 | 1.22 | 36.71 | 35.71 | 1738 | 1724 | 2535 | 2567 |
| | $S_3$ | 65.8 | 68.7 | 273 | 266 | 9.04 | 2.01 | 1.97 | 28.0 | 1.23 | 1.42 | 37.09 | 37.29 | 1847 | 1753 | 2543 | 2594 |
| L.S.D. at 0.05 | | 4.85 | 4.46 | 11.18 | 29.99 | 0.290 | 0.134 | 0.073 | 0.56 | 0.059 | 0.169 | 0.181 | 0.266 | 57.42 | 62.84 | 73.80 | 60.11 |

$I_1$ = Irrigation at lose 40% A.S.M.D
$I_2$ = Irrigation at lose 60% A.S.M.D
$I_3$ = Irrigation at lose 80% A.S.M.D

$S_1$ = Zero ascorbic acid
$S_2$ = 500 mg/L ascorbic acid
$S_3$ = 1000 mg/L ascorbic acid

weight, grain and straw yields / faddan in one season out of two. The lowest ones were obtained from irrigation at 80 % ASMD without application of ascorbic acid. It could be concluded that irrigation at 40 % ASMD with application of ascorbic acid gave the best results in yield and yield components of wheat in sandy soil.

## 4.2. Interaction effect between irrigation treatments and N-rates:

Results in Table (10) showed that the interaction between irrigation treatment and N-rate significantly affected plant height and number of grains/spike in one season out of two and number of spikes/$m^2$ , spike length , spike weight of grains/spike , 1000-grain weight , grain and straw yields of wheat per faddan in the two growing seasons. Irrigation of wheat plants at 40% ASMD with 100 kg N/faddan produced the highest values of yield and yield components of wheat in both seasons. Whereas the lowest ones were produced from irrigation at 80% ASMD with application of nitrogen fertilizer 60 kg N/faddan.

## 4.3. Interaction effect between ascorbic acid concentrations and N-rate:

The results presented in Table (11) indicate that the all characters under study of yield and yield components of wheat except number of grains / spike in the first season were significantly affected by the interaction between ascorbic acid and N-rate in the two growing seasons. The maximum mean values of grain and straw yields as well as yield components of

Table (10 ): The interaction significantly effects of irrigation treatments with nitrogen rates on yield and yield component.

| Characters | | Plant height (cm) at harvest | No. of spikes/ $m^2$ | | Spike length (cm) | | Spike weight (g) | | No. of grains/ spike | Weight of grains/ spike (g) | | 1000-grain weight (g) | | Grain yield (kg/fad.) | | Straw yield (kg/fad.) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Treatments | | season | | | | | | | | | | | | | | | |
| | | 1st | 1st | 2nd | 1st | 2nd | 1st | 2nd | 2nd | 1st | 2nd | 1st | 2nd | 1st | 2nd | 1st | 2nd |
| $I_1$ | $N_1$ | 89.6 | 327 | 330 | 10.75 | 12.03 | 2.59 | 2.50 | 37.8 | 1.68 | 1.75 | 42.74 | 41.76 | 2190 | 2307 | 3852 | 3911 |
| | $N_2$ | 96.5 | 355 | 370 | 12.53 | 13.35 | 3.31 | 3.07 | 39.4 | 1.99 | 2.15 | 46.12 | 44.16 | 2610 | 2694 | 4284 | 4390 |
| | $N_3$ | 99.6 | 371 | 387 | 12.95 | 13.60 | 3.50 | 3.33 | 41.5 | 2.07 | 2.25 | 47.02 | 45.25 | 2662 | 2759 | 4401 | 4509 |
| $I_2$ | $N_1$ | 84.0 | 311 | 322 | 10.02 | 10.89 | 2.52 | 2.38 | 35.6 | 1.34 | 1.73 | 38.59 | 37.55 | 2015 | 2126 | 3511 | 3497 |
| | $N_2$ | 91.6 | 344 | 361 | 11.67 | 12.11 | 2.85 | 2.90 | 38.0 | 1.85 | 1.93 | 41.69 | 40.50 | 2324 | 2390 | 3880 | 3985 |
| | $N_3$ | 93.5 | 355 | 378 | 12.07 | 12.78 | 3.00 | 3.07 | 39.3 | 1.90 | 2.03 | 42.74 | 41.64 | 2410 | 2481 | 4019 | 4124 |
| $I_3$ | $N_1$ | 59.8 | 242 | 253 | 7.61 | 7.83 | 1.76 | 1.62 | 22.3 | 1.03 | 0.98 | 34.07 | 33.27 | 1506 | 1571 | 2219 | 2197 |
| | $N_2$ | 65.2 | 256 | 259 | 8.63 | 8.84 | 1.98 | 1.83 | 28.1 | 1.15 | 1.35 | 36.09 | 35.44 | 1747 | 1734 | 2481 | 2544 |
| | $N_3$ | 67.0 | 262 | 266 | 9.10 | 9.41 | 2.02 | 1.99 | 29.2 | 1.21 | 1.39 | 36.86 | 36.29 | 1812 | 1770 | 2560 | 2617 |
| L.S.D. at 0.05 | | 4.29 | 10.53 | 22.50 | 0.329 | 0.203 | 0.154 | 0.068 | 1.63 | 0.103 | 0.145 | 0.279 | 0.181 | 49.01 | 55.87 | 63.54 | 53.08 |

$I_1$ = Irrigation at lose 40% A.S.M.D
$I_2$ = Irrigation at lose 60% A.S.M.D
$I_3$ = Irrigation at lose 80% A.S.M.D

$N_1$ = 60 kg N / faddan
$N_2$ = 80 kg /N / faddan
$N_3$ =100 kg N / faddan

Table (11): The interaction significantly effects of ascorbic acid concentrations with nitrogen rates on yield and yield components.

| Characters | | Plant height (cm) at harvest | | No. of spikes/ $m^2$ | | Spike length (cm) | | Spike weight (g) | | No. of grains/ spike | Weight of grains/ spike (g) | | 1000-grain weight (g) | | Grain yield (kg/fad.) | | Straw yield (kg/fad.) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Treatments | | season | | | | | | | | | | | | | | | | |
| | | 1st | 2nd | 1st | 2nd | 1st | 2nd | 1st | 2nd | 2nd | 1st | 2nd | 1st | 2nd | 1st | 2nd | 1st | 2nd |
| $S_1$ | $N_1$ | 73.1 | 75.08 | 272 | 290 | 8.63 | 9.03 | 2.06 | 1.99 | 29.8 | 1.25 | 1.33 | 34.94 | 33.99 | 1765 | 1824 | 2924 | 2962 |
| | $N_2$ | 79.0 | 81.6 | 288 | 300 | 9.89 | 10.40 | 2.28 | 2.24 | 33.1 | 1.54 | 1.61 | 37.54 | 36.29 | 1949 | 2026 | 3121 | 3198 |
| | $N_3$ | 83.6 | 86.2 | 306 | 314 | 11.06 | 11.41 | 2.56 | 2.57 | 35.3 | 1.68 | 1.78 | 39.85 | 38.87 | 2128 | 2190 | 3429 | 3508 |
| $S_2$ | $N_1$ | 79.0 | 81.9 | 299 | 302 | 9.68 | 10.62 | 2.37 | 2.18 | 32.1 | 1.38 | 1.49 | 40.25 | 38.95 | 1958 | 2066 | 3308 | 3291 |
| | $N_2$ | 85.4 | 88.3 | 329 | 341 | 11.45 | 11.87 | 2.90 | 2.68 | 35.2 | 1.71 | 1.83 | 43.05 | 41.19 | 2361 | 2361 | 3759 | 3838 |
| | $N_3$ | 86.5 | 89.7 | 336 | 348 | 11.52 | 12.02 | 2.96 | 2.67 | 37.0 | 1.73 | 1.89 | 43.22 | 41.58 | 2373 | 2380 | 3772 | 3844 |
| $S_3$ | $N_1$ | 81.3 | 86.0 | 308 | 312 | 10.07 | 11.10 | 2.45 | 2.34 | 33.7 | 1.42 | 1.64 | 40.18 | 39.64 | 1987 | 2114 | 3342 | 3352 |
| | $N_2$ | 89.0 | 90.7 | 337 | 350 | 11.48 | 12.02 | 2.95 | 2.87 | 37.2 | 1.73 | 1.98 | 43.31 | 42.63 | 2370 | 2432 | 3765 | 3883 |
| | $N_3$ | 90.0 | 93.0 | 347 | 370 | 11.52 | 12.35 | 3.01 | 3.06 | 37.8 | 1.76 | 2.00 | 43.55 | 42.73 | 2383 | 2440 | 3779 | 3897 |
| L.S.D. at 0.05 | | 4.29 | 3.73 | 10.53 | 22.50 | 0.329 | 0.203 | 0.154 | 0.068 | 1.63 | 0.103 | 0.145 | 0.279 | 0.181 | 49.01 | 55.87 | 63.54 | 53.08 |

$S_1$ = Zero ascorbic acid
$S_2$ =500 mg/L ascorbic acid
$S_3$ = 1000 mg/L ascorbic acid

$N_1$ = 60 kg N / faddan
$N_2$ = 80 kg /N / faddan
$N_3$=100 kg N / faddan

wheat were produced from adding 1000 mg / L. ascorbic acid + 100 Kg N / faddan. Whereas, the minimum one was obtained from adding 60 Kg N / faddan without application of ascorbic acid. On the contrary, no significant difference was obtained between application of ascorbic acid at 500 and 1000 mg / L. when applied 100 Kg N / faddan on grain and straw yields of wheat per faddan in the two growing seasons.

## 4.4. Interaction effect between the three factors:

The results in Table (12) illustrated that the interaction between irrigation treatments, ascorbic acid concentrations and N – rate significantly affected spike weight, 1000-grain weight, grain and straw yields / faddan in both seasons and spike length in the second season only. Irrigation of wheat plants at 40 % of available soil moisture depletion with sprayed 1000 mg / L. and applied 100 Kg N / faddan gave the greatest mean values of grain and straw yields / faddan and the above characters of yield components. Also, no significant difference was obtained between spraying of ascorbic acid at 500 and 1000 mg /L. with applied 80 and 100 Kg N / faddan and irrigation of wheat at 40 % of ASMD. It could be concluded that the application of ascorbic acid with decreasing soil moisture stress with increasing N-rate up to100 Kg N / faddan gave the maximum grain and straw yields of wheat per faddan.

**Table (12): The interaction significantly effects of irrigation treatments ascorbic acid concentrations with nitrogen rates on yield and yield components.**

| Characters | | | Spike length (cm) | Spike weight (g) | | 1000-grain weight (g) | | Grain yield (kg/fad.) | | Straw yield (kg/fad.) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Treatments | | | Season | | | | | | | | |
| | | | 2nd | 1st | 2nd | 1st | 2nd | 1st | 2nd | 1st | 2nd |
| $I_1$ | $S_1$ | $N_1$ | 11.10 | 2.29 | 2.22 | 39.25 | 38.48 | 2062 | 2112 | 3620 | 3686 |
| | | $N_2$ | 12.33 | 2.53 | 2.46 | 42.02 | 40.73 | 2280 | 2336 | 3805 | 3890 |
| | | $N_3$ | 12.90 | 2.91 | 2.97 | 44.23 | 43.13 | 2406 | 2505 | 4133 | 4211 |
| | $S_2$ | $N_1$ | 12.16 | 2.67 | 2.56 | 44.71 | 43.14 | 2253 | 2384 | 3929 | 4005 |
| | | $N_2$ | 13.73 | 3.66 | 3.23 | 48.05 | 45.22 | 2770 | 2830 | 4521 | 4612 |
| | | $N_3$ | 13.76 | 3.75 | 3.32 | 48.31 | 46.04 | 2789 | 2849 | 4533 | 4620 |
| | $S_3$ | $N_1$ | 12.83 | 2.82 | 2.69 | 44.26 | 43.66 | 2256 | 2426 | 4007 | 4042 |
| | | $N_2$ | 14.00 | 3.72 | 3.52 | 48.28 | 46.53 | 2780 | 2916 | 4527 | 4670 |
| | | $N_3$ | 14.13 | 3.84 | 3.70 | 48.50 | 46.58 | 2791 | 2924 | 4537 | 4694 |
| $I_2$ | $S_1$ | $N_1$ | 9.67 | 2.26 | 2.20 | 35.03 | 34.00 | 1830 | 1890 | 3124 | 3219 |
| | | $N_2$ | 11.23 | 2.49 | 2.60 | 37.09 | 36.09 | 1979 | 2123 | 3417 | 3503 |
| | | $N_3$ | 12.30 | 2.84 | 2.91 | 39.83 | 39.01 | 2231 | 2360 | 3800 | 3906 |
| | $S_2$ | $N_1$ | 11.30 | 2.62 | 2.29 | 40.29 | 38.85 | 2072 | 2200 | 3699 | 3580 |
| | | $N_2$ | 12.57 | 3.01 | 2.94 | 43.90 | 42.23 | 2489 | 2483 | 4108 | 4196 |
| | | $N_3$ | 12.83 | 3.08 | 3.07 | 44.15 | 42.53 | 2489 | 2505 | 4122 | 4205 |
| | $S_3$ | $N_1$ | 11.60 | 2.68 | 2.63 | 40.46 | 39.80 | 2143 | 2290 | 3711 | 3693 |
| | | $N_2$ | 12.53 | 3.03 | 3.16 | 44.09 | 43.18 | 2503 | 2564 | 4114 | 4255 |
| | | $N_3$ | 13.20 | 3.09 | 3.23 | 44.25 | 43.40 | 2511 | 2578 | 4134 | 4261 |
| $I_3$ | $S_1$ | $N_1$ | 6.23 | 1.62 | 1.52 | 30.52 | 29.48 | 1405 | 1470 | 2030 | 1980 |
| | | $N_2$ | 7.63 | 1.82 | 1.65 | 33.52 | 32.04 | 1589 | 1618 | 2141 | 2202 |
| | | $N_3$ | 9.03 | 1.91 | 1.84 | 35.47 | 34.49 | 1747 | 1705 | 2353 | 2406 |
| | $S_2$ | $N_1$ | 8.40 | 1.82 | 1.65 | 35.74 | 34.87 | 1550 | 1615 | 2296 | 2288 |
| | | $N_2$ | 9.33 | 2.04 | 1.87 | 37.18 | 36.11 | 1824 | 1770 | 2649 | 2706 |
| | | $N_3$ | 9.47 | 2.04 | 1.89 | 37.20 | 36.17 | 1841 | 1787 | 2660 | 2708 |
| | $S_3$ | $N_1$ | 8.86 | 1.84 | 1.71 | 35.81 | 35.46 | 1563 | 1626 | 2309 | 2321 |
| | | $N_2$ | 9.53 | 2.09 | 1.95 | 37.56 | 38.19 | 1828 | 1816 | 2653 | 2724 |
| | | $N_3$ | 9.73 | 2.11 | 2.24 | 37.91 | 38.22 | 1847 | 1818 | 2666 | 2737 |
| L.S.D. at 0.05 | | | 0.351 | 0.267 | 0.117 | 0.502 | 0.314 | 84.89 | 96.77 | 110.1 | 91.95 |

## III- Chemical analysis:

The mean values of crude protein, total carbohydrates, ash content and crude fiber in wheat grains, as well as nitrogen and water use efficiency influenced by irrigation treatments, ascorbic acid concentrations and nitrogen fertilizer rates in 2004/2005 and 2005/2006 growing seasons are shown in Table (13).

### 1- Effect of irrigation treatments:

#### 1.1. Crude protein content:

The results show clearly that irrigation treatments were significantly affected on the protein content in wheat grains in both seasons. The highest protein content was 11.96 and 11.83 %, produced from irrigation of wheat plants at 80 % available soil moisture depletion in the first and second seasons, respectively. On the other hand, irrigation at 40 % ASMD gave the lowest one (10.48 and 10.89 %,in the first and second seasons respectively). The same trend was obtained by **Kramer (1978)** who indicated 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. A similar trend was reported by **Stoskopf (1985)** who found that low soil water availability restricts wheat growth and allows more photosynthetic to be directed and differentiated into protein. Also, **Abd-El-Fatah (1982), Dawood**

**and Nassar (1993), Abu-Elela (1996), Munir *et al.* (2000), El-Sherbeny (2003), Rharrabti *et al.* (2003), Ozturk andAydin (2004), and El-Afandy (2006)** found that increasing depletion of available soil moisture caused a significant increase in crude protein content.

## 1.2. Total carbohydrates:

The results in Table (13) indicated that total carbohydrate content in wheat grains was significantly decreased by increasing soil moisture depletion up to 80 % ASMD in both seasons. Irrigation to early i.e. at 40 % available soil moisture depletion improved total carbohydrates which equal 71.28 and 71.36 % in the first and second seasons, respectively, when compared with irrigated to late i.e. at 80 % ASMD which equal to 67.63 and 67.91 %, in the first and second seasons in the first and second seasons respectively. It could be concluded from these results that there was a negative correlation between total carbohydrates and crude protein content. These results are in good agreement with that reported by **Kassab and El-Zeiny (2005).**

## 1.3. Ash content:

Ash content in wheat grains was significantly increased by increasing soil moisture depletion (ASMD) up to 80 % in both seasons as shown in Table (13). The highest percentage of ash in wheat grains was 1.954 and 1.936 % produced from irrigation of wheat plants at 80 % ASMD in the first and second seasons, respectively. It looks to be true that enough the available water in the soil are required for better dissolving absorption and accumulation of macro and micro minerals as ash content of the obtained wheat grains. Similar results were reported by **Dawood and Nassar (1993) and Ozturk and Aydin (2004)** whereas, they found that ash content was significantly increased by increasing water stress.

## 1.4. Crude fiber:

Irrigation of wheat plants at 80% available water moisture depletion significantly surpassed the irrigation at 40% ASMD in crude fiber content in wheat grain by 29.27 and 25.37% in the first and second seasons, respectively as shown in Table (13). From such obtained results, it could be true that at the inadequate water supply, plants start to stimulate forming fiber as a support indicator which used to decrease slightly by the increase in water supply. **Ozturk and Aydin (2004)** found that grain yield of wheat negatively correlated with ash content, crude fiber and protein content in wheat grains. Previous studies generally showed a negative relationship between grain yield and crude fiber **(Abdel - Fatah, 1982; Abd El-Hamed *et al.*, 1986; Dawood and Nasser, 1993; El-Defrawy *et al.*, 1994 and Rharrabti *et al.*, 2003).**

## 1.5. Nitrogen and water use efficiency:

The data presented in Table (13) pointed out that irrigation treatments had a great effect on nitrogen and water use efficiency by wheat in the two growing seasons. Irrigation at 60% available soil moisture depletion produced an increment in nitrogen use efficiency reached about 34.46 and 36.95% as well as increment in water use efficiency reached about 1.407 and 1.448 kg grains/m3 in the first and second seasons, respectively as compared to early and late irrigation. Nitrogen losses under prolonged intervals of irrigation due to nitrogen transformation may be 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 **Sadek and Mitkees (1997), El-Sherbeny (2003), Hefnawy and Wahba (2003), Mousa and Abdel-Maksoud (2004)** whereas,they found that excess water of irrigation led to reduction in nitrogen and water use efficiency. On the contrary, **Sud *et al.* (1990) and Sowers *et al.* (1994)** reported that increasing rates of irrigation led to increasing utilization of nitrogen and water.

## 2- Effect of ascorbic acid concentrations:

### 2.1. Crude protein content:

The results presented in Table (13) indicate that application of ascorbic acid concentrations to wheat plant significantly surpassed the untreated plant by ascorbic acid in the two growing seasons. The increases reached 5.28 and 4.96% as a result of application of ascorbic acid at 1000 mg/L. in the first and second seasons, respectively. Also the increases were not significantly between 500 and 1000 mg/L. in the first season. The obtained increase in the trait could be attributed to the increase in total leaf area and photosynthetic pigments concentration in wheat leaves and increased photosynthetic production and translocation from source organs (i.e leaves) to sink organs (i.e grains at last stage of plant age) thereby increased total crude protein in wheat grains **(Zewail, 2007).** Similar trend was obtained by **Adarouze (1997), Anton *et al.* (1999) , Hamed and Hamada (2002) and Irfan *et al.* (2006)**

## 2.2. Total carbohydrates:-

The results showed that total carbohydrates content in wheat grain was significantly decreased by application of ascorbic acid to wheat plants as compared to untreated plants in both seasons as shown in Table (13). The highest percentage of total carbohydrate was 70.63 and 70.92%, produced from without spraying of ascorbic acid in the first and second seasons, respectively, whereas, the lowest one was 69.24 and 69.44% , respectively produced from application of ascorbic acid at 1000 mg/L. On the other hand, no significant difference was obtained between adding 500 and 1000 mg/L. ascorbic acid in the first season. Application of ascorbic acid may be led to an increase in nitrogen absorption, which result in to an increase in protein content by decreasing total carbohydrates. These results in agreement with those obtained by **Yong *et al.* (1996).**These results are correlated negatively with total carbohydrates and crude protein content. On opposite **Anton *et al.* (1999), Irfan *et al.* (2006) and Zewail (2007)** found that foliar application of ascorbic acid on wheat plant significantly increased carbohydrates content.

## 2.3. Ash content:-

Table (13) indicate that ascorbic acid concentrations had a significant effect on ash content in wheat grains in 2004/2005 and 2005/2006 growing seasons. The greatest values of ash content were 1.850 and 1.845, produced from treated plants by 1000mg/L.ascorbic acid in both seasons. Whereas no significant difference was obtained between 500 and 1000 mg/L. ascorbic acid concentrations in ash content in both seasons. These results may be due to the stimulating effect of ascorbic acid on cells growth also, increased absorption and accumulation of macro and micro minerals of the obtained wheat grains as well as increasing of bran content, as resulted in decreasing in flour content in wheat grains.

## 2.4. Crude fiber:

The results in Table (13) show that crude fiber in wheat grain was significantly increased by application of ascorbic acid in the two growing seasons. No significant difference was obtained between the two concentrations of ascorbic acid in crude fiber in both seasons. Application of ascorbic acid to wheat plant at the two concentrations gave the maximum mean values of crude fiber in grains. It could be concluded that crude fiber gave the same results of ash content as affected by application of ascorbic acid in both seasons. In addition, these results may be attributed to an increase in bran content as a result of decreasing in flour content in wheat grains. **Pomeranze (1988)** found that the crude fiber of wheat is related to the amount of bran in the wheat.

## 2.5. Nitrogen and water use efficiency:-

Nitrogen and water use efficiency were significantly increased over the control (zero ascorbic acid) by foliar application of ascorbic acid in the two seasons as shown in Table (13). Foliar application of ascorbic acid at 1000 mg/L. gave the maximum mean values of nitrogen and water use efficiency which equal 31.65% and 1.330 kg grains/$m^3$ of water consumed in the first season, as well as 34.22% and 1.434 kg grains/$m^3$ of water consumed in the second season, respectively. Whereas the lowest ones were produced from without application of ascorbic acid in both seasons. **Grun *et al.* (1982)** reported that ascorbic acid is a product of D-glucose metabolism which effects nutritional cycles activity in higher plants, as will as ascorbic acid plays an important role in the electron transport system. These results are similarly to those obtained by **Bhat *et al.* (1990).**

## 3. Effect of nitrogen rates:

## 3.1. Crude protein content:

The differences between the mean values of crude protein significant affected by nitrogen fertilizer were in both seasons Table (13). The application of 80 and 100 kg N/faddan increased protein content by 4.96 and 6.55% respectively over application of 60 kg N/faddan in the first season. The corresponding increases were 5.00 and 6.62% respectively, in the second season. This result proved the great response of wheat grown in sandy soil to nitrogen fertilization. Similar conclusion was obtained by **Abd-El-Hamed *et al.* (1986), Darwiche (1994),**

**Salwau (1994), Abd El- Hakem (1996), Zaher (1996), El-Douby (1997), Zohary *et al.* (1998), Dardiry (1999), Munir *et al.* (2000), Toaima *et al.* (2000), Abou-El-Ela (2001), El-Nagar (2003), El-Sherbeny (2003) and Zewail (2007).**

## 3.2. Total carbohydrates :

It was clear from Table (13) that addition of nitrogen fertilizer to sandy soil significantly decreased total carbohydrates content in wheat grain in both seasons. The highest total carbohydrates content were 70.51 and 71% obtained from adding 60 kg N/faddan in the first and second seasons, respectively. Whereas the lowest ones were 69.08 and 69.56%, respectively, produced from application of 100 kg N/faddan. These results show negative correlation between total carbohydrates and protein contents in wheat grains. Similar results were obtained by **Toaima *et al.* (2000)** found that total carbohydrates in wheat grains was significantly decreased by increasing N rate up to 80 kg N/faddan. On the other hand, **Zewail (2007)** reported that using nitrogen fertilizer rate at 100 kg N/faddan significantly increased total carbohydrates content.

## 3.3 Ash content:-

The ash content in wheat grains was significantly increased by increasing N rate up to 100 kg N/faddan in the two seasons, whereas no significant difference was obtain between adding 80 and 100 kg N/faddan in the first season as shown in Table (13). The highest ash content were 1.874 and 1.864% obtained from application of 100 kg N/faddan in the first and second seasons, respectively. On the other hand the minimum ash content were 1.755 and 1.752% produced from adding 60 kg N/faddan, respectively. These results may be obtained by increasing absorption and accumulation of macro and micro minerals of the wheat grains. Similar trend was obtained by **Abd El-Fatah (1995) and Toaima *et al.* (2000).**

## 3.4. Crude fiber:

The results in Table (13) show that crude fiber in wheat grain was significantly increased by increasing N rate up to 100 kg N/faddan in both seasons. The maximum percentage of crude fiber in wheat grains were 1.927 and 1.934%, produced from application of 100 kg N/faddan in the first and second seasons, respectively. Whereas the minimum one were 1.669 and 1.606% obtained from adding 60 kg N/faddan, respectively. This result may be attributed to an increase in nitrogen fertilizer led to decreased flour content and increased bran and protein content, which caused an increase in the crude fiber in wheat grains. **Pomeranze (1988)** found that both the crude fiber and the ash content of wheat are related to the amount of bran in the wheat and hence, increasing in crude fiber and the ash content. These findings are according with **Toaima *et al.* (2000).**

## 3.5. Nitrogen and water use efficiency:

It was clear that from Table (13) the application of nitrogen fertilizer at 80 kg N/faddan to wheat significantly increasing resulted in N-utilized as compared to application of nitrogen at 100 kg N/faddan in the tow seasons, whereas no significant difference was obtained between application of

Table (13): Effect of irrigation treatments, ascorbic acid concentrations and nitrogen levels on chemical characters, N- utilized percentage and water use efficiency in 2004/2005 and 2005/2006 seasons.

| Characters | | Crude protein content (%) | | Total carbohydrates (%) | | Ash content (%) | | Crude fiber (%) | | N- utilized (%) | | Water use efficiency (Kg/m3) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Treatments | | Season | | | | | | | | | | | |
| | | 1st | 2nd | 1st | 2nd | 1st | 2nd | 1st | 2nd | 1st | 2nd | 1st | 2nd |
| Irrigation | $I_1$ | 10.48 c | 10.89 c | 71.28 a | 71.36 a | 1.726 c | 1.774 b | 1.619 c | 1.616 c | 31.99 b | 35.50 b | 1.348 b | 1.396 a |
| | $I_2$ | 10.83 b | 11.11 b | 70.26 b | 71.16 b | 1.789 b | 1.765 b | 1.744 b | 1.750 b | 34.46 a | 36.95 a | 1.407 a | 1.448 a |
| | $I_3$ | 11.96 a | 11.83 a | 67.63 c | 67.91 c | 1.954 c | 1.936 a | 2.093 a | 2.026 a | 21.91 c | 23.92 c | 1.051 c | 1.223 b |
| F-test | | * * | * * | * * | * * | * * | * * | * * | * * | * * | * * | * * | * * |
| Ascorbic acid | $S_1$ | 10.80 b | 10.99 c | 70.63 a | 70.92 a | 1.774 b | 1.776 b | 1.701 c | 1.670 c | 25.62 c | 27.94 c | 1.154 b | 1.241 c |
| | $S_2$ | 11.19 a | 11.30 b | 69.30 b | 70.07 a | 1.844 a | 1.825 a | 1.850 b | 1.823 b | 31.06 b | 33.83 b | 1.321 a | 1.392 b |
| | $S_3$ | 11.37 a | 11.53 a | 69.24 b | 69.44 b | 1.850 a | 1.845 a | 2.003 a | 1.899 a | 31.65 a | 34.22 a | 1.330 a | 1.434 a |
| F-test | | * * | * * | * * | * * | * * | * * | * * | * * | * * | * * | * * | * * |
| Nitrogen | $N_1$ | 10.68 c | 10.87 c | 70.51 a | 71.00 a | 1.755 b | 1.752 c | 1.669 c | 1.606 c | 29.72 b | 32.75 a | 1.127 c | 1.234 c |
| | $N_2$ | 11.21 b | 11.37 b | 69.42 b | 69.88 b | 1.839 a | 1.828 b | 1.860 b | 1.852 b | 31.34 a | 33.50 a | 1.317 b | 1.393 b |
| | $N_3$ | 11.38a | 11.59 a | 69.08 b | 69.56 c | 1.874 a | 1.864 a | 1.927 a | 1.934 a | 27.32 c | 30.01 b | 1.361 a | 1.440 a |
| F-test | | * * | * * | * * | * * | * * | * * | * * | * * | * * | * * | * * | * * |

$I_1$ = Irrigation at lose 40% A.S.M.D
$I_2$ = Irrigation at lose 60% A.S.M.D
$I_3$ = Irrigation at lose 80% A.S.M.D

$S_1$ = Zero ascorbic acid
$S_2$ =500 mg/L ascorbic acid
$S_3$ = 1000 mg/L ascorbic acid

$N_1$ = 60 kg N / faddan
$N_2$ = 80 kg N / faddan
$N_3$ = 100 kg /N / faddan

nitrogen fertilizer at 60 and 80 kg N/faddan in the second season. The lowest N use efficiency was 27.32 and 30.01%, produced from adding 100 kg N/faddan in the first and second seasons, respectively. The same trend was obtained by **Mohamed (1999)** found that N.U.E. was significantly decreased by increasing nitrogen rate. On the contrary, water use efficiency was significantly increased by increasing N-rate up to 100 kg N/faddan in both seasons. Application of nitrogen fertilizer at 100 kg N/faddan gave the greatest efficiency of water, which equal 1.361 and 1.440 kg grains/$m^3$ of water consumed in the first and second seasons, respectively. It is evident that applying nitrogen fertilizer at 100 kg N/faddan resulted in producing the highest water use efficiency than the other rate of nitrogen due to high yield production. The previous results are in accordance with those reported by **Rickert *et al.*(1987), Morgan(1988), *Sabrah et al.*(1992) and El-Sherbeny (2003).**

## 4. Interactions effect:

### 4.1. Interaction effect between irrigation treatments and ascorbic acid concentrations:-

The effect of the interaction between irrigation treatments and ascorbic acid concentrations were significant on the crude protein, the total carbohydrate, the water and nitrogen use efficiency in both seasons as well as the ash content and the crude fiber in wheat grains in the second season which are presented in Table (14).

Irrigation at 80 available soil moisture depletion with application of ascorbic acid at 1000 mg/L. gave the maximum mean values of crude protein content , ash content and crude fiber in wheat grains. On the contrary, the highest mean values of total carbohydrate were 72.64 and 71.93%, produced from irrigation at 40% ASMD without application of ascorbic acid.

With regard to nitrogen and water use efficiency, irrigation at 60% ASMD with adding 1000 mg/L. ascorbic acid gave the greatest mean values of nitrogen and water use efficiency. Whereas, the minimum ones were produced from irrigation at 80% ASMD without application of ascorbic acid.

## 4.2. Interaction effect between irrigation treatments and N-rates:-

Results in Table (15) showed that the interaction between irrigation treatments and N-rates had a significant effect on crude protein, total carbohydrate, ash content and crude fiber in wheat grains as well as nitrogen-utilized percentage in both seasons. Irrigation at 80% ASMD with application of nitrogen fertilizer at 100 kg N/faddan gave the greatest content of crude protein, ash and crude fiber in wheat grain in both seasons. On the contrary, the maximum total carbohydrate percentage was produced from irrigation at 40% ASMD with adding 60 kg N/faddan in both seasons. Also, irrigation at 60% ASMD with 80 kg N/faddan gave the best results of nitrogen use efficiency in both seasons. Whereas, the lowest results of nitrogen utilized percentage was produced from increasing soil moisture depletion up to 80% with increasing N rate up to 100 kg N/faddan.It could be concluded that the optimum rate of irrigation at 60%ASMD and 80 kg N/faddan obtained the greatest efficiency of nitrogen.

Table (14): The interaction significantly effects of irrigation treatments with ascorbic acid concentrations on chemical characterS, N- utilized percentage and water use efficiency.

| Characters | | Crude protein content (%) | | Total carbohydrates (%) | | Ash content (%) | Crude fiber (%) | N-utilized (%) | | Water use efficiency (kg/m$^3$) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Treatments | | Season | | | | | | | | | |
| | | 1st | 2nd | 1st | 2nd | 2nd | 2nd | 1st | 2nd | 1st | 2nd |
| $I_1$ | $S_1$ | 10.15 | 10.49 | 72.64 | 71.93 | 1.693 | 1.488 | 27.99 | 30.82 | 1.220 | 1.243 |
| | $S_2$ | 10.59 | 10.93 | 70.62 | 71.28 | 1.757 | 1.648 | 33.69 | 37.52 | 1.411 | 1.456 |
| | $S_3$ | 11.00 | 11.24 | 70.56 | 70.87 | 1.780 | 1.711 | 34.29 | 38.15 | 1.413 | 1.489 |
| $I_2$ | $S_1$ | 10.60 | 10.87 | 71.08 | 72.09 | 1.718 | 1.621 | 29.10 | 31.22 | 1.256 | 1.325 |
| | $S_2$ | 10.93 | 11.09 | 69.89 | 71.21 | 1.776 | 1.806 | 36.78 | 39.18 | 1.469 | 1.473 |
| | $S_3$ | 10.95 | 11.37 | 69.82 | 70.20 | 1.801 | 1.826 | 37.39 | 39.35 | 1.494 | 1.545 |
| $I_3$ | $S_1$ | 11.65 | 11.61 | 68.16 | 68.76 | 1.915 | 1.901 | 19.76 | 21.77 | 0.986 | 1.155 |
| | $S_2$ | 12.05 | 11.89 | 67.38 | 67.72 | 1.939 | 2.016 | 22.69 | 24.79 | 1.084 | 1.246 |
| | $S_3$ | 12.17 | 11.98 | 67.35 | 67.26 | 1.979 | 2.161 | 23.27 | 25.18 | 1.083 | 1.267 |
| L.S.D at 0.05 | | 0.152 | 0.113 | 0.516 | 0.162 | 0.072 | 0.056 | 0.211 | 1.204 | 0.045 | 0.056 |

$I_1$ = Irrigation at lose 40% A.S.M.D
$I_2$ = Irrigation at lose 60% A.S.M.D
$I_3$ = Irrigation at lose 80% A.S.M.D

$S_1$ = Zero ascorbic acid
$S_2$ =500 mg/L ascorbic acid
$S_3$ = 1000 mg/L ascorbic acid

Table (15): The interaction significantly effects of irrigation treatments with nitrogen rates on chemical characterS and N- utilized percentage.

| Characters | | Crude protein content (%) | | Total carbohydrates (%) | | Ash content (%) | | Crude fiber (%) | | N-utilized (%) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Treatments | | Season | | | | | | | | | |
| | | 1st | 2nd | 1st | 2nd | 1st | 2nd | 1st | 2nd | 1st | 2nd |
| $I_1$ | $N_1$ | 10.05 | 10.45 | 72.37 | 72.51 | 1.641 | 1.666 | 1.422 | 1.394 | 32.44 | 36.46 |
| | $N_2$ | 10.53 | 10.96 | 71.05 | 70.96 | 1.744 | 1.762 | 1.669 | 1.675 | 33.71 | 36.82 |
| | $N_3$ | 10.85 | 11.25 | 70.41 | 70.62 | 1.792 | 1.803 | 1.767 | 1.778 | 29.83 | 33.22 |
| $I_2$ | $N_1$ | 10.33 | 10.65 | 71.68 | 72.04 | 1.692 | 1.692 | 1.546 | 1.546 | 34.37 | 37.37 |
| | $N_2$ | 11.05 | 11.22 | 69.72 | 70.95 | 1.812 | 1.782 | 1.820 | 1.823 | 36.77 | 38.37 |
| | $N_3$ | 11.09 | 11.46 | 69.39 | 70.50 | 1.858 | 1.821 | 1.866 | 1.882 | 32.31 | 35.13 |
| $I_3$ | $N_1$ | 11.65 | 11.52 | 67.96 | 68.44 | 1.928 | 1.899 | 2.040 | 1.879 | 22.33 | 24.42 |
| | $N_2$ | 12.05 | 11.92 | 67.48 | 67.74 | 1.962 | 1.941 | 2.093 | 2.059 | 23.55 | 25.31 |
| | $N_3$ | 12.18 | 12.04 | 67.44 | 67.56 | 1.971 | 1.967 | 2.147 | 2.141 | 19.84 | 22.02 |
| L.S.D at 0.05 | | 0.138 | 0.117 | 0.542 | 0.121 | 0.052 | 0.060 | 0.113 | 0.068 | 0.145 | 1.089 |

$I_1$ = Irrigation at lose 40% A.S.M.D
$I_2$ = Irrigation at lose 60% A.S.M.D
$I_3$ = Irrigation at lose 80% A.S.M.D

$N_1$ = 60 kg N / faddan
N2 = 80 kg N / faddan
$N_3$ = 100 kg /N / faddan

## 4.3. Interaction effect between ascorbic acid concentrations and N-rates:

There were significant differences of the average values of crude protein, total carbohydrate, ash content and crude fiber in wheat grains and nitrogen and water use efficiency due to the interaction between ascorbic acid and N-rate in both seasons as shown in Table (16). The higher crude protein, ash content and crude fiber in wheat grains produced from the sandy soil, received 100 kg N/faddan and sprayed by ascorbic acid at 1000 mg/L. as compared to without spraying of ascorbic acid and 60 kg N/faddan in both seasons. While the maximum mean values of total carbohydrate content was produced from without application of ascorbic acid by adding 60 kg N/faddan in both seasons. No significant difference was obtained between 500 mg/L. ascorbic acid + 100 kg N/faddan and 1000 mg/L. + 80 or 100 kg N/faddan on all characters of chemical analysis under study in both seasons. The interaction results between spraying ascorbic acid at 1000 mg/L. with 80 and 100 kg N/faddan induced a significant improvement in nitrogen and water use efficiency, respectively in both seasons. Whereas the lowest ones were obtained from without application of ascorbic acid and 60 kg N/faddan.

It could be concluded that the best interaction produced from the interaction between application of ascorbic acid at 500 or 1000 mg/L. and fertilizer with 80 or 100 kg N/faddan in the two growing seasons when compared with the other interactions.

**Table (16): The interaction significantly effects of ascorbic acid concentrations with nitrogen rates on chemical characterS, N- utilized percentage and water use efficiency.**

| Characters | | Crude protein content (%) | | Total carbohydrates (%) | | Ash content (%) | | Crude fiber (%) | | N-utilized (%) | | Water use efficiency (kg/m$^3$) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Treatments | | Season | | | | | | | | | | | |
| | | 1st | 2nd | 1st | 2nd | 1st | 2nd | 1st | 2nd | 1st | 2nd | 1st | 2nd |
| $S_1$ | $N_1$ | 10.42 | 10.52 | 71.45 | 71.96 | 1.703 | 1.709 | 1.546 | 1.496 | 19.97 | 28.74 | 1.045 | 1.140 |
| | $N_2$ | 10.85 | 10.98 | 70.69 | 70.76 | 1.773 | 1.782 | 1.724 | 1.771 | 26.81 | 28.74 | 1.154 | 1.229 |
| | $N_3$ | 11.12 | 11.48 | 69.74 | 70.05 | 1.847 | 1.836 | 1.832 | 1.803 | 24.07 | 26.33 | 1.262 | 1.354 |
| $S_2$ | $N_1$ | 10.78 | 10.98 | 70.32 | 70.73 | 1.774 | 1.773 | 1.714 | 1.633 | 31.20 | 34.50 | 1.160 | 1.255 |
| | $N_2$ | 11.35 | 11.43 | 68.81 | 69.79 | 1.871 | 1.839 | 1.890 | 1.870 | 33.16 | 35.70 | 1.397 | 1.454 |
| | $N_3$ | 11.44 | 11.51 | 68.77 | 69.69 | 1.888 | 1.859 | 1.945 | 1.967 | 28.81 | 31.30 | 1.407 | 1.466 |
| $S_3$ | $N_1$ | 10.82 | 11.12 | 70.24 | 70.30 | 1.788 | 1.775 | 1.748 | 1.690 | 31.96 | 35.00 | 1.177 | 1.366 |
| | $N_2$ | 11.21 | 11.69 | 68.75 | 69.09 | 1.875 | 1.864 | 1.968 | 1.976 | 34.06 | 36.02 | 1.400 | 1.495 |
| | $N_3$ | 11.38 | 11.76 | 68.74 | 68.94 | 1.887 | 1.896 | 2.003 | 2.031 | 28.91 | 31.62 | 1.414 | 1.500 |
| L.S.D at 0.05 | | 0.138 | 0.117 | 0.542 | 0.121 | 0.052 | 0.060 | 0.113 | 0.068 | 0.145 | 1.089 | 0.030 | 0.052 |

$S_1$ = Zero ascorbic acid
$S_2$ =500 mg/L ascorbic acid
$S_3$ = 1000 mg/L ascorbic acid

$N_1$ = 60 kg N / faddan
$N_2$ = 80 kg /N / faddan
$N_3$ =100 kg N / faddan

## 4.4. Interaction effect between the three factors:-

Results in Table (17) illustrate the interaction effect between irrigation treatments, ascorbic acid concentrations and N-rates was significant on crude protein, total carbohydrate and nitrogen-utilized percentage in the first and second seasons as well as ash content and crude fiber in the first season only. Irrigation at 80% available soil moisture depletion with spraying ascorbic acid at 1000 mg/L. and application 100 kg N/faddan gave the maximum value of crude protein, ash content and crude fiber. On the other hand, irrigation at 40% ASMD without spraying of ascorbic acid and adding 60 kg N/faddan gave the highest percentage of total carbohydrate in wheat grains.

Regarding to N-use efficiency, the maximum percentage of nitrogen use efficiency was 40.55 and 41.76%, produced from irrigation at 60%ASMD + 1000 mg/L. ascorbic acid + 80 kg N/faddan in the first and second seasons, respectively. While, the minimum ones were 18.41 and 19.73%, respectively observed from irrigation at 80% ASMD + without spraying of ascorbic acid + 100 kg N/faddan. It could be concluded that irrigation at 60% ASMD with spraying of ascorbic acid at 1000 mg/L. and adding 80 kg N/faddan gave the best results of nitrogen use efficiency.

Table (17): The interaction significantly effects of irrigation treatments and ascorbic acid concentration with nitrogen rates on chemical characters and N- utilized percentage.

| Characters | | | Crude protein content (%) | | Total carbohydrates (%) | | Ash content (%) | Crude fiber (%) | N-utilized (%) | |
|---|---|---|---|---|---|---|---|---|---|---|
| Treatments | | | Season | | | | | | | |
| | | | 1st | 2nd | 1st | 2nd | 1st | 1st | 1st | 2nd |
| $I_1$ | $S_1$ | $N_1$ | 9.59 | 9.92 | 74.01 | 73.61 | 1.530 | 1.305 | 28.57 | 31.88 |
| | | $N_2$ | 10.16 | 10.44 | 72.88 | 71.52 | 1.686 | 1.495 | 29.10 | 31.16 |
| | | $N_3$ | 10.71 | 11.12 | 71.05 | 70.67 | 1.776 | 1.665 | 26.31 | 29.43 |
| | $S_2$ | $N_1$ | 10.24 | 10.59 | 71.62 | 72.05 | 1.685 | 1.413 | 34.07 | 38.39 |
| | | $N_2$ | 10.66 | 11.02 | 70.15 | 70.94 | 1.764 | 1.717 | 35.43 | 39.37 |
| | | $N_3$ | 10.89 | 11.16 | 70.11 | 70.85 | 1.800 | 1.814 | 31.58 | 34.81 |
| | $S_3$ | $N_1$ | 10.34 | 10.83 | 71.49 | 71.87 | 1.707 | 1.466 | 34.67 | 39.11 |
| | | $N_2$ | 10.79 | 11.41 | 70.11 | 70.41 | 1.783 | 1.811 | 36.60 | 39.91 |
| | | $N_3$ | 10.96 | 11.47 | 70.09 | 70.34 | 1.801 | 1.855 | 31.59 | 35.43 |
| $I_2$ | $S_1$ | $N_1$ | 10.15 | 10.25 | 72.04 | 73.11 | 1.679 | 1.389 | 29.74 | 32.14 |
| | | $N_2$ | 10.78 | 10.90 | 71.08 | 72.03 | 1.708 | 1.721 | 30.07 | 31.68 |
| | | $N_3$ | 10.87 | 11.45 | 70.11 | 71.12 | 1.818 | 1.751 | 27.49 | 29.85 |
| | $S_2$ | $N_1$ | 10.43 | 10.78 | 70.53 | 71.98 | 1.700 | 1.615 | 36.24 | 39.90 |
| | | $N_2$ | 11.18 | 11.22 | 69.09 | 70.90 | 1.867 | 1.840 | 39.68 | 41.69 |
| | | $N_3$ | 11.19 | 11.27 | 69.06 | 70.75 | 1.882 | 1.963 | 34.43 | 35.95 |
| | $S_3$ | $N_1$ | 10.43 | 10.92 | 71.46 | 71.03 | 1.710 | 1.636 | 37.13 | 40.07 |
| | | $N_2$ | 11.20 | 11.53 | 69.00 | 69.91 | 1.862 | 1.909 | 40.55 | 41.76 |
| | | $N_3$ | 11.23 | 11.64 | 69.01 | 69.65 | 1.876 | 1.933 | 34.48 | 36.24 |
| $I_3$ | $S_1$ | $N_1$ | 11.54 | 11.40 | 68.31 | 69.17 | 1.900 | 1.794 | 19.61 | 22.20 |
| | | $N_2$ | 11.63 | 11.58 | 68.11 | 68.73 | 1.924 | 1.917 | 21.26 | 23.39 |
| | | $N_3$ | 11.79 | 11.85 | 68.06 | 68.38 | 1.948 | 1.993 | 18.41 | 19.73 |
| | $S_2$ | $N_1$ | 11.70 | 11.55 | 67.81 | 68.16 | 1.937 | 1.873 | 23.29 | 25.21 |
| | | $N_2$ | 12.21 | 12.03 | 67.18 | 67.53 | 1.982 | 2.052 | 24.35 | 26.04 |
| | | $N_3$ | 12.25 | 12.09 | 67.14 | 67.46 | 1.893 | 2.215 | 20.43 | 23.12 |
| | $S_3$ | $N_1$ | 11.71 | 11.60 | 67.77 | 68.01 | 1.946 | 1.969 | 24.09 | 25.85 |
| | | $N_2$ | 12.32 | 12.13 | 67.15 | 66.95 | 1.980 | 2.208 | 25.03 | 26.49 |
| | | $N_3$ | 12.50 | 12.19 | 67.13 | 66.85 | 1.983 | 2.305 | 20.67 | 23.20 |
| L.S.D at 0.05 | | | 0.240 | 0.203 | 0.938 | 0.209 | 0.091 | 0.117 | 0.251 | 1.887 |

## IV- Technological properties

The effect of irrigation treatments, ascorbic acid concentrations and N-rates on technological properties of wheat i.e hectoliter weight, wheat milling , wet and dry glutein in 2004/2005 and 2005/2006 seasons are presented in Table (18).

### 1- Effect of irrigation treatments:

#### 1.1.Hectoliter weight:

Resulted presented in Table (18) shows that available soil moisture depletion had a significant effect on hectoliter weight. Increasing depletion of available soil moisture caused a decrease the hectoliter weight of wheat grains. The minimum value of hectoliter weight was 77.42 and 77.12 kg/hl. obtained by irrigation wheat plants at 80% ASMD in the first and second seasons , respectively. The different between irrigation at 40 and 60% ASMD in both seasons was not significant. These results may be due to decreasing grain filling and 1000-grain weight as influenced by increasing soil moisture depletion. Similar trend was reported by **Abd-El-Fattah (1982) Rharrabti *et al.* (2003) and Ozturk and Aydin (2004).**

#### 1-2- Wheat milling:

The results illustrated in Table (18) show that extraction percentage was significantly affected by increasing soil moisture depletion. The percentage of flour and fine bran extraction decreased continuously and consistently with increasing depletion soil moisture up to irrigation at 80% AMSD. Opposite, coarse bran percentage was increased by increasing soil moisture stress up to 80% . these results were true the two growing seasons. It means that providing soil of wheat plant with sufficient moisture (irrigation at 40% depletion of available soil moisture) increased the quality of wheat grains by increasing flour and decreasing coarse bran. These results are similar with these obtained by **Abd-El-Fattah (1982) , Dawood and Kheiralla (1994) and El- Defrawy *et al.* (1994).**

## 1.3. Wet and dry glutein:

The results in Table (18) indicate that wet and dry glutein percentages were significantly affected by the three irrigation treatments in the two growing seasons. Irrigation of wheat plants at 80% depletion of available soil moisture gave the highest wet and dry glutein percentage, which equal to 30.68 and 13.07% in the first season and 31.20 and 12.86% in the second season, respectively. While minimum mean values were 27.89 and 12.02% in the first season, 28.32, and 12.33% in the second season, respectively obtained by irrigation wheat plants at 40% depletion of available soil moisture. The decreasing of glutein content percentage calculated as wet and dry percentage by increasing soil moisture depletion may be due to decreasing of crude protein percentage. These results are in harmony with these obtained by **El-Defrawy *et al.* (1994) and Ozturk and Aydin (2004).**

## 2- Effect of ascorbic acid concentrations:

### 2.1. Hectoliter weight:

The results in Table (18) show that hectoliter weights were increased with application of ascorbic acid concentrations in 2004/2005 and 2005/2006 seasons. The highest weight of hectoliter was existed with two concentrations of 500 and 1000 mg/L. whereas, it reached 78.81 and 78.66 kg/hl in the first season and 78.02 and 78.42 kg/hl in the second season respectively. Meanwhile unsprayed wheat plants was reached 77.70 and 77.20 kg/hl in both seasons, respectively , and there is not a significant effect between the two concentrations 500 and 1000 mg/L. in the first season. In this respect, the obtained increased of this trait could be attributed to the increment of grain filling and 1000-grain weight as a result to increased of nitrogen absorption.

### 2.2. Wheat milling:

The results reported in Table (18) show that ascorbic acid concentration had a statistical significant effect on extraction flour , fine and coarse bran percentages, whereas, the flour percentage significantly decreased by increasing concentration of ascorbic acid.

The highest reduction value of flour percentage was existed by using 1000 mg/L. ascorbic acid whereas, the reduction reached 2.54 and 2. 92% when compared with the unsprayed wheat plants in the first and second seasons, respectively. Also, the fine bran percentage take the some trend of flour extraction percentage by using 1000 mg/L. ascorbic acid concentration when compared with unsprayed in the first and second seasons. On the contrary, coarse bran percentage was significantly increased by increasing ascorbic acid concentrations whereas, the increment reached 8.99 and 8.20% for 500 mg/L. and 10.68 and 10.51% for 1000 mg/L. in the two growing seasons, respectively, as compared to unsprayed plants of ascorbic acid. These results may be due to the increasing in total carbohydrates and reduce of protein content in wheat grains. These factors led to increase flour and fine bran and decreased coarse bran extraction percentage at unsprayed ascorbic acid on wheat plants.

## 2.3. Wet and dry glutein:

Results presented in Table (18) show the effect of ascorbic acid concentration wet and dry glutein in both seasons. The change of glutein content percentage calculated as wet and dry percentage as a results of application ascorbic acid gave the same pattern of change of crude protein percentage. Maximum wet and dry glutein were obtained by using 1000 and 500 mg/L. ascorbic acid concentration in the two seasons. The highest value was existed with 1000 mg/L. that reached 29.75 and 12.89 % in the first season and 30.35 and 13.12% in the second season for wet and dry glutein , respectively , when compared with the plants did not spray by ascorbic acid. There is no significant effect between 500 and 1000 mg/L. for wet and dry glutein in the first season, but in the second season, the effect was significant which may be due to increasing protein content as a result of increasing in nitrogen absorption.

## 3- Effect of nitrogen rates:

### 3.1. Hectoliter weight:

The results in Table (18) indicate that hectoliter weight was significantly affected by increasing N-rates up to 100 kg N/faddan in both seasons. The application of 100 kg N/faddan gave the highest mean values, which equal to 78.88 and 78.39% kg/hl in the first and second seasons, respectively. Whereas, no significant difference was obtained between application 80 and 100 kg N/faddan on hectoliter weight in both seasons. This was in true with weight of grains which increasing led to increasing hectoliter weight. These results agree with those obtained by **Toaima *et al.* (2000) and El-Nagar (2003).**

### 3-2- Wheat milling:

Concerning to wheat milling, the mean values of flour and fine bran extraction percentage were significantly decreased by increasing N-rates up to 100 kg N/faddan in the two seasons, whereas, coarse bran percentage was significantly increased as shown in Table (18). Application of 100 kg N/faddan gave the lowest percentage of flour and fine bran. On the contrary coarse bran extraction percentage was significantly increased by increasing nitrogen fertilizer rate up to 100 kg N/faddan in both seasons. The highest value of coarse bran was 26.29 and 26.95% produced by using highest N-rate i.e. 100 kg N/faddan in the first and second seasons, respectively. While, lowest values were 23.82 and 24.36% obtained by using 60 kg N/faddan in the two growing seasons, respectively. Similar trend was reported by **Toaima *et al.* (2000) and El-Nagar (2003).**

**Table (18): Effect of irrigation treatments, ascorbic acid concentrations and nitrogen rates on technological properties in 2004/2005 and 2005/2006 seasons .**

| Characters | | Hectoliter (kg/hl) | | Wheat milling | | | | | | Wet glutein (%) | | Dry glutein (%) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Flour (%) | | Coarse bran (%) | | Fine bran (%) | | | | | |
| Treatments | | Season | | | | | | | | | | | |
| | | 1st | 2nd | 1st | 2nd | 1st | 2nd | 1st | 2nd | 1st | 2nd | 1st | 2nd |
| Irrigation | $I_1$ | 78.80 a | 78.30 a | 69.53 a | 68.96 a | 23.12 c | 24.37 c | 7.35 a | 6.67 a | 27.89 c | 28.32 c | 12.03 c | 12.33 c |
| | $I_2$ | 78.75 a | 78.27 a | 68.35 b | 68.51 b | 24.65 b | 24.87 b | 7.00 b | 6.62 a | 28.81 b | 29.21 b | 12.28 b | 12.64 b |
| | $I_3$ | 77.42 b | 77.12 b | 66.29 c | 66.10 c | 27.60 a | 28.08 a | 6.11 c | 5.82 b | 30.68 a | 31.20 a | 13.07 a | 12.86 a |
| F-test | | ** | ** | ** | ** | ** | ** | ** | ** | ** | ** | ** | ** |
| Ascorbic acid | $S_1$ | 77.70 b | 77.20 c | 69.12 a | 69.08 a | 23.58 c | 24.26 c | 7.30 a | 6.66 a | 27.97 b | 28.33 c | 11.70 b | 11.86 c |
| | $S_2$ | 78.81 a | 78.02 b | 67.68 b | 67.37 b | 25.70 b | 26.25 b | 6.62 b | 6.37 b | 29.67 a | 29.97 b | 12.80 a | 12.85 b |
| | $S_3$ | 78.66 a | 78.42 a | 67.41 b | 67.12 b | 26.10 a | 26.81 a | 6.49 b | 6.07 c | 29.75 a | 30.35 a | 12.89 a | 13.12 a |
| F-test | | ** | ** | ** | ** | ** | ** | ** | ** | ** | ** | ** | ** |
| Nitrogen | $N_1$ | 77.52 b | 77.18 b | 68.85 a | 68.92 a | 23.82 c | 24.36 c | 7.33 a | 6.72 a | 28.10 c | 28.51 c | 11.87 c | 12.01 c |
| | $N_2$ | 78.57 a | 78.07 a | 68.00 b | 67.64 b | 25.27 b | 26.01 b | 6.73 b | 6.35 b | 29.36 b | 29.82 b | 12.65 b | 12.75 b |
| | $N_3$ | 78.88 a | 78.39 a | 67.31 c | 67.02 c | 26.29 a | 26.95 a | 6.39 c | 6.03 c | 29.92 a | 30.31 a | 12.86 a | 13.07 a |
| F-test | | ** | ** | ** | ** | ** | ** | ** | ** | ** | ** | ** | ** |

$I_1$ = Irrigation at lose 40% A.S.M.D
$I_2$ = Irrigation at lose 60% A.S.M.D
$I_3$ = Irrigation at lose 80% A.S.M.D

$S_1$ = Zero ascorbic acid
$S_2$ = 500 mg/L ascorbic acid
$S_3$ = 1000 mg/L ascorbic acid

$N_1$ = 60 kg N / faddan
$N_2$ = 80 kg /N / faddan
$N_3$ = 100 kg N / faddan

## 3.3. Wet and dry glutein:

It was clear that from Table (18) wet and dry glutein were significantly increased with increasing nitrogen rate up to 100 kg N/faddan in both seasons, which gave the highest increase equal to (29.92 and 30.31%) and (12.86 and 13.07%) in the first and second seasons, respectively, for wet and dry glutein percentage which resulted by increasing protein content. This result was increment with those obtained by **Pameranze (1988)** who reported that protein and gluten content take parallel trend. Also, **Ozturk and Aydin (2004)** found that the higher wet glutein content can be associate with higher grain protein content.

## 4. Interactions effect:

### 4.1. Interaction between irrigation treatments and ascorbic acid concentrations:

The results in Table (19) show that the interaction between irrigation treatments and ascorbic acid concentrations was significantly affected on hectoliter weight and wheat milling. The highest values of hectoliter weight and extraction percentage were produced from irrigation at 40% available soil moisture depletion with application 1000 mg/L. of ascorbic acid in both seasons. While the maximum flour and fine bran percentages were produced from irrigation at 40% ASMD without application of ascorbic acid. On the contrary, no significant differences were obtained in between irrigation at 40 and 60% ASMD with application of ascorbic acid at 500 and 1000 mg/L. The lowest hectoliter weight was obtained from irrigation at 80% depletion of available soil moisture with

Table (19): The interaction significantly effects of irrigation treatments with ascorbic acid concentrations on technological properties.

| Characters | | Hectoliter (kg/hl) | | Wheat milling | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Flour (%) | | Coarse bran (%) | | Fine bran (%) | |
| Treatments | | Season | | | | | | | |
| | | 1st | 2nd | 1st | 2nd | 1st | 2nd | 1st | 2nd |
| $I_1$ | $S_1$ | 78.03 | 77.47 | 70.85 | 70.42 | 21.23 | 22.58 | 7.91 | 7.00 |
| | $S_2$ | 79.14 | 78.51 | 69.00 | 68.40 | 23.93 | 24.92 | 7.06 | 6.68 |
| | $S_3$ | 79.22 | 78.90 | 68.84 | 68.07 | 24.20 | 25.60 | 6.96 | 6.33 |
| $I_2$ | $S_1$ | 77.97 | 77.41 | 69.72 | 70.20 | 22.74 | 22.88 | 7.54 | 6.91 |
| | $S_2$ | 79.14 | 78.44 | 67.88 | 67.80 | 25.36 | 25.66 | 6.76 | 6.15 |
| | $S_3$ | 79.13 | 78.82 | 67.45 | 67.52 | 25.88 | 26.07 | 6.67 | 6.41 |
| $I_3$ | $S_1$ | 77.11 | 76.72 | 66.77 | 66.62 | 26.78 | 27.31 | 6.45 | 6.08 |
| | $S_2$ | 77.55 | 77.11 | 66.16 | 65.91 | 27.83 | 28.18 | 6.01 | 5.91 |
| | $S_3$ | 77.62 | 77.54 | 65.93 | 65.78 | 28.23 | 28.75 | 5.84 | 5.47 |
| L.S.D at 0.05 | | 0.347 | 0.159 | 0.524 | 0.449 | 0.593 | 0.184 | 0.405 | 0.315 |

$I_1$ = Irrigation at lose 40% A.S.M.D
$I_2$ = Irrigation at lose 60% A.S.M.D
$I_3$ = Irrigation at lose 80% A.S.M.D

$S_1$ = Zero ascorbic acid
$S_2$ = 500 mg/L ascorbic acid
$S_3$ = 1000 mg/L ascorbic acid

untreated wheat plants by ascorbic acid concentration. Irrigated at 80% ASMD with 1000 mg/L. ascorbic acid gave the minimum percentage of flour and fine bran extraction whereas, irrigated at 40% ASMD with unsprayed wheat plants by ascorbic acid gave the lowest percentage of coarse bran in both seasons. It could be concluded that irrigation at 40% ASMD with application of ascorbic acid at 500 or 1000 mg/L. gave the best results of hectoliter weight.

## 4.2. Interaction between irrigation treatments and nitrogen rates:

The data presented in Table (20) show that a significant effects in hectoliter weight, wheat milling and wet glutein content detected by the interaction between irrigation treatments and nitrogen rates in the two growing seasons. Irrigation at 40 or 60 % depletion of available soil moisture with adding 100 kg N/faddan gave the maximum mean values of hectoliter weight. While , irrigation at 40% ASMD and application 60 kg N/faddan gave the highest mean values of flour and fine bran extraction percentage in the first and second seasons. But, the highest mean values of coarse bran and wet glutein percentage were obtained from irrigation at 80% depletion of available soil moisture with application 100 kg N/faddan. However, the minimum mean values hectoliter weight was produced from irrigation 80% ASMD with adding 60 kg N/faddan. Respect to flour and fine bran extraction percentage which recorded with the irrigation at 80% depletion of available soil moisture and application 100 kg N/faddan. With regard coarse bran and wet glutein content percentage the obtained from irrigation at 40% ASMD, with adding 60 kg N/faddan.

**Table (20): The interaction significantly effects of irrigation treatments with nitrogen rates on technological properties.**

| Characters | | Hectoliter (kg/hl) | | Wheat milling | | | | | | Wet glutein (%) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Flour (%) | | Coarse bran (%) | | Fine bran (%) | | | |
| Treatments | | Season | | | | | | | | | |
| | | 1st | 2nd | 1st | 2nd | 1st | 2nd | 1st | 2nd | 1st | 2nd |
| $I_1$ | $N_1$ | 77.83 | 77.62 | 70.57 | 70.49 | 21.51 | 22.43 | 7.92 | 7.08 | 26.69 | 26.82 |
| | $N_2$ | 79.12 | 78.44 | 69.34 | 68.56 | 23.41 | 24.82 | 7.25 | 6.62 | 28.27 | 28.69 |
| | $N_3$ | 79.45 | 78.82 | 68.70 | 67.84 | 24.44 | 25.85 | 6.86 | 6.31 | 28.73 | 29.18 |
| $I_2$ | $N_1$ | 77.78 | 77.31 | 69.32 | 69.75 | 23.13 | 23.27 | 7.55 | 6.98 | 27.95 | 28.40 |
| | $N_2$ | 79.04 | 78.51 | 68.39 | 68.24 | 24.69 | 25.17 | 6.92 | 6.59 | 29.12 | 29.41 |
| | $N_3$ | 79.42 | 78.86 | 67.33 | 67.55 | 26.14 | 26.17 | 6.53 | 6.28 | 29.37 | 29.83 |
| $I_3$ | $N_1$ | 76.95 | 76.59 | 66.67 | 66.53 | 26.81 | 27.38 | 6.52 | 6.09 | 29.67 | 30.31 |
| | $N_2$ | 77.56 | 77.28 | 66.28 | 66.12 | 27.70 | 28.03 | 6.02 | 5.85 | 30.72 | 31.37 |
| | $N_3$ | 77.76 | 77.49 | 65.91 | 65.66 | 28.30 | 28.82 | 5.79 | 5.52 | 31.66 | 31.93 |
| L.S.D at 0.05 | | 0.347 | 0.159 | 0.541 | 0.738 | 0.442 | 0.160 | 0.435 | 0.352 | 0.364 | 0.201 |

$I_1$= Irrigation at lose 40% A.S.M.D
$I_2$= Irrigation at lose 60% A.S.M.D
$I_3$= Irrigation at lose 80% A.S.M.D

$N_1$ = 60 kg N / faddan
$N_2$ = 80 kg /N / faddan
$N_3$=100 kg N / faddan

## 4.3. Interaction effect between ascorbic acid concentrations and N-rates:

Results in Table (21) showed that there were significant difference in technological properties as affected by the interaction between ascorbic acid concentrations and nitrogen rates in 2004/2005 and 2005/2006 growing seasons. Application of 100 kg N/faddan with sprayed wheat plants by using 1000 mg/L. ascorbic acid concentration gave the highest mean values with hectoliter weight in the second season, coarse bran extraction, wet and dry glutein percentage in the first and second seasons, as recorded the lowest mean values with flour and fine bran extraction percentage. However adding 60 kg N/faddan with unsprayed ascorbic acid gave the best mean values of flour and fine bran extraction percentage.

## 4.4. Interaction effect between the three factors:

Results illustrated in Table (22) indicate that mean values of hectoliter weight, flour, fine and coarse bran extraction percentage were significantly affected by the interaction between the three factors under study in both seasons. Irrigation at 40 depletion of available soil moisture with unsprayed ascorbic acid and application 60 kg N/faddan were the best values of flour, fine and coarse bran extraction percentage in the two growing seasons. While, the irrigation at 60% available soil moisture depletion with using 1000 mg/L. ascorbic acid concentration and adding 100 kg N/faddan gave the best mean values of hectoliter weight in the second season compared with irrigation at 80% depletion of available soil moisture with unsprayed ascorbic acid and application 60 kg N/faddan.

Table (21): The interaction significantly effects of ascorbic acid concentrations with nitrogen rates on technological properties.

| Characters | | Hectoliter (kg/hl) | Wheat milling | | | | | | Glutein content | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Flour (%) | | Coarse bran (%) | | Fine bran (%) | | Wet glutein (%) | | Dry glutein (%) | |
| Treatments | | Season | | | | | | | | | | |
| | | $2^{nd}$ | $1^{st}$ | $2^{nd}$ | $1^{st}$ | $2^{nd}$ | $1^{st}$ | $2^{nd}$ | $1^{st}$ | $2^{nd}$ | $1^{st}$ | $2^{nd}$ |
| $S_1$ | $N_1$ | 76.51 | 69.96 | 70.09 | 21.90 | 22.81 | 8.13 | 7.10 | 26.69 | 27.16 | 10.87 | 11.00 |
| | $N_2$ | 77.21 | 69.31 | 69.16 | 23.68 | 24.20 | 7.01 | 6.64 | 28.12 | 28.42 | 11.84 | 11.88 |
| | $N_3$ | 77.89 | 68.08 | 67.99 | 25.17 | 25.75 | 6.75 | 6.26 | 29.09 | 29.41 | 12.38 | 12.69 |
| $S_2$ | $N_1$ | 77.40 | 68.35 | 68.49 | 24.64 | 24.84 | 7.01 | 6.67 | 28.82 | 29.03 | 12.31 | 12.40 |
| | $N_2$ | 78.25 | 67.57 | 66.99 | 25.85 | 26.57 | 6.58 | 6.44 | 29.94 | 30.35 | 13.02 | 13.06 |
| | $N_3$ | 78.40 | 67.12 | 66.62 | 26.62 | 27.35 | 6.26 | 6.03 | 30.27 | 30.53 | 13.07 | 13.10 |
| $S_3$ | $N_1$ | 77.62 | 68.26 | 68.18 | 24.91 | 25.43 | 6.83 | 6.39 | 28.82 | 29.34 | 12.44 | 12.62 |
| | $N_2$ | 78.77 | 67.22 | 66.76 | 26.28 | 27.25 | 6.50 | 5.98 | 30.05 | 30.69 | 13.10 | 13.31 |
| | $N_3$ | 78.89 | 66.74 | 66.43 | 27.12 | 27.74 | 6.14 | 5.83 | 30.40 | 31.01 | 13.14 | 13.43 |
| L.S.D at 0.05 | | 0.148 | 0.541 | 0.738 | 0.442 | 0.160 | 0.435 | 0.352 | 0.364 | 0.201 | 0.165 | 0.188 |

$S_1$ = Zero ascorbic acid
$S_2$ = 500 mg/L ascorbic acid
$S_3$ = 1000 mg/L ascorbic acid

$N_1$ = 60 kg N / faddan
$N_2$ = 80 kg /N / faddan
$N_3$ = 100 kg N / faddan

Table (22): The interaction significantly effects of irrigation treatments and ascorbic acid concentrations with nitrogen rates on technological properties.

| Characters | | | Hectoliter (kg/hl) | Wheat milling | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Flour (%) | | Coarse bran (%) | | Fine bran (%) | |
| Treatments | | | Season | | | | | | |
| | | | 2nd | 1st | 2nd | 1st | 2nd | 1st | 2nd |
| $I_1$ | $S_1$ | $N_1$ | 77.00 | 71.94 | 71.77 | 19.11 | 20.52 | 8.95 | 7.71 |
| | | $N_2$ | 78.39 | 70.76 | 70.47 | 21.69 | 22.64 | 7.55 | 6.89 |
| | | $N_3$ | 78.03 | 69.86 | 69.03 | 22.91 | 24.58 | 7.23 | 6.39 |
| | $S_2$ | $N_1$ | 77.85 | 69.95 | 70.21 | 22.60 | 22.88 | 7.45 | 6.91 |
| | | $N_2$ | 78.67 | 68.82 | 67.72 | 24.20 | 25.57 | 6.98 | 6.71 |
| | | $N_3$ | 79.01 | 68.24 | 67.25 | 25.00 | 26.32 | 6.76 | 6.43 |
| | $S_3$ | $N_1$ | 78.02 | 69.83 | 69.48 | 22.82 | 23.89 | 7.35 | 6.63 |
| | | $N_2$ | 79.26 | 68.70 | 67.48 | 24.36 | 26.24 | 6.94 | 6.28 |
| | | $N_3$ | 79.42 | 68.00 | 67.24 | 25.42 | 26.67 | 6.58 | 6.09 |
| $I_2$ | $S_1$ | $N_1$ | 76.67 | 70.94 | 71.58 | 20.60 | 21.19 | 8.46 | 7.23 |
| | | $N_2$ | 77.36 | 70.26 | 70.25 | 22.59 | 22.86 | 7.15 | 6.89 |
| | | $N_3$ | 78.20 | 67.98 | 68.78 | 25.03 | 24.61 | 6.99 | 6.61 |
| | $S_2$ | $N_1$ | 77.44 | 68.54 | 68.95 | 24.25 | 24.09 | 7.21 | 6.96 |
| | | $N_2$ | 78.92 | 67.80 | 67.45 | 25.40 | 26.04 | 6.80 | 6.51 |
| | | $N_3$ | 78.95 | 67.30 | 67.00 | 26.43 | 26.85 | 6.27 | 6.15 |
| | $S_3$ | $N_1$ | 77.82 | 68.50 | 68.71 | 24.56 | 24.55 | 6.94 | 6.74 |
| | | $N_2$ | 79.28 | 67.12 | 67.00 | 26.10 | 26.62 | 6.78 | 6.38 |
| | | $N_3$ | 79.44 | 66.73 | 66.86 | 26.98 | 27.05 | 6.29 | 6.09 |
| $I_3$ | $S_1$ | $N_1$ | 75.86 | 67.02 | 66.92 | 26.00 | 26.72 | 6.98 | 6.36 |
| | | $N_2$ | 76.88 | 66.91 | 66.75 | 26.76 | 27.12 | 6.33 | 6.31 |
| | | $N_3$ | 77.43 | 66.39 | 66.17 | 27.59 | 28.08 | 6.02 | 5.75 |
| | $S_2$ | $N_1$ | 76.90 | 66.56 | 66.32 | 27.09 | 27.56 | 6.35 | 5.12 |
| | | $N_2$ | 77.17 | 66.08 | 65.81 | 27.96 | 28.09 | 5.96 | 6.10 |
| | | $N_3$ | 77.23 | 65.84 | 65.60 | 28.44 | 28.88 | 5.72 | 5.52 |
| | $S_3$ | $N_1$ | 77.03 | 66.44 | 66.35 | 27.36 | 27.87 | 6.12 | 5.78 |
| | | $N_2$ | 77.80 | 65.86 | 65.80 | 28.38 | 28.90 | 5.76 | 5.30 |
| | | $N_3$ | 77.81 | 65.48 | 65.78 | 28.96 | 29.49 | 5.56 | 5.31 |
| L.S.D at 0.05 | | | 0.256 | 0.936 | 1.269 | 0.766 | 0.277 | 0.753 | 0.611 |

# V- Rheological properties

Results presented in Table (23) and Figs (5-58) show the effect of irrigation treatments, ascorbic acid concentrations and nitrogen rates on rheological properties in the two growing seasons.

## 1- Effect of irrigation treatments:

### 1.1. Water absorption percentage:

Results reported in Table (23) illustrate that effect of available soil moisture depletion on water absorption percentage in wheat flour dough was significant determined according to **Mixolab** test.

Increasing of available soil moisture depletion (ASMD) caused an increase in water absorption percentage. The maximum mean values were 61.03 and 59.92 %, obtained by irrigation at 80 % depletion of available soil moisture in the first and second seasons, respectively. Meanwhile, irrigation at 40 % depletion of available soil moisture gave the minimum value of water absorption, which reached 57.38 and 58.25 % in the two growing seasons respectively. This results may be due to that soil moisture stress increasing crude protein content in wheat grains followed glutein content were obtained by increasing water absorption percentage. These results are in harmony with those obtained by **Biskupski *et al.* (1976) and Abd-El-Fattah (1982).** They

v found that dough quality and baking characters reduced by increasing irrigation.

### 1.2. Mixing time , stable period and weakening time:

Regarding to mixing time, stability and weakening time. The obtained results indicated that there are a significantly affected by the three irrigation treatments in the two seasons (Table 23). Irrigation at 40 and 80 % depletion of available soil moisture decreased the mixing time, stable period, whereas resulted in increasing in weakening time in the first and second seasons. Irrigation at 60 % available soil moisture depletion led to significantly increment in mixing time, stable period, but decreased weakening time compared to the irrigation at 40 and 80 % depletion of available soil moisture. These results suggest that increasing soil moisture led to decrease dough quality as results to depress the crude protein content as well as decreased glutein content percentage. While, high moisture stress may be led to the protein demolition and the glutein net weakening whereas due to the decrease in mixing time and stable period , while, increasing weakening time. **Abd-El-Hamed *et al.* (1986), Dawood and Nassar (1993)** obtained similar trend.

## 2- Effect of ascorbic acid concentrations:

### 2.1. Water absorption percentage:

The results presented in Table (23) indicate that in both seasons, the application of ascorbic acid significantly increased water absorption percentage when compared with the control treatment (unsprayed ascorbic acid). Whereas, application of ascorbic acid at 500 and 1000 mg /L. concentration produced the best rate of water absorption percentage in the two growing seasons. Maximum value of water absorption were 59.81 and

60.34 %, which obtained by using 1000 mg / L. of ascorbic acid concentration in the first and second seasons, respectively. There was not in significant difference between 500 and 1000 mg/L. due to the ascorbic acid concentration in the first season. Meanwhile, unsprayed wheat plants gave the minimum value, which equal 57.39 and 57.86 % in the first and second seasons, respectively. Application of ascorbic acid may be led to an increase in nitrogen absorption, which caused an increase in protein content, and in turn increase glutein content, which resulted from increasing water absorption.

## 2.2. Mixing time ,stable period and weakening time:

The results presented in Table (23) show the effect of ascorbic acid on mixing time, stability and weakening time in 2004/2005 and 2005/2006 seasons. The results show that ascorbic acid had a significant effect on the above characters. Whereas, sprayed wheat plants by 1000 mg / L. ascorbic acid gave the highest mixing time of dough, which equal to 1.62 and 1.73 min. On the contrary, unsprayed of wheat plants gave the minimum one (1.39 and 1.57 min.) in the first and second seasons, respectively. Also, there was no significant difference between use 500 and 1000 mg/L. ascorbic acid concentrations in 2005/2006 season, but the difference between 500 and 1000 mg / L. ascorbic acid was significant in mixing time in the second season as well as stability and weakening time in both seasons. The stability was increased with application of ascorbic acid. The highest value was existed with use 1000 mg / L. ascorbic acid concentration in the two growing seasons. Meanwhile, control value gave the minimum value of stability which equal to 2.78 and 3.18 min. in 2004/2005 and 2005/2006 seasons, respectively. From the above-mentioned result it could be used concentration of ascorbic acid. Whereas, there is not a significant effect between use 500 and 1000 mg / L. in the two growing seasons. On the other side, application of ascorbic acid led to decrease weakening time in the first and second seasons. It is clear that the best weakening time were 0.69 and 0.64 Nm. produced from adding 1000 mg / L. ascorbic acid in the first and second season, respectively. Whereas, the lower ones were 0.75 and 0.68 Nm. respectively, obtained from unsprayed wheat plants by ascorbic acid. It could be concluded that the application of 500 mg/L. is similar to the application of 1000 mg/L. ascorbic acid concentration in both seasons. These results could be attributed to that increase of protein biosynthesis by adding ascorbic acid which led to increasing gluten net which resulted from increasing stable period because dough strength. To improve the dough quality by increasing water absorption percentage and mixing time as well as decreased weakening time.

## 3- Effect of nitrogen rates:

### 3.1. Water absorption percentage:

As shown in Table (23) that the mean values of water absorption percentage were significantly increased by increasing nitrogen rate up to 100 Kg N / faddan. The application of 100 Kg N / faddan gave the highest values of water absorption, which equal to 59.82 and 59.43 % in the first and second seasons, respectively. Whereas, no significant difference was obtained between adding 80 and 100 Kg N / faddan in the second season.

These results caused subsequent increase glutein content in wheat grains as indicator of the increase in protein content, which resulted from of increasing nitrogen fertilizer. These results are in agreement with those obtained by **Yamamoto *et al.* (1996), Yang *et al.* (1996), Pechanek *et al.* (1997) and Toaima *et al.* (2000).**

## 3.2. Mixing time , stable period and weakening time:

The effect of N-rates on mixing time, stable period and weakening time was significant in both seasons as shown in Table (23). The highest values of mixing time and stability were 1.63 and 1.73 min. as well as 3.44 and 3.76 min. in the two seasons, respectively. On the contrary, weakening time decreased by increasing N-rates. The best value of weakening were 0.68 and 0.64 Nm., obtained by application of 100 Kg N / faddan in the first and second seasons, respectively. It could be observed that there is not a significant effect between 80 and 100 Kg N / faddan in the second season. The obtained increase of this trait could be attributed to that increasing nitrogen which resulted in increasing crude protein content. Also, these results approved a correlation between glutein content and rheological properties i.e. increasing net glutein led to improve dough quality whereas, increasing water absorption, mixing time and stable period as well as decreased weakening time as indicator on protein and glutein netting strength. These results are similar to those obtained by **Abd-El-Hamed *et al.* (1986), Ayoub *et al.* (1994), Zaher (1996), Pechanek *et al.* (1997), Toaima *et al.* (2000), El-Nagar (2003) and Abd-El-Hady *et al.* (2006).**

Table (23): Effect of irrigation treatments, ascorbic acid concentrations and nitrogen rates on rheological properties in 2004/2005 and 2005/2006 seasons.

| Characters | | Water absorption (%) | | Mixing time (min) | | Stable period (min) | | Weakening (Nm ) | |
|---|---|---|---|---|---|---|---|---|---|
| Treatments | | Season | | | | | | | |
| | | 1st | 2nd | 1st | 2nd | 1st | 2nd | 1st | 2nd |
| Irrigation | $I_1$ | 57.38 c | 58.25 b | 1.60 b | 1.69 a | 3.39 b | 3.66 b | 0.68 b | 0.61 b |
| | $I_2$ | 58.45 b | 58.32 b | 2.11 a | 2.41 b | 4.86 a | 5.57 a | 0.56 c | 0.46 c |
| | $I_3$ | 61.03 a | 59.92 a | 0.89 c | 0.91 c | 1.21 c | 1.20 c | 0.92 a | 0.88 a |
| F-test | | ** | * | ** | ** | ** | ** | ** | ** |
| Ascorbic acid | $S_1$ | 57.39 b | 57.86 c | 1.39 c | 1.57 b | 2.78 b | 3.18 b | 0.75 a | 0.68 a |
| | $S_2$ | 59.67 a | 58.98 b | 1.57 b | 1.70 a | 3.31 a | 3.59 a | 0.70 b | 0.65 b |
| | $S_3$ | 59.81 a | 60.34 a | 1.62 a | 1.73 a | 3.36 a | 3.67 a | 0.69 b | 0.64 b |
| F-test | | * | ** | ** | * | ** | ** | ** | ** |
| Nitrogen | $N_1$ | 57.63 c | 58.14 b | 1.41 c | 1.59 c | 2.89 c | 3.12 c | 0.75 a | 0.67 a |
| | $N_2$ | 59.41 b | 58.92 a | 1.56 b | 1.68 b | 3.13 b | 3.53 b | 0.72 b | 0.65 b |
| | $N_3$ | 59.82 a | 59.43 a | 1.63 a | 1.73 a | 3.44 a | 3.76 a | 0.68 c | 0.64 b |
| F-test | | * | ** | * | * | * | ** | * | * |

$I_1$ = Irrigation at lose 40% A.S.M.D
$I_2$ = Irrigation at lose 60% A.S.M.D
$I_3$ = Irrigation at lose 80% A.S.M.D

$S_1$ = Zero ascorbic acid
$S_2$ =500 mg/L ascorbic acid
$S_3$ = 1000 mg/L ascorbic acid

$N_1$ = 60 kg N / faddan
$N_2$ = 80 kg /N / faddan
$N_3$ =100 kg N / faddan

## 4- Interactions effect:

### 4.1. Interaction effect between irrigation and ascorbic acid concentrations

Results in Table (24) showed that the average values of rheological properties i.e. water absorption percentage, mixing time, stable period and weakening time were significantly affected by the interaction between irrigation treatments and ascorbic acid concentrations. Irrigation at 80 % depletion of available soil moisture and sprayed by 1000 mg / L. ascorbic acid concentration gave the maximum water absorption percentage in wheat dough by 11.15 and 7.59 % over from the treated to irrigation at 40 % available soil moisture depletion with unsprayed ascorbic acid in the first and second seasons, respectively. The highest mean values of water absorption percentage were 62.08 and 60.92 % obtained from irrigation at 80 % depletion of available soil moisture with sprayed 1000 mg / L. ascorbic acid concentration in the two growing seasons, respectively . However, the lowest ones were 55.85 and 56.62 % produced from irrigation at 40 % ASMD and without ascorbic acid in the first and second seasons, respectively. While, irrigation at 60 % ASMD with use 1000 mg / L. ascorbic acid concentration gave the maximum mean values of mixing time, stable period and the best weakening time were (2.22 and 2.47 min.), (5.27 and 5.85 min.) and (0.52 and 0.44 Nm) in the first and second seasons, respectively. On the contrary, the minimum ones were (0.89 and 0.88 min.), (1.18 and 1.19 min.) and (0.92 and 0.90 Nm) in the two growing seasons, respectively.

Table (24): The interaction significantly effects of irrigation treatments with ascorbic acid concentrations on rheological properties.

| Characters | | Water absorption (%) | | Mixing time (min) | | Stable period (min) | | Weakening (Nm ) | |
|---|---|---|---|---|---|---|---|---|---|
| Treatments | | Season | | | | | | | |
| | | 1st | 2nd | 1st | 2nd | 1st | 2nd | 1st | 2nd |
| $I_1$ | $S_1$ | 55.85 | 56.62 | 1.38 | 1.50 | 3.00 | 3.31 | 0.72 | 0.63 |
| | $S_2$ | 58.09 | 58.37 | 1.64 | 1.76 | 3.57 | 3.72 | 0.66 | 0.61 |
| | $S_3$ | 58.20 | 58.66 | 1.78 | 1.80 | 3.60 | 3.95 | 0.64 | 0.59 |
| $I_2$ | $S_1$ | 57.13 | 56.95 | 1.91 | 2.30 | 4.15 | 5.03 | 0.61 | 0.51 |
| | $S_2$ | 59.08 | 58.63 | 2.19 | 2.45 | 5.16 | 5.82 | 0.53 | 0.46 |
| | $S_3$ | 59.14 | 59.38 | 2.22 | 2.47 | 5.27 | 5.85 | 0.52 | 0.44 |
| $I_3$ | $S_1$ | 59.18 | 58.90 | 0.89 | 0.88 | 1.18 | 1.19 | 0.92 | 0.90 |
| | $S_2$ | 61.84 | 59.95 | 0.92 | 0.90 | 1.20 | 1.22 | 0.89 | 0.88 |
| | $S_3$ | 62.08 | 60.92 | 0.90 | 0.92 | 1.23 | 1.21 | 0.88 | 0.87 |
| L.S.D at 0.05 | | 0.318 | 1.093 | 0.041 | 00.53 | 0.265 | 0.162 | 0.055 | 0.072 |

$I_1$= Irrigation at lose 40% A.S.M.D
$I_2$= Irrigation at lose 60% A.S.M.D
$I_3$= Irrigation at lose 80% A.S.M.D

$S_1$= Zero ascorbic acid
$S_2$ =500 mg/L ascorbic acid
$S_3$ = 1000 mg/L ascorbic acid

## 4- Interactions effect:

### 4.1. Interaction effect between irrigation and ascorbic acid concentrations

Results in Table (24) showed that the average values of rheological properties i.e. water absorption percentage, mixing time, stable period and weakening time were significantly affected by the interaction between irrigation treatments and ascorbic acid concentrations. Irrigation at 80 % depletion of available soil moisture and sprayed by 1000 mg / L. ascorbic acid concentration gave the maximum water absorption percentage in wheat dough by 11.15 and 7.59 % over from the treated to irrigation at 40 % available soil moisture depletion with unsprayed ascorbic acid in the first and second seasons, respectively. The highest mean values of water absorption percentage were 62.08 and 60.92 % obtained from irrigation at 80 % depletion of available soil moisture with sprayed 1000 mg / L. ascorbic acid concentration in the two growing seasons, respectively . However, the lowest ones were 55.85 and 56.62 % produced from irrigation at 40 % ASMD and without ascorbic acid in the first and second seasons, respectively. While, irrigation at 60 % ASMD with use 1000 mg / L. ascorbic acid concentration gave the maximum mean values of mixing time, stable period and the best weakening time were (2.22 and 2.47 min.), (5.27 and 5.85 min.) and (0.52 and 0.44 Nm) in the first and second seasons, respectively. On the contrary, the minimum ones were (0.89 and 0.88 min.), (1.18 and 1.19 min.) and (0.92 and 0.90 Nm) in the two growing seasons, respectively.

Table (24): The interaction significantly effects of irrigation treatments with ascorbic acid concentrations on rheological properties.

| Characters | | Water absorption (%) | | Mixing time (min) | | Stable period (min) | | Weakening (Nm ) | |
|---|---|---|---|---|---|---|---|---|---|
| Treatments | | Season | | | | | | | |
| | | 1st | 2nd | 1st | 2nd | 1st | 2nd | 1st | 2nd |
| $I_1$ | $S_1$ | 55.85 | 56.62 | 1.38 | 1.50 | 3.00 | 3.31 | 0.72 | 0.63 |
| | $S_2$ | 58.09 | 58.37 | 1.64 | 1.76 | 3.57 | 3.72 | 0.66 | 0.61 |
| | $S_3$ | 58.20 | 58.66 | 1.78 | 1.80 | 3.60 | 3.95 | 0.64 | 0.59 |
| $I_2$ | $S_1$ | 57.13 | 56.95 | 1.91 | 2.30 | 4.15 | 5.03 | 0.61 | 0.51 |
| | $S_2$ | 59.08 | 58.63 | 2.19 | 2.45 | 5.16 | 5.82 | 0.53 | 0.46 |
| | $S_3$ | 59.14 | 59.38 | 2.22 | 2.47 | 5.27 | 5.85 | 0.52 | 0.44 |
| $I_3$ | $S_1$ | 59.18 | 58.90 | 0.89 | 0.88 | 1.18 | 1.19 | 0.92 | 0.90 |
| | $S_2$ | 61.84 | 59.95 | 0.92 | 0.90 | 1.20 | 1.22 | 0.89 | 0.88 |
| | $S_3$ | 62.08 | 60.92 | 0.90 | 0.92 | 1.23 | 1.21 | 0.88 | 0.87 |
| L.S.D at 0.05 | | 0.318 | 1.093 | 0.041 | 00.53 | 0.265 | 0.162 | 0.055 | 0.072 |

$I_1$= Irrigation at lose 40% A.S.M.D
$I_2$= Irrigation at lose 60% A.S.M.D
$I_3$= Irrigation at lose 80% A.S.M.D

$S_1$ = Zero ascorbic acid
$S_2$ =500 mg/L ascorbic acid
$S_3$ = 1000 mg/L ascorbic acid

## 4.2. Interaction effect between irrigation treatments and N-rates:

The interaction effect between irrigation treatments and nitrogen rates were significant on water absorption percentage, mixing time, stable period as well as weakening time in both seasons, as shown in Table (25). The highest water absorption percentage were 62.11 and 60.60 %, produced from irrigation at 80 % available soil moisture depletion and applied 100 Kg N / faddan in the first and second seasons, respectively. On the other hand, irrigation at 40 % ASMD with applied 60 Kg N / faddan gave the minimum one which equal to 56.10 and 57.86 %, respectively. Whereas, mixing time and stable period were decreased by increasing soil moisture stress and N-rate up to 100 Kg N / faddan in both seasons. The highest values of mixing time and stable period as well as the best weakening time were obtained from irrigation at 60 % depletion available soil moisture with applied 100 Kg N / faddan. It could be concluded that irrigation at 60 % ASMD and applied 100 Kg N / faddan gave the best results of mixing time and stability as well as weakening time.

## 4.3. Interaction effect between ascorbic acid concentrations and N-rates:

The results in Table (26) show that the interaction between ascorbic acid and nitrogen rates was significantly affected on rheological properties in both seasons. The application of 100 Kg N / faddan with use 1000 mg / L. ascorbic acid concentration gave the highest mean values of water

Table (25): The interaction significantly effects of irrigation treatments with nitrogen rates on rheological properties.

| Characters | | Water absorption (%) | | Mixing time (min) | | Stable period (min) | | Weakening (Nm ) | |
|---|---|---|---|---|---|---|---|---|---|
| Treatments | | Season | | | | | | | |
| | | 1st | 2nd | 1st | 2nd | 1st | 2nd | 1st | 2nd |
| $I_1$ | $N_1$ | 56.10 | 57.86 | 1.42 | 1.56 | 2.97 | 3.25 | 0.72 | 062 |
| | $N_2$ | 57.84 | 58.25 | 1.62 | 1.71 | 3.33 | 3.66 | 0.68 | 0.61 |
| | $N_3$ | 58.20 | 58.65 | 1.75 | 1.78 | 3.87 | 4.07 | 0.63 | 0.60 |
| $I_2$ | $N_1$ | 57.36 | 57.54 | 1.94 | 2.32 | 4.48 | 4.94 | 060 | 0.51 |
| | $N_2$ | 58.83 | 58.38 | 2.16 | 2.41 | 4.85 | 5.74 | 0.55 | 0.47 |
| | $N_3$ | 59.16 | 59.04 | 2. 23 | 2.49 | 5.25 | 6.01 | 0.50 | 0.44 |
| $I_3$ | $N_1$ | 59.43 | 59.04 | 0.88 | 0.89 | 1.18 | 1.20 | 0.92 | 0.91 |
| | $N_2$ | 61.56 | 60.13 | 0.90 | 0.91 | 1.22 | 1.21 | 0.91 | 0.89 |
| | $N_3$ | 62.11 | 60. 60 | 0.89 | 0.92 | 1.23 | 1.22 | 0.89 | .088 |
| L.S.D at 0.05 | | 0.314 | 1.216 | 0.058 | 0.082 | 0.289 | 0.241 | 0.413 | 0.716 |

$I_1$= Irrigation at lose 40% A.S.M.D
$I_2$= Irrigation at lose 60% A.S.M.D
$I_3$= Irrigation at lose 80% A.S.M.D

$N_1$ = 60 kg N / faddan
$N_2$ = 80 kg /N / faddan
$N_3$ =100 kg N / faddan

Table (26): The interaction significantly effects of ascorbic acid concentrations with nitrogen rates on rheological properties.

| Characters | | Water absorption (%) | | Mixing time (min) | | Stable period (min) | | Weakening (Nm ) | |
|---|---|---|---|---|---|---|---|---|---|
| Treatments | | Season | | | | | | | |
| | | 1st | 2nd | 1st | 2nd | 1st | 2nd | 1st | 2nd |
| $S_1$ | $N_1$ | 55.89 | 56.50 | 1.31 | 1.50 | 2.43 | 2.88 | 0.78 | 0.69 |
| | $N_2$ | 57.62 | 57.49 | 1.40 | 1.58 | 2.84 | 3.15 | 0.75 | 0.68 |
| | $N_3$ | 58.65 | 58.48 | 1.47 | 1.62 | 3.07 | 3.50 | 0.71 | 0.66 |
| $S_2$ | $N_1$ | 58.45 | 58.09 | 1.44 | 1.62 | 3.08 | 3.23 | 0.73 | 0.66 |
| | $N_2$ | 60.24 | 59.39 | 1.59 | 1.72 | 3.26 | 3.65 | 0.70 | 0.64 |
| | $N_3$ | 60.32 | 59.47 | 1.68 | 1.76 | 3.60 | 3.87 | 0.68 | 0.63 |
| $S_3$ | $N_1$ | 58.55 | 58.73 | 1.49 | 1.65 | 3.16 | 3.28 | 0.72 | 0.66 |
| | $N_2$ | 60.36 | 58.89 | 1.67 | 1.74 | 3.28 | 3.80 | 0.69 | 0.63 |
| | $N_3$ | 60.51 | 60.34 | 1.72 | 1.80 | 3.66 | 3.93 | 0.67 | 0.62 |
| L.S.D at 0.05 | | 0.314 | 1.216 | 0.058 | 0.082 | 0.289 | 0.241 | 0.413 | 0.716 |

$S_1$ = Zero ascorbic acid
$S_2$ =500 mg/L ascorbic acid
$S_3$ = 1000 mg/L ascorbic acid

$N_1$ = 60 kg N / faddan
$N_2$ = 80 kg /N / faddan
$N_3$=100 kg N / faddan

absorption percentage, mixing time and stable period as well as weakening time. However, the lowest values ones were produced from applied 60 Kg N / faddan and without ascorbic acid in the two growing seasons. It could be noticed that no significant effect between application of 80 and 100 Kg N / faddan and between spraying 500 and 1000 mg/L. ascorbic acid concentrations.

## 4.4. Interaction effect between the three factors:

Results illustrated in Table (27) and Figs.(5-58) indicate that water absorption in the second season and mixing time, stable period and weakening time in both seasons were significantly affected by the interaction between the three factors under study. It was clear that, the highest mean values of water absorption percentage was 61.53 %, produced from irrigation at 80 % depletion of available soil moisture with sprayed 1000 mg / L. ascorbic acid concentration and applied of 100 Kg N / faddan in the second season, whereas, the lowest mean values of water absorption percentage was 55.57 % obtained from irrigation at 40 % available soil moisture depletion with untreated wheat plants of ascorbic acid and applying 60 Kg N / faddan. It could be concluded that moisture stress with sprayed 500 or 1000 mg / L. ascorbic acid concentration and application 100 or 80 Kg N/faddan gave the best water absorption percentage to wheat flour dough cultivated in sandy soil of improved. On the other side, the maximum mean values of mixing time and available soil moisture with use 1000 mg / L. ascorbic acid concentration and applying 100 Kg N / faddan. No significant effect between the two concentrations of ascorbic acid 500 and 1000 mg / L. and between 100 and 80 Kg N / faddan with irrigation at 60 % depletion of available soil moisture in the two growing seasons. Meanwhile, the lowest mean values were produced from irrigation at 80 % ASMD with application 60 Kg N / faddan and without ascorbic acid, which equal to (0.86 and 0.87 min) for mixing time, (1.16 and 1.18 min.) for stable period and ( 0.91 and 0.92 Nm.) for weakening time in the first and second seasons, respectively.

Table (27): The interaction significantly effects of irrigation treatments and ascorbic acid with nitrogen rates on rheological properties.

| Characters | | | Water absorption | Mixing time (min) | | Stable period (min) | | Weakening (Nm ) | |
|---|---|---|---|---|---|---|---|---|---|
| Treatments | | | Season | | | | | | |
| | | | 2nd | 1st | 2nd | 1st | 2nd | 1st | 2nd |
| I1 | S1 | N1 | 55.57 | 1.24 | 1.40 | 2.51 | 2.82 | 0.78 | 0.65 |
| | | N2 | 56.59 | 1.38 | 1.51 | 3.00 | 3.25 | 0.73 | 0.63 |
| | | N3 | 57.70 | 1.52 | 1.59 | 3.50 | 3.86 | 0.66 | 0.62 |
| | S2 | N1 | 57.28 | 1.46 | 1.63 | 3.20 | 3.41 | 0.70 | 0.61 |
| | | N2 | 58.88 | 1.65 | 1.80 | 3.51 | 3.64 | 0.66 | 0.60 |
| | | N3 | 58.94 | 1.81 | 1.83 | 4.10 | 4.12 | 0.63 | 0.60 |
| | S3 | N1 | 57.39 | 1.57 | 1.64 | 3.21 | 3.53 | 0.68 | 0.60 |
| | | N2 | 59.27 | 1.84 | 1.84 | 3.52 | 4.08 | 0.64 | 0.59 |
| | | N3 | 59.27 | 1.92 | 1.92 | 4.09 | 4.25 | 0.61 | 0.58 |
| I2 | S1 | N1 | 56.02 | 1.80 | 2.22 | 3.58 | 4.62 | 0.65 | 0.54 |
| | | N2 | 56.94 | 1.94 | 2.31 | 4.33 | 5.01 | 0.62 | 0.52 |
| | | N3 | 57.91 | 2.02 | 2.36 | 4.52 | 5.45 | 0.56 | 0.49 |
| | S2 | N1 | 57.94 | 2.00 | 2.34 | 4.83 | 5.08 | 0.58 | 0.49 |
| | | N2 | 58.92 | 2.24 | 2.45 | 5.08 | 6.10 | 0.52 | 0.46 |
| | | N3 | 59.05 | 2.34 | 2.56 | 5.57 | 6.27 | 0.50 | 0.43 |
| | S3 | N1 | 58.67 | 2.17 | 2.39 | 5.04 | 5.13 | 0.57 | 0.48 |
| | | N2 | 59.30 | 2.29 | 2.46 | 5.13 | 6.12 | 0.51 | 0.43 |
| | | N3 | 60.17 | 2.34 | 2.56 | 5.65 | 6.31 | 0.48 | 0.41 |
| I3 | S1 | N1 | 57.90 | 0.86 | 0.87 | 1.16 | 1.18 | 0.91 | 0.92 |
| | | N2 | 58.94 | 0.88 | 0.88 | 1.19 | 1.20 | 0.90 | 0.91 |
| | | N3 | 59.85 | 0.90 | 0.89 | 1.22 | 1.21 | 0.91 | 0.90 |
| | S2 | N1 | 59.06 | 0.88 | 0.91 | 1.21 | 1.20 | 0.90 | 0.91 |
| | | N2 | 60.63 | 0.89 | 0.92 | 1.21 | 1.22 | 0.91 | 0.89 |
| | | N3 | 60.42 | 091 | 0.90 | 1.22 | 1.23 | 0.92 | 0.91 |
| | S3 | N1 | 60.14 | 0.89 | 0.91 | 1.23 | 1.19 | 0.91 | 0.90 |
| | | N2 | 61.09 | 0.90 | 0.92 | 1.23 | 1.20 | 0.90 | 0.89 |
| | | N3 | 61.53 | 0.92 | 0.90 | 1.23 | 1.22 | 0.91 | 0.90 |
| L.S.D at 0.05 | | | 1.894 | 0.084 | 0.092 | 0.547 | 0.328 | 0.078 | 0.086 |

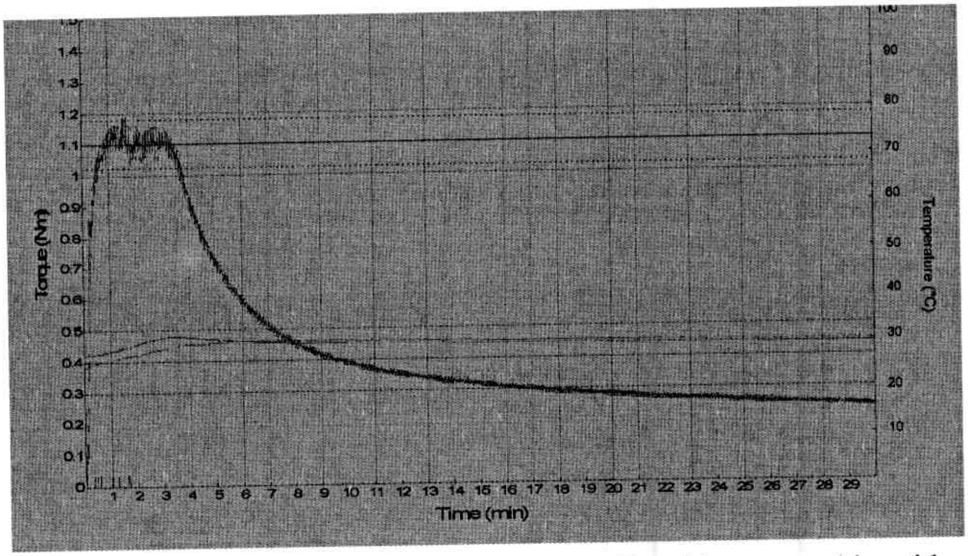



Fig.(5): Effect of irrigation at 40% ASMD, without ascorbic acid and 60 kg N / faddan in the first season

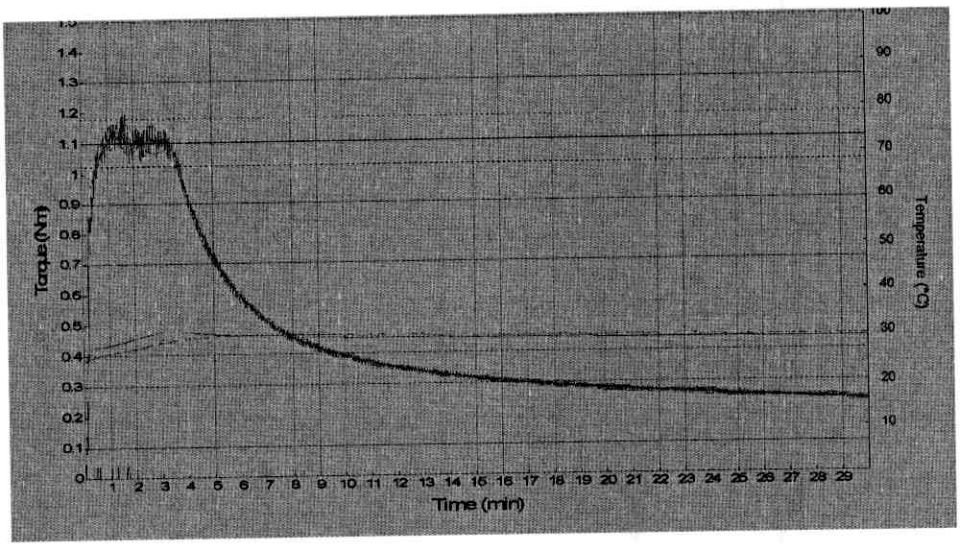



Fig. (6): Effect of irrigation at 40% ASMD, without ascorbic acid and 60 kg N / faddan in the second season

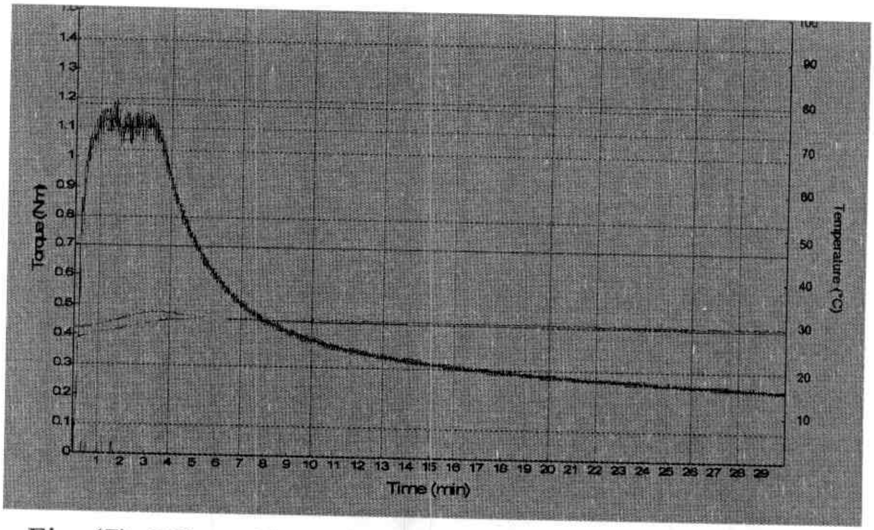



Fig. (7): Effect of irrigation at 40% ASMD, without ascorbic acid and 80 kg N / faddan in the first season

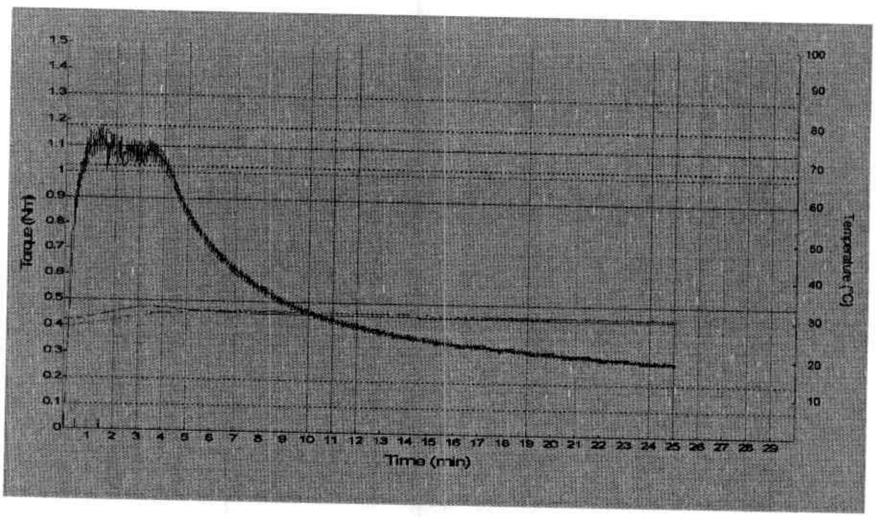



Fig. (8): Effect of irrigation at 40% ASMD, without ascorbic acid and 80 kg N / faddan in the second season

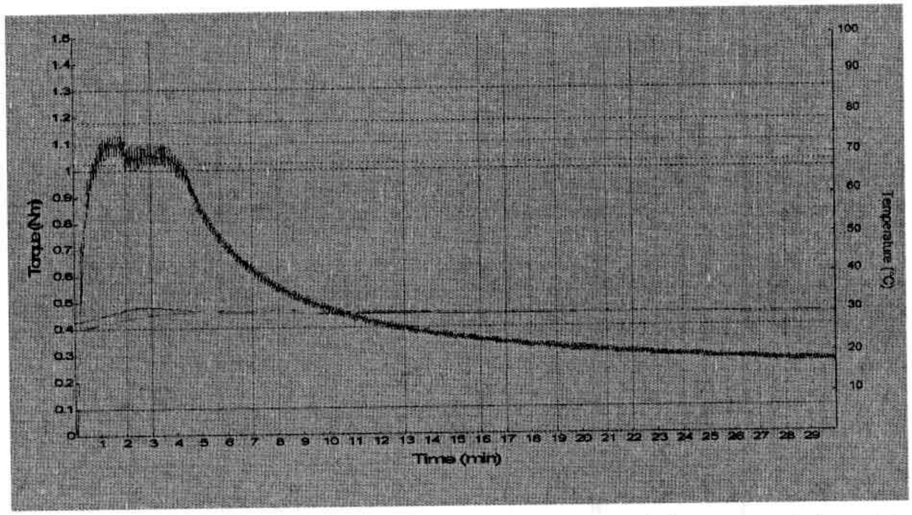



Fig. (9): Effect of irrigation at 40% ASMD, without ascorbic acid and 100 kg N / faddan in the first season

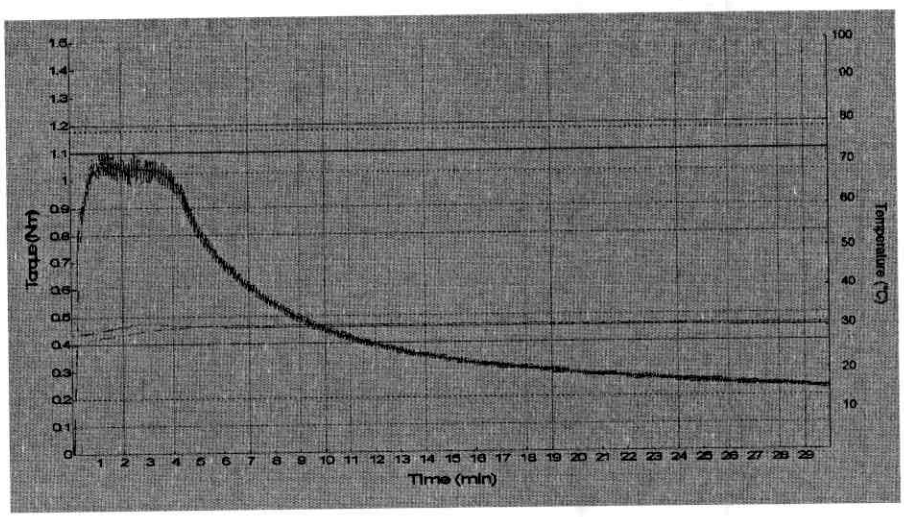



Fig. (10): Effect of irrigation at 40% ASMD, without ascorbic acid and 100 kg N / faddan in the second season

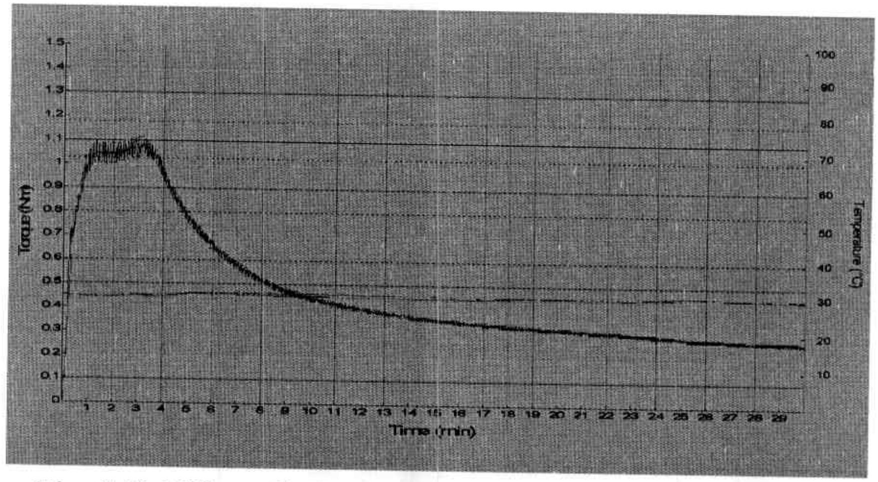



Fig. (11): Effect of irrigation at 40% ASMD, 500mg/L. ascorbic acid and 60 kg N / faddan in the first season

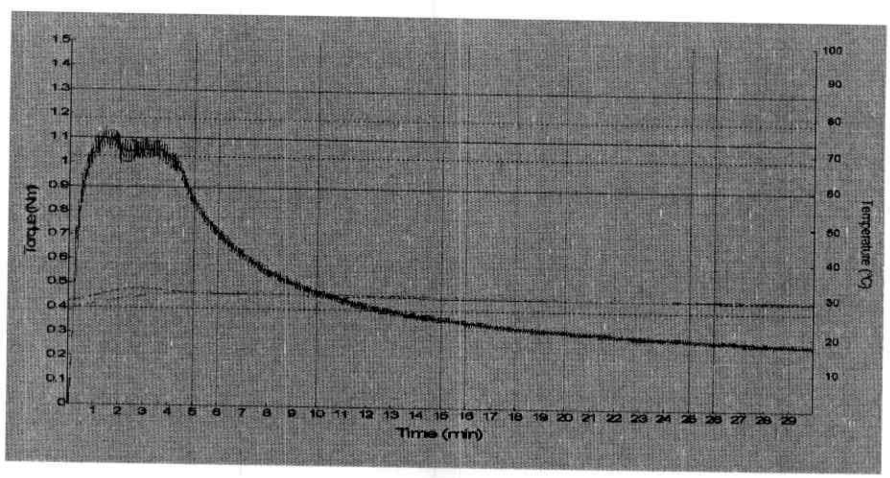



Fig. (12): Effect of irrigation at 40% ASMD, 500mg/L. ascorbic acid and 60 kg N / faddan in the second season

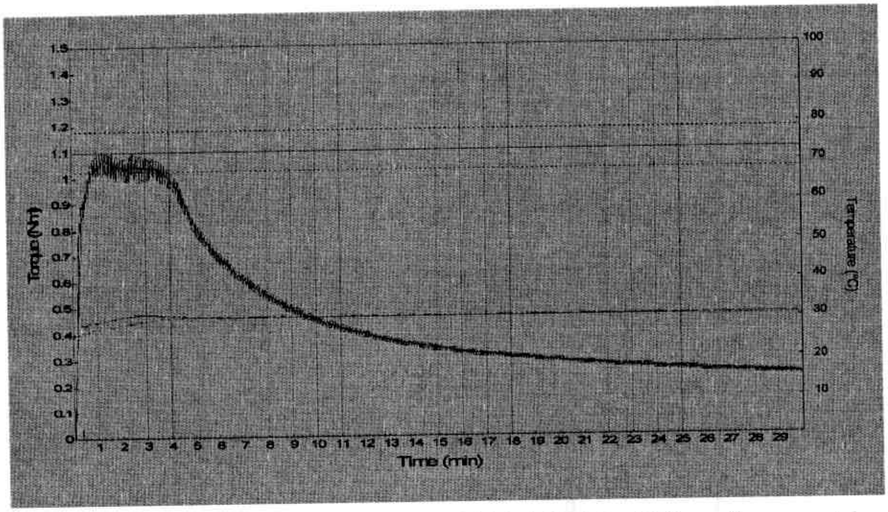



Fig. (13): Effect of irrigation at 40% ASMD, 500mg/L. ascorbic acid and 80 kg N / faddan in the first season

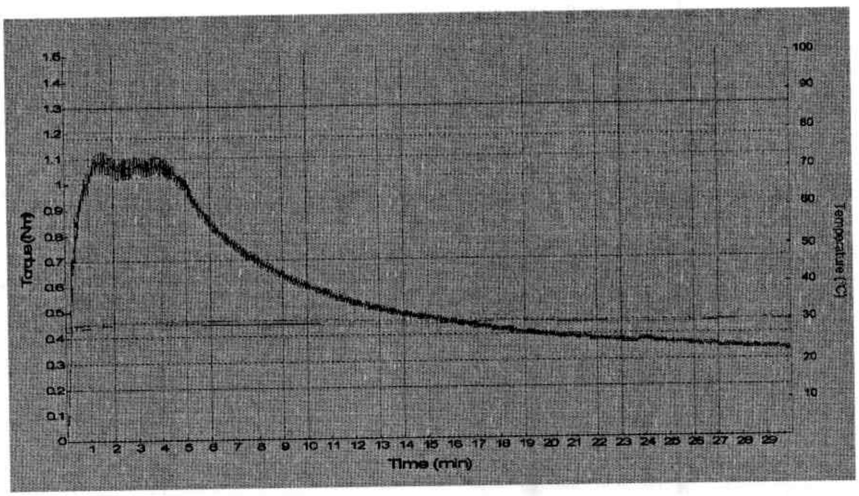



Fig. (14): Effect of irrigation at 40% ASMD, 500mg/L. ascorbic acid and 80 kg N / faddan in the second season

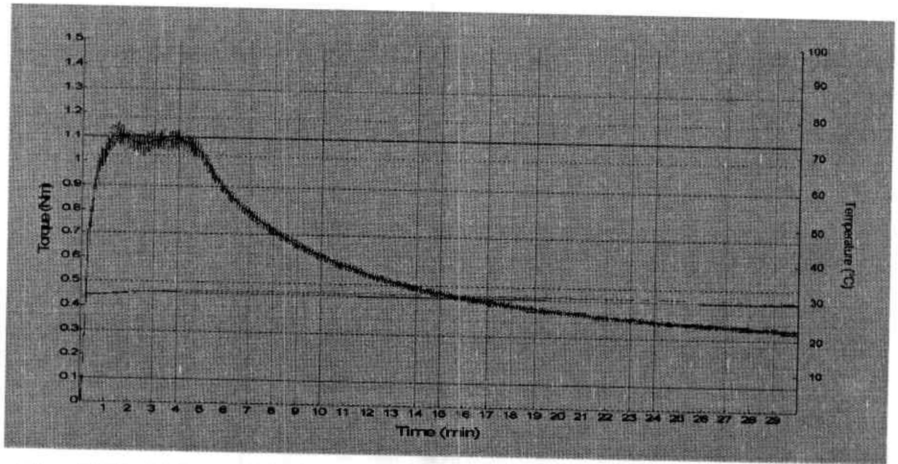



Fig. (15): Effect of irrigation at 40% ASMD 500mg/L.ascorbic acid and 100 kg N / faddan in the first season

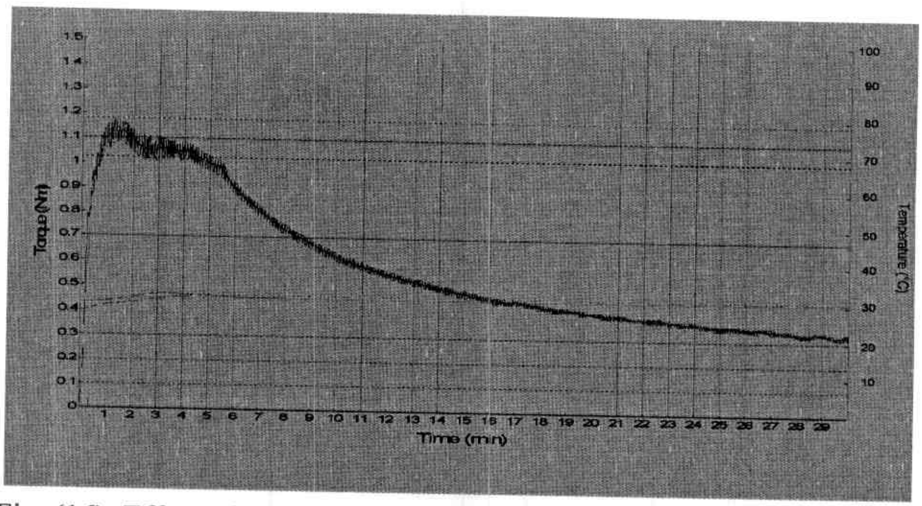



Fig. (16): Effect of irrigation at 40% ASMD, 500mg/L. ascorbic acid and 100 kg N / faddan in the second season

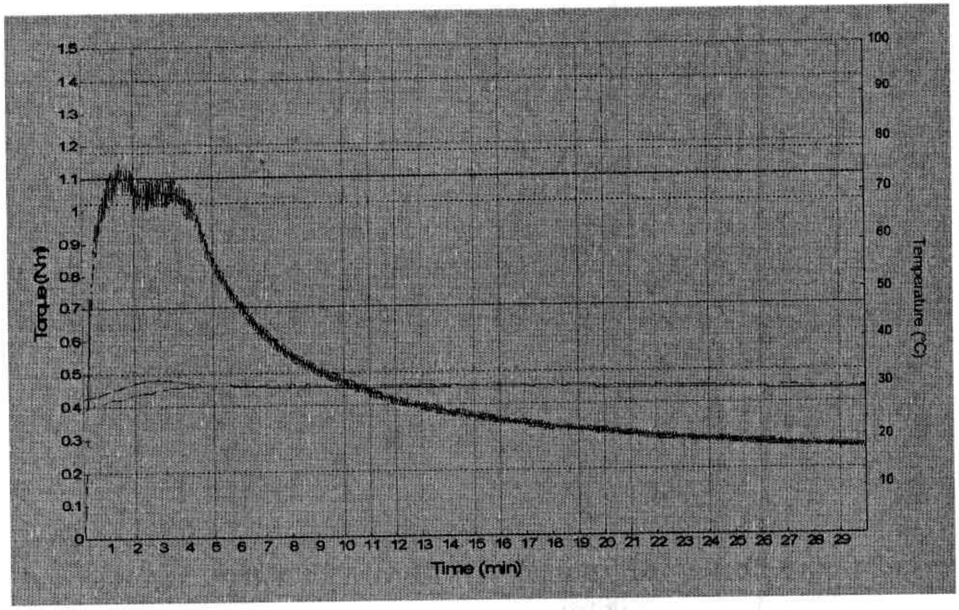



Fig. (17): Effect of irrigation at 40% ASMD, 1000mg/L. ascorbic acid and 60 kg N /faddan in the first season

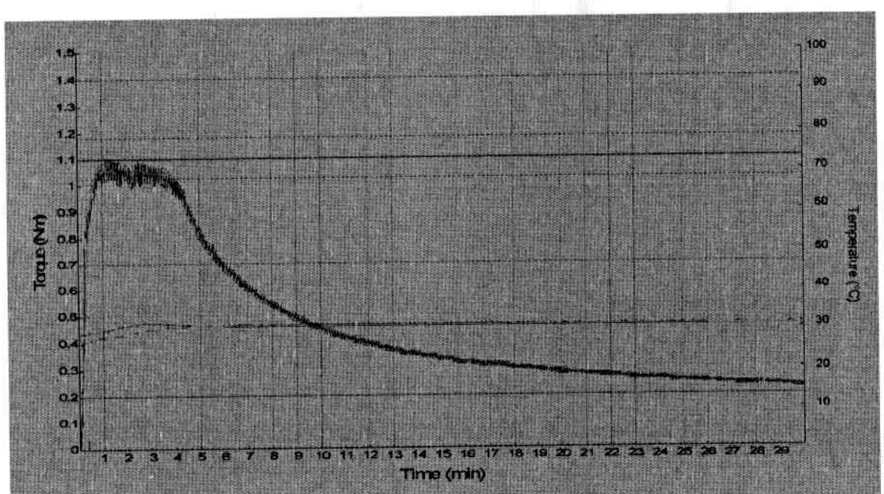



Fig. (18): Effect of irrigation at 40% ASMD, 1000mg/L.zero ascorbic acid and 60 kg N / faddan in the second season

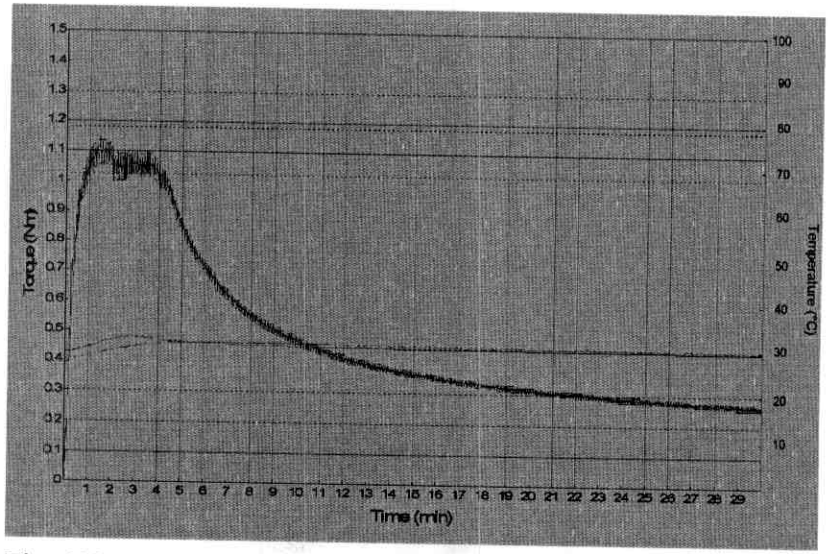


Fig. (19): Effect of irrigation at 40% ASMD, 1000mg/L.ascorbic acid and 80 kg N / faddan in the first season

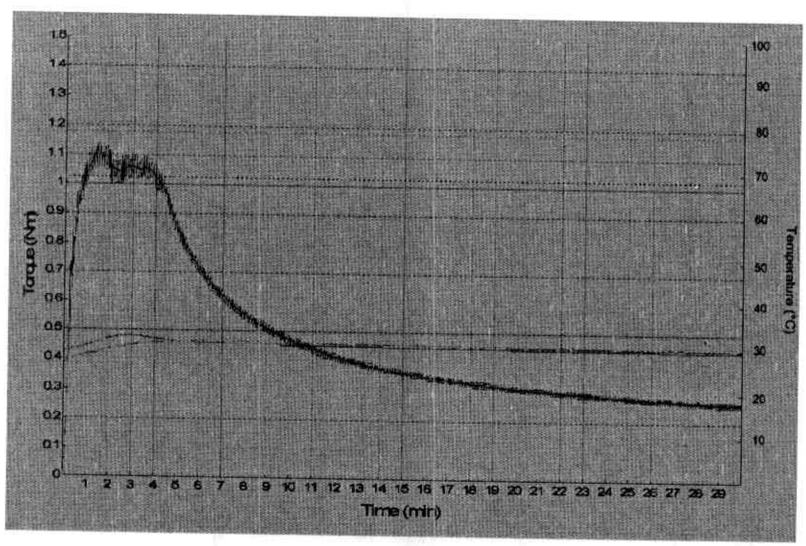


Fig. (20): Effect of irrigation at 40% ASMD, 1000mg/L. ascorbic acid and 80 kg N / faddan in the second season

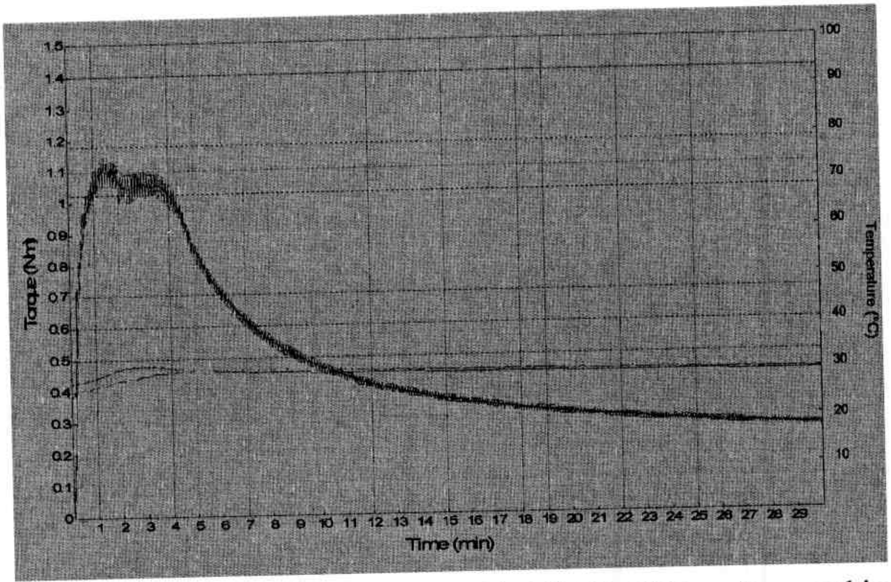



Fig. (21): Effect of irrigation at 40% ASMD, 1000mg/L. ascorbic acid and 100 kg N / faddan in the first season

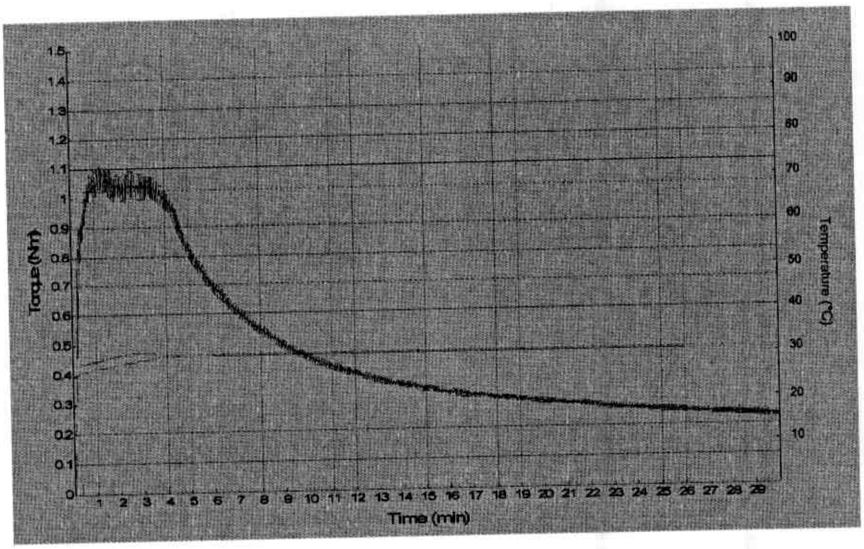



Fig. (22): Effect of irrigation at 40% ASMD, 1000mg/L.ascorbic acid and 100 kg N / faddan in the second season

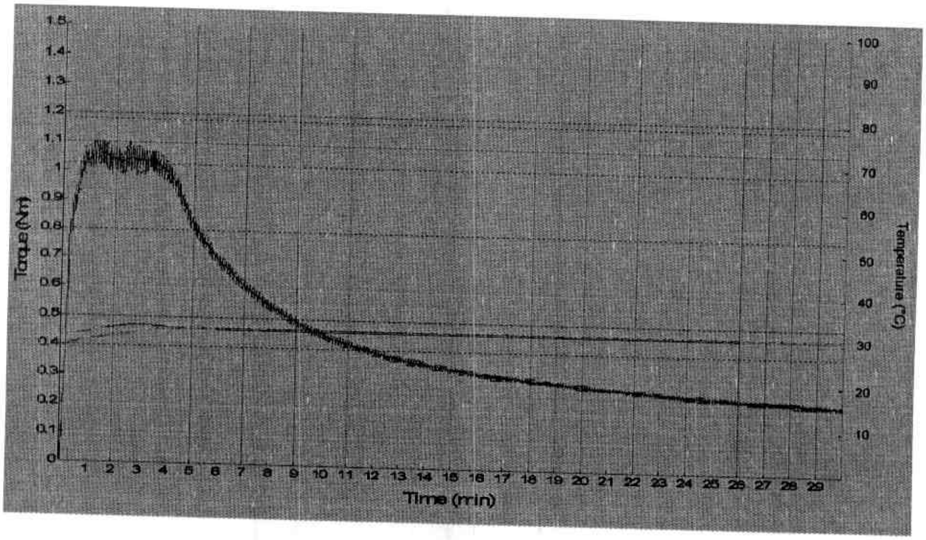



Fig. (23): Effect of irrigation at 60% ASMD, zero ascorbic acid and 60 kg N /faddan in the first season

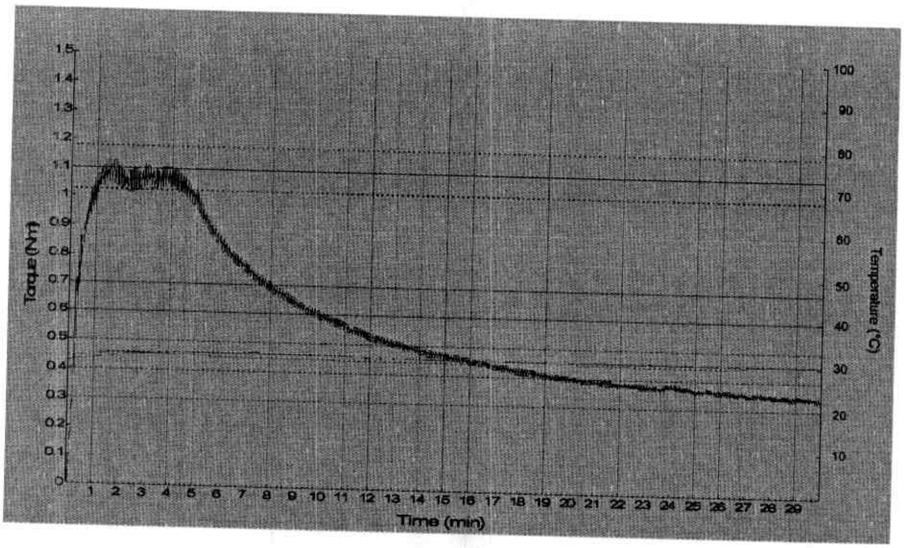



Fig. (24): Effect of irrigation at 60% ASMD, zero ascorbic acid and 60 kg N /faddan in the second season

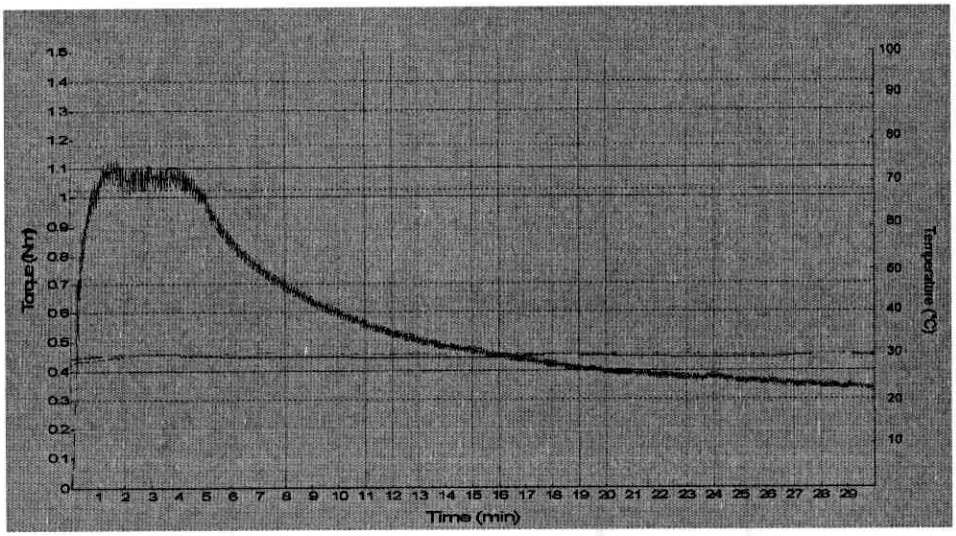



Fig. (25): Effect of irrigation at 60% ASMD, zero ascorbic acid and 80 kg N /faddan in the first season

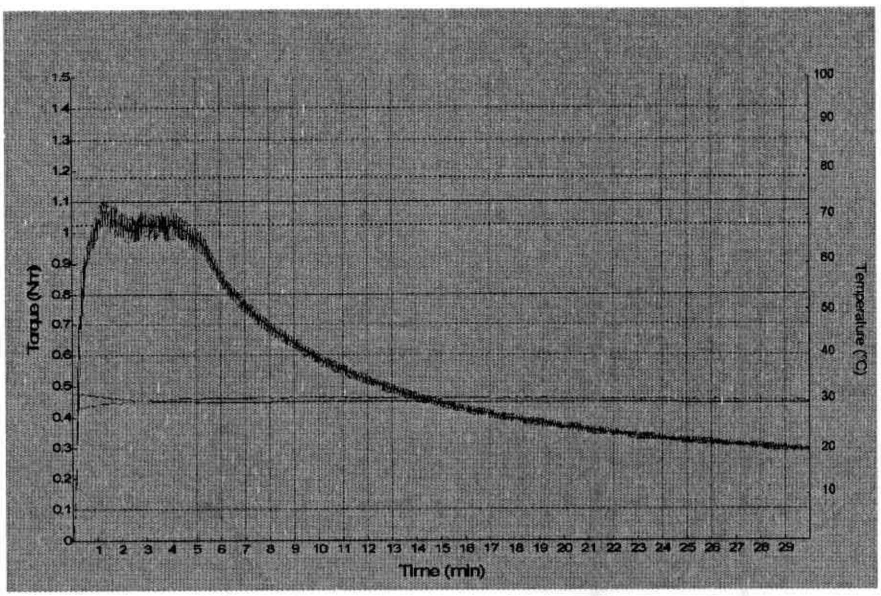



Fig. (26): Effect of irrigation at 60% ASMD , zero ascorbic acid and 80 kg N /faddan in the second season

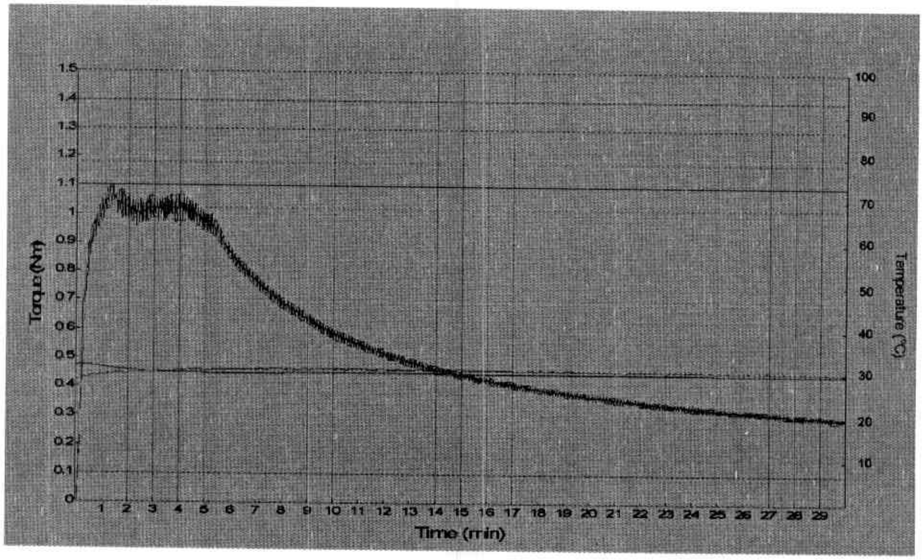



Fig. (27): Effect of irrigation at 60% ASMD, zero ascorbic acid and 100 kg N /faddan in the first season

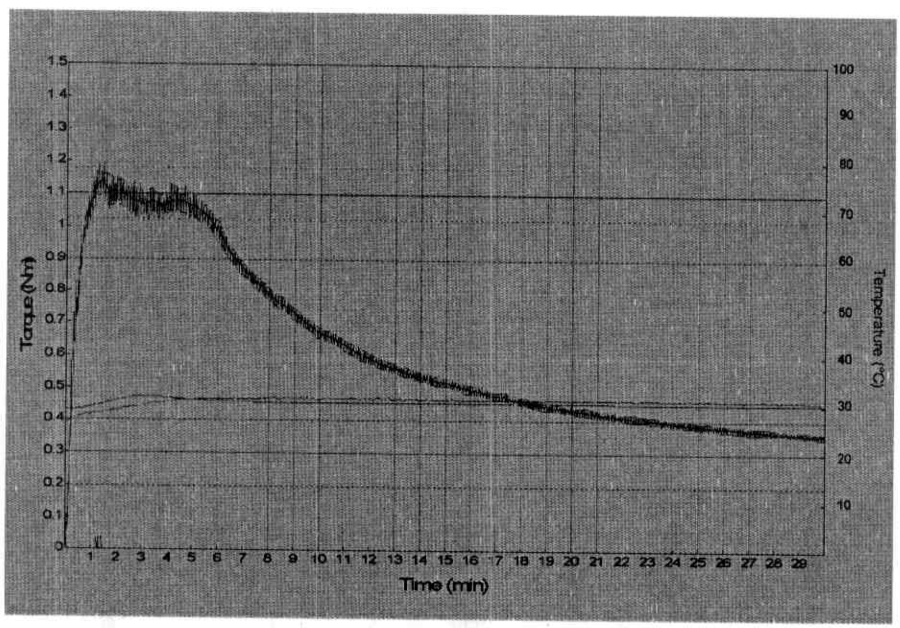



Fig. (28): Effect of irrigation at 60% ASMD, zero ascorbic acid and 100 kg N /faddan in the first season

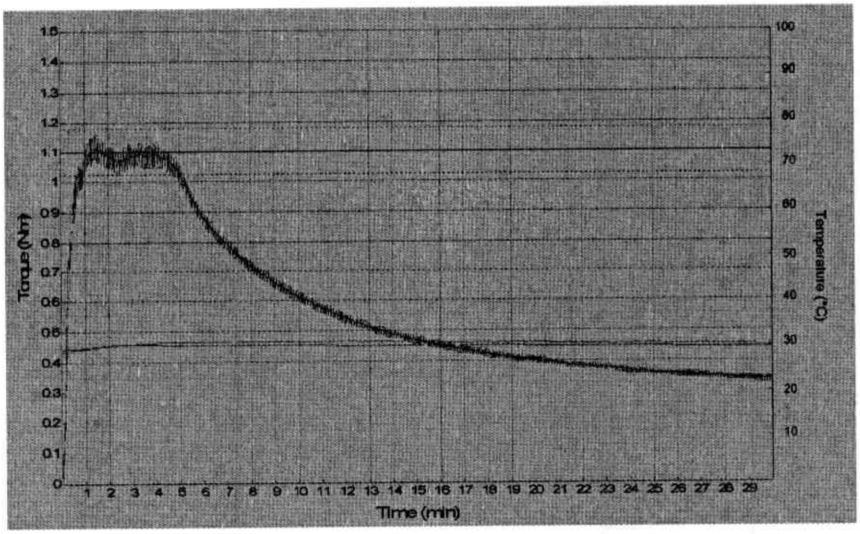



Fig. (29): Effect of irrigation at 60% ASMD , 500mg/L. ascorbic acid and 60 kg N /faddan in the first season

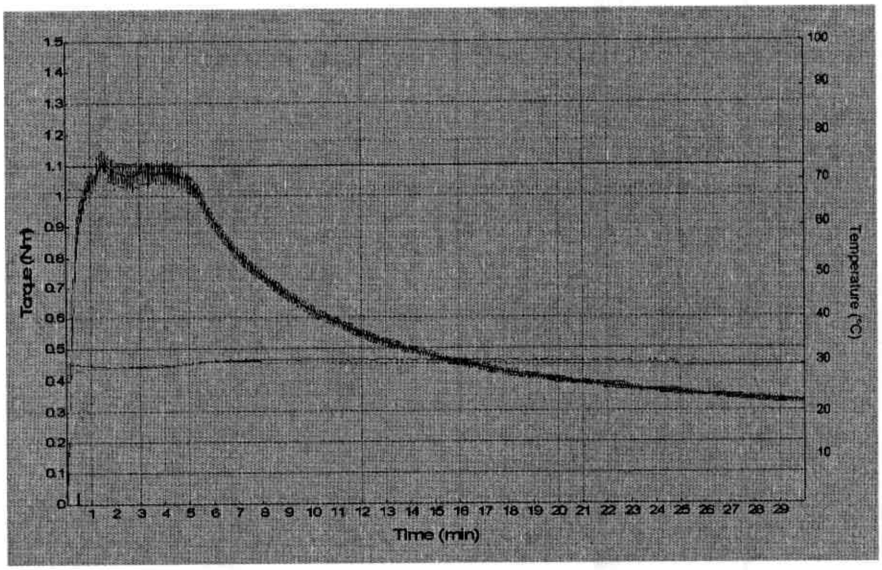



Fig. (30): Effect of irrigation at 60% ASMD , 500mg/L.ascorbic acid and 60 kg N /faddan in the second season

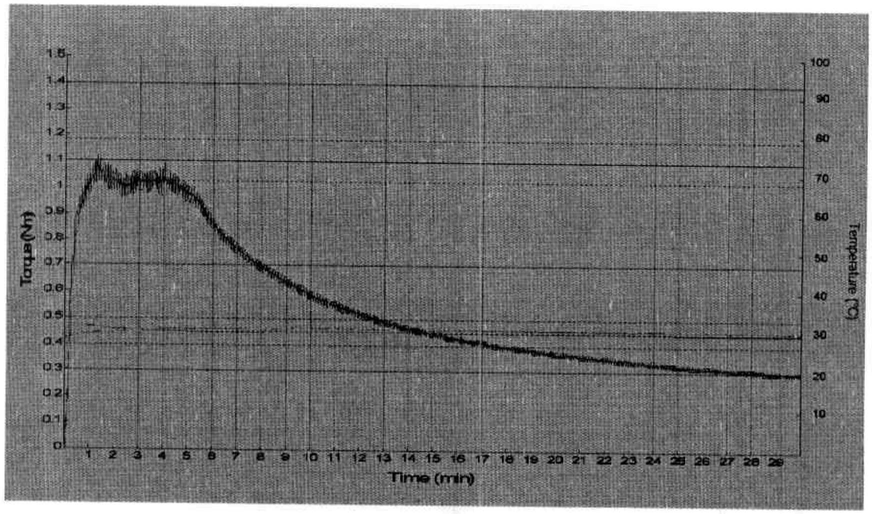



Fig. (31): Effect of irrigation at 60% ASMD , 500mg/L. ascorbic acid and 80 kg N/faddan in the first season

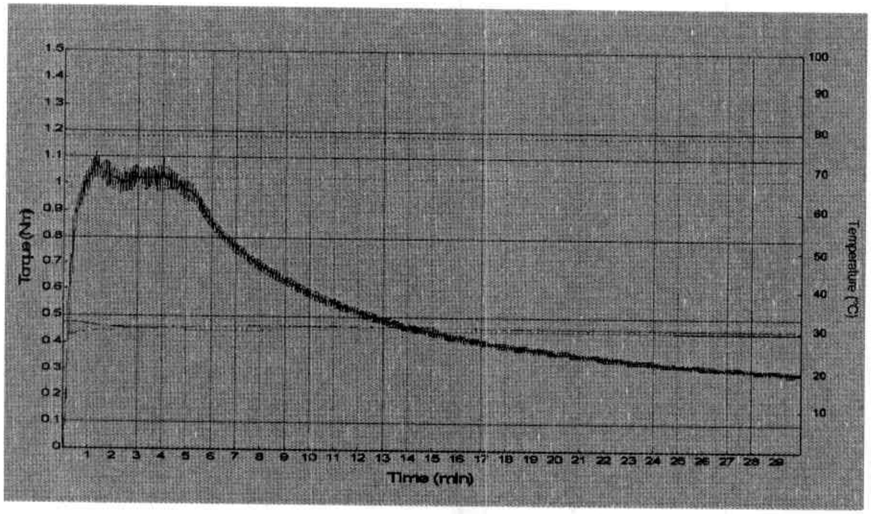



Fig. (32): Effect of irrigation at 60% ASMD , 500mg/L. ascorbic acid and 80 kg N /faddan in the second season

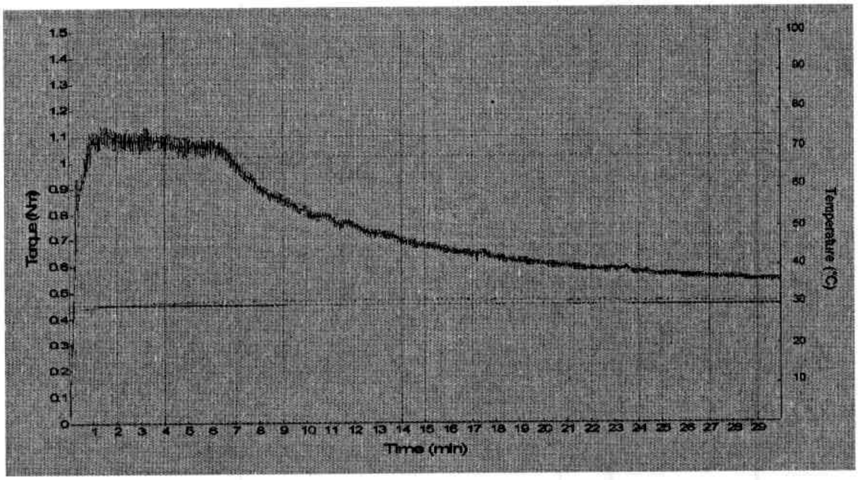



Fig. (33): Effect of irrigation at 60% ASMD , 500mg/L. ascorbic acid and 100 kg N /faddan in the first season

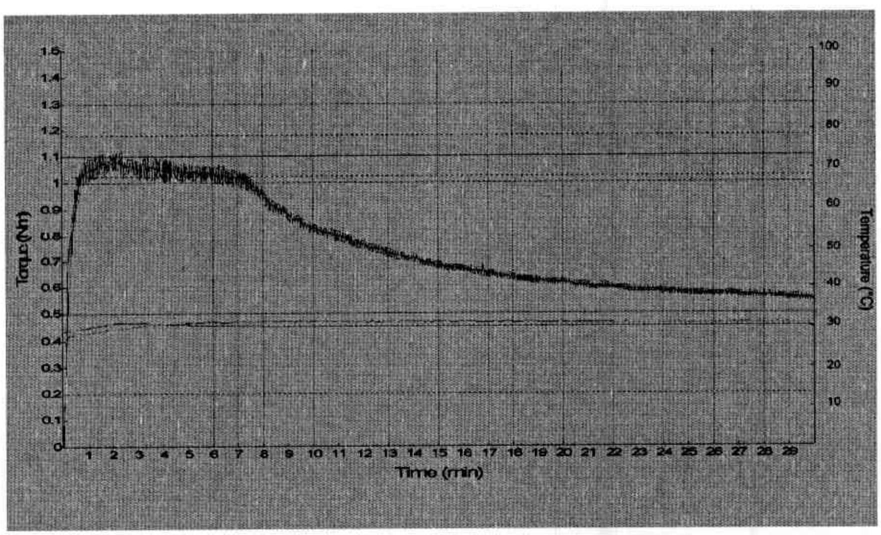



Fig. (34): Effect of irrigation at 60% ASMD , 500mg/L. ascorbic acid and 100 kg N /faddan in the second season

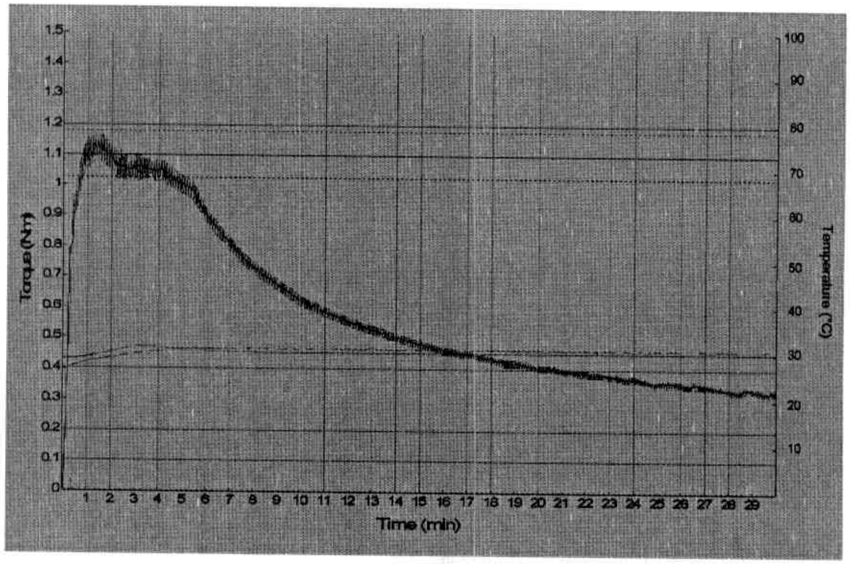



Fig. (35): Effect of irrigation at 60% ASMD , 1000mg/L. ascorbic acid and 60 kg N /faddan in the first season

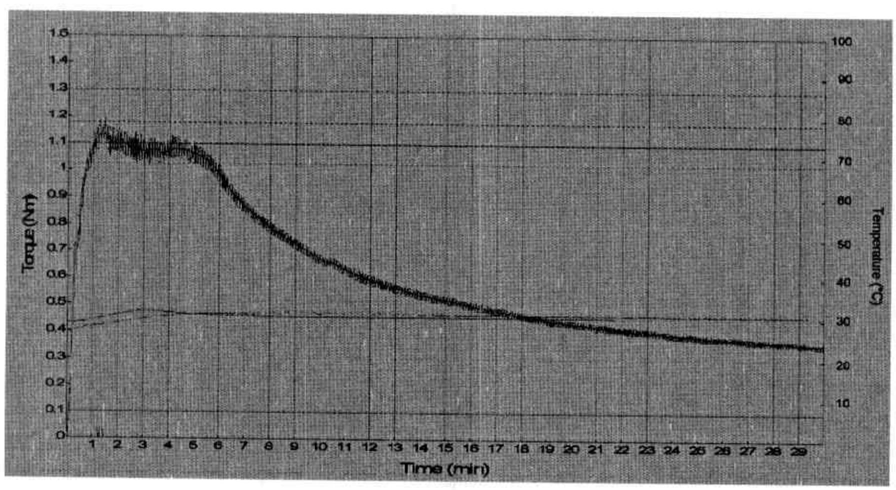



Fig. (36): Effect of irrigation at 60% ASMD , 1000mg/L. ascorbic acid and 60 kg N /faddan in the second season

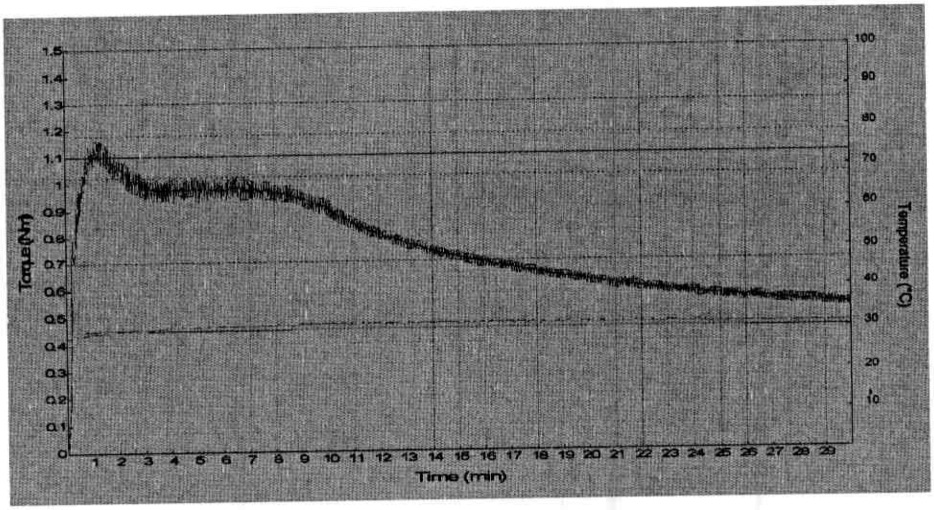



Fig. (37): Effect of irrigation at 60% ASMD , 1000mg/L. ascorbic acid and 80 kg N /faddan in the first season

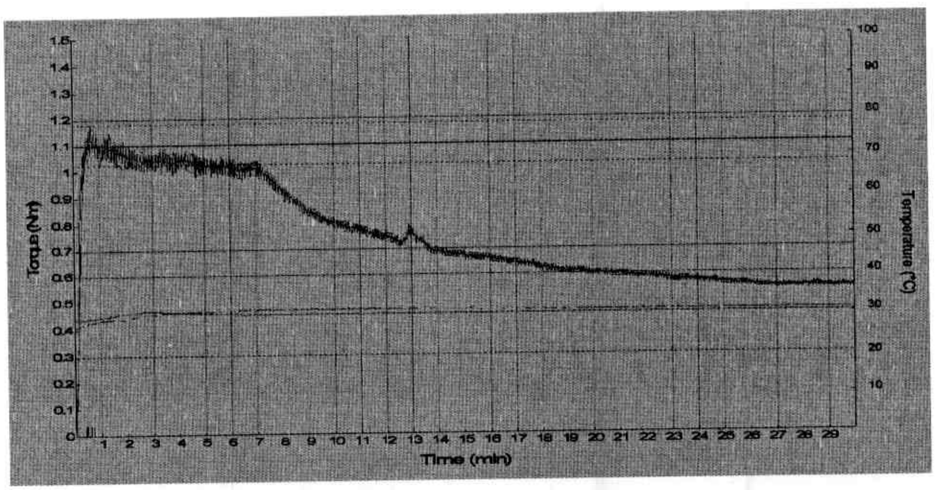



Fig. (38): Effect of irrigation at 60% ASMD , 1000mg/L. ascorbic acid and 80 kg N /faddan in the second season

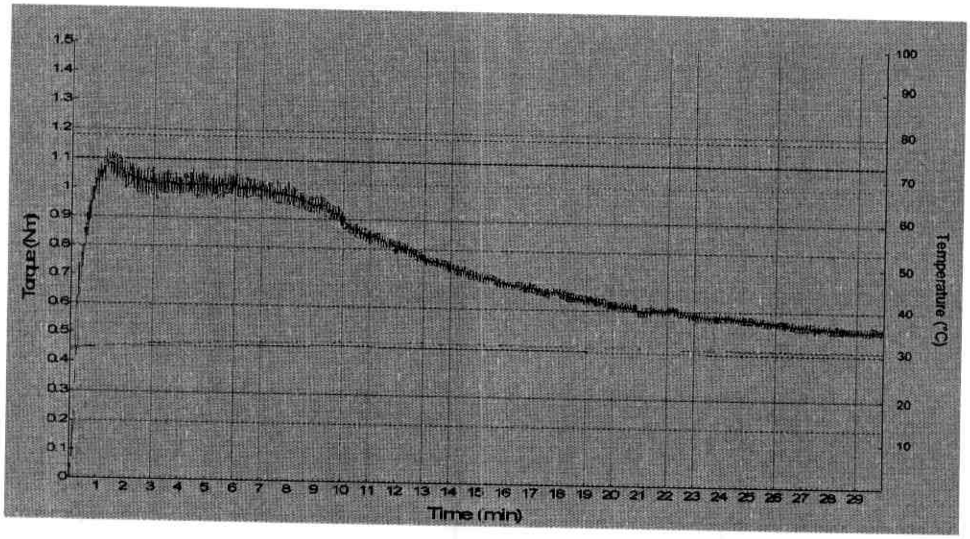



Fig. (39): Effect of irrigation at 60% ASMD , 1000mg/L. ascorbic acid and 100 kg N /faddan in the first season

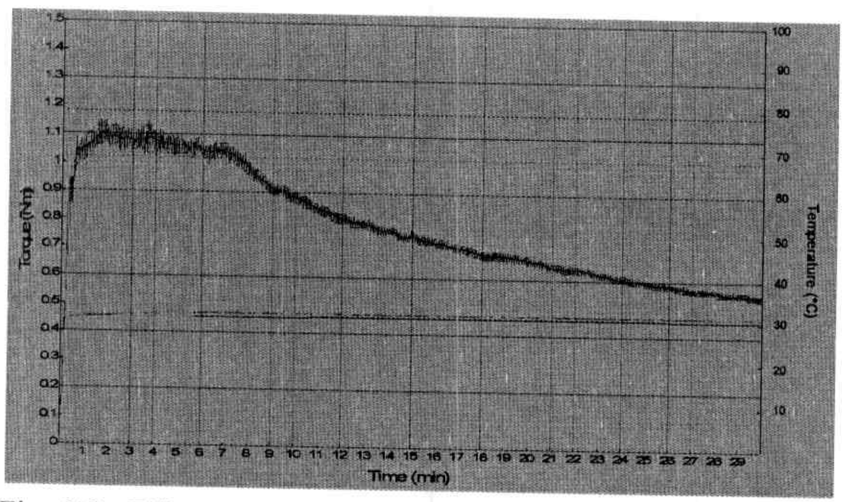



Fig. (40): Effect of irrigation at 60% ASMD , 1000mg/L. ascorbic acid and 100 kg N /faddan in the second season

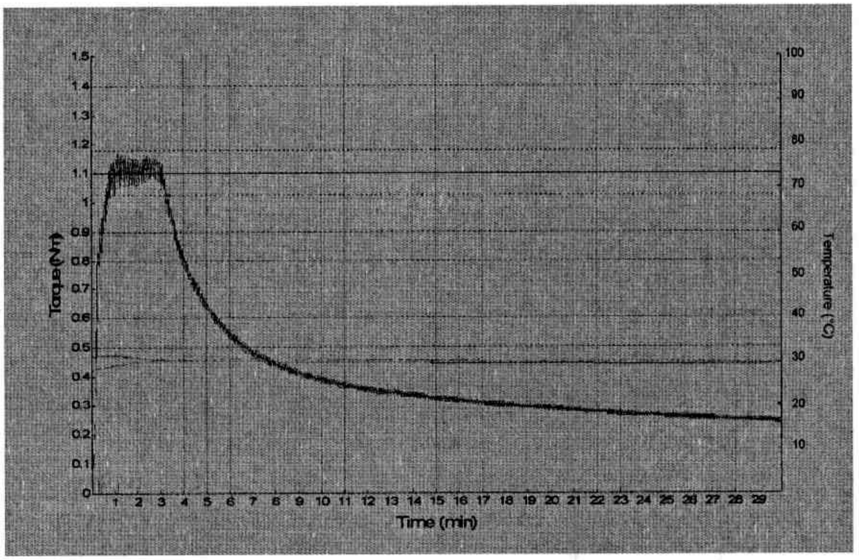



Fig. (41): Effect of irrigation at 80% ASMD , zero ascorbic acid and 60 kg N /faddan in the first season

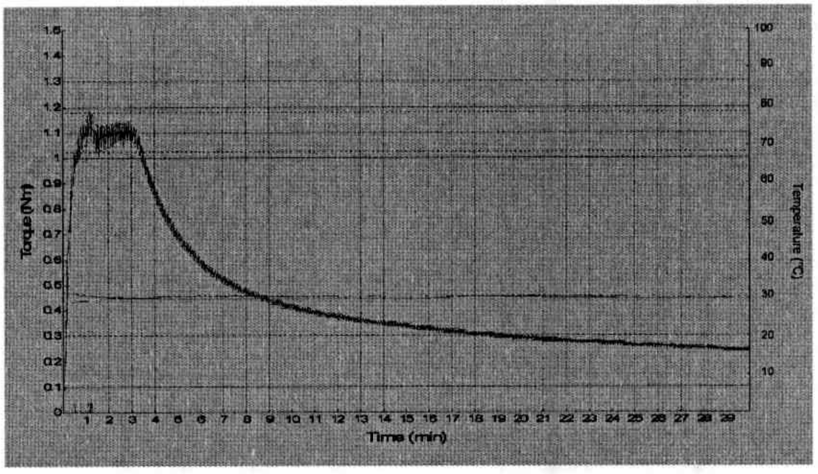



Fig. (42): Effect of irrigation at 80% ASMD , zero ascorbic acid and 60 kg N /faddan in the second season

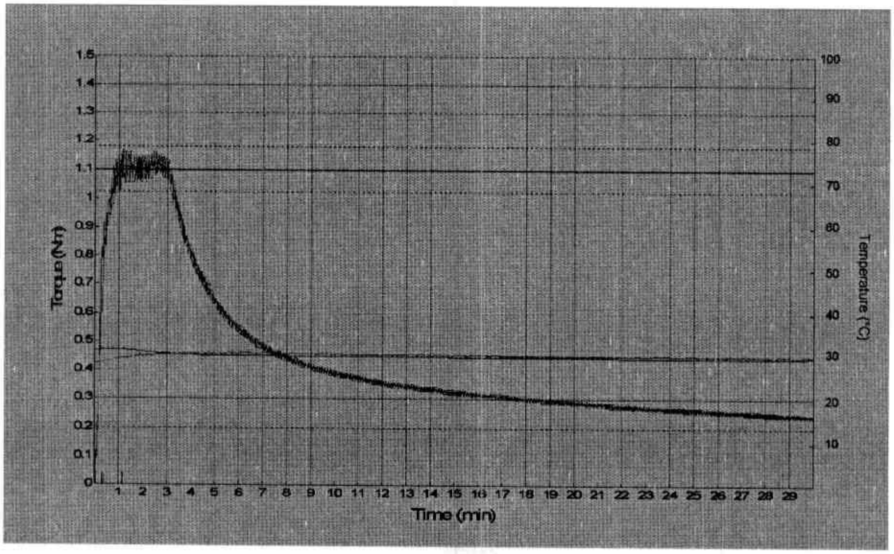



Fig. (43): Effect of irrigation at 80% ASMD , zero ascorbic acid and 80 kg N /faddan in the first season

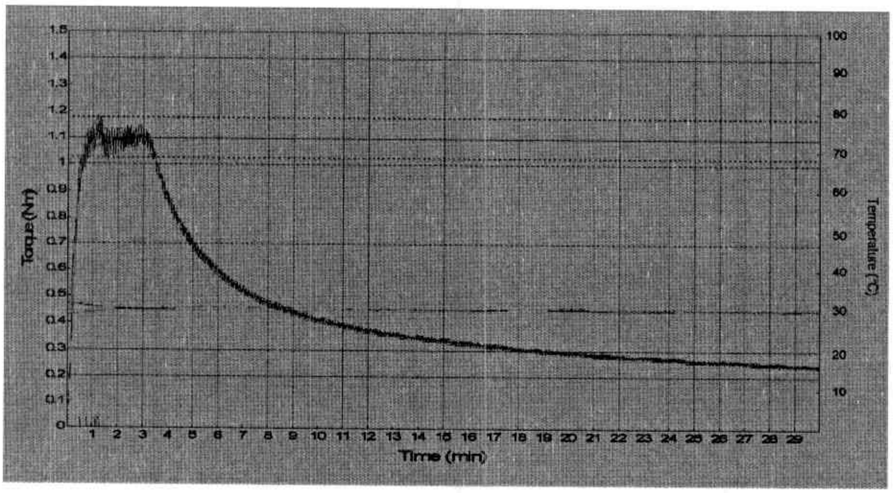



Fig. (44): Effect of irrigation at 80% ASMD , zero ascorbic acid and 80 kg N /faddan in the second season

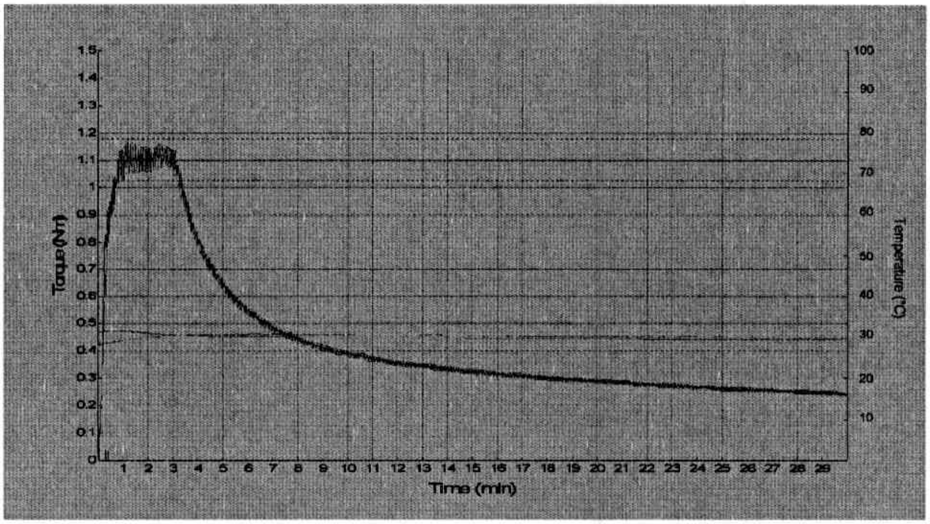



Fig. (45): Effect of irrigation at 80% ASMD, zero ascorbic acid and 100 kg N /faddan in the first season

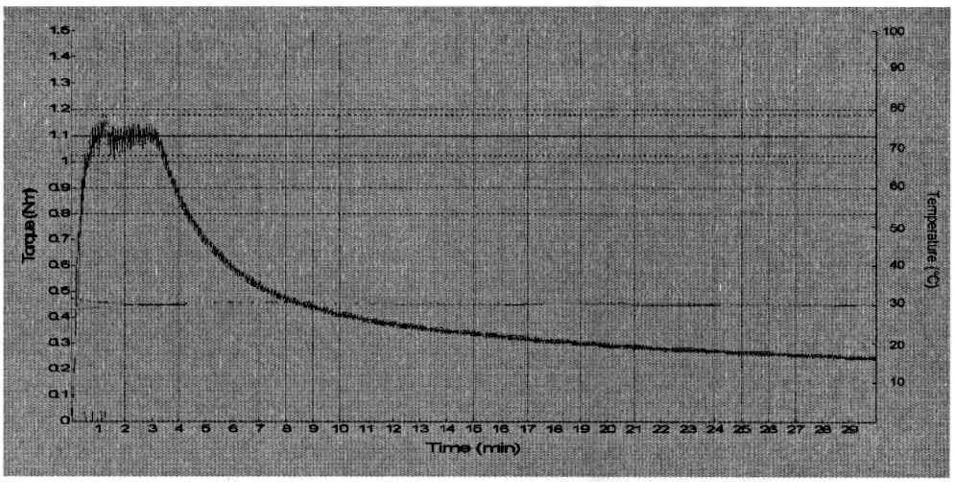



Fig. (46): Effect of irrigation at 80% ASMD, zero ascorbic acid and 100 kg N /faddan in the second season

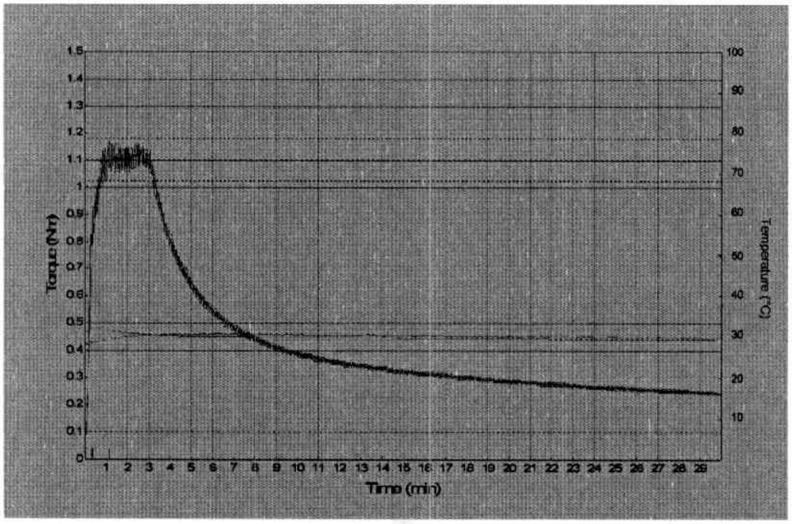



Fig. (47): Effect of irrigation at 80% ASMD, 500mg/L. ascorbic acid and 60 kg N /faddan in the first season

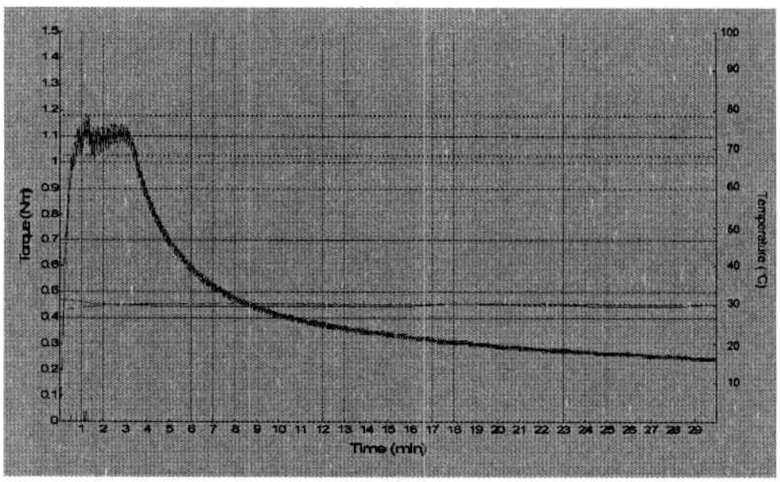



Fig. (48): Effect of irrigation at 80% ASMD, 500mg/L. ascorbic acid and 60 kg N /faddan in the second season

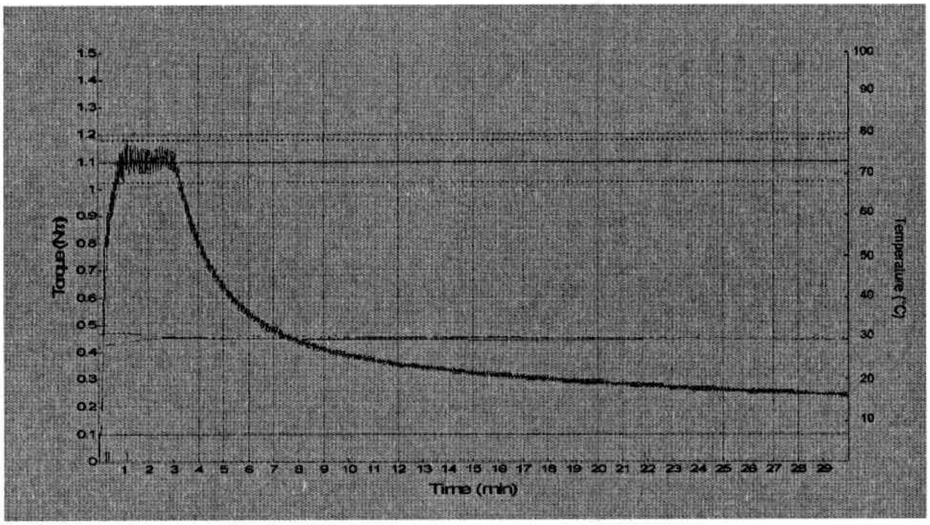



Fig. (53): Effect of irrigation at 80% ASMD, 1000mg/L.ascorbic acid and 60 kg N / faddan in the first season

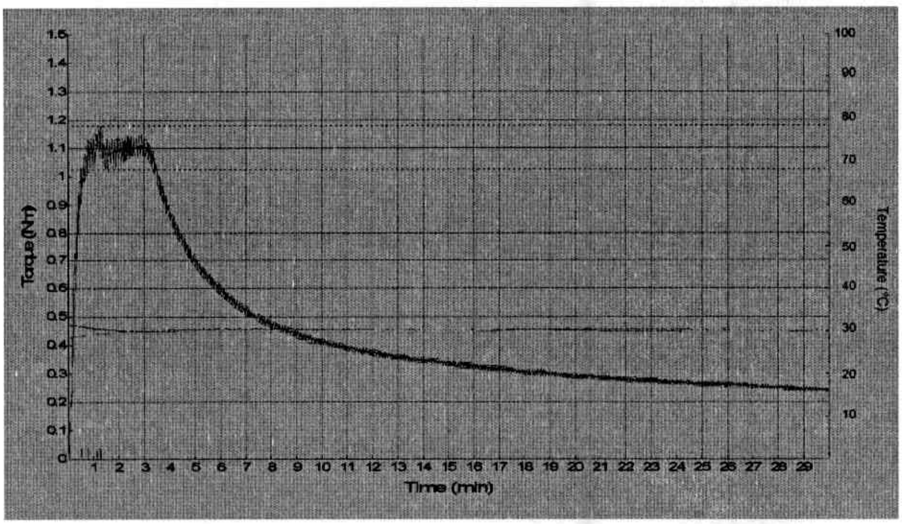



Fig. (54): Effect of irrigation at 80% ASMD, 1000mg/L. ascorbic acid and 60 kg N faddan in the second season

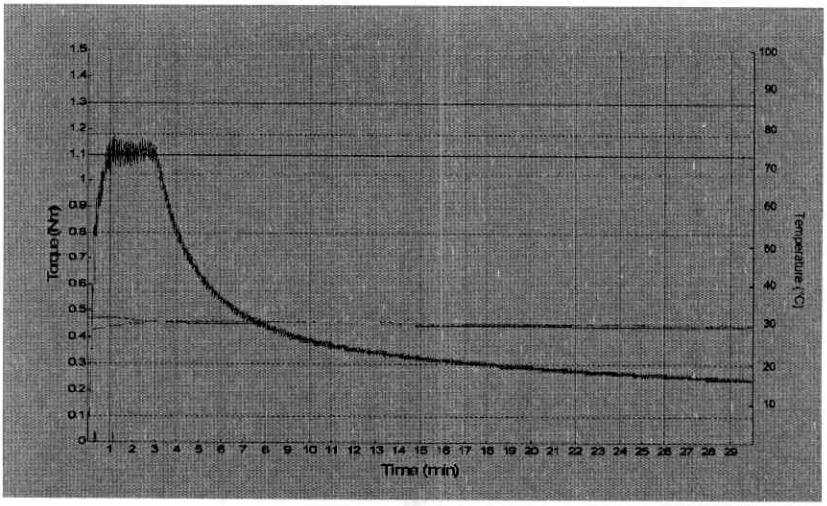



Fig. (55): Effect of irrigation at 80% ASMD, 1000mg/L. ascorbic acid and 80 kg N / faddan in the first season

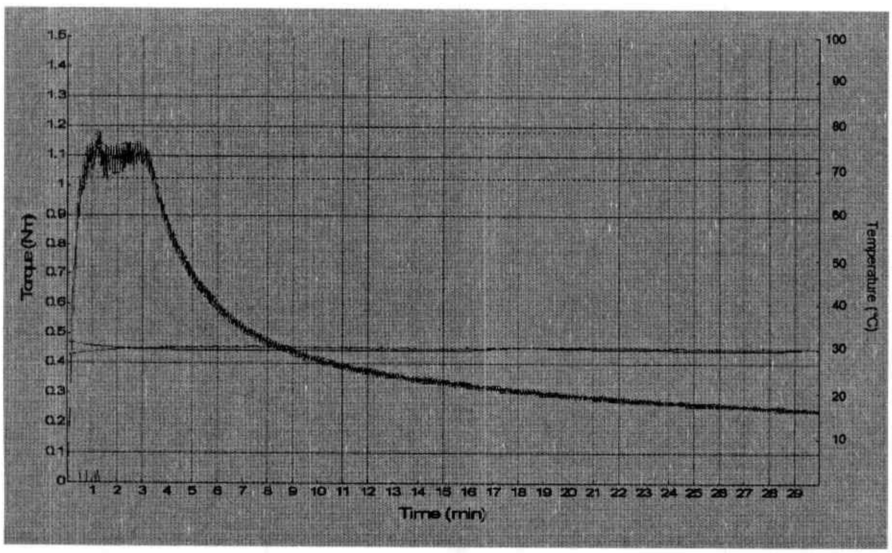



Fig. (56): Effect of irrigation at 80% ASMD, 1000mg/L. ascorbic acid and 80 kg N faddan in the second season

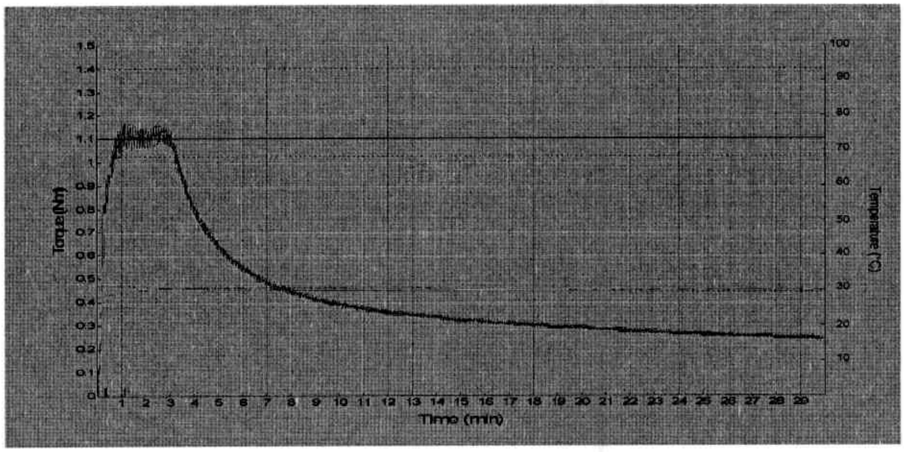



Fig. (57): Effect of irrigation at 80% ASMD, 1000mg/L.ascorbic acid and 100 kg N / faddan in the first season

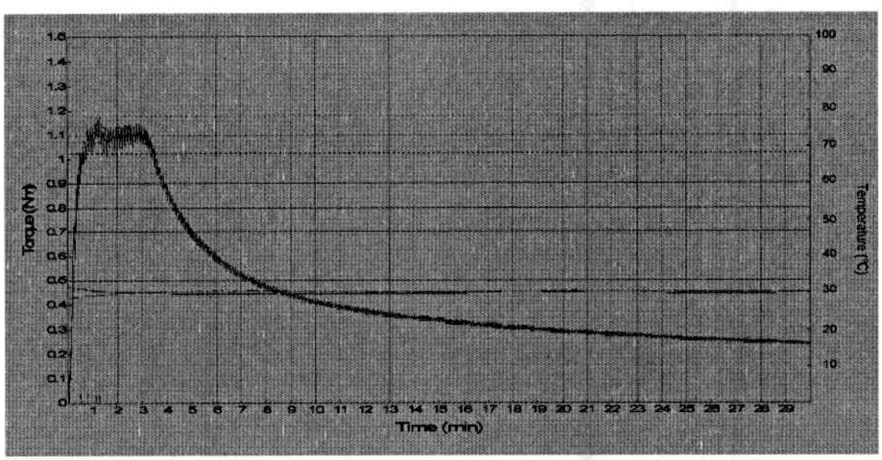



Fig. (58): Effect of irrigation at 80% ASMD, 1000mg/L. ascorbic acid and 100 kg N / faddan in the second season