EFFECT OF SOWING DATES AND PLANTING DENSITY ON THE INFESTATION OF ONION MAGGOT (*Delia alliaria* Fonseca) IN ONION (*Allium cepa* L.) CROPS

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ABSTRACT

Onion maggot (*Delia alliaria* Fonseca) is an important pest of onion in Iraq, it is responsible for causing serious quantitative and qualitative losses to the onion crops. Nursery and field studies were conducted at college of Agriculture, Abu Ghraib, Iraq to evaluate the effects of sowing date and plant density on onion infestation with onion maggot. Onion seeds were sowing in nursery at three dates viz 5th & 20th September and 3rd October, 2010 with two plants density i.e. 10seed/2m² and 15 seeds /2m². From Nursery, the plants were transplanted to the field at three dates viz 14th & 24th December, 2010 and 3rd January, 2011 with two density i.e. 10seed/2m² and 15 seeds /2m² with 10 cm and 6 cm plant spacing. Result of the study showed that the lowest infestation of onion maggot was manifested at the lower plants density and first date of cultivation at both nursery and field level. At nursery level 6.16, 6.83 and 7.50 % infestation was reported for three dates of showing respectively at 10g seeds / 2 m² while this infestation was 8.61, 7.50 and 11.5 % respectively for the three sowing dates at 15 g/2 m² densities. Similar types of results were reported in the field study but with slightly higher infestation, here 8.81, 12.54 and 14.04 % infestation was reported on the three plantings dates at 10 cm plant spacing respectively while this infestation was much higher 12.13, 16.81 and 19.04 % respectively for three sowing dates on the 6 cm plant spacing. Higher yield was obtained from the plants of the 1st date of sowing for both the plant densities with best quality. The mean bulb weights were 252.90, 228.30 and 172.00g for the plants growing at 10 cm spacing while this weights was 213.5 , 167.0 and 153.7 g for the plants growing at 6 cm spacing for all the three dates of cultivation respectively. Results of the study revealed that cultivation onion at early date with suitable spaces between the plants may be promising to manage the infestation with onion maggot.

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1 Introduction

Onion (Allium cepa L.) belongs to family Amaryllidaceae/ Liliaceae is cultivated as a winter vegetable crops in several parts of the world including United States, China, India, Egypt and Brazil (FAO, 1988). In Iraq onion crop is cultivated in the middle and northern areas especially in Nineveh and AL-Anbar governorates at area attained to 22990.25 Hectare and the mean productivity was 1065.95 kg /Hectare and 474.67 kg / Hectare of fresh and dry onion respectively in 2010 ( Central Bureau of Statistics agricultural, 2010).

It has been reported that worldwide onion plants severely infested with onion maggot (Delia alliaria Fonseca); the percentage infestation ranged was reported from 20 – 60% and it was causing heavy losses in yield quality and quantity (Ellis & Eckenord, 1979, Taylor et al., 2001). It has been well reported that the size and quality of onion bulbs were affected by the date of cultivation and onion cultivar (Finch et al., 1986). It was observed that early cultivation of onion plants escaped from the infestation by the first generation of the insect and reduced eggs deposition by females which led finally to decrease the damage of yield (Brewster, 1994). Szwejda (1986) tested the effect of three dates of onion cultivation on the infestation of D. antiqua at nursery level study in Poland and reported that early sowing reduced the percentage of infestation. Similarly, Ali et al. (1986) evaluated the effect of four onion cultivation dates at nursery level and reported lower infestation of D. antiqua larvae on the plants of first cultivation date while the highest infestation was reported on the plants of the 3rd date. Furthermore, it was also reported that the space between onion plants also affect the rate of D. antiqua infestation and the lowest infestation was registered on the plantation of suitable spaces in the field (Al-Sroe & Abdel Hamid , 1985 ) EL-Zaadany & Salman (2000) reported lower percentage infestation at 10 cm onion plant spacing. The study was conducted to determine the suitable date of onion cultivation in Iraq. Furthermore, effect of plant spacing and the effect of D. alliaria infestation on the quality and quantity of the onion bulb were also studied.

2 Materials and Methods

2.1 Effect of sowing date and plant density on the infestation with Delia alliaria at nursery level

The experiment was conducted at the Collage of Agriculture, Abu – Ghrailb, Iraq. Onion seeds of White Grano cultivar were sown in nursery at three dates viz 5th & 20th September and 3rd October, 2010 with two plants density i.e. 10seed/2m² and 15 seeds /2m² in randomized complete block design (RCBD) with three replications. The seeds were sown in blocks of 1x2 m² at lines spacing of 20 cm. Fifteen plants of each replication were pulled out at 15cm depth and the percentage of D. alliaria infestation was evaluated. Removal of plants was followed weekly until transplantation into the field.

2.2 Effect of cultivation date and plantation density on bulbs size and weight

Onion seedlings were transplanted into the field on three dates viz 14th & 24th December, 2010 and 3rd January, 2011. Seedlings were planted at two sides of lines with 5m length spacing of 75 cm with three replications (5 lines / replication). The treatments were distributed in RCBD at two plantation densities (6 cm and 10 cm of plants spacing). After two weeks of transplantation 15 plants of each replicates were pulled out from 15 cm depth and the infestation percentage was calculated. Number, size and weight of onion bulbs for one line / replication were estimated at harvesting stag. Based on the size, onion bulbs were divided to three grades grade 1 (diameter more than 7 cm), Grade 2 (diameter between 4-7 cm) as graded 3 (diameter less than 4cm) as described by Nguthi et al. (1994).

3 Results and Discussions

3.1 Effect of sowing date and plant density on the onion infestation with Delia alliaria in nursery

Results of the study are presented in table 1, these results revealed that first infection was appeared at the beginning of November, 2010 and the lowest infestation was reported on the 1st date of sowing (1.33%) and it was comparatively lower than 2nd (3.33) and 3rd (2.33%) date of sowing at 10 g seeds/ 2m² density. The infestation percentages were found higher on the plants sown at high density (15 g seed / 2m²) and these plants attained 1.67, 5.00, and 3.00 % infestation for three showing dates respectively. The insect infestation was gradually increased and attains the maximum infection during the first week of December with significant differences between the two plant densities. It was reported 9.33, 11.67 and 13.00 % for the plants of 10 g seeds / 2m² while it reached to 13.67, 15.00, and 19.00 % for the plants of 15 g seeds / 2m² for the three dates of cultivation respectively.

The general means of infestation percentage with D. alliaria indicated that the lowest infestation percentage which was observed on the plants generated from onion seeds cultivated in the first week of September, 2010 (Table 1). The highest infestation percentage by the insect was reported at the third date of sowing in 15 g seeds / 2m² (11.5%). These results were in accordance with several previous studies conducted in Iraq indicated that the lowest infestation percentage with D. antiqua was registered on the plants of the first date of sowing (2nd week of September, 2010) while the highest infestation percentage by the insect was on the plants of the 3rd date (3rd of October, 2010) Similar type of findings was reported by Ali et al. (1986).
According to Brewster (1994) plants from the early sowing have escaped from the infestation by the first generation of D. antiqua and it is associated with decrease in eggs deposited by the females and finally reduced the infestation percentage in nursery.

### 3.2 Effect of cultivation dates and plant spacing on the onion infestation by D. alliaria under field conditions

Result of the field experiment indicated a significant differences in onion infestation percentage by D. alliaria between the three cultivation dates and for the two plantation densities under the field condition (Table 2). Like nursery, here also the lowest infestation was reported on the plants of 1st date of cultivation with 10 cm spacing (8.93 %) in January month, this was followed by 3rd date (9.45 %) date of sowing and the highest infestation was reported for the sowing of 2nd date (11.41%). The lowest infestation with 6 cm spacing was reported on the 1st date of plantation while the highest infestation was in 2nd date. This infestation was 13.32, 15.30, and 14.04 % for the three cultivation dates respectively. It was observed that in February, 2011 the lowest insect infestation was reported for the 2nd date of cultivation while the highest infestation was reported for the 3rd date for the two plantation densities, 12.99, 11.6 and 18.55% respectively on the plants of 10 cm spacing and 16.35, 12.83 and 24.44% on the plants of 6cm spacing for the three dates respectively.

The infestation means were slightly decreased during March, 2011 but re-increased and attain the maximum insect infestation in the month of April, 2011 for the three dates of cultivation on both of plantation densities. At this stage, infestation percentage were reported 11.84, 22.30 and, 25.19 % for the plants of 10 cm spacing while this was 15.89, 30.50 and 35.02 % for the 6 cm spacing for the three dates of cultivation respectively. The infestation by the insect was then highly decreased and reach to 0.33, 2.58 and 3.89 % for the plants of 10 cm spacing while it is 0.64, 3.77 and 4.44 % for the 6 cm spacing for the three dates of cultivation respectively in the month of June, 2011.

Result of this study showed that the lowest infestation by D. alliaria was reported in the onion plants of 10 cm spacing from the first date of cultivation compared to those of 2nd and 3rd date of cultivation. This may rendered to that the size of onion bulbs of 2nd and 3rd date of cultivation were larger than those of the 1st date which may be more preferable by the adult for eggs deposition and easy to penetrate by the larvae and reached to plant center causing plant death through short period (Ali et al., 1986).

In addition the ecological conditions, Temperature, Humidity, Rain and Wind may play a significant role in insect activity as shown by decrease and increase of infestation percentage during the period of the experiment. Several previous studies reported that the lowest infestation by the insect was found in September while the highest was in the last week of October (Ali et al., 1986). Brewster (1994) found that the early cultivation has decreased the damage caused by the larvae, where onion plants are too small to be preferred by the female to deposit the eggs which may lead finally to escape from the infestation by the insect. The results of this study are contradictory to the findings of Werling (2004) those who have reported lower insect infection on the plants of the 3rd date, while the higher infection was on 1st date of cultivation (37.21, 2 % respectively) for the three dates of cultivation. Nault et al. (2011) in the United States reported that retardation of onion sowing 2-4 weeks has led to reduction in onion infection with D. antiqua. The differences in the results may attributed to the difference in environmental conditions between Iraq and the United States which led to difference to the date of insect emergence. Table (3 and 4) showed significant differences in bulbs weight between the three dates of cultivation in the two plantation densities. The highest weights were found in the plants of first (early) date of cultivation, while the lowest weights were found in those of 3rd (late) date of cultivation. This weight was 4.13, 3.64 and 2.35 kg in the plants of 10 cm spacing for the three dates respectively. The mean of one bulb weight was found 252.90, 228.30 and 172.00 g in the plants of the 10 cm spacing while it was 213.50, 167.00 and 153.70 g in the plants of 6 cm spacing for the three dates of cultivation respectively.

### Table 1 Effect of sowing date and plant density on the infestation percentage with D. alliaria in nursery

| Cultivation Dates | Plantation density | 6th November, 2010 | 19th November, 2010 | 22nd November, 2010 | 29th November, 2010 | 6th December, 2010 | 13th December, 2010 | Mean |
|-------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|------|
| 1st date          | 10 g seeds / 2m²   | 1.33               | 4.67               | 5.67               | 7.00               | 9.33               | 8.00               | 6.16 |
|                   | 15 g seeds / 2m²   | 1.67               | 3.00               | 8.00               | 12.67              | 13.67              | 11.33              | 8.61 |
| 2nd date          | 10 g seeds / 2m²   | 3.33               | 5.00               | 6.00               | 8.33               | 11.67              | 6.67               | 6.83 |
|                   | 15 g seeds / 2m²   | 5.00               | 7.00               | 9.67               | 12.33              | 15.00              | 9.67               | 9.55 |
| 3rd date          | 10 g seeds / 2m²   | 2.33               | 6.67               | 7.00               | 9.00               | 13.00              | 8.67               | 7.50 |
|                   | 15 g seeds / 2m²   | 3.00               | 9.00               | 11.00              | 16.33              | 19.00              | 14.33              | 11.5 |
| Mean              |                    | 2.66               | 7.83               | 9.00               | 12.66              | 16.00              | 11.5               | 9.5  |

0.05 LSD: 0.45 1.02 0.62 0.80 1.1 1.24 0.84
Table 2 Effect of cultivation date and plant spacing on the infestation by *D. alliaria* in field.

| Dates                  | Planting spacing | Infestation percentage with onion maggot | Mean |
|------------------------|------------------|----------------------------------------|------|
|                        |                  | January     | February    | March      | April     | June     |
| First date             |                  |             |             |            |           |          |
| 14 December, 2010      | 10 cm            | 8.93        | 12.99       | 10.00      | 11.84     | 0.33     | 8.81     |
|                        | 6 cm             | 13.33       | 16.35       | 14.44      | 15.89     | 0.64     | 12.13    |
| Second date            |                  |             |             |            |           |          |
| 24 December, 2010      | 10 cm            | 11.41       | 11.66       | 14.76      | 22.30     | 2.58     | 12.54    |
|                        | 6 cm             | 15.30       | 12.83       | 21.66      | 30.50     | 3.77     | 16.81    |
| Third date             |                  |             |             |            |           |          |
| 3 January, 2011        | 10 cm            | 9.45        | 18.55       | 13.16      | 25.19     | 3.89     | 14.04    |
|                        | 6 cm             | 14.04       | 24.44       | 17.27      | 35.02     | 4.44     | 19.04    |
| Mean                   |                  |             |             |            |           |          |
|                        |                  | 12.07       | 16.13       | 15.19      | 23.45     | 2.60     | 13.89    |
| 0.05LSD                |                  | 0.95        | 1.16        | 1.24       | 2.32      | 0.32     | 2.10     |

Table 3 Effect of cultivation dates on the infestation percentages of injury onion fly *D. alliaria* in holds and the quality of bulbs planted by 10 cm spacing between plants.

| Dates        | % infestation | Holds onion | %Sizes bulbs according to diameters |
|--------------|---------------|-------------|-----------------------------------|
|              | Mean of weight onion Kg/ treatment | Average bulb weight per g / treatment | % Grade1 | % Grade2 | % Grade3 |
| First date   | 7.90          | 4.13        | 252.90                            | 75.49    | 12.30    | 12.30    |
| Second date  | 10.88         | 3.64        | 228.30                            | 74.94    | 16.80    | 8.20     |
| Third date   | 12.07         | 3.37        | 172.00                            | 72.56    | 15.10    | 12.30    |
| Mean         | 10.28         | 3.37        | 217.70                            | 74.33    | 14.70    | 10.93    |
| LSD 0.05     | 1.12          | 0.22        | 12.52                             | 13.54    | 8.69     | 4.77     |

Table 4 Effect of cultivation dates on the infestation percentages of injury onion fly *D. alliaria* in holds and the quality of bulbs planted by 6 cm spacing between plant.

| Dates        | % infestation | Holds onion | %Sizes bulbs according to diameters |
|--------------|---------------|-------------|-----------------------------------|
|              | Mean of weight onion Kg/ treatment | Average bulb weight per g / treatment | % Grade1 | % Grade2 | % Grade3 |
| First date   | 11.22         | 3.41        | 213.5                               | 72.90    | 15.87    | 13.65    |
| Second date  | 14.75         | 2.45        | 167.00                              | 68.80    | 16.67    | 14.58    |
| Third date   | 16.61         | 2.01        | 153.70                              | 64.30    | 21.97    | 12.27    |
| Mean         | 14.19         | 2.65        | 178.10                              | 68.80    | 18.17    | 13.50    |
| LSD 0.05     | 1.25          | 0.42        | 7.79                                | 13.26    | 5.71     | 6.84     |

The increase in bulb weights was found associated with increase in bulbs size means of grade 1st for the two plantation densities which attained to 74.33, 14.70 and 10.93% in 10 cm spacing plants, 68.80, 18.17 and 13.50 % in 6 cm spacing plants for the three grade ( G1, G2 , G3) respectively . No significant differences in weights between cultivation dates were observed, 75.49, 74.94 and 72.56 % in 10 cm spacing plants, 72.90, 68.80 and 64.30 % in 6 cm spacing plants for the three dates respectively. The results of this study revealed that plant spacing and date of cultivation exhibited high effects on onion yield. Sowing onion seeds in the first of September and transplanting into the field in December at 10 cm spacing are the more suitable to minimize the infestation by onion maggot and obtain high yield with high quality (Al-Sroe & Abdel Hamid, 1985, Ali et al., 1986, EL-Saadany & Salman, 2000).

Conflict of interest

The authors declare no conflict of interest.

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