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EFFECT OF CROSS-POLLINATION ON CROP COMPONENTS AND CHEMICAL CONTENTS OF CANOLA (*Brassica campestris* L. AND *Brassica napus* L.) UNDER GIZA GOVERNORATE ENVIRONMENTAL CONDITIONS.

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ABSTRACT

This work was carried out in the apiary of Experimental Station, Faculty of Agriculture, Cairo University, during two successive seasons (06/07 & 07/08), to evaluate the effect of open pollination on the seed yield of canola (*Brassica campestris* & *Brassica napus*). Also, the Germination Speed Index (GSI), Germination Percentage (GP), and chemical composition of seeds that produced from open and caged plots were determined.

The obtained data showed that the open pollination resulted in increasing the number of pods/plant; weight of seeds/plant; mean yield/feddan, and seed index (weight of 1000 seeds) than those produced from caged treatment. Also, the presence of pollinators on canola increased the germinability of resulting seeds from 74.00% to 96.00% and from 88.00% to 98.00% for both species, respectively. The open pollination induced an alternation of chemical composition of seeds and increased the total lipids; crude protein, and carbohydrates than seeds produced from caged treatments.

INTRODUCTION

The rapeseed (canola) is one of the most important oilseed crops in the world where the seed production has reached to 40 million tones during the year of 2000 and ranked as the second largest volume oilseed traded following soybeans. However, until now it was cultivated in small areas (about 2000 feddans and produced 4 thousands tones) in Egypt (Taha, 2007). As a (Turnip rape) *Brassica campestris* L., and (Swede rape) *Brassica napus* L. for oilseed.

These crops are self – fertile and can give good yield without insect pollination, but in presence of pollinators, especially honeybees, it produced greater seed yield than without insect pollinators (Friese and Stark, 1983; Williams, 1985). Also a remarkable improvement on the qualities of seeds was observed with the cross – pollination (Sabbahi, *et al*., 2005a). Many authors reported that rapeseed plots caged with bees produced greater seed yields than plots caged without bees (Fujita,1939 , Jenkinson, *et al*., 1953 , Barbier,1978) ; They added that when bees are present , plants produce fewer flowers but set a greater proportion of them , show earlier petal fall ; have more seeds per pod and that seeds are more even in size and more viable (Jenkinson, *et al*., 1953 ; Meyerhoff,1958 ; Radchenko,1964 ; Barbier,1978 ; Williams,1984) .

The presence of pollinators on canola flowers increases the germination of resulting seeds from 83 % to 96 % (Keven and Eisikawitch, 1990). Also (Karise *et al*., 2004) found that the insect pollinators make positive effects on

reduction of flowering period , an acceleration of ripening , an increase of seed germination rate and increasing of seed yield production by 19 - 25 % .

On the other hand the *Brassica* species are considered as an abundant source of nectar and pollen and very attractive to bees (Free and Nuttal, 1968).Bell (1984) recorded that chemical composition of canola's oil approximately is 35-45 % Oil; 25 % Protein; 25 % Carbohydrates; and 5 % Lignin.

This work aims to study the role of insect-pollinators in an improving the yields of *B. campestris* and *B. napus* on cultivars , such as , seed weight / plant , seed index (weight of 1000 seed) , estimated yield of one feddan , calculating of germination percentages and chemical analysis of seeds .

MATERIALS AND METHODS

This study was conducted during two successive seasons 06/07 and 07/ 08, in the apiary of Agricultural Experimental Station, Faculty of Agriculture, Cairo University in Giza governorate, Egypt. Two species of canola (*Brassica campestris* L., and *Brassica napus* L.) were cultivated; *Brassica campestris* represented by line Sakha 225, while, *Brassica napus* represented by the commercial variety "Serw 4", where the seeds were obtained from Sakha Research Station.

Canola species under study were planted in fall (October & November) , and harvested in spring (March); in two seasons, All of the correctly methods of farming had made in this experiment ; sowing of seeds , irrigation , fertilization , and harvesting which were carried out according to Weiss (1983).

The canola species were cultivated in four plots each (6m X 7m per plot) and the caged area was (3m X 3.5m X 2.25m high). The caged area was covered with mosquito net to exclude insect pollinators especially honeybees to visit the plants inside the cage, the cages were put on the chosen plots just before the starting of the blooming period. The distance between the apiary and plants was about 50 meters

The following parameters, number of pods (siliquae) / plant, weight of seeds / plant, weight of 1000 seeds " Seed Index ", weight of seeds / m^2, estimated productivity of one feddan ,Germination Speed Index (GSI),Germination Percentage (GP), and chemical composition of seeds were measured and compared in both treatments (open " un-caged" and caged) during the two successive years of study.

Seed germination was assessed by placing 100 seeds of each species for both treatments (open " un-caged" and caged), in a glass Petri dishes with single layer of Whatman filter paper # 1, The filter paper was saturated with distilled water and then kept moist in the incubator at 20°C, then, the first reading of germination was taken after 5 days, while the last reading was after 2days later. The GSI was calculated according to the AOSA on vigor described below:

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The chemical analysis of canola oil was done to determine percentage of lipids, protein, carbohydrates, moisture, and ash; according to methods of Vogel (1975) and AOAC (2000).

RESULTS AND DISCUSSION

Potential value for canola crop of open pollination

Data presented in Table (1) show that the mean numbers of pods per plant was significantly in open areas which exposed to insect pollinators than those under cages (isolated from pollinators) for both *B. campestris* and *B. napus*. However , the increasing values were 2.16 ; 2.12 folds in the first and second seasons , respectively for *B. campestris* , but for *B. napus* these values were1.32 folds in two seasons . Besides, the mean No. of pods/plant for *B. campestris* was significantly higher in the two successive seasons, (426.30 & 345.62) then those for *B. napus*, (256.79 & 189.32), respectively. These results are in agreement with the findings of Mishra *et al*;(1988), they reported that pod setting, number of seeds per pod were significantly higher for open-pollinated flowers compared with net-caged and muslin-bagged flowers of rape crop.

The means of seeds weight per plant for the two canola species were higher (20.70gr. , 15.87gr.) in the 1st. season, and (16.88gr. , 15.95gr.) in the 2nd season, when exposed to insect pollinators than those isolated ones which were (5.82gr. & 6.01gr.) and (5.45gr.& 6.56gr.) during the two seasons respectively, (Table 1) . The increasing values were also higher in *B. campestris* (3.56 & 3.10 folds) than for *B. napus* (2.64 & 2.43 folds) when exposed to honeybees visitors than caged ones in two seasons. In general, the mean seeds weight/plant of both canola species increased about 2.90 times in the open cultivated areas than those caged ones.

These results go in line with the findings of Williams, *et al*., (1987) where they reported that honeybees clearly increased the rape crop. They added that, although honeybees increased the number of pods per plant, the pods from the plots with honeybees contained 20 - 51 % more seeds than the pods from the plots without bees.

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The average weight of healthy dry 1000 seeds (Seed Index) from open treatment was significantly higher (3.05gm & 3.50gm) than the weight of seed index from caged ones (2.41gm & 3.08gm) in the mentioned two species, respectively.(Table 1), Also, the mean of 1000th seed weight (seed index) was higher in open treatment (3.05gm & 3.05gm and 3.59gm & 3.41gm) than in caged ones (2.55gm & 2.26gm and 3.16gm & 2.99gm) for *B. campestris* and *B. napus* during both cultivated seasons, respectively. The open pollination gave only an increasing value of 1.28 and 1.14 folds. These results support the results of Mishra, *et al* ;(1988), they found that; the proportion of healthy seeds was significantly higher in open-pollinated flowers than in net-caged and muslin bagged ones. On the other hand they noted that the average weight of 100 seeds were significantly greater from muslin than from net-caged and open-pollinated flowers. They said that although muslin-bagged flowers set fewer seeds but heavier ones than open-pollinated due to the lesser number of seeds per pod are expected to draw better nutrition and thus become heavier.

Also, data presented in Table (1) show that, the mean yields per one square meter was heavier in open treatment (0.93kgm & 0.89kgm) than in caged ones (0.47kgm & 0.45kgm) for both species (*B.campestris* & *B.napus*), in the first year, respectively . The corresponding figures in the second year were (0.91kgm & 0.89kgm) and (0.46kgm & 0.53kgm); respectively.

The open pollination gave an increasing value of 1.98 and 1.83 folds for seed yield / m^2, from both species, respectively. Free and Nuttal (1968) reported that although the rape plots caged without bees produced less seeds; these seeds were smaller and less weight than produced from un-caged ones.

Also, data recorded in Table (1) that the estimated mean yield of seeds / feddan (4200m^2) was higher in open treatments (3895.50kgm & 3727.50kgm and 3811.50kgm & 3717.50kgm) than the caged ones (1953.00kgm & 1879.50kgm and 1942.50kgm & 2205.00kgm) during the two seasons from *B.campestris* and *B.napus* ; respectively, Also, the open pollination of rape added an increasing value of 1.98 and 1.84 folds for the seasonal crop / feddan ., Similar results were obtained by Kisselhegn, (1977) and Kubisova, *et al*; (1980); they recorded an increase of 60 % for the open pollinated oil-seed rape.

Germination Test and Chemical analysis of canola seeds:

The obtained results in (Table 2) showed that, the GSI of seeds produced from open treatment was higher (15.86 & 17.04 %) than those produced from caged ones (11.89 & 15.33 %) of *B.campestris* and *B.napus*, respectively.

Nearly the same trend was noted for the GP of seeds produced from open treatment (96 & 98 %) and caged plots (74 & 88 %) of the mentioned species. This may be due to the increasing of healthy seeds produced from open pollinated plots than caged ones. The same results were obtained by Kevan & Eisikowitch, (1990); they found that in canola *B.napus*, the presence of pollinators increases the germinability resulting seeds from 83 % to 96 %.

Also, data recorded in (Table 2) showed the chemical analysis of seeds produced from open and caged plots of canola species. The results revealed

that ; the open pollinated area produced seeds with high contents of total lipids (36.66 & 43.33 %) , crude protein (36.40 & 35.00 %) and carbohydrates (16.25 & 11.20 %) than those produced from caged ones , whereas the corresponding values were (23.66 & 32.89 %) , (30.80 & 32.20 %) and (12.52 & 10.12 %), for *B.campestris* and *B.napus* , respectively . On the other hand the open pollination decreases the values of moisture and ash. Although, Langridge &Goodman, (1975) found no significant difference in oil content of rape seeds under enclosed and open pollination conditions. Mishra,*et al*;(1988) reported that , the open pollination increased the oil content of seeds (5 folds than oil content of caged seeds). Also, Zeiton (1999) reported that, the Egyptian canola (*B.napus*) seeds; yielded 45±2 % crude oil and 23.60 % protein content.

Table (2) Effect of pollinating conditions on GSI and GP and Chemical composition of *B.campestris* and *B.napus* seeds.

Parameter / Species	*B.campestris*		*B.napus*	
	Open	Cage	Open	Cage
Germination Test (%)				
Germination Speed Index (GSI)	15.86	11.89	17.04	15.33
Germination Percentage (GP)	96	74	98	88
Chemical Components (%)				
Total Lipids	36.66	23.66	43.33	32.89
Crude Protein	36.40	30.80	35.00	32.20
Carbohydrates	16.25	12.52	11.20	10.12
Moisture	5.00	6.00	5.00	6.00
Ash	4.20	6.40	5.20	5.30

REFERENCES

A.O.A.C. (2000): Official Methods of Analysis of the Association of Official Analytical Chemist. 14th cd Washington, D.C., USA.

A.O.S.A. (1983): Seed vigor testing handbook. contribution No.32 to the Handbook on seed testing. 93p.

Barbier,E. (1978): Pollination du colza chez les abeilles.Rev.Fr.Apic.365:288-291.

Bell,J.M. (1984): Nutrients and toxicants in rapeseed meal. A review.J.Anim.Sci. 58:996-1010.

Friese,I. and Stark,J.(1983): Measuring the importance of honeybees in rapeseed production.J.Apic.Res.22(4):272-276.

Fujita,M.(1939): [Influence of honeybees on the fructification of rape.] Bull.imp.Zootech.Exp.Stn.Chiba-chi.34:1. *In Japanese*.

Jenkinson,J.G. and Glynne,J.G.D.(1953): Observations on the pollination of oil rape and broccoli. Bee World 34:173-177.

Karise,R.;Mand,M.;Vijk,E;Laaniste,P; and Martin,A.J.(2004): The abundance of bees on spring oilseed rape by different cropping systems. Transactions of the Estonian Agricultural Univ.Agronomy.219:88-90.

Kevan,P.G. and Eisikowitch,D.(1990): The effects of insect pollination on canola(*Brassica napus* L. cv. O.A.C.Triton) seed germination. Euphytica 45:39-41.

Kisselhegn,S.(1977):[Seed yield is increased if there are bees on the rape.] Tidsskrift for Biavl 111:66-67. (C.F.Mishra,*et al*.,1988).

Kubisova,S.;Nedbalova.V., and Plesnik,R.(1980): [The pollinating activity of honeybees on rape.] Polnohospodárstvo, 26:744-754. (C.F.Mishra,et al.,1988).

Langridge,D.F. and Goodman,R.D.(1975): A study on pollination of oil seed rape (*Brassica campestris*).Aus.J.Exp.Agric.Anim.Husb.15:285-288.

Meyerhoff,G.(1958):[Behavior of bees foraging on rape.] Leipzig. Beinenztng. 72(6):164-165.

Mishra,R.C.,Kumar,J., and Gupta,J.K.(1988):The effect of mode of pollination on yield and oil potential of *Brassica campestris* L.var Sarson with observations on insect pollinators.J.Agric.Res.27(3):186-189.

Radchenko,T.G.(1964):[The influence of pollination on the crop and the quality of seed of winter rape.] Bdzhilńitstvo 1:68-74. *In Ukrainian*.

Sabbahi,R.,D. de oliveira, and J.Marceau.(2005a): Influence of honeybee (Hymenoptera:Apidae)density on the production of canola (Cruciferae:Brassicacae).J.Econ.Entomol.98:367-372.

Taha,M.H.(2007):Effect of seeding and harvesting dates, method and rate of seeding on yielding ability and yield structure of rapeseed (canola) .Ph.D,Thesis.Fac.Agric.Cairo.Univ.,Egypt.190pp.

Vogel,A.J.(1975):A text book of practical organic chemistry.3rd ed.p.969-971,English Language Book Society and Longman Group Ltd. London.

Weiss,E.A.(1983):Tropical oilseed crops. – (Tropical agriculture series).1st ed.p.161-215, Longman Inc., New York,USA.

Williams,I.H.(1984): The concentrations of air-borne rape pollen over a crop of oilseed rape (*Brassica napus* L.).J.Agric.Sci.,Cambridge 103:353-357.

Williams,I.H.(1985): The pollination of swede rape (*Brassica napus* L.).Bee World 66:16-22.

Williams,I.H.,Martin,A.P.,and White,R.P.(1987): The effect of insect pollination on plant development and seed production in winter oilseed rape (*Brassica napus* L.).J.Agric.Sci.,Cambridge 109:135-139.

Zeiton,M.A.M.(1999): Lipid composition and oxidative stability of canola seed oil(*Brassica napus* L.)recently grown in Egypt.Arab.Univ.J.Agric.Sci.Ain Shams Univ.Cairo.7(2):493-506.

تأثير التلقيح الخلطى على انتاجية بذور الكانولا وتركيبها الكيميائى تحت الظروف البيئيه لمحافظة الجيزه

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تم اجراء هذا البحث فى منحل محطة التجارب الزراعيه – كلية الزراعه – جامعة القاهره ، خلال موسمين متتاليين هما (٠٧/٠٦ و ٠٨/٠٧) وذلك لتقدير تأثير التلقيح الخلطى على انتاجية بذور نوعين من الكانولا ، وكذلك تم حساب سرعة ونسبة الانبات للبذور الناتجه من النباتات المعرضه للتلقيح الخلطى وتلك الناتجه من النباتات المحجوزه تحت الاقفاص ، وايضا تم اجراء التحليل الكيماوى لبذور كلا المعاملتين لمعرفة تأثير نوعى التلقيح (الذاتى والخلطى) على نسبة المكونات الكيميائيه للزيت الناتج .

وقد اظهرت نتائج الدراسه ما يلى :

١ - على الرغم من ان الكانولا من المحاصيل التى تكون فيها نسبة التلقيح الذاتى مرتفعه ؛ الا ان التلقيح الخلطى أظهر نتائج جيده ذات فروق معنويه لكلا من : عدد القرون / النبات الواحد – محصول البذره من النبات الواحد – محصول المتر المربع الواحد – الانتاجيه المتوقعه من الفدان الواحد (لكلا المعاملتين).

٢ - للتلقيح الخلطى تأثير ايجابى ملموس على سرعة ونسبة الانبات بالنسبه للمعامله المعرضه للتلقيح الخلطى بالمقارنه بمعاملة التلقيح الذاتى .

٣- أظهر التحليل الكيميائى زياده فى نسبة الدهون الكليه والبروتين الخام وكذلك نسبة الكربوهيدرات وذلك فى البذور الناتجه من معاملة التلقيح المفتوح عن تلك التى انتجت من معاملة داخل الاقفاص .

Table (1) Effect of pollinating conditions on mean number of pods/plant , mean seed weight(gr.)/plant , mean weight of 1000 seeds(gr.) (Seed Index), mean seed yield (kgm.) / m², and estimated mean seed yield (kgm.) / feddan.

Parameter / Species	2nd season				1st season			
	Open	Cage	Mean	Increasing value	Open	Cage	Mean	Increasing value
No. of pods / plant								
B.campestris	583.10	269.50	426.30 A	2.16	469.99	221.24	345.62 A	2.12
B.napus	291.93	221.65	256.79 B	1.32	215.21	163.42	189.32 B	1.32
Mean	437.52	245.5	341.55	1.74	342.60	192.33	267.47	1.74
	A	B			A	B		
Seed weight (gr.) / plant								
B.campestris								
B.napus	20.70	5.82	13.26 A	3.56	16.88	5.45	11.17 A	3.10
Mean	15.87	6.01	10.94 A	2.64	15.95	6.56	11.26 A	2.43
	18.29	5.92	12.11	3.09	16.42	6.01	11.22	2.73
Seed Index (gr.)	A	B			A	B		
B.campestris	3.05	2.55	2.80 B	1.20	3.05	2.26	2.66 B	1.35
B.napus	3.59	3.16	3.38 A	1.14	3.41	2.99	3.20 A	1.14
Mean	3.32	2.86	3.09	1.17	3.23	2.63	2.93	1.25
	A	B			A	B		
Seed weight (gr.) / m²								
B.campestris	0.93	0.47	0.70 A	1.98	0.91	0.46	0.69 A	1.98
B.napus	0.89	0.45	0.67 A	1.98	0.89	0.53	0.71 A	1.68
Mean	0.91	0.46	0.68	1.98	0.90	0.50	0.70	1.83
	A	B			A	B		
Yield (kgm.) / Feddan								
B.campestris	3895.5	1953.0	2924.3 A	2.00	3811.5	1942.5	2877.0 A	1.96
B.napus	3727.5	1879.5	2803.5 A	1.98	3717.5	2205.0	2961.0 A	1.69
Mean	3811.5	1916.3	2863.9	1.99	3764.3	2073.8	2919.0	1.83
	A	B			A	B		

Mean of each parameter followed by the same letter in each column or row for the individual season are not significant at 5 % level according to Duncan Multiple Range Test.