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EFFECT OF CANOLA FENCE ON WHEAT PRODUCTIVITY UNDER EL-WADI EL-GEDID CONDITIONS.

BY

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ABSTRACT

Two field experiments were conducted in the Experimental Farm of Desert Research Center, El-Kharga Oasis, El Wadi El Gedid Governorate, during winter seasons 2005-2006 and 2006-2007. Soil properties were sandy clay loam, pH 7.93, $CaCO_3$ 11.38 %, 690 ppm used for surface irrigation. This work aims to study the effect of canola fence systems on wheat productivity. The width of canola fence consists of two treatment groups i.e. 0, 10, 20, or 30 % of wheat unit area, while the distance between fence plants were 15, 20 or 25 cm. Data recorded for wheat plants behind the fence of canola at 1, 5 or 10 m. Highest grain, straw, and biological yields of wheat were obtained by width of canola fence 30 % of wheat unit area, 25 cm distance between fence plants and 5 m behind canola fence as a single factors as well as their interactions.

It could be concluded that 5 meter of canola was an effective protection zone behind wheat concomitant by width 30 % of unit area and 25 cm apart for increasing wheat production under El Wadi El Gedid conditions in Egypt.

Key words: Canola, Wheat, Fence Width, Density, Growth, Yield El-Wadi El-Gedid.

INTRODUCTION

New Valley Governorate, represents 45% of Egypt total area (about 3.3 million feddans) is suffering from many constrains. It is exposed to strong wind waves during winter seasons that affect greatly growth, flowers, and buds of plants. Farmers there prefer to cultivate wheat, faba bean, barley and clover than canola. Canola characterized by its ability to form high number of shoots and roots that can resist various environmental conditions. However, it is difficult to introduce canola as a sole-crop in the New valley rotation. So it canola could be cultivated as a fence of winter crop against wind direction to protect other winter crops and provide inhabitants by vegetable oil in the New Valley.

Wind affects the exchange of heat and water between plants and atmosphere, exerts mechanical effects leading to breakage plant parts and alter enzyme activities through metabolic changes arising from wind-induced water stress or injury by soil particles (Sturrock, 1974).These changes are at once profound and complex. Long exposure to strong winds may produce morphological and anatomical changes. Whitehead, (1962 and 1963a, b) working with several species including maize and sunflower, showed that strong wind promotes the development of xerophytic characters with production of thicker leaves development of more woody and vascular tissue, changes in number and size of stomata and increases in root.

This study aims to investigate the effect of different fence systems of canola and location of wheat plants behind canola on the productivity of wheat under the New Valley conditions.

MATERIALS AND METHODS

Two field experiments were conducted in the Experimental Farm of Desert Research Center, El-Kharga Oasis (30.53 altitude, 25.4 latitude and elevation 78.8.), El Wadi El Gedid Governorate, Egypt during winter seasons 2005-2006 and 2006-2007.

Canola fence was located to protect wheat plants from wind injury which its direction was investigated over the last decade.

The canola fence systems included 12 treatments which were the combination between four treatments of width % of wheat unit area and three treatments of plant distances.

They were as follows:

A- Width of canola fence as % of wheat unit area.

1- 0 % without canola fence (control treatment)
2- 10 % of unit area
3- 20 % ,,,,,,
4- 30 % ,,,,,,

Wheat unit area was 100 m^2.

B- Distance between canola plants.

1- 15 cm
2- 20 cm
3- 25 cm

Data recorded on wheat plants estimated 1, 5 and 10 meter behind canola fence systems. So, every experiment included 36 treatments which were the combinations between the twelve treatments of canola fence and three locations of wheat behind canola fence.

The recommended common agricultural practices for growing canola and wheat under El-wadi El-Gedid were applied. Soil texture of the experiment was sandy clay loam with pH 7.93, containing 11.38 % of $CaCO_3$ and surface irrigation was used with saline water (690 ppm).

Canola c.v. Serw 4 and wheat c.v. Giza 164 were planted on 1st October and 15th November in the first and 4th October and 19th November in the second seasons, respectively.

The direction of the wind was investigated over the last decade before starting the experiments of 2005/2006 and 2006/2007 for fixing canola fence location.

Data recorded:

At maturity wheat plants were harvested from one inner square meter at three places (locations) and the following data were recorded: plant height, 1000 grain weight, grain, straw, and biological yield and crop as well as harvest indexes, in addition to total grain nitrogen content (A.O.A.C., 1980) and crude protein (protein % =N % × 5.75) kg/fed.

Statistical analyses.

The treatments were arranged in a complete randomized block design (Gomez and Gomez,1984) in six replicates.

For comparison between different mean values, the least significant difference (L.S.D) at 5%level of significant was used.

RESULTS AND DISCUSSION

Collected data of the growth, yield and chemical contents of wheat could be explained under the main following headings:

1- Effect of canola fence width as % of wheat unit area .
2- Effect of distance between canola plants.
3- Effect of distance behind canola fence .
4- Effect of the interactions
   a- Canola fence width as % of wheat unit area × distance between canola plants
   b- Canola fence width as % of wheat unit area × distance behind canola fence
   c- distance between canola plants× distance behind canola fence

1- Effect of canola fence width as % of wheat unit area:

Table (1) indicates the effect of canola width unit area percentage on wheat growth, yield and chemical contents in 2005-2006 and 2006-2007.

Table (1): Effect of canola width as % of wheat unit area on wheat growth, yield and chemical contents in the two growing seasons under El-Wadi El-Gedid conditions.

Width of canola fence of wheat unit area (%)	Plant height (cm)	1000 grain weight (g)	Yield			Crop index (%)	Harvest index (%)	Protein	
			Grain (kg/fed	Straw (kg /fed)	Biological (kg /fed)			Content (%)	Yield kg/fed
2005-2006									
10	66.73	40.38	1485.37	2827.96	4316.00	52.52	34.36	12.34	184.38
20	65.71	40.35	1501.29	2855.22	4356.66	52.71	34.51	12.28	185.86
30	73.34	40.20	1546.22	2941.37	4479.66	52.58	34.45	12.23	190.38
0 (Without fence)	63.37	40.29	1472.0	2749.00	4221.10	53.59	34.89	12.30	181.99
LSD at 5%	**1.07**	**N.S**	**26.67**	**70.46**	**89.78**	N.S	0.41	0.03	3.36
2006-2007									
10	80.53	40.89	1527.70	2910.0	4437.70	52.45	34.40	12.40	189.07
20	83.31	40.25	1537.40	2920.0	4457.40	52.63	34.48	12.34	189.55
30	89.75	39.59	1598.14	3030.0	4628.14	52.55	34.44	12.29	196.87
0 (Without fence)	76.70	40.42	1458.77	2915.0	4373.77	49.90	33.16	12.42	181.23
LSD at 5%	**0.95**	**0.18**	**27.99**	**50.0**	**80.0**	**0.18**	**0.08**	**N.S**	**4.01**

In the first season (2005-2006), application and increasing the percentage of canola fence of wheat unit area significantly increased plant height, grain, straw, biological, and protein yields/faddan of wheat plant compared with the control treatment (without zero fence). Therefore, cultivating canola fence 30 % of wheat unit area gave the highest values. Similar results were obtained in the second season except that there were no significant differences between the control treatment with straw yield of 10 and 20 % of wheat unit area and with biological yield of 10 % fence.

Canola was sown 45 days before wheat sowing (see material& method), So canola plants act as windbreak that protected wheat plants from physical damage i.e. abrasion of leaves and fruits (Kort, 1988, Sun and Dickinson, 1997) and lodging of mature crops (Marshal,1967, Mc Naughton, 1988; Grace, 1989; Sun and Dickinson, 1997). Cleugh, *et al.* (1998) reported that wind causes changes in plant physiological function as a result of both physical damage and micro-climate variables.

The weight of 1000 grains, crop index, harvest index and grain protein % were not affected by varying canola fence under the 5% level of significance. Results were similar with those obtained by Zhang and Brandle (1996 & 1997); Crawford (1998); Nuberg and Mylius (1998) who found that there were a reduction of the plant height, 1000-grain wt., crop index, harvest index and protein %.

Increasing width of canola fence 30 % of wheat unit area out-numbered those of zero fence by 5 % for grain, 7 % for straw, 6.14 % for biological 4.6 % for protein yields in the first season the percentage increase was 9.55, 4.0, 6.0, and 9.0 in the second season for the respective yields.

2- Effect of distance between canola plants:

Data reported in Table (2) indicate that increasing the distance between canola plants from 15 to 25 cm exerted significant increases in grain, straw and biological, grain protein percent and yield in both growing seasons .Therefore, maximum values were obtained at 25 cm apart between canola plants. These results might be attributed to the higher competition between canola plants under narrow spacing which affected the growth of plants and reduced their branching. On the contrary ability canola plants did not suffer

from severe competition under wider planting apart for light, nutrients and water. Therefore their growth would be increased and produced higher number of branches per plant and leaves that reticulated with the other plants to form good shelter for protecting wheat plants from physical, physiological and lodging damages. Similar results were obtained by Noureldin, Nemat *et al.* (1983). They found that straw and biological yields of canola increased by increasing distance between plants from 10 to 30 cm as wide distance minimize intraspecific competition between canola plants for nutrient, moisture and light consequently they favored growth parameters.

Narrowing distance between canola fence from 25 to 15 cm caused an increase in wheat height from 66.48 to 72.09 cm in the first season and from 82.65 to 86.33 cm in the second season. The differences in change of crop and harvest indices of wheat plant in both growing seasons by changing canola density did not reach the 5% level of significance.

Table (2): Effect of distance between canola plants on wheat growth, yield and chemical contents in the two growing seasons under El Wadi El Gedid conditions.

Distance between canola plants (cm)	Plant height (cm)	1000 grain weight (g)	Yield			Crop index (%)	Harvest index (%)	Protein	
			Grain (kg/fed	Straw (kg /fed)	Biological (kg /fed)			content (%)	Yield kg/fed
2005-2006									
15	72.09	40.41	1485.40	2836.96	4320.44	52.36	34.29	12.25	183.11
20	67.21	40.19	1513.18	2880.18	4393.37	52.67	34.49	12.29	187.21
25	66.48	40.03	1534.29	2907.40	4438.51	52.79	34.54	12.31	190.30
LSD at5%	1.07	0.23	26.67	70.46	89.78	N.S	N.S	0.03	3.36
2006-2007									
15	86.33	40.39	1535.33	2920.0	4455.33	52.52	34.43	12.31	188.58
20	84.61	40.29	1562.40	2970.0	4532.40	52.51	34.42	12.34	192.74
25	82.65	40.05	1565.51	2970.0	4540.51	52.61	34.47	12.39	194.16
LSD at5%	0.95	0.18	27.99	50.0	80.0	N.S	N.S	0.03	4.01

3- Effect of distance behind canola fence:

Table (3) indicates that canola fence did not induce any significant difference in wheat height, 1000-grains wt., crop index and harvest index in the first season. Whereas 10 m behind canola fence exerted a significant reduction compared to 1 m for wheat height and 1000-grain wt., in the second season.

Wheat grown 5 m behind the canola fence produced more grain, straw, biological and protein yields in both growing seasons over those grown at 1 m behind. In the first season the percentage increases were 3.41, 4.92, 4.63 and 5.27 and in the second season were 3.21, 4.86, 4.29 and 5.15 for grain, straw, biological and protein yields respectively.

Canola fence may improve the micro-climate conditions for plant growth, heat, reduce wind erosion and sustain soil fertility leading to stable and higher yield (Michels *et al.*1998). Radke and Burrows (1970) found that soybeans sheltered by temporary corn windbreaks grew taller had more total leaf area, produced more dry matter and yielded 10 to 30 % seed. Kort, (1988), Sun and Dickinson, 1997; and Cleugh *et al.* 1998, found that wind affected greatly plants by physical and physiological damage.

4- Effect of the interactions:

a- Canola fence width as % of wheat unit area × distance between canola plants:

Table (4) indicates the effect of the interaction between the width canola fence % of wheat unit area and its density on the growth, yield, and chemical contents of wheat plant. Data revealed that maximum grain, straw, biological and protein yields were obtained by 30 % of wheat unit area and 25 cm apart of canola fence plants. This is true in

both seasons. The increase of canola width as % of wheat unit area and 25 cm apart out-numbered those of the control treatment (zero treatment) by 8.98, 10.37, 9.66 and 8.87 in the first growing season whereas in the second growing season they were 11.40, 5.66, 7.57 and 11.05 % for grain, straw, biological and protein yields respectively.

Several investigators pointed out that yield and its components were increased by increasing the width of different fence over control by 19.7 %, 39.2% and 13.5% of Cereals, Sunflower and Maize respectively, and 17 % over control for wheat (Mozheiko and Semyakin, 1984), and Li, 1985)

Table (3): Effect of the distance behind canola fence systems right away on wheat growth, yield and chemical contents in the two growing seasons under El -Wadi El-Gedid conditions.

Distance behind canola fence (m)	Plant height (cm)	1000 grain weight (g)	Yield			Crop index (%)	Harvest index (%)	Protein	
			Grain (kg/fed	Straw (kg /fed)	Biological (kg/fed)			content (%)	Yield kg/fed
2005-2006									
1	68.49	40.34	1478.07	2786.77	4256.92	53.04	34.65	12.13	179.94
5	68.82	40.27	1528.51	2924.03	4454.25	52.26	34.32	12.30	189.43
10	68.47	40.25	1526.29	2913.74	4441.14	52.51	34.35	12.43	191.24
LSD at 5%	N.S	N.S	26.67	70.46	89.78	N.S	N.S	0.03	3.36
2006-2007									
1	85.70	40.35	1531.73	2880.00	4411.73	52.08	34.67	12.16	186.41
5	84.24	40.23	1581.03	3020.00	4601.03	52.23	34.30	12.38	196.02
10	83.66	40.16	1546.16	2950.00	4496.16	52.32	34.35	12.50	193.06
LSD at 5%	0.95	0.18	27.99	50.0	80.0	0.18	0.08	0.03	4.01

b- Canola fence width as % of wheat unit area × distance behind canola fence:

Data reported in Table (5) indicate that grain, straw, biological and protein yields were significantly affected by the interaction between unit area percentage of canola fence and the distance behind it. Their maximum values were obtained by cultivating canola fence at a width unit area of 30 % and 5m behind it in both 2005/2006 and 2006/ 2007.Grain and protein yield differences between 30 % × 5 m and 30 % × 10 m were not significant at 5% level of probability.

The percentages in increase of 30 % 5 m over the control treatment (without fence) for grain, straw, biological and protein yields were 8.27, 8.63, 7.89 and 9.09 in the first season and 12.65, 7.71, 9.36 and 12.36 in the second season respectively.

c- distance between canola plants× distance behind canola fence:

Maximum wheat yields i.e. grain, straw, biological and protein increased by increasing the distance between canola plant up to 25 cm apart at 5m behind canola fence in 2005/06 and 2006/07 growing seasons as reported in Table (6).

It could be concluded that, the recommended treatment for wheat yield and its components i.e. grain, straw, biological and protein yields was 5 meter as an effective protection zone behind wheat concomitant by width 30 % of wheat unit area and 25 cm apart between its plants.

The study revealed that the yield and its components, straw, biological and biomass of wheat were reduced in plants that were closer to canola fence i.e. 1 m behind fence compared to the unsheltered ones.

Table (4): First order interaction effect between canola width fence % of wheat unit area and distance between canola plants on wheat growth, yield and chemical contents in the two growing seasons under El Wadi El-Gedid conditions.

Width of canola fence of wheat unit area (%)	Distance between canolas plant (cm)	Plant height (cm)	1000 grain weight (g)	Yield			Protein	
				Grain (kg/fed	Straw (kg /fed	Biological (kg /fed)	content (%)	yield kg/fed
2005-2006								
10	15	71.22	40.34	1465.88	2790.22	4264.11	12.29	181.34
	20	64.71	40.31	1506.55	2868.00	4374.55	12.35	186.77
	25	64.26	40.48	1483.66	2825.66	4309.33	12.39	185.04
20	15	71.83	40.37	1488.44	2847.44	4336.33	12.25	183.36
	20	63.78	40.28	1500.55	2856.00	4356.55	12.30	186.49
	25	61.53	40.41	1514.88	2862.22	4377.11	12.29	187.72
30	15	73.22	40.54	1501.88	2873.22	4360.88	12.21	184.62
	20	73.14	39.98	1532.44	2916.55	4449.00	12.23	188.36
	25	73.66	39.20	1604.33	3034.33	4629.11	12.26	198.14
0 (Without fence)		**63.37**	**40.29**	**1472.0**	**2749**	**4221.10**	**12.30**	**181.99**
L S D at 5%		**1.20**	**0.26**	**29.81**	**78.75**	**100.3**	**0.04**	**3.75**
2005-2006								
10	15	82.35	40.90	1515.44	2880.10	4395.44	12.36	186.37
	20	80.58	41.08	1535.44	**2930.18**	4475.44	12.39	190.25
	25	78.65	40.68	1532.22	2910.16	4442.22	12.44	190.58
20	15	85.68	40.28	1523.88	2890.00	4413.88	12.31	187.81
	20	82.16	40.26	1549.11	2940.10	4489.11	12.33	190.98
	25	82.10	40.22	1539.22	2920.19	4460.22	12.38	190.66
30	15	90.96	39.99	1566.66	2980.66	4546.66	12.25	192.37
	5	91.10	39.54	1602.66	3040.33	4642.66	12.29	197.00
	10	87.21	39.25	1625.11	3080.22	4705.11	12.34	201.26
0 (Without fence)		**76.70**	**40.42**	**1458.77**	**2915.50**	**4373.77**	**12.42**	**181.23**
L S D at 5%		**1.06**	**0.20**	**31.28**	**50.0**	**90.0**	**0.04**	**4.48**

Table (5): First order interaction effect between canola width fence % of wheat unit area and distance behind canola fence on wheat growth, yield and chemical contents in the two growing seasons under El Wadi El-Gedid conditions

Width of canola fence of wheat unit area (%)	Distance Behind canola fence (m)	Plant height (cm)	1000 grain weight (g)	Yield			Protein	
				Grain (kg/fed	Straw (kg /fed)	Biological (kg /fed)	Content (%)	Yield kg/fed
2005-2006								
10	1	67.31	40.34	1468.33	2763.11	4239.44	12.15	179.48
	5	66.31	40.31	1501.77	2876.00	4377.77	12.38	187.10
	10	66.57	40.48	1486.00	2844.77	4330.77	12.38	186.58
20	1	66.03	40.37	1484.22	2808.00	4292.22	12.13	180.66
	5	65.24	40.28	1520.55	2909.66	4430.66	12.30	188.29
	10	65.87	40.41	1499.11	2848.00	4347.11	12.42	188.62
30	1	72.14	40.54	1481.66	2789.22	4239.11	12.11	179.69
	5	74.92	39.98	1563.22	2986.44	4554.33	12.22	192.90
	10	72.96	39.20	1593.77	3048.44	4645.55	12.37	198.54
0 (Without fence)		63.37	40.29	1472.0	2749.00	4221.10	12.30	181.99
L S D at 5%		1.20	0.26	29.81	78.75	100.3	0.04	3.75
2005-2006								
10	1	81.50	41.04	1531.33	2890.00	4421.33	12.18	186.65
	5	80.40	40.92	1564.00	2990.26	4554.0	12.45	194.74
	10	79.70	40.70	1487.77	2840.10	4337.77	12.55	185.81
20	1	84.63	40.25	1535.11	2880.15	4425.11	12.17	186.76
	5	83.34	40.23	1565.88	2990.18	4565.88	12.38	193.23
	10	81.97	40.28	1511.22	2880.22	4391.22	12.48	188.67
30	1	90.96	39.76	1528.88	2870.33	4398.88	12.12	185.83
	5	89.00	39.53	1622.22	3100.50	4722.22	12.31	200.09
	10	89.31	39.49	1643.33	3140.10	4783.33	12.46	204.70
0 (Without fence)		76.70	40.42	1458.77	2915.00	4373.77	12.42	181.23
L S D at 5%		1.06	0.20	31.28	50.0	90.0	0.04	4.48

Table (6): Second order interaction effect between distance between canola plants and distance behind canola fence on wheat growth, yield and chemical contents in the two growing seasons under El Wadi El-Gedid conditions

Distance between Canola plants (cm)	Distance behind canola fence (m)	Plant height	(cm) 1000 grain weight (g)	Yield			Protein	
				Grain (kg/fed	Straw (kg /fed)	Biological (kg /fed)	content (%)	yield kg/fed
2005-2006								
15	1	72.36	40.49	1441.77	2748.44	4176.00	12.11	174.86
	5	71.95	40.35	1507.77	2879.00	4391.88	12.26	186.76
	10	71.95	40.40	1506.66	2883.44	4393.44	12.39	187.70
20	1	67.14	40.29	1473.88	2774.44	4248.33	12.15	179.22
	5	67.37	40.21	1530.33	2929.11	4459.44	12.31	189.38
	10	67.12	40.06	1535.33	2937.00	4472.33	12.43	193.02
25	1	65.97	40.08	1518.55	2837.44	4346.44	12.14	185.75
	5	67.14	39.99	1547.44	2964.00	4511.44	12.33	192.14
	10	66.34	40.02	1536.88	2920.77	4457.66	12.47	193.01
L S D at 5 %		1.20	0.26	29.81	78.75	100.3	0.04	3.75
2006-2007								
15	1	86.84	40.49	1525.66	2870.15	4395.66	12.12	184.93
	5	86.45	40.40	1559.77	2980.26	4540.77	12.35	192.40
	10	85.71	40.28	1520.55	2900.22	4420.55	12.45	188.42
20	1	85.86	40.46	1541.11	2910.33	4451.11	12.16	187.31
	5	84.12	40.27	1587.77	3030.00	4620.77	12.37	196.42
	10	83.86	40.15	1558.33	2970.10	4528.33	12.48	194.49
25	1	84.38	40.10	1528.55	2860.66	4388.55	12.20	186.99
	5	82.16	40.01	1604.55	3070.22	4674.55	12.41	199.24
	10	76.70	40.42	1458.77	2915.00	4373.77	12.42	181.23
L S D at 5 %		1.06	0.20	31.28	50.0	90.0	0.04	4.48

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تأثير سياج الكانولا على انتاجية القمح تحت ظروف الوادى الجديد

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أقيمت تجربتان حقليتان في المزرعة التجريبية لمركز بحوث الصحراء (الخارجة) محافظة الوادي الجديد خلال موسمي شتاء ٢٠٠٥/٢٠٠٦ و٢٠٠٦/٢٠٠٧ بهدف دراسة تأثير عرض سياج الكانولا (٠-١٠-٢٠-٣٠ % من وحدة مساحة القطعة التجريبية للقمح) والمسافات بين نباتات السياج (١٥-٢٠-٢٥ سم) لثلاثة قياسات خلف السياج على نبات القمح (١-٥-١٠ متر) وكذلك دراسة منطقة الحماية الفعالة. كان قوام التربة للتجربة رملى طينى سلتي ورقم الحموضة ٧,٩٣ وتحتوى على ١١,٣٨ % كربونات كالسيوم وبلغت ملوحة مياه الري ٦٩٠ جزء في المليون. أوضحت النتائج: تفوق عرض السياج ٣٠% والمسافة الأوسع بين نباتات السياج(٢٥سم) في أن تعطى أعلى حماية لنباتات القمح حيث أعطت أعلى محصول حبوب وقش وبيولوجي في كلا الموسمين مقارنة بمعاملة الكنترول. وكان هناك فرق معنوي بين مواقع اخذ العينات خلف السياج ومعاملة الكنترول للقياسات السابقة، بينما بلغت أعلى إنتاجية لمواقع اخذ العينات الثلاث عند ٥متر.

وأوضحت النتائج أنه لزيادة إنتاجية القمح تحت ظروف الوادى الجديد، ينصح بزراعة سياج كانولا بعرض ٣٠% بمسافات بين النباتات ٢٥سم حيث أوضحت هذه الدراسة أن هذه المعاملة أعطت أعلى إنتاجية من الحبوب والقش والمحصول البيولوجي علاوة على تجنب الأضرار الميكانيكية والفسيولوجية التي تسببها الرياح.