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CARBOHYDRATE FRACTIONS OF WHEAT PLANTS AND GRAINS (*CULTIVAR* GEMMEIZA-7) AS AFFECTED BY DIFFERENT LEVELS OF NITROGEN FERTILIZER AND UNICONAZOLE

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***ABSTRACT*: Two field experiments were carried out using wheat plants (*cultivar* Gemmeiza-7) at the experimental farm of Gemmeiza Agriculture Research Station, during two successive winter seasons 2001/2002 and 2002/2003. The effect of three levels of nitrogen fertilizer (35, 70 and 105 kg nitrogen/fed.) and foliar application of the growth retardant uniconazole (0, 50 and 100 ppm) on carbohydrate fraction of wheat plants was studied. The obtained data indicated that increasing nitrogen fertilizer levels, decreased carbohydrate fractions significantly. Carbohydrate fractions increased significantly with increasing uniconazole concentration from 0 up to 100 ppm.**

Key words: Wheat, growth retardant, uniconazole, nitrogen fertilizer, carbohydrate fractions.

INTRODUCTION

Wheat represents one of the major sources of food all over the world and the most important cereal crop in Egypt. Nitrogen is the most important fertilizer element for plant growth and grains production. as it is an essential constituent of amino acids, nucleotides, nucleo protein and cell division. Growth regulator uniconazole have been the focus numerous studies. Most studies were concerned with the biological effects of this regulator (uniconazole) on the growth. Some of these effects are broad spectral; anti-lodging, plant size control, promotion of flower bud

formation, promotion of fruit set and resistance to environmental stress. Many investigators reported that increasing nitrogen fertilizer levels significantly decreased carbohydrate fractions of wheat plants (Ellen 1987). Nitrogen application at heading reduced water-soluble carbohydrates content of the shoot in wheat plants (Banziger *et al.*; 1994, Herwaarden *et al*; 1998 and Guohua *et al.*; 2002). Applied nitrogen fertilizer at rates of 60 and 75 kg nitrogen/fed significantly decreased carbohydrates content in wheat grains with increasing nitrogen fertilizer rate (Zahran *et al.*; 2002). Increasing uniconazole concentrations significantly increased carbohydrate fractions of wheat plants. Dressing wheat seeds with 10, 30 and 50 mg uniconazole/liter for 4 hours increased the total sugar content in leaves and nodes (Liu *et al.*; 1993). Treating wheat seeds with uniconazole increased the soluble carbohydrate content (Shen *et al*; 1993 and Kim *et al.*; 1994). Soaking wheat seeds for 12 hours, sealing seeds in a container for 3 hours or dressing seeds before sowing increased photosynthetic efficiency (Wang *et al.*; 1995a). Spraying wheat plants with different concentrations of uniconazole solution at the heading stage enhanced the photosynthetic rate of wheat plant (Wang *et al.*; 1995b). The present investigation is conducted to study the effect of different levels of nitrogen fertilizer and uniconazole on carbohydrate fractions of wheat plants and grains.

MATERIALS AND METHODS

Two field experiments were carried out during the two successive seasons 2001/2002 and 2002/2003 at the experimental farm of Gemmeiza, Agricultural Research Station (Middle Delta, Egypt). The soil in the experimental field was clay loam with pH value 7.7 (in 1:2.5 suspension) in the two seasons. Available N, P and K were 41, 7 and 420 ppm in the first season and 39, 8 and 460 ppm in the second one, respectively. Wheat seeds (*cultivar* Gemmeiza-7) used in this study was obtained from the wheat Research Department, Agric. Res. Center, Ministry of Agric., Egypt.

The wheat seeds were sown on December 1st in the two seasons under study. Split plot design was

used with three replicates. The area of each experimental plot was 10.5 m^2 (3 x 3.5 m). The experiment included three treatments at main plots occupied by different nitrogen fertilization rates as follow: 35, 70 and 105 kg nitrogen/fed. The nitrogen fertilizer form was urea (46 % N). Sub-plots occupied by uniconazole treatments -a new growth retardant -[(E)-1-(4-chlorophenyl)-4,4- dime -thyl-2- (1, 2, 4- triazol-1-yl)-1-pentene-3-ol] as follow: 0.00, 50 and 100 ppm uniconazole. The amounts of nitrogen fertilizer were divided into two equal doses to be added before the first and the second irrigations. The growth regulator was applied twice as foliar spray 200 L/fed. The first one was applied after 58 days from sowing, when the first node of stem was formed, the second spray was applied after one week from the first one. Samples of wheat plants were taken from each treatment at two different stages of growth. The first sample was taken after 2 weeks from the final uniconazole spray. The second one was taken after one month from the first sample.

Determination of Carbohydrate Fractions: Reducing and total soluble sugars as well as total carbohydrate were determined in shoots, grains and straw using picric acid method according to Thomas and Dutcher (1924).

All collective data were statistically analyzed according to the procedure described by Sendecor and Cochran (1967).

RESULTS AND DISCUSSION

Data concerning the effect of different levels of nitrogen fertilizer on carbohydrate fractions in wheat plants in the two seasons of study are illustrated in Tables 1, 2, 3, 4, 5 and 6. Data show that all fractions were significantly affected by the nitrogen fertilizer levels added to wheat plants. where the effect was clear in both seasons. Generally, increasing nitrogen fertilizer levels to plants, decreased the contents of carbohydrate fractions in wheat. Total hydro-lysable carbohydrates (T.H.C.) in shoots, grains and straw are recorded in Tables (1 and 4). Data show that lowest level of nitrogen fertilizer (35 kg nitrogen / fed) gave the highest T.H.C.

Table 1 : Effect of nitrogen fertilizer levels on carbohydrate fractions percentage of wheat plants (as glucose gm / 100 gm sample)

Parameter / Treatments	T.H.C	T.S.C	N.S.C	R.S	N.R.S	T.H.C	T.S.C	N.S.C	R.S	N.R.S
	Season 2001-2002									
	80 days after sowing					110 days after sowing				
35 kg N/fed (Low level)	27.12	13.45	13.67	5.29	8.16	32.56	16.41	16.15	5.52	10.89
70 kg N/fed (Recommended level)	26.10	13.15	12.95	5.07	8.08	31.56	15.79	15.77	5.16	10.63
105 kg N/fed (High level)	25.52	12.84	12.68	4.85	8.00	30.26	15.12	15.14	4.85	10.27
L.S.D at 0.05	0.220	0.095	0.231	0.075	0.026	0.508	0.182	0.556	0.033	0.171
	Season 2002-2003									
	80 days after sowing					110 days after sowing				
35 kg N/fed (Low level)	25.71	12.52	13.19	5.10	7.42	30.08	15.54	14.54	5.42	10.13
70 kg N/fed (Recommended level)	24.45	12.11	12.34	4.94	7.17	29.48	15.16	14.32	5.19	9.97
105 kg N/fed (High level)	23.97	11.85	12.11	4.78	7.07	29.05	14.86	14.19	4.96	9.89
L.S.D at 0.05	0.175	0.133	0.088	0.035	0.142	0.112	0.057	0.085	0.082	0.048

T.H.C = Total hydrolysable carbohydrate.

T.S.C = Total soluble carbohydrate.

N.S.C = Non – soluble carbohydrate

L.S.D = Least significant difference.

R.S = Reducing sugars.

N.R.S = Non – reducing sugars.

N = Nitrogen fertilizer.

Table 2: Effect of uniconazole concentrations on carbohydrate fractions percentage of wheat plants (as glucose gm/100 gm sample)

Parameter / Treatments	T.H.C	T.S.C	N.S.C	R.S	N.R.S	T.H.C	T.S.C	N.S.C	R.S	N.R.S
	Season 2001-2002									
	80 days after sowing					110 days after sowing				
0 ppm (control)	25.01	12.49	12.51	4.55	7.94	30.18	15.03	15.15	4.55	10.48
50 ppm	26.35	13.29	13.06	5.17	8.11	31.49	15.82	15.67	5.29	10.53
100 ppm	27.39	13.66	13.74	5.48	8.18	32.71	16.47	16.24	5.68	10.79
L.S.D at 0.05	0.646	0.053	0.649	0.049	0.033	0.575	0.121	0.626	0.053	0.121
	Season 2002-2003									
	80 days after sowing					110 days after sowing				
0 ppm (control)	23.48	11.33	12.15	4.36	6.97	28.6	14.59	14.01	4.79	9.80
50 ppm	24.52	12.26	12.26	5.04	7.23	29.53	15.11	14.42	5.16	9.95
100 ppm	26.12	12.89	13.23	5.43	7.46	30.48	15.86	14.62	5.62	10.24
L.S.D at 0.05	0.211	0.108	0.166	0.024	0.111	0.111	0.075	0.090	0.049	0.055

T.H.C = Total hydrolysable carbohydrate. R.S = Reducing sugars.

T.S.C = Total soluble carbohydrate. N.R.S = Non – reducing sugars.

N.S.C = Non – soluble carbohydrate L.S.D = Least significant difference.

Table 3: The interaction effect between nitrogen fertilizer levels and uniconazole concentrations on carbohydrate fractions percentage of wheat plants. (as glucose gm / 100 gm sample)

Seasons		2001 - 2002									
Days after sawing		80 days					110 days				
Treatments	Uniconazole	T.H.C	T.S.C	N.S.C	R.S	N.R.S	T.H.C	T.S.C	N.S.C	R.S	N.R.S
	0.0 ppm	26.1	12.86	13.24	4.81	8.04	31.3	15.64	15.66	4.88	10.76
35 kg N/fed	50 ppm	27.07	13.51	13.56	5.32	8.19	32.54	16.52	16.02	5.60	10.92
	100 ppm	28.2	13.99	14.21	5.73	8.25	33.83	17.06	16.77	6.07	10.99
	0.0 ppm	24.87	12.45	12.42	4.50	7.95	30.17	14.99	15.18	4.52	10.47
70 kg N/fed	50 ppm	26.27	13.28	12.98	5.16	8.12	31.74	15.81	15.93	5.31	10.50
	100 ppm	27.17	13.72	13.46	5.54	8.17	32.75	16.56	16.19	5.65	10.91
	0.0 ppm	24.05	12.19	11.86	4.35	7.84	29.06	14.45	14.61	4.25	10.20
105 kg N/fed	50 ppm	25.71	13.19	12.64	5.04	8.03	30.18	15.13	15.05	4.97	10.16
	100 ppm	26.81	13.27	13.54	5.15	8.12	31.54	15.79	15.75	5.33	10.46
L.S.D at 0.05		N.S	0.092	N.S	0.084	N.S	N.S	N.S	N.S	N.S	N.S

T.H.C = Total hydrolysable carbohydrate. **R.S = Reducing sugars.**

T.S.C = Total soluble carbohydrate. **N.R.S = Non – reducing sugars.**

N.S.C = Non – soluble carbohydrate. **L.S.D = Least significant differenc**

N= Nitrogen fertilizer. **N.S = Non significant.**

Table 3: Continue

Seasons		2002 - 2003									
Days after sawing		80 days					110 days				
Treatments	Uniconazole	T.H.C	T.S.C	N.S.C	R.S	N.R.S	T.H.C	T.S.C	N.S.C	R.S	N.R.S
	0.0 ppm	24.76	11.80	12.96	4.56	7.24	28.99	14.96	14.03	5.01	9.95
35 kg N/fed	50 ppm	25.77	12.60	13.18	5.15	7.45	30.13	15.56	14.57	5.44	10.13
	100 ppm	26.60	13.16	13.44	5.59	7.57	31.12	16.11	15.01	5.81	10.30
	0.0 ppm	23.02	11.2	11.82	4.32	6.88	28.65	14.60	14.05	4.82	9.78
70 kg N/fed	50 ppm	24.08	12.18	11.89	5.04	7.15	29.39	14.99	14.40	5.10	9.89
	100 ppm	26.25	12.95	13.30	5.47	7.48	30.40	15.88	14.51	5.65	10.23
	0.0 ppm	22.66	10.99	11.67	4.20	6.80	28.16	14.20	13.96	4.52	9.68
105 kg N/fed	50 ppm	23.72	12.01	11.71	4.92	7.08	29.06	14.78	14.28	4.96	9.83
	100 ppm	25.52	12.56	12.96	5.23	7.33	29.93	15.59	14.34	5.41	10.18
L.S.D at 0.05		0.366	N.S	0.288	0.042	N.S	0.193	0.129	0.155	0.084	N.S

T.H.C = Total hydrolysable carbohydrate.

T.S.C = Total soluble carbohydrate.

N.S.C = Non – soluble carbohydrate.

N= Nitrogen fertilizer.

R.S = Reducing sugars.

N.R.S = Non – reducing sugars.

L.S.D = Least significant difference.

N.S = Non significant.

Table 4: Effect of nitrogen fertilizer levels on carbohydrate fractions percentage of wheat grains and straws. (as glucose gm / 100 gm sample)

Parameter / Treatments	T.H.C	T.S.C	N.S.C	R.S	N.R.S	T.H.C	T.S.C	N.S.C	R.S	N.R.S
	Season 2001-2002									
	Grains					Straw				
35 kg N/fed (Low level)	68.46	2.97	65.49	0.462	2.51	10.58	1.70	8.88	0.381	1.32
70 kg N/fed (Recommended level)	67.25	2.75	64.49	0.439	2.31	10.00	1.53	8.48	0.352	1.18
105 kg N/fed (High level)	66.37	2.57	63.79	0.414	2.16	9.32	1.42	7.89	0.324	1.09
L.S.D at 0.05	0.681	0.063	0.651	0.005	0.063	0.236	0.018	0.229	0.002	0.019
	Season 2002-2003									
Treatments	Grains					Straw				
35 kg N/fed (Low level)	66.53	2.62	63.92	0.423	2.20	9.88	1.45	8.43	0.363	1.08
70 kg N/fed (Recommended level)	65.01	2.46	62.54	0.414	2.05	9.45	1.31	8.14	0.347	0.964
105 kg N/fed (High level)	64.64	2.31	62.33	0.408	1.90	8.97	1.21	7.77	0.334	0.875
L.S.D at 0.05	0.106	0.038	0.136	0.003	0.039	0.056	0.020	0.048	0.003	0.019

T.H.C = Total hydrolysable carbohydrate.

T.S.C = Total soluble carbohydrate.

N.S.C = Non -- soluble carbohydrate.

R.S = Reducing sugars.

N.R.S = Non – reducing sugars.

N = Nitrogen fertilizer.

L.S.D = Least significant difference.

percentage, while the highest level (105 kg nitrogen / fed) gave the lowest T.H.C. percentage.

Results of total soluble carbohydrates, (T.S.C.) presented in Tables 1 and 4 indicate that T.S.C. was significantly affectedby nitrogen fertilizer levels in the two seasons of the study.Non- soluble carbohydrates (N.S.C.) percentage decreased with increasing nitrogen fertilizer levels (Tables 1 and 4).

Reducing and non-reducing sugars data are shown in Tables (1 and 4). The lowest value resulted from using 105 kg nitrogen / fed (high level), while adding 35 kg nitrogen / fed (low level) produced the maximum percentage of reducing and non-reducing sugars of wheat plants in the two seasons. Generally, increasing nitrogen fertilizer levels decreased the levels of carbohydrate fractions. Similar results were reported by Ellen (1987), Banziger *et al.* (1994), Herwaarden (1998), Guohua *et al* (2002) and Zahran *et al* (2002).

The effect of different concentrations of uniconazole on carbohydrate fractions percentage indicate that it's application significantly increased carbohydrate fractions of wheat plants in the two seasons of study (Tables 2 and 5). Generally, it seems that increasing concentrations of uniconazole increased carbohydrate fractions of wheat plants. These results are in agreement with those obtained by Wang *et al* (1995a).

The interaction effect between the nitrogen fertilizer levels and uniconazole application on carbohydrate fractions percentage in wheat plants are shown in Tables (3 and 6). It is clear from the data that the highest value of carbohydrate fractions percentage was obtained when wheat plants were fertilized with 35 kg nitrogen / fed and sprayed with 100 ppm uniconazole. On the other hand, the lowest value of carbohydrate fractions percentage was obtained when plants were fertilized with 105 kg nitrogen / fed without applicating any uniconazole.

Table 5: Effect of uniconazole concentrations on carbohydrate fractions percentage of wheat grains and straws. (as glucose gm / 100 gm sample)

Treatments / Parameter	T.H.C	T.S.C	N.S.C	R.S	N.R.S	T.H.C	T.S.C	N.S.C	R.S	N.R.S
	Season 2001-2002									
	Grains					Straw				
0 ppm (control)	66.22	2.56	63.66	0.403	2.15	9.16	1.42	7.74	0.334	1.09
50 ppm	67.08	2.76	64.33	0.447	2.31	10.01	1.56	8.45	0.349	1.22
100 ppm	68.78	2.98	65.79	0.466	2.52	10.73	1.66	9.08	0.374	1.29
L.S.D at 0.05	0.379	0.050	0.364	0.004	0.049	0.245	0.022	0.240	0.004	0.023
	Season 2002-2003									
Treatments	Grains					Straw				
0 ppm (control)	64.46	2.14	62.32	0.395	1.75	8.95	1.14	7.81	0.331	0.804
50 ppm	65.40	2.48	62.92	0.416	2.07	9.48	1.36	8.13	0.348	1.01
100 ppm	66.32	2.77	63.55	0.433	2.34	9.86	1.47	8.39	0.364	1.11
L.S.D at 0.05	0.045	0.029	0.063	0.002	0.029	0.079	0.017	0.076	0.002	0.015

T.H.C = Total hydrolysable carbohydrate.

T.S.C = Total soluble carbohydrate.

Non. soluble carbohydrate.

R.S = Reducing sugars.

N.R.S = Non - reducing sugars. N.S.C =

L.S.D = Least significant difference.

Table 6: The interaction effect between nitrogen fertilizer levels and uniconazole concentrations on carbohydrate fractions percentage of wheat grains and straws. (as glucose gm / 100 gm sample)

Seasons		2001 - 2002									
Treatments		Grains					straw				
	Uniconazole	T.H.C	T.S.C	N.S.C	R.S	N.R.S	T.H.C	T.S.C	N.S.C	R.S	N.R.S
	0.0 ppm	67.29	2.79	64.49	0.424	2.37	9.86	1.53	8.33	0.363	1.16
35 kg N/fed	50 ppm	68.18	2.96	65.22	0.468	2.49	10.53	1.75	8.79	0.380	1.37
	100 ppm	69.92	3.16	66.76	0.495	2.66	11.35	1.84	9.51	0.399	1.44
	0.0 ppm	66.14	2.50	63.64	0.404	2.10	9.35	1.42	7.93	0.335	1.09
70 kg N/fed	50 ppm	66.99	2.75	64.24	0.448	2.31	10.03	1.53	8.50	0.347	1.18
	100 ppm	68.62	3.00	65.62	0.466	2.54	10.64	1.64	9.00	0.374	1.26
	0.0 ppm	65.23	2.37	62.86	0.380	1.99	8.27	1.32	6.95	0.305	1.02
105 kg N/fed	50 ppm	66.08	2.55	63.52	0.424	2.13	9.47	1.42	8.05	0.319	1.10
	100 ppm	67.79	2.79	65.00	0.438	2.35	10.21	1.52	8.69	0.349	1.17
L.S.D at 0.05		N.S.	N. S.	N.S.	N. S.	N.S.	N. S.	0.037	N.S.	N. S.	0.040

T.H.C = Total hydrolysable carbohydrate.

T.S.C = Total soluble carbohydrate.

N.S.C = Non – soluble carbohydrate.

N.S = Non significant.

R.S = Reducing sugars.

N.R.S = Non – reducing sugars.

L.S.D=Least significant difference.

N = Nitrogen fertilizer.

Table 6: Continue

Seasons		2002 - 2003									
Treatments		Grains					straw				
	Uniconazole	T.H.C	T.S.C	N.S.C	R.S	N.R.S	T.H.C	T.S.C	N.S.C	R.S	N.R.S
	0.0 ppm	65.54	2.23	63.31	0.405	1.83	9.49	1.22	8.26	0.350	0.874
35 kg N/fed	50 ppm	66.38	2.65	63.73	0.423	2.23	9.91	1.48	8.43	0.362	1.12
	100 ppm	67.97	2.97	64.72	0.440	2.53	10.23	1.63	8.60	0.376	1.26
	0.0 ppm	64.10	2.16	61.94	0.392	1.77	9.14	1.14	8.00	0.329	0.811
70 kg N/fed	50 ppm	65.11	2.76	62.63	0.415	2.06	9.39	1.35	8.04	0.347	1.00
	100 ppm	65.82	3.00	63.06	0.434	2.33	9.81	1.45	8.36	0.365	1.08
	0.0 ppm	63.75	2.04	61.70	0.387	1.66	8.22	1.04	7.17	0.315	0.728
105 kg N/fed	50 ppm	64.72	2.32	62.39	0.409	1.91	9.15	1.25	7.91	0.335	0.912
	100 ppm	65.45	2.57	62.88	0.424	2.14	9.56	1.34	8.22	0.352	0.984
L.S.D at 0.05		0.077	0.049	0.109	N. S.	0.049	0.138	0.029	0.131	0.004	0.026

T.H.C = Total hydrolysable carbohydrate.

T.S.C = Total soluble carbohydrate.

N.S.C = Non – soluble carbohydrate.

N.S = Non significant.

R.S = Reducing sugars.

N.R.S = Non – reducing sugars.

L.S.D =Leastsignificant difference.

N = Nitrogen fertilizer.

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المكونات الكربوهيدراتية لنباتات وحبوب القمح (صنف جميزة ٧) تحت تأثير مستويات مختلفة من التسميد النيتروجيني و اليونيكونازول

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[١] قسم الكيمياء الحيوية الزراعية ــ كلية الزراعة ــ جامعة الزقازيق.

[٢] معهد بحوث الأراضى والمياة والبيئة ــ مركز البحوث الزراعية ــ وزارة الزراعة جمهورية مصر العربية.

أجريت تجربة حقلية بالمزرعة البحثية لمحطة البحوث الزراعية بالجميزة خلال الموسمين الزراعيين الشتويين ٢٠٠١/٢٠٠٢ و٢٠٠٢/٢٠٠٣ لدراسة تأثير تركيزات مختلفة من منظم النمو اليونيكونازول (صفر و٥٠ و١٠٠جزء فى المليون) على نباتات القمح تحت تأثير مستويات مختلفة من التسميد النيتروجينى (٣٥ و٧٠ و١٠٥ كجم سماد نيتروجينى/الفدان) وتقدير محتوى النباتات والحبوب والقش من الصور المختلفة من المواد الكربوهيدراتية.

أوضحت النتائج المتحصل عليها أنه بزيادة التسميد النيتروجيني ينخفض المحتوى الكلى من الكربوهيدرات فى العينات بصورة معنوية حيث نجد أن النسبة المئوية للكربوهيدرات فى المستوى الأقل للتسميد أعلى من المستوى الأعلى فى التسميد النيتروجينى.

لوحظ عند المعاملة بمنظم النمو اليونيكونازول زيادة النسبة المئوية للكربوهيدرات بزيادة تركيز اليونيكونازول حيث كانت النسبة المئوية للكربوهيدرات فى حالة النباتات المعاملة بتركيز ١٠٠جزء فى المليون أعلى من النباتات المعاملة بتركيز ٥٠ جزء فى المليون.

وبدراسة التداخل بين تأثير كل من التسميد النيتروجيني ومنظم النمو اليونيكونازول وجد أن أعلى نسبة للكربوهيدرات كانت فى حالة استخدام أدنى مستوى من تركيز السماد النيتروجينى (٣٥ كجم سماد نيتروجينى/الفدان) وأعلى مستوى مستخدم من منظم النمو اليونيكونازول (١٠٠جزء فى المليون) مقارنة بالنباتات المعاملة بأعلى مستوى من التسميد النيتروجينى (١٠٥ كجم سماد نيتروجينى/الفدان) وأدنى مستوى مستخدم فى ظروف التجربة من منظم النمو (صفر جزء فى المليون).