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EFFECT OF PLANTING DATES AND SPACES ON CERTAIN PESTS INFESTING THREE MEDICAL AND AROMATIC PLANTS

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ABSTRACT: Three aromatic and medical plants ,i.e. guar, roselle and peppermint were planted under different planting dates and spaces during two successive growing seasons at Gemmeza region, Gharbia Governorate . The obtained results clearly revealed that the tested planting dates had highly significant differences between average numbers of *Aphis gossypii* Glover, *Empoasca lybica* de Berg, *Thrips tabaci* Lind., *Bemisia tabaci*(Genn.) and *Tetranychus* spp. during the two successive growing seasons of 1994 and 1995, except in case of *E. lybica* which showed significant effect in 1994 season and insignificant in 1995. The abundance level of *Tetranychus* spp. responded significantly and high significantly according to tested sowing dates in the first and second seasons, respectively. In 1994 and 1995 roselle growing seasons, the abundance level of *A. gossypii, E. lybica, T. tabaci, B. tabaci, Earias insulana* Boisd., *Oxycarenus hyalinipennis* Costa and *Tetranychus* spp. varied significantly according to the date of planting. The differences between average numbers of these pests were highly significant, except for *E. lybica* that showed insignificant variations in both seasons. Numbers of *Tetranychus* spp. insignificantly varied in the second season. The differences between the five tested transplanting dates on the rate of occurrence of the four insect species *A. gossypii, E. lybica, T. tabaci, B. tabaci* and the two mite species, *Tetranychus* spp. and *B. abovatus* on peppermint plants proved to be statistically significant in the two studied seasons of 1995 / 1996 and 1996/ 1997. *E. lybica* and *A. gossypii* showed insignificant variances during the first and second seasons, respectively. *T. tabaci, Tetranychus* spp. and *E. lybica* average numbers insignificantly differed in the first season and significantly in the second one. *B. tabaci* and *B. obovatus* appeared on mint plants with high numbers with the fifth transplanting date compared with other pests.

Concerning to the effect of planting spaces, it was found that *B. tabaci* and *Tetranychus* spp. infesting guar plants significantly varied according to the sowing spaces in both seasons. Whereas, *A. gossypii* and *T. tabaci* differently responded and varied from one season to

another. *E. lybica* insignificantly influenced by changing sowing spaces. The obtained data demonstrated that the fourth sowing space of roselle was more suitable for *A. gossypii* development and reproduction as compared with the other tested spaces during the first season. *A. craccivora* and *Tetranychus* spp. individuals completely disappeared with all sowing spaces during the second season of 1995. *A. craccivora* disappeared with the second space (30 cm) while *Tetranychus* spp. disappeared on the second and fourth ones in the first season. *E. lybica* disappeared on roselle plants in the third and fourth spaces during the second season. *A. gossypii, E. lybica, T. tabaci, B. tabaci, Tetranychus* spp. and *B. obovatus* infested peppermint plants with all transplanting spaces during the two investigating seasons except *A. gossypii* and *E. lybica* that completely vanished with the third and fourth spaces in case of *A. gossypii* and with the second and fourth spaces with *E. lybica* in the first season. In the second season, those pests disappeared on plants transplanted with each of the second and fourth spaces, respectively. *T. tabaci* completely disappeared on plants of all spaces in the second season but in the first season, *T. tabaci* disappeared with the fourth space only. In both seasons, the effect of tested planting spaces on the incidence of the above-mentioned plants proved to be statistically significant and highly significant.

Key words: Guar, roselle, peppermint, insects, mites, planting dates, planting spaces.

INTRODUCTION

The medical and aromatic plants are important for human. They are used as food and for industry to produce drugs, cosmetics and others. Nowadays, the area cultivated with these plants are increased, especially in the newly reclaimed lands to cope the increasing needs for local consumption, as well for export purposes. These plants are infested with certain injurious insect and mite pests that reduce crop quantity and quality of these plants.

Owing to the serious harmful effects of pesticides on human health, domestic animals and useful natural enemies; therefore, it must be another safe methods other than pesticides for controlling insect and mite pests attacking medical and aromatic plants. Agricultural practices are considered the most important safe methods for pest control. The effects of certain agricultural practices such as fertilization, irrigation; pruning hoeing, tillage, planting date and space on crop as well on the incidence of the important pests received relatively little attention by some authors such as Meena *et al.* (1984),

Al-Shannaf (1994),Brar *etal*(1994), Metwally *et al.* (1994), Baruah (1995), Gurbinder Singh and Brar (1995),Man Singh *et al.* (1995), Pawar *et al.* (1996), Diz Franco and Ortegon (1997), Ramu and Farooqi (1997), Galambosi *et al.* (1998), Metwally, Samia (1999), Chirasree – Gangopadhay *et al.* (2001), Salman and Abou-Elhagag (2001). The present work aims to study the effect of planting dates and spaces on the incidence of certain insect and mite species infesting guar, roselle and peppermint aromatic and medical plants.

MATERIALS AND METHODS

Field ecological experiments were carried out at the Experimental Farm of Gemmaza Agricultural Research Station in Gharbia Governorate, Agriculture Research Center, Ministry of Agriculture, Egypt during the period from 1994 to 1997 for studying the effect of planting date and space on the abundance level of insect and mite species on guar (*Cyamopsis tetragonoloba* Tuab), roselle (*Hibiscus sabdariffa* Linne) and peppermint (*Mentha piperita* Linne).

The experimental area (126 m^2), was divided into three replicates (42 m^2 each). The replicate consisted of 23 ridges (3 m in length x 60 cm in width). Treatments were distributed in completely randomized blocks design. All agricultural practices were carried out in due time and no pesticidal treatments were applied. Five monthly dates were tested for evaluating the impact of planting time on insect and mite population during the two successive seasons of 1994 and 1995. The tested planting dates for both guar and roselle began on the 16^{th} of March in 1994 and a week later in 1995; While, they began on the 8^{th} and 10^{th} of March for peppermint in summer plantation during 1995/ 1996 and 1996/1997 seasons, respectively. Four different planting spaces were tested by applying four spaces between plants planted on the 3^{rd} date (May) during the two successive seasons of 1994 and 1995 for both guar and roselle in 1995/ 1996 and 1996/1997 seasons for peppermint. The investigated planting spaces for both peppermint and roselle were 20, 30, 40 and 50 cm between plants on the ridge and they were 15, 25, 35 and 45 cm for guar.

Weekly samples including 20 leaves from guar, roselle and peppermint as well as 20 roselle fruits were taken at random from different levels of plant height immediately after foliage appearance for leaves and after fruits formation in case of roselle fruits until harvest. These samples were kept in tightly closed paper bags and then transferred to laboratory for inspection on the same day with the aid of a

stereomicroscope. The number of aphids as well leafhoppers (nymphs and adults) and thrips (larvae and adults) were counted on the two surfaces of leaf. Whereas, in case of whitefly (immature stages) and mites (moving individuals) were counted in an area of one inch^2 on the lower surface of each leaf of roselle and leaflet of guar, but in case of mint the individuals were counted on the lower surface of each leaf. The tested area was chosen at the base of the leaf or leaflet and around its mid- rib. Roselle fruits were carefully dissected and internally inspected on the same day of sampling to determine the population density of adults and nymphs of cotton seeds bug and larvae of spiny bollworm. In each replicate, two ridges were left to determine the crop yield at harvest, without picking any samples of either leaves or green fruits during the whole period of the two experimenting seasons.

To show the variance between the studied treatments, the obtained data were statistically analyzed using F. test according to Fisher (1944), Snedecor (1957) and Snedecor and Cochran (1972).

RESULTS AND DISCUSSION

1. Planting Dates

The effect of five monthly planting dates on the infestation of guar, roselle and peppermint plants with certain insect and mite pests was studied at Gemmeza region during two successive seasons. The obtained results, can be arranged and discussed as follows:

1.1. Pests infesting guar

1.1.1. The cotton aphid, *Aphis gossypii* Glover

As shown in Table (1), the averages numbers of individuals of *A. gossypii* on guar leaves were high significantly affected with changing the five tested dates of planting during the two experimental successive seasons of 1994 and 1995. In the first season of 1994, plants cultivated in May harboured the greatest numbers of individuals of 5.94 aphids / 20 leaves, but in the second one (1995), the insect occurrence was the highest (0.95 aphid per 20 leaves) on plants sown on March. The lowest population densities of 0.10 and 0.16 aphid / 20 leaves were recorded with the latter planting date of July during 1994 and 1995 seasons, respectively. From the present results it is evident that the average numbers of *A. gossypii* recorded on guar plants sown on the four dates of March, April, May and June were higher in the first season than those recorded in the second one, whereas the reverse was true with July sowing date.

These results are in agreement with those of Shehata (1998) who found that certain planting dates

Table 1: Effect of different sowing dates on the infestation of guar plants with some leaf insect and mite pests along with seeds yield at Gemmeza region during the two successive seasons of 1994 and 1995.

Sowing dates	Avg. no. of individuals / 20 leaves			Avg. no. of individuals/inch^2 of 20 leaflets		Mean seeds yield (kg/fed.)
	A. gossypii	*E. lybica*	*T. tabaci*	*B. tabaci*	*Tetranychus* spp.	
1994 season :						
March	2.25 C	0.00 B	0.98 A	7.65 D	2.10 A	425.93 B
April	2.35 C	0.02 B	0.53 B	11.41 C	0.03 B	313.03 C
May	5.94 A	0.03 B	0.25 C	12.70 C	0.02 B	432.56 B
June	3.08 B	0.14 A	0.06 D	15.51 B	0.00 B	536.87 A
July	0.10 D	0.06 AB	0.07 D	70.52 A	0.00 B	161.27 D
F. test	**	*	**	**	*	**
1995 season :						
March	0.95 A	0.00	0.14 B	13.12 C	0.19 B	991.67 A
April	0.18 D	0.00	0.07 BC	10.74 D	0.03 C	680.56 B
May	0.76 B	0.00	0.29 A	7.75 E	0.44 A	470.17 B
June	0.42 C	0.05	0.02 C	28.37 B	0.02 C	535.28 B
July	0.16 D	0.00	0.00 C	50.89 A	0.00 C	365.56 C
F. test	**	N.S.	**	**	**	**

- Sowing dates were on the 16th and 22nd of each month in 1994 and 1995 seasons, respectively.
- N.S. = Insignificant differences. * = Significant diff. (0.05). **= Highly significant diff. (0.01).
- Averages followed by the same letters are not significantly different at 0.05 level of probability.

had an adverse effect on the activity of individuals of *Aphis gossypii* infesting cowpea. The same author observed significant differences between numbers of *A. gossypii* due to cowpea planting dates which sown in khattara region, Sharkia Governorate during the two seasons of 1995 and 1996.

1.1.2.The cotton leafhopper, *Empoasca lybica* de Berg

Guar plants sown in five different monthly dates from March to July had low significant and insignificant variances between average numbers of cotton jassids during the two seasons of 1994 and 1995, successively. Plants of the fourth

date of June had the highest average numbers of 0.14 and 0.05 jassid/ 20 leaves during the first and second seasons, respectively. The individuals of this species of jassids completely disappeared on plants of April, May and July sowing dates during 1995 season and of March during the two seasons (Table 1).

These results partially agree with the findings of Metwally *et al.* (1994) who proved that the differences between infestation degree of *E. decipiens* on common bean plants for five tested sowing dates were highly significant during the two growing seasons. Also, Ba - Angood *et al.* (2000) in Yemen found that high numbers of the jassid *Jacobiasca lybica* occurred on sesame plants at early sowing in August and September compared to February and October sowing dates.

1.1.3. The cotton thrips, *Thrips tabaci* Lind.

The data compiled in Table (1) obviously show that during the two seasons of investigation, the individuals of cotton thrips on guar plants were high significantly influenced with the five tested sowing dates showing average numbers ranged between 0.06-0.98 thrips/20 leaves in 1994 season and 0.00 -0.29 in 1995 .

In upper Egypt, Salman and Abou Elhagag (2001) stated that numbers of *Thrips tabaci* differed on faba bean according to sowing dates.

1.1.4.The cotton whitefly, *Bemisia tabaci* (Genn.)

Data in Table (1) indicate highly significant wide rating in average numbers of cotton whitefly on guar leaves between the five tested dates of planting. Plants sown on July were heavily invaded with the highest numbers of *B. tabaci* individuals (70.52 and 50.89 eggs, larvae and pupae / inch^2 of 20 leaflets) during the first and second seasons, consecutively. The lowest abundances of 7.65 and 7.75 individuals / inch^2 of 20 leaflets were recorded on plants sown on March during 1994 season and May during 1995, respectively.

These results disagree with those obtained by Meena *et al.* (1984) who mentioned that *Bemisia tabaci* numbers was the highest in guar crop sown on 1 June and least in that sown on 20 July. On the other hand, the present findings agree with those of Shehata (1998) and Metwally, Samia (1999) who found high levels of immature stages of *B. tabaci* on cowpea plants sown on the 1st of June compared with that of the 1st of March and the population on kidney bean was lower on March planting, respectively.

1.1.5. The common red spider mite, *Tetranychus* spp.

The data presented in Table (1) clearly reveal that in both 1994 and 1995 seasons, sowing date of guar plants proved to have significant and highly significant impacts on the population density of mite moving individuals. The average numbers of mites ranged from 0.02 moving individual / inch^2 of 20 leaflet (3rd sowing date) to 2.10 (1st), whereas in the second one, the range was from 0.02 (4th) to 0.44 (3rd). It is worthy to mention that, guar leaves of plants sown on both June and July of 1994 season as well as on July of 1995 were completely free from mite moving individuals of this species.

These results agree with those obtained by Shehata (1998) who found that the highest average number of moving individuals of *Tetranychuys* spp. were recorded on cowpea plants of the first sowing date (1st of February) but the lowest population was obtained with the last sowing date (1st of June).

1.1.6. Seeds yield

As clearly shown in Table (1), seeds yield of guar plants high significantly varied according to the date of planting showing a wide range from 161.27 (5th date) to 536.87 (4th) and from 365.56 (5th) to 991.67 (1st) kg / fed. during the two seasons of 1994 and 1995, successively.

The present results are in harmony with those obtained by Meena *et al.* (1984) who found that *B. tabaci* reduced yields of guar seeds because of the borne discase which transmitted by *B. tabaci* individuals. Also, Metwally *et al.*(1994) and Salman and Abou-Elhagag (2001) stated that changing the time of sowing date caused significant reduction in the yield of common bean seeds and faba bean, respectively

1.2. Pests infesting roselle

1.2.1. The cotton aphid, *Aphis gossypii* Glover

As obviously indicated in Table (2), highly significant differences between average numbers of this aphid species on roselle plants sown in five monthly dates from March to July during the two successive seasons of 1994 and 1995 were detected. The present results revealed that the lowest average numbers of aphids of 0.69 and 1.58 nymphs and females /20 leaves were recorded on plants of the latest sowing date (July), whereas the highest corresponding values (18.88 and 12.74) were obtained with plants sown on the third date of May during the first and second seasons, respectively. It is worthy to mention that, in both investigating seasons, individual comparisons between all average numbers according to least significant differences tests (L.S.D) obtained in the five tested sowing dates proved to be statistically significant.

Table 2: Effect of different sowing dates on the infestation of roselle plants with some insect and mite pests along with crop yield at Gemmeza region during the two successive seasons of 1994 and 1995.

Sowing dates	Avg. no. of individuals/ 20 leaves			Avg. no. of individuals / inch^2 of 20 leaves		Avg. no. of individuals/ 20 fruits		Mean crop yield (kg/fed.)	
	A. gossypii	*E. lybica*	*T. tabaci*	*B. tabaci*	*Tetranychus* spp.	*E. insulana*	*O. hyalinipennis*	Seeds	Sepals
1994season:									
March	12.30 B	0.33	1.45 A	6.37 B	0.09 B	1.61 A	66.11 A	330.60 C	147.88 B
April	5.58 C	0.23	1.21 A	5.92 B	0.14 B	0.67 C	49.19AB	572.25 A	312.90 A
May	18.88 A	0.06	0.48 B	2.70 B	0.00 B	1.14 B	10.00 C	424.25 B	160.34 B
June	9.26 B	0.26	0.14 B	15.29 B	0.96 A	0.33 D	16.24BC	186.28 D	66.83 C
July	0.69 D	0.14	0.08 B	92.52 A	0.00 B	0.14 E	8.86 C	156.75 D	67.78 C
F. test	**	N.S.	**	**	**	**	*	**	**
1995season:									
March	12.08 A	0.12	0.20 A	6.01 B	0.20	1.09 A	39.24 A	367.50 A	162.94AB
April	3.06 C	0.08	0.06 B	4.61 BC	0.00	0.33 BC	5.90 B	450.33 A	238.00 A
May	12.74 A	0.18	0.03 B	3.31 C	0.00	0.14 C	6.05 B	376.24 A	118.42 B
June	7.83 B	0.14	0.08 B	3.53 C	0.03	0.39 B	11.82 B	189.41 B	118.87 B
July	1.58 D	0.00	0.00 B	22.46 A	0.00	0.38 B	6.05 B	220.89 B	107.33 B
F. test	**	N.S.	*	**	N.S.	**	**	**	*

The present results are partially confirmed with those reported by Al-Shannaf (1994) who found that the effect of sowing dates of cotton plants on the incidence of cotton aphids proved to be statistically significant in 1991 season and insignificant in 1992 season, as well as the sowing date of April caused a great reduction in aphids numbers in both seasons of investigation.

1.2.2.The cotton leafhopper, *Empoasca lybica* de Berg

This cicadellid species of jassids appeared on leaves of roselle plants of the five tested dates with low and insignificant numbers that ranged between 0.06 – 0.33 and 0.00-0.18 jassid/ 20 leaves during the five tested sowing dates of 1994 and 1995 seasons, consecutively (Table 2).

Rao *et al.* (1983) found that the correlation relationship of *Amrasca biguttula biguttula* incidence with sowing date of roselle was not significant.

1.2.3. The cotton thrips, *Thrips tabaci* Lind.

The data compiled in Table (2) obviously indicate that the differences in average numbers of this *Thrips* species on roselle leaves were statistically highly significant and significant during 1994 and 1995 seasons, respectively. The highest values of 1.45 and 0.20 individuals/ 20 leaves were recorded on plants of March sowing date during first and second seasons, alternatively. The variations in the insect population density on roselle plants of March, April and May, June, July (during 1994 season) and plants of April, May, June, July (during 1995 season) were statistically insignificant at 0.05 level of probability. From the present results, it can be concluded that the abundance levels of *T. tabaci* in the first season were much higher than those recorded in the second one with all tested sowing dates.

Al-Shannaf (1994) stated that the influence of sowing date of cotton plants on abundance of *T. tabaci* was not constant and varied from one season to another. This effect was highly significant in the first season and insignificant in the second one.

1.2.4.The cotton whitefly, *Bemisia tabaci* (Genn.)

As shown in Table (2), roselle plants sown on July high significantly harboured the highest numbers of cotton whitefly immatures (92.52 and 22.46 individuals / inch^2 of 20 leaves) during the two successive seasons of 1994 and 1995, consecutively. Contrarily the insect lowest population densities of 2.70 in first season and 3.31 in the second one were recorded on roselle leaves of plants sown on the optimal sowing date of May (3rd). Whereas, plants of the second and fourth dates showed moderate

levels of immatures abundance in both investigating seasons.

These results are in harmony with findings of Al-Shannaf (1994) who reported that time of cotton sowing had highly significant effect on the population density of immature stages (larvae and pupae) of cotton whitely attacking cotton leaves. The same author added that numbers of *B. tabaci* individuals were high on cotton plants sown on March than those recorded on plants sown on April.

1.2.5.The spiny bollworm, *Earias insulana* Boisd.

The data arranged in Table (2) clearly demonstrate that average numbers of spiny bollworm larvae recorded in fruits of roselle sown on March were the highest (1.61 and 1.09 larvae/ 20 fruits) and high significantly varied with those concerning the other tested late dates during the two seasons of 1994 and 1995 respectively. On the other hand, the lowest population density of 0.14 larva /20 fruits was recorded in fruits of roselle plants sown on July of the first season and May of the second one.

These results are in disaccordance with those obtained by Al-Shannaf (1994), but in partially agreement with those of Brar *et al.* (1994). The first author found that the influence of sowing dates of cotton plants on the larval population abundance of spiny bollworms appeared to be not significant in both investigating seasons, whereas the second ones reported that percentage of fruits infestation in okras caused by *Earias* spp. was lowest in crops sown on 15 May or 30 July.

1.2.6.The cotton seeds bug, *Oxycarenus hyalinipennis* Costa

Both adults and nymphs of cotton seeds bug recorded inside roselle fruits of plants cultivated during March were nearly twicely in numbers during 1994 season (66.11 individuals) than that during 1995 season (39.24). Statistical analysis of variance using F. test proved that the differences between the insect population densities inside roselle fruits of plants sown on the five tested different dates were significant at 0.05 level of probability and highly significant during the first and second seasons, successively (Table 2).

1.2.7.The common red spider mite, *Tetranychus* spp.

This tetranychid complex species was investigated with highly significant and insignificant low numbers ranged between 0.00-0.96 and 0.00-0.03 moving individual / inch^2 of 20 leaves of roselle plants sown on monthly five dates during the period from March to July in the two consecutive roselle growing seasons of 1994 and 1995, alternatively (Table 2).

Chirasree – Gangopadhay *et al.* (2001) stated that the incidence of *Tetranychus cinnabarinus* infesting bhindi can be minimized by shifting the sowing date.

1.2.8. Crop yield

The yield of roselle seeds high significantly varied between the five tested sowing dates and ranged between 156.75 (July s.d.)-572.55 (April s.d.) and 189.41 (June s.d.) - 450.33 (April s.d.) kg/ fed. during 1994 and 1995 seasons, successively. Similarly, the same trend was detected with yields of roselle sepals that ranged between 66.83 (June s.d.) - 312.90 (April s.d.) and 107.33 (July s.d.)-238.00 (April s.d.) kg / fed. to show highly significant and significant differences according to the date of sowing during the first and second seasons, respectively (Table 2).

Pawar *et al.* (1996) showed that okra sown on 15th May and 1st June had a lower incidence of *Amrasca devastans* and *Earias vittella*, with a good yield of marketable fruits while mite (*Tetranychus cinnabarinus*) was zero in the crop sowing on 1st September, 15th September and 1st October. Also, Diz Franco and Ortegon (1997) and Passam *et al.* (1998) found that the size of okra seeds yield was affected by sowing dates.

1.3.Pests infesting peppermint

1.3.1. The cotton aphid, *Aphis gossypii* Glover

The leaves of peppermint planted in five monthly dates in the period from March to July were attacked with low highly significant and insignificant average numbers of this pest that ranged between 0.03 - 0.66 and 0.00 - 0.39 aphid /20 leaves during the first and second seasons, successively (Table 3). In 1995 / 1996 seasons, the highest population density of this species of aphids was recorded on peppermint plants transplanted in the earlier date of March, whereas the lowest abundance was detected with those of the later planting date of July. Contrarily, during 1996 / 1997 season, peppermint plants of July planting date harboured the highest aphid numbers and those of May date were completely free from the insect.

Bhattacharyya and Mandal (2001) in Nadia, West Bengal and India, found that plants of *Colocasia esuculenta* L. planted on 1 April recorded maximum infestation by aphid, *Aphis gossypii* as compared with those obtained at other planting dates (1 and 5 March, 15 April and 1 May).

1.3.2.The . cotton leafhopper, *Empoasca lybica de Berg*

As obviously indicated in Table (3), the differences in average numbers of this jassid on

Table 3: Effect of different transplanting dates on the infestation of peppermint plants with some leaf insect and mite pests along with fresh canopy yield at Gemmeza region during the two successive seasons of 1995 and 1996.

Transplanting dates	Average numbers of individuals / 20 leaves						Mean fresh canopy yield (ton/ fed.)
	A. gossypii	*E. lybica*	*T. tabaci*	*B. tabaci*	*Tetranychus* spp.	*B. obovatus*	
1995/1996 season:							
March	0.66 A	0.10	0.00 C	13.42 D	1.16 A	12.52 C	2.88 A
April	0.05 C	0.10	0.14 AB	20.82 D	0.87 A	49.31 A	1.09 B
May	0.05 C	0.00	0.03 BC	35.46 C	0.49 B	45.66 AB	1.63 B
June	0.19 B	0.00	0.17 A	64.67 B	0.69 A	17.13 C	3.11 A
July	0.03 C	0.00	0.02 C	79.89 A	0.08 B	41.42 B	2.92 A
F. test	**	N.S.	*	**	*	**	**
1996/1997 season:							
March	0.26	0.03 A	0.05 B	42.19 C	4.22 A	55.01 A	3.03 A
April	0.12	0.00 B	0.07 A	10.47 D	4.67 A	45.85 B	0.88 B
May	0.00	0.03 A	0.00 C	268.10 A	0.71 C	7.85 D	1.58 B
June	0.00	0.00 B	0.00 C	125.66 B	1.49 BC	10.02 D	2.74 A
July	0.39	0.00 B	0.00 C	51.88 C	2.62 B	30.10 C	2.66 A
F. test	N.S.	*	**	**	**	**	**

peppermint leaves insignificantly and significantly varied due to the time of transplantation during the two successive summer growing seasons of 1995 / 1996 and 1996 / 1997 , respectively. The average numbers of this cicadellid insect were nearly equal in case of different tested times of planting and did not greatly varied from one season to another, where they ranged between 0.00-0.10 and 0.00-0.03 jassid / 20 leaves during first and second seasons, successively.

Men and Kandalkar (2001) reported that planting dates of sunflower had an adverse effect on the activity of jassids (*Amrasca biguttulla).*

1.3.3. The cotton thrips, *Thrips tabaci* Lind.

The data compiled in Table (3) evidently demonstrate that significant and highly significant low populations of this thripid on peppermint plants were recorded with the different monthly five dates of planting ranging between 0.00-0.17and 0.00-0.07 individuals

per 20 leaves during first and second seasons , consecutively .

1.3.4.The cotton whitefly, *Bemisia tabaci* (Genn.)

The highly significant differences in the average numbers of cotton whitefly immature stages on the leaves of peppermint plants transplanted in monthly five dates during the two alternative seasons of investigation 1995/1996 and 1996/1997 were shown in Table (3). The best date having the lowest average numbers of *B. tabaci* (13.42 and 10.47 individuals / 20 leaves) was recorded in March and April during 1995/1996 and 1996/ 1997seasons, success-ively. Whereas, the highest average numbers of whitefly eggs, larvae and pupae/ 20 leaves of 79.89 in the first season and 268.10 in the second were recorded on plants transplanted in July and May, respectively.

Many authors such as El-Gendi *et al.* (1997) , Borah and Bordoloi (1998) and Lakra *et al.* (2003) studied the effect of planting dates on the incidence of whitefly on tomato and potato and they found that numbers of *B. tabaci* changed according to planting dates.

1.3.5. The common red spider mite, *Tetranychus* spp.

Moving stages of this tetranychid mite were recorded with significant and highly significant low numbers ranging between 0.08-1.16 and 0.71-4.67 mites/20 leaves on leaves of peppermint planted in monthly five dates of March, April, May , June and July during the first and second seasons, consecutively (Table 3). It is worthy to note in 1995/1996 season, that peppermint plants transplanted in the first earlier date of March harboured the highest mite population, but the lowest one was recorded with those planted lately in the fifth date of July. On the other hand, during 1996/1997, the lowest abundance was observed with the third date (May) and the highest one was with the second (April).

1.3.6.The flat spider mite, *Brevipalpus abovatus* Donadieu

The moving individuals of this species of mites were observed with relatively high average numbers, ranged between 12.52 mites / 20 leaves (March p.d.) - 49.31 (April p.d.) and 7.85 (May p.d) - 55.01 (March p.d.), on peppermint plants of the five tested dates of transplanting during the two successive seasons of 1995/ 1996 and 1996/1997 , respectively. Statistical analysis of variance using F. test revealed that the differences in average numbers of mites between the five tested dates of March, April, May, June and July were highly significant during the two seasons of investigation.

1.3.7. Canopy yield

The highly significant differences in means fresh canopy yield of peppermint plants transplanted in five monthly dates from March to July of the two alternative seasons of 1995/1996 and 1996/1997 ranged between 1.09-3.11 and 0.88-3.03 tons/ fed., successively (Table 3). In both seasons, the lowest fresh canopy yield was recorded with peppermint plants transplanted in the second date of April. Whereas, the highest yield occurred differently during the two investigating seasons as it was in the fourth date of June 1995/ 1996 season and in first date of March 1996/1997 seasons.

Confirmed results were reported by some investigators such as Pike and Glozer (1982) and Man Singh *et al.* (1995) who found that improved yields due to agricultural practices that reduced the population of insect pests of peppermint by about 81%. The same authors added that the size of both quantity and quality of *M. spicata* canopy yield was greatly influenced by changes of transplanting dates.

2. Planting Spaces

The effect of four planting spaces on the incidence of certain insect and mite pests on guar, roselle and peppermint plants was studied under the environmental conditions of Gemmeza region during two successive summer growing seasons. The obtained results can be presented and discussed in the following points:

2.1. Pests infesting guar

2.1.1. The cotton aphid , *Aphis gossypii* Glover

The incidence of this homopterous species on guar leaves was high significantly and insignificantly affected with the tested sowing spaces of 15, 25, 35 and 45 cm during the two guar summer growing seasons of 1994 and 1995, respectively. From the obtained results in Table (4), it is clear that the increasing of space between plants from 15 to 25 and 35cm increased the population density of *A. gossypii* on guar leaves. The highest averages numbers of 8.29 and 0.91 nymphs and adult females /20 leaves were recorded on guar plants sown with 35cm space. However, the lowest ones of 2.86 and 0.33 were obtained with the widest space (45cm) during the first and second seasons, consecutively. Guar plants sown in narrowest spaces of 15 and 25 cm showed moderate levels of aphid abundance.

2.1.2. The cotton leafhopper, *Empoasca lybica* de Berg

The average numbers of *E. lybica* on guar plants had low insignificant differences between the tested sowing spaces and ranged between 0.03 - 0.08 and

Table 4: Effect of different sowing spaces on the infestation of guar plants with some leaf insect and mite pests along with seeds yield at Gemmeza region during the two successive seasons of 1994 and 1995.

Sowing spaces (cm)	Avg. no. of individuals / 20 leaves			Avg. no. of individuals / inch² of 20 leaflets		Mean seeds yield (kg/fed.)
	A. gossypii	*E. lybica*	*T. tabaci*	*B. tabaci*	*Tetranychus* spp.	
1994 season :						
15	4.98 C	0.03	1.18	9.62 D	0.07 AB	382.60 B
25	5.95 B	0.03	0.25	12.70 C	0.02 B	432.56 AB
35	8.29 A	0.05	0.07	14.91 B	0.02 B	496.28 A
45	2.86 D	0.08	0.46	16.20 A	0.12 A	419.78 B
F. test	**	N.S.	N.S.	**	*	*
1995 season :						
15	0.76	0.02	0.00 B	9.97 A	0.06 D	372.94
25	0.76	0.00	0.29 A	7.75 C	0.44 C	470.17
35	0.91	0.02	0.11 AB	9.79 AB	0.94 A	575.56
45	0.33	0.02	0.13 AB	8.83 BC	0.67 B	609.00
F. test	N.S.	N.S.	*	**	**	N.S.

0.00-0.02 jassid / 20 leaves during the two investigating seasons of 1994 and 1995, respectively (Table 4).

2.1.3.The cotton thrips, *Thrips tabaci* Lind.

Data compiled in Table (4) clearly indicate that the average numbers of this thripid species on guar plants sown in four different spaces from 15 to 45 cm had insignificant and significant differences during 1994 and 1995 seasons, successively. The average numbers of the first season (1994) ranged from 0.07 to 1.18 thrips/20 leaves, whereas those of the second one (1995) ranged from 0.00 to 0.29 individual/ 20 leaves.

2.1.4.The cotton whitefly, *Bemisia tabaci* (Genn.)

The immature stages of cotton whitefly appeared on guar plants sown with different spaces of 15, 25, 35 and 45 cm between plants on the ridge with highly significant average numbers of 9.62, 9.97; 12.70, 7.75; 14.91, 9.79 and 16.20, 8.83 individuals per inch^2 of 20 leaflets during the two successive seasons of 1994 and 1995, respectively (Table 4).

2.1.5.The common red spider mite, *Tetransychus* spp.

The moving stages of this tetranychid mite had significant and highly significant low numbers that ranged between 0.02-0.12 and 0.06-0.94 individual/ inch^2 of 20 leaflets of guar planted in different spaces between plants during the two seasons of 1994 and 1995 , successively (Table 4).

2.1.6. Seeds yield

As evidently demonstrated in Table (4), seeds yield of guar plants sown with 15, 25, 35 and 45 cm between plants on the ridge significantly and insignificantly differed during 1994 and 1995 seasons, consecutively. Mean yield of crop seeds ranged between 382.60 - 496.28 kg/feddan during the first seasons and 372.94-609.00 during the second one. It is worthy to mention that guar plants sown on the two widest spaces of 35 and 45 cm gave yield higher than those sown on the narrowest ones (15 and 25 cm) in both first and second seasons.

2.2. Pests infesting roselle

2.2.1.The cotton aphid, *Aphis gossypii* Glover

As obviously shown in Table (5), roselle plants sown on 30 cm space had the lowest average numbers of this pest of 18.88 and 12.74 individuals /20 leaves during the first and second seasons of 1994 and 1995 successively. On the other hand, plants of 50 and 40 cm spaces had the highest and lowest average numbers (43.44 and 44.94 aphids/ 20 leaves) during the first and second seasons, respectively. Statistical analysis of variance using. F. test revealed that the differences between average numbers of cotton aphids on roselle plants sown on different tested spaces (20, 30, 40 and 50 cm) were significant and highly significant during 1994 and 1995 seasons, alternatively .

These results agree with those obtained by Al-Shannaf (1994) during the second season but in the first season partially agreement was observed, who found that in both seasons planting spaces had highly significant influence on the incidence of aphids infesting cotton plants. Also, Parajulee *et al.* (1999) mentioned that row spacing had a significant effect on aphid abundance, with a strong positive relationship between the number of rows skipped and cotton aphid abundance.

2.2.2.The leguminous aphid, *Aphis craccivora* Koch

This homopterous species appeared with highly significant low numbers ranged between 0.00-0.14 aphid/ 20 leaves on roselle plants sown on 10 cm different tested spaces from 20 to 50 cm during the first season. But, the corresponding average numbers of this insect during the second season were nil (Table 5).

Table 5: Effect of different sowing spaces on the infestation of roselle plants with some insect and mite pests along with crop yield at Gemmeza region during the two successive seasons of 1994 and 1995.

Sowing dates	Avg. no. of individuals / 20 leaves			Avg. no. of individuals / inch^2 of 20 leaves			Avg. no. of individuals / 20 fruits		Mean crop yield (kg/fed.)	
	A. gossypii	*A. craccivora*	*E. lybica*	*T. tabaci*	*B. tabaci*	*Tetranychus* spp.	*E. insulana*	*O. hyalinipennis*	Seeds	Sepals
1994 season:										
20	24.61 B	00.02 BC	0.12	0.20	3.48 B	0.02	0.05 B	7.53 C	458.29A	178.07 A
30	18.88 B	00.00 C	0.06	0.48	2.70 C	0.00	1.14 A	10.00 BC	424.25B	160.34 A
40	30.95 AB	00.05 B	0.14	0.32	2.82 C	0.02	0.24 B	11.38 B	384.02C	174.12 A
50	43.44 A	00.14 A	0.12	0.43	4.18 A	0.00	0.52 B	16.43 A	273.08D	114.61 B
F. test	*	**	N.S.	N.S.	**	N.S.	**	**	**	*
1995 season:										
20	55.75 B	00.00	0.02 B	0.06	1.40 C	0.00	0.38 B	8.43 C	398.42	132.71
30	12.74 A	00.00	0.18 A	0.03	3.31 A	0.00	0.14 C	6.05 C	376.24	118.42
40	44.94 C	00.00	0.00 B	0.06	2.31 B	0.00	0.43 B	13.67 B	393.17	165.38
50	33.26 D	00.00	0.00 B	0.05	2.39 B	0.00	1.76 A	17.67 A	250.00	106.69
F. test	**	-	**	N.S.	**		**	**	N.S.	N.S.

2.2.3. The cotton leaf hopper, *Empoasca lybica* de Berg

Data given in Table (5) indicate insignificant and highly significant differences in average numbers of this cicadellid insect on roselle plants sown on different spaces during the two seasons of 1994 and 1995, respectively. The average numbers of this homopterous insect pest ranged between 0.06-0.14 and 0.00-0.18 individual/ 20 leaves during the first and second seasons, respectively.

These results are in partial agreement with the findings of Al-Shannaf (1994) who stated that the effect of tested planting spaces seemed to be statistically insignificant on the average numbers of *E. lybica* infesting cotton plants in both seasons of study.

2.2.4.The cotton thrips , *Thrips tabaci* Lind.

The average numbers of this thripid species occurred on roselle plants sown on different spaces insignificantly varied during the two seasons of investigation and ranged between 0.20-0.48 insect / 20 leaves during 1994 season and 0.03-0.06 during 1995 season (Table 5).

The present results partially agree with Al-Shannaf (1994) who found that the differences between numbers of *T. tabaci* recorded on cotton plants cultivated at three spaces were insignificant in the first season and significant in the second one.

2.2.5.The cotton whitefly, *Bemisia tabaci* (Genn.)

Roselle plants cultivated in 20, 30 , 40 and 50 cm between hills harboured different average numbers that ranged between 2.70-4.18 and 1.40-3.31 eggs , larvae and pupae/inch^2 of 20 leaves with highly significant differences between treatments during both 1994 and 1995 seasons (Table 5).

Al-Shannaf (1994) found that the space of 20 cm proved to be more effective in reducing whitefly immatures population density on cotton plants and the influence of sowing spaces proved to be statistically highly significant in the first season and insignificant in the second one.

2.2.6.The spiny bollworm, *Earias insulana* Boisd.

Data compiled in Table (5) reveal that fruits of roselle plants sown on different spaces contained relatively low numbers of larvae of the spiny bollworm with highly significant differences during the two successive seasons . The ranges of average numbers of insect larvae were 0.05 -1.14 and 0.14-1.76 larvae / 20 fruits during 1994 and 1995 seasons, respectively.

According to the findings of Al Shannaf (1994) the percentage

of bolls infestation by *Earias insulana* did not respond significantly by changing the planting space of cotton plants from 15 to 20 or 25 cm showing dissimilarity with the present results .

2.2.7.The cotton seeds bug, *Oxycarenus hyalinipennis* Costa

The numbers of this heteropterous insect pest shown in Table (5) reveal that there are highly significant differences between the tested sowing spaces during the two seasons of the present study. The average numbers of this bug were nearly equal during the two seasons of 1994 and 1995, where they ranged between 7.53-16.43 and 6.05-17.67 nymphs and adults / 20 fruits , respectively.

2.2.8. The common red spider mite, *Tetranychus* spp.

Leaves of roselle plants were invaded with insignificant low numbers of this tetranychid mite that ranged between 0.00-0.02 moving individual / 20 leaves during the first season of 1994 but they were completely free from this pest during the second season of 1995 (Table 5) .

Similar results were obtained by Al-Shannaf (1994) who mentioned that no obvious relationship was detected between the population density of common red spider mite on cotton leaves and the three planting spaces of 15, 20 and 25 cm. The same author added that the differences proved to be statistically significant in both seasons.

2.2.9.Crop yield.

As evidently shown in Table (5) the yield of both seeds and sepals were significantly different due to the tested sowing spaces during the first season, whereas those of the second one proved to be statistically insignificant at 0.05 level of probability. The mean crop yield of seeds and sepals ranged between 273.08-458.29, 250.00-398.42 and 114.61-178.07, 106.69-165.38 kg / fed., respectively. It is worthy to mention that in both first and second seasons for seeds yield and in the first season for sepals yield, the narrowest sowing space (20 cm) gave the highest yield and the widest space (50 cm) yielded the lowest yield. Whereas, during the second season the highest and lowest sepals yields were recorded with the third and fourth spaces (40 and 50 cm, respectively).

These results are confirmed with those obtained by Baruah (1995), Gurbinder and Brar (1995) and Ramu and Farooqi (1997) who studied the effect of planting spaces on yield of okra and roselle respectively. They found that seeds yield of okra or roselle plants was high with close spacing and low with wide one.

2.3. Pests infesting peppermint

2.3.1.The cotton aphid, *Aphis gossypii* Glover

As obviously shown in Table (6) low average numbers ranged between 0.00-0.05 and 0.00-0.14 aphid/ 20 leaves of this pest were recorded on peppermint plants transplanted in spaces of 20, 30, 40 and 50 cm during the two seasons of investigation. Statistical analysis of the obtained results proved that the differences between these treatments were highly significant during 1995 / 1996 season and significant during 1996/ 1997.

2.3.2.The cotton leafhopper, *Empoasca lybica* de Berg

Although the highly significant differences in numbers of this cicadellid jassid species between the tested treatments of transplanting spaces, the numbers of nymphal and adult individuals / 20 leaves were very low and ranged between 0.00-0.08 and 0.00-1.20 during the first and second seasons, successively (Table 6).

2.3.3.The cotton thrips, *Thrips tabaci* Lind.

Data in Table (6) clearly show that this thripid species appeared on peppermint plants transplanted in different spaces of 20, 30, 40 and 50 cm with low significant numbers that ranged from nil to 0.06 individual / 20 leaves during the first season of 1995/ 1996, but the individuals completely disappeared on peppermint plants of all tested spaces during the second season of 1996 / 1997.

2.3.4.The cotton whitefly, *Bemisia tabaci* (Genn.)

The highly significant variations in immatures numbers of *B. tabaci* on peppermint plants transplanted in different spaces indicate that plants planted in 30 cm were attacked with the highest average numbers of 35.46 and 268.10 individuals/ 20 leaves during the two seasons of investigation of 1995/ 1996 and 1996/1997, respectively (Table 6).

2.3.5.The common red spider mite, *Tetranychus* spp.

The effect of four tested transplanting spaces on the incidence of this mite species differed from one season to another where plants transplanted on 40 cm in the first season and 20 cm in the second one harboured the highest average numbers of 3.86 and 2.57 moving individuals of mites / 20 leaves, respectively. Also, the lowest average numbers of 0.49 and 0.09 mite/ 20 leaves were recorded on plants planted in 30 cm and 50 cm spaces during 1995/ 1996 and 1996/ 1997 seasons, successively (Table 6).

Table 6: Effect of the different transplanting spaces on the infestation of peppermint plants with some leaf insect and mite pests along with fresh canopy yield during the two successive seasons of 1995/1996 and 1996/1997.

Transplanting spaces (cm)	Average numbers of individuals/20 leaves						Mean fresh canopy yield (ton/fed.)
	A. gossypii	*E. lybica*	*T. tabaci*	*B. tabaci*	*Tetranychus* spp.	*B. obovatus*	
1995/96 season:							
20	0.02 B	0.08 A	0.02 B	30.08 B	1.10 B	51.00 A	1.23 C
30	0.05 A	0.00 C	0.03 B	35.46 A	0.49 B	45.66 A	1.63 AB
40	0.00 C	0.02 B	0.06 A	18.78 C	3.86 A	50.67 A	1.52 B
50	0.00 C	0.00 C	0.00 C	20.06 C	0.91 B	31.33 B	1.83 A
F. test	**	**	*	**	**	*	*
1996/97 season:							
20	0.08 A	1.20 A	0.00	93.85 D	2.57 A	11.54 A	1.05 B
30	0.00 B	0.03 B	0.00	268.10 A	0.71 B	7.85 C	1.58 A
40	0.04 AB	0.06 B	0.00	238.96 B	0.72 B	9.40 B	1.51 A
50	0.14 A	0.00 B	0.00	130.09 C	0.09 C	6.75 C	1.72 A
F. test	*	**		**	**	**	**

2.3.6. The flat spider mite, *Brevipalpus obovatus* Donnadieu

Data compiled in Table (6) reveal also that peppermint plants of 20,30 and 40 cm spaces in 1995/1996 were insignificantly invaded with nearly equal numbers of *B. obovatus* of 51.00, 45.66 and 50.67 moving individuals/ 20 leaves, respectively, but they significantly varied with those transplanted on 50 cm that had the lowest average numbers per 20 leaves of 31.33. During the second season, this trend differed significantly between treatments where the highest average (11.54) was observed with the narrowest space of 20 cm and the lowest one of 6.75 mites/ 20 leaves was recorded with the widest space of 50 cm.

2.3.7. Canopy yield

The differences between means of fresh canopy yield (ton/ fed.) were statistically significant and highly significant in the first and second seasons, respectively. The amount of yield ranged from 1.23 to 1.83 ton / fed. during the first season of 1995/ 1996 and from 1.05 to 1.72 during the second one of 1996/ 1997. The highest yield was recorded with 50 cm transplanting space and the lowest yield was recorded with 20 cm space in the two investigating seasons of 1995/ 1996 and 1996 /1997 (Table 6).

Galambosi *et al.* (1998) stated that the amount of fresh yield of peppermint can be changed according to transplanting spaces.

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تأثير مواعيد ومسافات الزراعة على بعض الآفات التى تصيب ثلاث نباتات طبية وعطرية

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زرعت ثلاث نباتات طبية وعطرية وهى الجوار، الكركديه والنعناع الفلفلى فى مواعيد ومسافات زراعه مختلفة أثناء موسمين متتاليين للنمو فى منطقة الجميزه، محافظة الغربية. أوضحت مواعيد الزراعه المختبرة معنوية عالية للفروق بين متوسطات أعداد حشرات من القطن، نطاط أوراق القطن، تربس القطن، ذبابة القطن البيضاء واكاروس العنكبوت الاحمر العادى أثناء موسمى النمو المتتاليين ١٩٩٤ و ١٩٩٥م، فيما عدا فى حالة نطاط أوراق القطن والذى أظهر تأثيراً معنوياً فى موسم ١٩٩٤م وتأثير غير معنوى فى موسم ١٩٩٥ م، وكذلك اتضح أن مستوى تعداد اكاروس العنكبوت الأحمر العادى إستجاب بدرجة معنوية وعالية المعنوية طبقاً لمواعيد الزراعه المختبرة فى الموسمين الأول والثانى، على التوالى. فى موسمى نمو الكركديه لعامى ١٩٩٤ و ١٩٩٥ تباينت مستويات تعداد كل من آفات من القطن، نطاط أوراق القطن، تربس القطن، ذبابة القطن البيضاء، دودة اللوز الشوكية، بقة بذور القطن وأكاروس العنكبوب الأحمر العادى بدرجة معنوية طبقاً لميعاد الزراعة. إتضح أن الفروق بين متوسطات تعداد تلك الآفات كانت عالية المعنوية بأستثناء تلك الخاصة بنطاط أوراق القطن والتى أظهرت إختلافات غير معنوية فى كلا الموسمين. إختلف تعداد الأفراد المتحركة لأكاروس العنكبوت الأحمر العادى بدرجة غير معنوية فى الموسم الثانى. تبين أن الفروق بين مواعيد الشتل الخمسة المختبرة لنباتات النعناع الفلفلى على معدل التواجد لأربع أنواع حشرية وهى من القطن، نطاط أوراق القطن، تربس القطن، ذبابة القطن البيضاء ونوعى من الحلم هما أكاروس العنكبوت الأحمر العادى وأكاروس العنكبوت المبطط كانت معنوية من الناحية الإحصائية فى موسمى الدراسة ١٩٩٤، ١٩٩٥ م، باستثناء مايخص نطاط أوراق القطن ومن القطن والتى أظهرت تباينات غير معنوية أثناء الموسمين الأول والثانى، على التوالى. ولقد إختلفت متوسطات أعداد اكاروس العنكبوت الأحمر العادى ونطاط أوراق القطن بدرجة غير معنوية فى الموسم الأول ومعنوية فى الموسم الثانى. ظهرت أفراد الذبابة البيضاء وأكاروس العنكبوت المبطط على نباتات النعناع بأعداد مرتفعه مع ميعاد الشتل الخامس مقارنة بالآفات الأخرى.

فيما يختص بتأثير مسافات الزراعة، وجد أن نباتات الجوار أصيبت بذبابة القطن البيضاء وأكاروس العنكبوت الأحمر العادى بدرجات مختلفة المعنوية حسب مسافات الزراعة، بينما استجابت حشرتى من القطن وتربس القطن بدرجة مختلفة من موسم الأخر ولقد تأثرت حشرة نطاط أوراق القطن بدرجة غير معنوية بتغير مسافة الزراعة. ولقد أثبتت النتائج المتحصل عليها أن مسافة الزراعه الرابعة للكركديه كانت أكثر مناسبة لنمو وتكاثر حشرة من القطن مقارنة

بالمسافات المختبرة الأخرى أثناء الموسم الأول. إختفت أفراد كل من منّ البقوليات وأكاروس العنكبوت الأحمر العادى مع مسافات الزراعه المختبرة خلال الموسم الثانى لعام ١٩٩٥م، ولقد إتضح أيضاً أن حشرات من البقوليات اختفت من على النباتات المنزرعه للمسافة الثانية (٣٠سم). بينما إختفى أكاروس العنكبوت الأحمر العادى فى مسافتى الزراعة الثانية والرابعه فى الموسم الأول. ولكن، إختفت أفراد حشرة نطاط أوراق القطن من على نباتات الكركدية المنزرعة بمسافتى الزراعة الثالثة والرابعة أثناء الموسم الثانى. أصابت حشرات من القطن، نطاط أوراق القطن، تربس القطن، ذبابة القطن البيضاء وأكاروسى العنكبوت الأحمر العادى والمبطط نباتات النعناع الفلفلى فى مسافات الزراعة المختبرة خلال موسمى البحث باستثناء حشرتى من القطن ونطاط أوراق القطن والتى اختفت تماماً من على نباتات النعناع التى شتلت بالمسافتين الثالثة والرابعة فى حالة من القطن ومع المسافتين الثانية والرابعة لنطاط أوراق القطن فى الموسم الأول. فى الموسم الثانى، إختفت تلك الآفات من على النباتات المشتولة بكل من المسافتين الثانية والرابعة، على التوالى. لقد إختفت أفراد تربس القطن تماماً على نباتات النعناع المشتولة بكل مسافات الزراعة فى الموسم الثانى ولكن فى الموسم الأول اختفت أفراد تربس القطن من على نباتات مسافة الشتل الرابعة فقط. فى كلا الموسمين، ثبت أن تأثير مسافة الشتل لنباتات النعناع الفلفلى على تواجد الآفات سالفة الذكر كان معنوى وعالى المعنوية من الناحية الإحصائية.