ROLE OF PARASITOIDS AND HOST PLANT TOLERANCE IN CONTROLLING THE CABBAGE APHID, *BREVICORYNE BRASSICAE* (L.) (HOMOPTERA : APHIDIDAE) ON CANOLA AT EL-MINIA GOVERNORATE- EGYPT

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Abstract

This study was carried out at El-Minia Governorate for the two successive seasons, 2005 and 2006 to evaluate the efficacy of the integration of parasitoids and host plant tolerance against the cabbage aphid, *Brevicoryne brassicae* (L.) in canola (rapeseed) fields. It was recorded two aphid peaks, the first was weak during the budding stage, and the second was severing during flowering growth stage (5195-4125 individuals/20 plants) in both seasons, respectively. Rate of parasitism by the sole identified parasitoid, *Diaeretiella rapae* Mc'Intosh on the cabbage aphid was recorded through January to April in both years with average of 72.3 and 85.9% in 2005 and 2006 seasons, respectively. The highest parasitism percentage (100%) was recorded in mid April during ripening stage in both seasons.

Varieties M2&12 were the best and could be recommended to be used in an integrated control program against aphid on canola plants. These varieties harbored the lowest numbers of aphids (143.3-193.8 and 100.0-144.5 aphids/20 plants, respectively), had the highest rate of parasitism and produced the heaviest seed yield (933.8-1127.4 and 956.1 -1285.0 Kg. seed/fed., respectively). On the other side, varieties M260 &339 were the worst.

Key Word: Aphid, Parasitoid, Biological control, canola.

INTRODUCTION

Canola, *Brassica napus* is one of the most important oil seeds in the world. This crop has been cultivated in Egypt since few years as a good source of vegetable oil for human. The crop is likely to play a major role to the country's self reliance in oil production. In Egypt, the local shortage in edible oil represents about 80% of our needs, so, canola was introduced to reduce this gap.

The cabbage aphid, *Brevicoryne brassicae* (L.) infests heavily this crop causing a pronounced damage by sucking the plant juice and affecting the quantity and quality of the oil yield (Muhammad and Saleem 2001). It also transmits many lethal viruses (Devi *et at.* 2004). Boyd and Lentz (1994), found that populations of aphid most frequently during the flowering stage rapeseed in Tennessee, and reduced pod formation and uneven stand maturity.

Canola varieties under field conditions differ greatly in their relative susceptibility to aphid infestation (Hou *et al.,* 1995). The aphidiid parasitoids are used as a

biological control agent with significant results in many countries of the world, (Baker *et al.*, 2003 and Geiger *et al.*, 2005). The parasitoid, *Diaeretiella rapae* is a common parasitoid on the cabbage aphid, *B. brassicae* and some other aphid species all over the world (Lotfalizaden, 2002 and El-Mandarawy *et al*, 2006).

The present work was conducted to shed light on the population dynamics of this aphid and its parasitoids on canola plants and their relation with tolerance varieties. Results will undoubtedly help in the integrated control of this pest.

MATERIALS AND METHODS

The present study was carried out at the reclaimed lands of El-Minia Governorate during the two successive seasons, 2005 and 2006. In each season, the experimental area was divided into two equal parts, each included 20 plots (6x7 m^2). The first part was sown with the recommended variety Sarw on October 17 and specialized for studying the fluctuation of the cabbage aphid, *Brevicoryne brassicae* and its parasitoids. The second part was also sown on the same day with five canola varieties, M2, M12, M19, M260 and M339 each in four same measured plots distributed through a randomized complete block design. The last experiment was specialized to clarify the susceptibility of these varieties to the aphid infestation and occurrence of the parasitoids through the season. All recommended agricultural practices, except chemical control were done in the two experiments.

Weekly samples were taken from the two experiments starting about 70 days after sowing, when the primary branches started to emerge and the performance of aphid infestation became evident, and continued till harvest. Sample size was five plants chosen randomly from each plot, the free and parasitized aphids (mummies) were counted. The collected parasitized aphids were individually kept in gelatin capsules to identify the emerged parasitoids.

In the varietal experiment, the rate of parasitism and the effect of aphid infestation on canola yield were estimated, the siliqua of plants found in the two central rows of each plot, were shelled, dried and weighed.

Throughout the two seasons of work, maximum, minimum (mean) temperatures and relative humidity (R.H.%) were weekly recorded from Mallawi Meteorological Station. Statistical analysis was carried out by using F test and Duncan (1955) method through SAS-computer program to evaluate the differences between means of treatments.

RESULTS AND DISCUSSION

1. Identification of parasitoids

In this work, the identification of emerged parasitoids revealed that, *Diaeretiella rapae* was the sole parasitoid secured from the cabbage aphid, *Brevicoryne brassicae*.

2. Population dynamics of *Brevicoryne brassicae* and its parasitoid

Data presented in Figs. (1 and 2) showed that *B. brassicae* infested canola plants throughout the period extended from January until April 2005 and 2006 seasons. The total aphids collected from 20 plants started in low numbers (18, 12 aphids) at the second week of January and increased gradually till reached 85 individuals in the first week of February 2005 (the mean temperature and relative humidity were 11.6°C and 73%) and 96 individuals in the second week of February 2006 (16.7C° and 75% R.H), representing a weak peak. After that, the population of aphid decreased to 67 individuals on the second week of February 2005 (8.8C° and 74% R.H) and to 72 individuals in the third week of February 2006 (16.4 °C and 78% R.H.). It increased again clearly till reached a maximum of 5195 individuals on the third week of March 2005 (17.6C° and 56% R.H) and 4125 individuals in the fourth week of the same month of 2006 (17.9C° and 81% R.H) representing a sever peak. The population declined again gradually until April 25th with a density of 33-45 individuals in both seasons (26.1C°, 72% R.H and 22.8C°, 64% R.H., respectively). Regardless of season, data illustrated in the same figures showed that, the parasitism rate started, on Jan. 10th in a low level (11.1-16.7%) and increased gradually to record 33.0-51.0% as a first climax through 7-14 Feb. In the same time, while the rate of parasitism lowered to 28.4%, on Feb. 14, 2005, it still increases in 2006 season till reached a maximum (100%) on April 11th, represented the second climax. This maximum level was also recorded in the first season on April 18th *i.e.* one week later maybe due to differentiations in the plant and climatic conditions. The trend of the parasitoid activity and aphid population were identical in both seasons, where the highest activity of *D. rapae* was observed through the period between Feb. 28 and April 4 in which the aphid population was also high, 56.3-86.2% and 387-1472 individuals/20 plants in 2005 and 66.1-97.8% and 510-1118 individuals /20 plants in 2006, respectively. The suppression in the population counts of aphids occurring during the period after April 4th maybe due to the high parasitism by *D. rapae.* It is also cleared that, the aphid population was more affected with age of plant than the weather factors. These observations are in agreement with those of Raj and Lakhanpal (1998), who found that the natural parasitism by *D. rapae* on *B. brassicae* in the Indian fields varied from 2.85 to 30.74% with a peak in the first fortnight of

March. The parasitoid commenced activity from the first week of February to the first week of April, when mean maximum and minimum temperatures varied from 14.3 to 25.08C° and 5.1 to 14.3C°, respectively. In India too, Kulkarni and Patel (2001) showed that, aphid incidence on *Brassica juncea* occurred between the first week of January and the fourth week of February, the peak was recorded during the first week of February. *D. rapae* was firstly observed during the first week of February (11.3% parasitism) and gradually increased until the fourth week (43.68%). Also, Bukovinszky *et al.* (2003) in Netherlands mentioned that, the rate of parasitism of *B. brassicae* by *D. rapae* was significantly higher during flowering periods. Finally in Egypt, El-Mandarawy *et al.* (2006) found that, *B. brassicae* populations increased during the periods of development and flowering of canola plants and the rate of parasitism was highest during March.

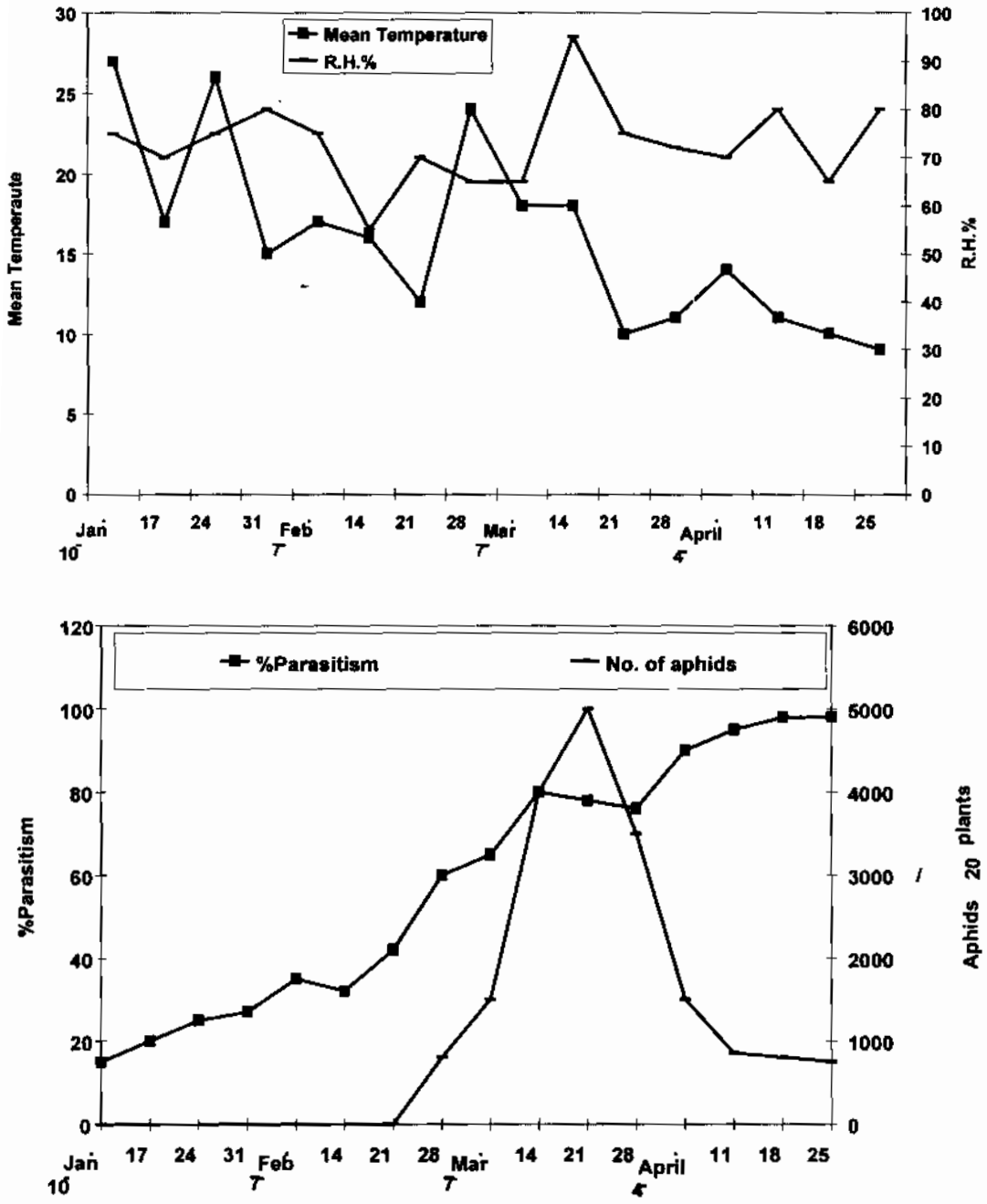

Fig. 1. Weekly mean number of the cabbage aphid, *Brevicoryne brassicae* /20 plants and percentage of parasitism by *Diaeretiella. rapae*, El-Minia, 2005.

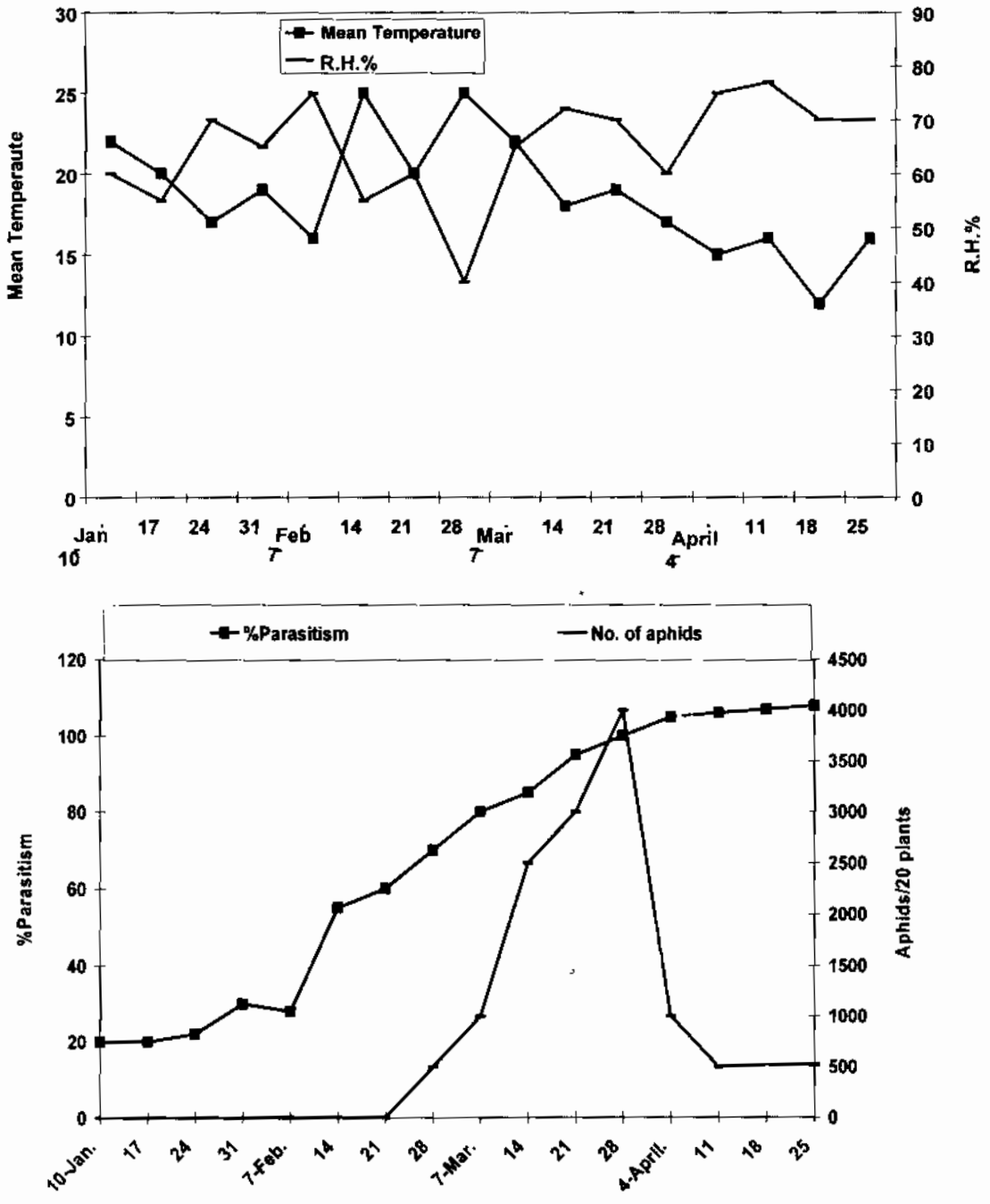

Fig. 2. Weekly mean number of the cabbage aphid, *Brevicoryne brassicae* /20 plants and percentage of parasitism by *rapae, Diaeretiella.* El-Minia, 2006.

3. Susceptibility of canola varieties

The average numbers of all collected aphids and percentage of parasitism in relation to five canola varieties are presented in Tables (1 and 2).

Regardless of variety, the obtained data clearly demonstrated that, the number of aphids increased from 12-37 and 8-36 individuals in January to reach a peak of 415-3025 and 281-2711 individuals/20 plants in March 2005 and 2006, respectively. Also, the rate of parasitism ranged 10.8-16.7 and 19.4-25.0% (January), and increased to 70.1-88.2 and 75.1 -88.3 (March) with a maximum of 8l .9-100.0 and 86.8-100% (April) for the two seasons, respectively.

The results of March of both years showed that, M339 and M260 were the most susceptible varieties, harbored 3025-2711 and 2152-1985 aphids, respectively. The variety M19 was moderate, harbored 605-716 aphids, while M2 and M12 were the least preferable varieties, harbored 565-402 and 415-281 aphids only, respectively. Also, the general mean of aphids confirmed this result, 977.8, 688.0, 268.5, 144.5 and 193.8 in 2005 and 807.8, 591.0, 216.3, 100, and 143.3 in 2006 for these respective varieties, respectively. On the contrary, the highest parasitism rate (97.5- 100%) was recorded with M2, l2and 19 varieties, where it ranged 85.5-89.4 % with M260 and 81.9-86.8 % with M339 variety.

The parasitism rate was in a positive relation with the tolerance of variety against aphids. While, the highest parasitism (84.6, 81.7%) was found with the least susceptible varieties (M12, M2) to the aphid, the lowest (69.7 and 73.3%) was found with the most susceptible genotypes (M339 and M260), respectively in 2005 season. The same trend was also noted in 2006 season.

Table 1. Average number of aphids and percentages of parasitism in different canola varieties, in El-Minia Governorate, 2005 season.

Date	Aphids/ 20 plants					Percentage of parasitism				
	M2	M12	M19	M260	M339	M2	M12	M19	M260	M339
January	19	l2	24	29	37	15.8	16.7	12.5	13.8	10.8
February	69	55	96	132	197	40.6	45.5	39.6	36.4	33.5
March	565	415	716	2152	3025	85.0	88.2	81.0	74.0	70.1
April	122	96	238	439	652	100	100	97.5	85.0	81.9
Overall	775	578	1074	2752	3911	-	-	-	-	-
General Mean	193.8d	144.5e	268.5c	688.0b	977.8a	81.7 ab	84.6 a	79.4 b	73.3 c	69.7 d
Seeds (Kg./fed.)						933.8	956.1	869.2	602.5	488.8

Means had the same letters are statistically insignificant.

The results showed clear differences between the tolerant varieties (M2 & 12) and the others specially M260 and M339 either in the rate of parasitism or seed yield. While the general mean of the parasitism, regardless of season, ranged 81.7-84.6 and 84.6-86.5% in case of M2 and M12, respectively, it was 79.4-83.1% in M19 and decreased to 69.7-74.0 in M339 and 73.3-77.2% in M260. The same observation was reported by Hafez (1994), the highest number of aphidophagous insects (predators and parasitoids) was found associated with the resistant genotypes which appeared as low susceptible to aphids. This means that, some genotypes play an important role in attracting these beneficial insects. This result agrees also with finding of Bukovinszky *et al.* (2003), the different genotypes of Brussels sprouts-black mustard differed in their attraction of different parasitoids and predators according to flowering periods and rate of infestation by aphids.

As for the yield, the first two varieties (M2 and M12) produced the heaviest weights, 933.8-1127.4 and 956.1-1285.0 Kg./fed., respectively. M19 variety occupied the medium rank in this respect, (869.2-1017.2 Kg. /fed.), followed with M260 & 339 which produced the lightest weights, 602.5-743.4 and 488.8-547.6 Kg./fed., respectively.

A general view for the varietal experiment results, it could be noticed that, canola varieties M2 & 12 had the lowest mean number of aphid, the highest percentage of parasitism and produced the heaviest yield. On the other hand, the lowest yield was from M339 variety, had the highest number of aphid with the lowest percentage of parasitism. So, genotypes M2 and M12 could be recommended as suitable varieties for a range of environments, having average tolerance and produced the highest seed yield.

Table 2. Average number of aphids and percentages of parasitism in different canola varieties, in El-Minia Governorate, 2006 season.

Date	Aphids/ 20 plants					Percentage of parasitism				
	M2	M12	M19	M260	M339	M2	M12	M19	M260	M339
January	13	8	20	31	36	23 9	25.0	20.0	19.4	19.4
February	57	36	75	102	166	54.4	58.3	50.7	46.1	44.2
March	402	281	605	1985	2711	85.3	88.3	84.0	78.1	75.1
April	101	75	165	246	318	100	100	100	89.4	86.8
Overall	573	400	865	2364	3231	-	-	-	-	-
General Mean	143.3d	100 e	216.3c	591.0b	807.8a	84.6 ab	86.5 a	83.1 bc	77.2 d	74.0 e
Seeds (Kg./fed.)						1127.4	1285.0	1017.2	743.4	547.6

Means had the same letters are statistically insignificant.

Similar results were obtained by Muhammad and Saleem (2001) in Pakistan, who found the number of grains and pods per plant, was the highest in resistant varieties to aphid attack, while it was the lowest in susceptible ones.

Generally, it is cleared from this study that, the parasitoid D. rapae could be successfully used as a biological control agent against B. brassicae especially with tolerant canola varieties.

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دور الطفيليات ومستويات التحمل الصنفية في مكافحة من الصليبيات علي محصول الكانولا في منطقة المنيا – مصر

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معهد بحوث وقاية النباتات – مركز البحوث الزراعية – الدقي – جيزة

تمت هذه الدراسة في الأراضي الجديدة بمحافظة المنيا خلال موسمي ٢٠٠٥، ٢٠٠٦ لتقييم تأثير كل من دور الطفيليات ومستويات التحمل الصنفية في حماية محصول الكانولا ضد من الصليبيات. أوضحت الدراسات أن أعلي تعداد لحشرة المن كان في مرحلتي تكوين البراعم (الأسبوع الأول من فبراير) ومرحلة تكوين الأزهار (الأسبوع الثالث من مارس) في موسم ٢٠٠٥ أما في موسم ٢٠٠٦ فكان أعلي تعداد للحشرة في الأسبوع الثاني من فبراير والأسبوع الرابع من مارس وفي هذه المنطقة يتطفل علي هذه الآفة طفيل واحد هو *Diaeretiella rapae* في الفترة من يناير حتي أبريل وكان متوسط نسبة التطفل ٧٢,٣٠% في الموسم الأول و٨٥,٨٨% في الموسم الثاني. وسجلت أعلي نسبة تطفل (١٠٠%) في مرحلة تكوين الثمار والنضج (منتصف شهر أبريل في كلا الموسمين).

سجلت أصناف الكانولا (م٢، م١٢) أقل متوسط لتعداد حشرة المن وأعلي نسبة تطفل بالإضافة الي أعلي إنتاجية من البذور خلال موسمي الدراسة ولهذا فقد أعتبر هذان الصنفان من الأصناف المحتمله لحشرة المن. أما الأصناف الأعلي إصابة فكانت م٢٦٠، م٣٣٩ سجلت أعلي متوسط للتعداد الشهري مع أقل نسبة تطفل بالإضافة الي أقل إنتاجية من البذور خلال موسمي الدراسة.

وبناء علي هذه الدراسة يمكن التوصية بزراعة صنفي م٢، م١٢ واللذان يتكاملا مع طفيل *Diaeretiella rapae* في مكافحة من الصليبيات علي نباتات الكانولا.