SUMMARY

Onion (*Allium cepa* L.) is, undoubtedly, one of the important vegetable crops in Egypt, for local consumption and Exportation. Due to the steady increase of areas cultivated with this crop, the present study was carried out at the Experimental Farm of the Faculty of Agriculture at Moshtohor throughout two successive onion seasons (1993 / 94 and 1994 / 95) in the nursery and permanent field to study the relationship between three factors (onion variety, seeding or transplanting date and the rate of nitrogen fertilization) and the infestation rate of onion plants by two main onion pests; the onion thrips, *Thrips tabaci* Lind. and the onion maggot, *Delia alliaria* Fons. Another study was carried out to evaluate the possibility of using traps of different colours placed in different directions of the onion field for attracting and trapping adults of the mentioned pests. The obtained results may be summarized as follows:

1- Nursery experiments:

The obtained results of two onion seasons (1993 / 94 and 1994 / 95) indicated the following:

A- The Improved Giza 6 onion variety was more susceptible to infestation by *T. tabaci* larvae and adults than Giza 20 variety, the two season mean numbers of *T. tabaci* larvae / 10 plants were 60.95 ± 10.41 and 41.15 ± 6.37 while those of adults were 7.90 ±1.45 and 5.58 ± 0.93, respectively. As for infestation of the two onion varieties by *D. alliaria* larvae, the differences between mean counts recorded from the two varieties were insignificant. This may be attributed to that the larvae were detected in onion seedlings in very low numbers
(two season mean counts were only $0.16 \pm 0.04$ and $0.15 \pm 0.03$ larvae / 10 plants of Giza 20 and Improved Giza 6 varieties, respectively).

**B**- The population of *T. tabaci* larvae and adults was found to be increased by retarding the seeding date. The two season mean numbers of *T. tabaci* individuals were $35.09 \pm 4.88$, $43.54 \pm 7.10$, $55.34 \pm 11.52$ and $69.93 \pm 12.24 / 10$ seedlings, while the corresponding counts of adults were $4.30 \pm 0.89$, $5.36 \pm 1.06$, $7.23 \pm 1.15$ and $10.06 \pm 1.75$ by sowing in the first (Sep., 25th), second (Oct., 11th), third (Oct., 27th) and fourth (Nov., 12th) dates, respectively. Generally, by seeding in either of the four dates, *T. tabaci* larval and adults population showed low abundance in October and increased gradually from first of November till the second half of January.

The larvae of *D. alliaria* were found in low numbers in all seeding dates, but larval counts in seedling from the third seeding date were, relatively, higher than those from the three other dates. The two season mean larval counts were $0.06 \pm 0.03$, $0.08 \pm 0.04$, $0.28 \pm 0.10$ and $0.22 \pm 0.05$ larva / 10 seedlings from the 1st, 2nd, 3rd and 4th dates, respectively. The lowest number of *D. alliaria* larvae was recorded in October and increased gradually from the end of November till the second half of January.

**C**- By studying the combined effect of onion variety and seeding date on the rate of *T. tabaci* larval and adults' infestation to onion seedlings, data indicated that seedlings of Improved Giza 6 variety that grew after sowing in the latest date suffered the heaviest infestation level (overall means of two seasons $81.04 \pm 11.75$ larvae and $11.91 \pm 1.96$ adults/10 seedlings) than all recorded on the remaining 7 treatments. On the contrary, seedlings of Giza 20 onion
variety that grew after sowing in the earliest date harboured the lowest counts of larvae and adults (28.06±4.79 larvae and 3.26±0.59 adults / 10 seedlings).

II- Permanent field experiments :

A- Date indicated that Improved Giza 6 onion variety was more liable to infestation with *T. tabaci* larvae and adults than Giza 20. (Two season means of 49.2±7.82 larvae and 4.4±0.56 adults on Improved Giza 6 plant opposed to 35.5±5.17 larvae and 3.7±0.47 adults on an Giza 20 plant). As for the onion maggot, *D. alliaria* larvae, those were detected in, relatively, very small numbers in the two seasons of study with no significant between the two varieties. The two season mean counts were only 0.078±0.022 and 0.084±0.023 larva / plant for the two mentioned varieties, respectively.

B- Infestation by *T. tabaci* larvae and adults on onion plants increased significantly as the transplanting date was delayed. The lightest infestation rates (means of 30.71±4.83 larvae and 3.13±0.42 adults) were detected on plants of the earliest transplanting date (December, 6th) while on the contrary the heaviest infestation level (overall means of two seasons, 56.59±9.12 larvae and 4.91±0.64 adults) occurred on plants of the latest transplanting date (January, 20th). The intermediate transplanting dates (December, 21st) and January, 5th) gave plants that sowed intermediate positions between the earliest and latest transplanting dates. From inspection of the weekly samples, it was noticed that the number of *T. tabaci* larvae and adults started low in January and increased from the end of February to the end of May. Concerning infestation of onion plants transplanted at
different dates on the infestation level by *D. alliaria*, the larvae of this pest appeared in very low numbers also and the differences between the mean infestation rates after transplanting at different dates were, statistically, insignificant. The recorded means for the number of *D. alliaria* larvae were 0.040±0.010, 0.035±0.010, 0.071±0.024 and 0.067±0.023 larvae/plant after transplanting on December, 6th and 21st and January, 5th and 20th, respectively.

C- Evaluation of the effect of ammonium nitrate, as a nitrogen fertilizer, to soil after transplanting of onion at 3 rates (60, 90 and 120 N units / feddan) revealed a positive significant correlation in both seasons of study between the applied rate of nitrogenous fertilizer and the rate *T. tabaci* infestation. That was clearly evident in cases of the pest larvae and adults. The lightest infestation level occurred on plants of the control check which did not receive any N - fertilization as the two season averages were 15.34±2.13 larvae and 1.68±0.19 adults / plant apsosed to 36.98±5.58, 50.34±7.75 and 66.34±10.57 larvae, and 3.55±0.47, 4.81±0.64 and 6.16±0.79 adults / plant in treatments that received N - fertilization at 60, 90 and 120 N-units / feddan, respectively. *D. alliaria* larvae were detected in onion plants of all treatments in very low numbers (mean of two seasons; 0.024±0.007, 0.019±0.006, 0.037±0.015 and 0.027±0.008 larvae / plant in the control treatment and the three treatments of ammonium nitrate applications, respectively). The differences between the mentioned means were found, statistically, insignificant.

D- The combined effect of both onion variety and transplanting date on the rate of *T. tabaci* and *D. alliaria* infestation were also studied. The two factors' effect was found significant on *T. tabaci* larval and adults
count. The lightest rate of infestation occurred on plants of Giza 20 variety that were transplanted on December, 6th, i.e.; the earliest date (26.65±4.44 & 24.14±4.7 larvae, and 4.49±0.71 & 4.41±0.8 adults/plant in 1994 and 1995 seasons, respectively. On the other extreme, plants of Improved Giza 6 variety transplanted at the latest date (January, 20th) harboured the highest rates of *T. tabaci* infestations (77.08±12.35 & 63.1±12.54 larvae, and 6.51±0.83 & 4.83±0.88 adults/plant in both seasons, respectively). The remaining treatments gave intermediate values of *T. tabaci* infestations, although the same trend of higher infestation on Improved Giza 6 variety and delaying the transplanting date could be, easily, detected. As for *D. alliiaria* larvae infestations in onion plants, the recorded counts were very low in both seasons of study so that most of the inspected samples were found free from any onion maggot infestation. The calculated F value between the obtained means indicated that the differences between means of *D. alliiaria* larvae from different treatments were insignificant.

E- By studying the impact of onion variety and the rate of nitrogenous fertilization on infestation by the two pests under investigation, significant F values were detected between treatments when *T. tabaci* larvae and adults' infestation rates to onion plants were concerned. The highest rates of infestation occurred significantly to onion plants of Improved Giza 6 variety that received the nitrogen fertilizer (ammonium nitrate) at the highest rate; i.e., 120 N-units/feddan (80.01±13.75 & 78.43±13.28 larvae and 6.84±0.85 & 6.53±1.03 adults/plant in 1994 and 1995 seasons, respectively), while the lightest infestation rates occurred, significantly, on Giza 20 onion plants that grew without any N-fertilization (13.93±2.05 & 15.39±
2.38 larvae and 1.49±0.22 & 1.48±0.23 adults /plant in both seasons, respectively). The general trend of data indicated higher rates of *T. tabaci* infestation on Improve Giza 6 than Giza 20 variety, and also the rate of infestation increased by increasing the N-fertilization rate. As for *D. alliaria* infestation to onion plants of different treatments, the larval counts ranged between 0.022 - 0.079 and 0.006 - 0.014 larva / plant of Giza 20, and between 0.009 - 0.044 larva and 0.009 - 0.016 larva / plant of Improved Giza 6 variety in 1994 and 1995 seasons, respectively with insignificant differences between mean larval counts from different treatments, and accordingly no fixed correlation could be detected between both factors and the rate of *D. alliaria* infestation.

**F-** The combined effect of transplanting date and nitrogen fertilization level on *T. tabaci* infestation rate to onion plants proved significant. Generally, infestation with larval and adult stages of the pest increased by increasing the dose of ammonium nitrate added to soil, on one hand, and by delaying the transplanting date, on the other hand. The highest overall mean of *T. tabaci* larval and adults' counts occurred on plants of the latest transplanting date and received the highest dose of ammonium nitrate (91.44±14.25 & 82.36±17.65 larvae, and 8.71±1.16 & 8.32±1.1 adults / plant in 1994 and 1995 seasons, respectively). On the other extreme the lowest counts occurred on onion plants that did not receive any N-fertilization and were transplanted at the two earliest dates 15.98±2.36 & 11.04±1.76 larvae/plant in 1994 and 11.24±1.83 & 14.72±1.98 larvae / plant in 1995 on the unfertilized plants transplanted on December, 6th and 21st, respectively, while in case of adult counts, the receptive counts were 1.31±0.23 & 1.76±0.36 adults / plant in 1994 and 1.10±0.15 &
1.53±0.27 adults /plant in 1995. Data indicated also that increasing N-fertilization level had much more effect in increasing the *T. tabaci* infestation rate than that occurred due to delaying the transplanting date.

The three studied factors; i.e., onion variety, transplanting date and N-fertilization altogether proved to have a significant combined effect on the rate of infestation by *T. tabaci* larvae and adults. The highest rate of infestation occurred on plants of Improved Giza onion variety transplanted on January, 20th (the latest date) and received the highest dose of ammonium nitrate (120 N-units / fed.) as in this case the larval and adults' populations reached their maxima numbers (124.09±22.49 & 98.08±21.58 larvae and 10.49±1.45 & 7.33±1.43 adults / plant in 1994 and 1995 seasons, respectively). The lowest infestation rates occurred, on the other hand, on onion plants of Giza 20 variety transplanted on December, 6th and did not receive any nitrogen fertilizer (8.09±1.73 & 10.26±1.79 larvae and 1.21±0.21 and 0.81±0.13 adults / plant in both seasons, respectively).

It could be, generally, concluded that N-fertilization was the most pronounced factor that affected the rate of *T. tabaci* infestation and consequently this point seemed to need further investigations to find out the best dose of nitrogen fertilization that could be applied to onion plants to insure the least infestation level with *T. tabaci* and the highest crop yield at the same time. It appeared also important to choose the variety which proof of relative resistance to *T. tabaci* infestation and gives better crop yield from the quantity and quality points of view. It could be also recommended that onion is better to be sown and transplanted earlier as in this case the plants were found to be infested
with lower populations of *T. tabaci*. As for the onion maggot the recorded rates of infestation were very low throughout the two seasons of study to the level that no definited recommendation could be concluded.

III. Efficiency of colour traps and their directions in attracting *T. tabaci* and *D. alliaria* adults to colour traps:

1- Attractiveness of *T. tabaci* and *D. alliaria* adults to colour traps.

The efficiency of different colour traps in attracting adults of *T. tabaci* and *D. alliaria* was assayed. Five different colours were evaluated (white, yellow, blue, green and red). Results showed the following:

A- Attractiveness of *T. tabaci* adults:

White colour traps proved as superior in attracting adults of the cotton thrips adults (922.78 and 1392.38 adults / trap left in position in 5 day in 1994 and 1995 seasons, respectively). Blue traps came the next in both seasons (689.25 and 918.91 adults / trap), while the yellow traps took the third position (372.41 and 528.97 adults, respectively). The green and red colour traps were of minor efficiency compared to the formerly mentioned colours.

B- Attractiveness of *D. alliaria* adults:

Significant differences between mean adult counts attracted to traps from different colours were, statistically, detected. The white colour traps caught the highest adult numbers, followed by the yellow and the blue colour traps (means of two season counts 17.06, 15.02 and 11.59 *D. alliaria* adults / trap, respectively). The green and red colour
traps were always of minor efficiency (4.81 and 2.44 adults / trap, respectively).

2- Distribution of *T. tabaci* and *D. alliaria* adults in different directions of onion field:

A- *T. tabaci*:

In both seasons of study, the highest mean count of *T. tabaci* adults were those attracted to traps placed in southern direction of the onion field (669 and 793 adults / trap in 1994 and 1995 seasons, respectively), while the lowest count was detected in traps placed in the eastern direction (247.93 and 535.23 adults, respectively). Traps of different colour, that were placed in the north or west directions showed intermediate positions. Superiority of southern direction may be due to the normal wind direction from north to south.

B- *D. alliaria*:

*D. alliaria* adult counts that were detected in traps placed in different directions averaged 4.35-9.19 in 1994 and 10.2 - 14.25 adults/trap in 1995 indicating low abundance of the onion maggot throughout the two seasons of study. According to the means of both seasons data, the density of *D. alliaria* adults in the 4 directions may be arranged descendingly as east (11.41 adults), south (10.28), north (9.63) and west (9.3 adults / trap). The differences between the mentioned means were statistically, significant.

3- Combined effect of the colour and place of trap on the catch:

A- *T. tabaci* adults:

Highest mean counts of *T. tabaci* adults caught to traps occurred by using white traps placed in the southern direction of the onion field.
(1481.38 and 1895.25 adults/trap in 1994 and 1995 seasons, respectively). While the lowest count was, on the other hand, detected in case of red traps placed in the eastern direction of the field (only 31.13 and 112.25 adults/trap in both seasons, respectively). It could be generally concluded that the colour of trap was more effective on the distribution of *T. tabaci* adults than wind direction. Using of white traps placed in either the south or north directions may be fairly, recommended as efficient tool to insure higher catch of *T. tabaci* adults to be used for estimating the population. It is thought that using the white colour traps in southern or northern directions to control *T. tabaci* is a point that needs further investigations before any recommendation.

3- *D. alliaria* :

The caught numbers of *D. alliaria* adults in traps of different colour placed at different directions were, relatively, low, although this numbers varied from one colour to another and also between the different directions. It could be also stated, from the obtained results, that the colour of trap was more effective in attracting *D. alliaria* adults than the wind direction. It was clear that the white colour traps attracted highest *D. alliaria* adult numbers, whether these traps were placed in the east, west or southern directions (19.88, 18.07 and 15.94 adults / trap, respectively). That was followed by the yellow traps placed in the east, south, north or western directions, then came the white traps placed in the northern direction (15.88, 14.88, 14.51, 14.44 and 13.88 adults / trap, respectively). Accordingly, the white or yellow colour traps may be, fairly, considered valuable in monitoring the population of *D. alliaria* adults in onion fields wherever these traps are placed.