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STUDIES ON THE TOMATO LEAFMINER , *TUTA ABSOLUTA* (Meyrick) AND ITS ASSOCIATED NATURAL ENEMIES.

BY

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VI. SUMMARY

The present experiments were conducted to study the population density of the tomato leafminer, *Tuta absoluta* and its predatory insects on tomato plants in three tomato planting dates; February, June and September, during two successive growing seasons 2020 and 2021. Field experiments were conducted at experimental farm belonging to Agricultural Research center in Kafr El Sheikh . The laboratory experiments were conducted at the laboratory of Biological Control Department, Plant Protection Institute, Sakha branch .

The obtained results could be summarized as following:

6.1. Influence of tomato planting dates on population density of the tomato leafminer, *Tuta absoluta* and its associated predatory insects .

6.1.1. On the tomato leafminer , *Tuta absoluta*.

6.1.1.1. February plantation

The highest peak of the population abundance for the larvae in February plantation were recorded in the first week of May 2020 and in the second week of May 2021 and represented by **56** and **55** larvae / plant during the two seasons, respectively . Meanwhile , for the male moths in February plantation , the highest peaks were recorded in the fourth week of April 2020 and the third week of April 2021 and represented by **375** and **380** moths / trap respectively .

6.1.1.2. June plantation

The highest peaks of *T. absoluta* larvae in June plantation were recorded on the second week of July 2020 and on the fourth week of July

Summary

2021 and represented by **124** and **130** larvae / plant during the two seasons , respectively .While , the highest peak of *T. absoluta* male moths were recorded in the first week of August 2020 and 2021 during the two seasons 2020 and 2021 and represented by **770** and **780** moths / trap , respectively.

6.1.1.3. September plantation

The highest peaks of *T. absoluta* larvae in September Plantation were recorded in the first week of January 2021 and 2022 during the two seasons and represented by **32** and **22** larvae / plant , respectively . Moreover , the highest peaks of *T. absoluta* male moths were recorded in the first week of January 2021 and in the second week of January 2022 and represented by **65** and **59** moths / trap. respectively.

6.1.1.4. The monthly and the seasonal average number of the larvae

In February plantation , May 2020 recorded the highest average number of *T. absoluta* larvae (**47.0 ± 4.8 larvae / plant**) during the first season while , April 2021 recorded the highest average number of the insect larvae(**47.3 ± 4.1 larvae / plant**) during the second season .

In June plantation , July 2020 recorded the highest average number of the insect larvae (**96.0 ± 24.7 larvae / plant**) during the first season . Also , the highest average number of the insect larvae recorded in July 2021 (**102.0 ± 16.2 larvae / plant**) during the second season .

In September plantation , January 2021 and 2022 recorded the highest average number of the insect larvae and represented by (**32.0 ± 0.0 and 22.0 ± 0.0 larvae / plant**) during the two seasons , respectively .

Summary

The highest annually average number of the insect larvae recorded in June plantation during the two seasons 2020 and 2021 and represented by (**51.4 ± 12.0** and **60.9 ± 10.8 larvae / plant**), respectively . Statistical analysis revealed that , a highly significant differences between the the three planting dates during the two seasons according to the annually average number of the insect larvae .

6.1.1.5. The monthly and the seasonal average number of the male moths .

In February plantation , April 2020 recorded the highest number of *T. absoluta* male moths (**291.2 ± 35.9 male moths/trap**) during the first season while , during the second season , the highest average number recorded (**313.8 ± 23.9 male moths/trap**) in April 2021

In June plantation , July 2020 recorded the highest average number of the insect male moths (**350.0 ± 203.1 male moths/trap**) during the first season while , during the second season , the highest average number recorded (**382.5 ± 184.9 male moths/trap**) in July 2021

In September plantation , December 2020 recorded the highest average number of *T. absoluta* male moths (**30.0 ± 3.7 male moths/trap**) during the first season while , November 2021 recorded the highest average number of the insect male moths (**37.3 ± 13.1 male moths /trap**) during the second season .

The highest annually average number of the insect male moths recorded in June plantation during the two successive seasons 2020 and 2021 and represented by (**200.0 ± 80.0** and **181.5 ± 53.1 male moths /trap**), respectively .

Summary

Statistical analysis recorded that, a highly significant differences between the three plantations during the two seasons according to the annually average number of the insect male moths .

6.1.2. On the associated predatory insects .

6.1.2.1. The eleven-spot ladybird , *Coccinella undecimpunctata* L.

February plantation recorded the first category . It hosted the highest annually average number of the insect predator *C. Undecimpunctata* and presented by 3.4 ± 0.7 and 3.0 ± 0.5 individuals in both 2020 and 2021 seasons , respectively . While , September plantation harboured the lowest annually average number and presented by 0.5 ± 0.2 and 0.6 ± 0.3 individuals in both 2020 and 2021 seasons , respectively .

6.1.2.2. The mirid bug, *Macrolophus pygmaeus* Rambur.

June plantation recorded in the first category . It hosted the highest annually average number of the insect predator *M. pygmaeus* and presented by 1.6 ± 0.8 and 2.7 ± 0.6 individuals in both 2020 and 2021 seasons , respectively . While , February and September plantations did not harbour any individuals in both 2020 and 2021 seasons .

6.1.2.3. The earwig , *Labidura riparia*(Pallas).

June plantation came in the first category . It hosted the highest annually average number of the insect predator *L. riparia* and presented by 8.5 ± 3.1 and 7.6 ± 2.9 individuals in both 2020 and 2021 seasons , respectively . While , February and September plantations did not harbour or attracted any individuals in both 2020 and 2021 seasons .

6.1.2.4. The green lacewing , *Chrysoperla carnea* (Stephens)

February plantation came in the first category . It hosted the highest annually average number of the insect predator *C. carnea* and

Summary

presented by 0.9 ± 0.3 and 10.5 ± 0.5 individuals in both 2020 and 2021 seasons, respectively. While, June and September plantations did not harbour or attract any individuals in both 2020 and 2021 seasons.

6.1.2..5. the tomato bug, *Nesidiocoris tenuis* Reuter.

June plantation came in the first category. It hosted the highest annually average number of the insect predator *N. tenuis* and presented by 300.0 ± 70.5 and 286.0 ± 89.9 individuals in both 2020 and 2021 seasons, respectively. While, February plantation harboured the lowest annually average number and presented by 2.1 ± 0.6 and 1.4 ± 0.6 individuals in both 2020 and 2021 seasons, respectively.

6.1.2..6. The relationship between associated predatory insects and

T. absoluta.

The tomato bug, *N. tenuis* recorded the highest average number 300.0 ± 70.5 and 286.9 ± 89.9 individuals, followed by *L. riparia* 8.5 ± 3.1 and 7.6 ± 2.9 individuals in June plantation during the two seasons 2020 and 2021, respectively. Meanwhile *C. undecimpunctata* came in the first category during February plantation and represented by 3.4 ± 0.7 and 3.0 ± 0.5 individuals during the two seasons, respectively.

The simple correlation coefficient between the numbers of *T. absoluta* and its predators on tomato plants in three planting dates during the two growing seasons 2020 and 2021 demonstrated that, this relation varied from date to date and from season to season particularly to the tomato predatory bug, *N. tenuis*. The numbers of *N. tenuis* significantly correlated with those of *T. absoluta* during February and September plantations in the first season, but were correlated during June and September plantations in the second season. In both seasons, the

Summary

numbers of the eleven-spotted ladybird *C. undecimpunctata* significantly coincided with those of *T. absoluta* during February and June plantations, but not during September plantation.

6.2. Seasonal activity and biological studies on the mirid zoophytophagous bug *N. tenuis* .

6.2.1. Effect of planting dates on population density of *N. tenuis* .

In February plantation , the tomato bug *N. tenuis* recorded the highest population density (**160** and **133** individuals / plant) in the fourth week of May 2020 and 2021 during the two seasons , respectively .

In June plantation , the tomato bug *N. tenuis* recorded the highest population density (**680** and **450** individuals / plant) in the fourth week of September 2020 and 2021 during the two seasons , respectively .

In September plantation , the tomato bug *N. tenuis* recorded the highest population density(**5** individuals /plant) in the second week of October 2020 during the first season and (**8** individuals /plant) in the first week of January 2022 during the second season

The highest average number of *T. absoluta* was estimated in June plantation in the first and second seasons (**51.4 ± 12.0** and **60.8 ± 10.9** larvae / plant , respectively). In addition, the highest average number of *N. tenuis* was estimated also in June plantation of both seasons (**285.9 ± 96.1** and **263.4 ± 88.1** individuals, respectively).

The numbers of *N. tenuis* positively coincided with those of *T. absoluta*, in a significant way, during February and June plantations, but not during September plantation during the two seasons .

Summary

6.2.2. Effect of food type on some biological aspects of the tomato bug *N. tenuis*.

No difference found between the incubation period of the tomato bug eggs of those fed on tomato plants only or on larvae of *T. absoluta* only presented by (**7.0 ± 0.49 days**) while the incubation period of the tomato bug eggs of those fed on tomato plants with larvae of *T. absoluta* was shorter presented by (**6.4 ± 0.21 days**)

The total developmental stage of the tomato bug *N. tenuis* recorded the shortest duration when fed on the larvae of *T. absoluta* or tomato plants with larvae of *T. absoluta* and presented by (**13.0 ± 0.33** and **12.4 ± 0.33 days**) with no significant differences ,while the longest duration nymphal stage was recorded when tomato bugs fed on tomato plants only and presented by (**15.8 ± 0.49 days**) .

In case of feeding on tomato plant only, the longevity of *N. tenuis* adults was shorter than that when predator fed on the other two feeding types and presented by (**18.8 ± 0.95 days**) . The fecundity of *N. tenuis* female was higher when fed on tomato plants infested with *T. absoluta* larvae or on *T. absoluta* larvae presented by (**91.6 ± 4.25 egg / female**) than those fed on tomato plants only that presented by (**43.2 ± 5.5 egg / female**) .

6.2.3 The relationship between the insect pest , *T.absoluta* and the tomato bug ,*N.tenuis* .

The relationship between , *N.tenuis* and *T.absoluta* , (predator – prey ratio) on tomato plants in different plantating dates , during the two seasons , 2020 and 2021. The very narrowed predator - prey ratio was recorded in June plantation in both yrs ;2020 and 2021 represented by (**1 : 0.18**) and (**1 : 0.23**) , respectively. Moreover September

Summary

plantation in both years ;2020 and 2021 were also narrowed and represented by (1 : 2.8) and (1 : 1.5) ,respectively .Meanwhile , February plantation came in the last category in both years and represented by (1 : 22.7) and (1:12.4), respectively

6.3. Effect of four solanaceous plants on developmental and population parameters of the tomato leaf miner, *Tuta absoluta* (Meyrick) under free and no choice feeding conditions.

The mean number of the developmental stages of *T. absoluta* reared on different solanaceous host plants under no choice feeding conditions show that tomato plants recorded the highest average number of larvae followed by egg plants and potato plants and represented by **99.3 ± 5.6** , **52.3 ± 4.1** and **51.3 ± 4.1** larvae / cadge , respectively . No larvae were found in pepper plants . In tomato plants also the larvae developed to pupal stage and adult stage followed by egg plant and potato . Tomato plants exhibited the most preferred host plant for rearing the insect larvae followed by egg plant and potato plants .statistical analysis revealed that , a highly significant differences were recorded between the different solanaceous host plants according to the mean number of the insect developmental stages.

The mean number of the developmental stages of *T. absoluta* reared on different solanaceous host plants under free choice feeding conditions show that tomato plants recorded the highest average number of larvae followed by egg plant and potato plant and represented by **37.7±3.5** , **25.3 ± 2.7** and **24.7 ± 2.2** larvae / plant , respectively . No larvae were found in pepper plants . In tomato plants also the highest larvae developed to pupal stage and adult stage followed by egg plant and potato plants . Tomato plants attracted the female insect to egg-laying and

Summary

exhibited the most preferred host plant for rearing the insect larvae followed by egg plant and potato plants . statistical analysis revealed that , a highly significant differences were recorded between the different solanaceous host plants according to the mean number of the insect developmental stages.

The duration and survival rate of the developmental stages of the insect on different solanaceous host plants under no choice feeding conditions show no significant differences in the incubation period or the pupal stage for the tomato leaf miner *T. absoluta* on different solanaceous host plants . Meanwhile , the larval stage recorded he lowest average duration on tomato plants followed by egg plant and potato plants and presented by **9.0 ± 0.8** , **13.3 ± 0.8** and **14.2 ± 1.8** days, respectively with significant differences. Pepper plants recorded no eggs , larvae or pupae during the experiments . Tomato plants exhibited the highest survival rates for all the immature stages of the insect and recorded **99.3 %** , **95.7% and 95.8 %** for larval stage , pupal stages and total immature stages , respectively . Egg plant ranked the second category and recorded **94.2%** for the total immature stages .while potato came in the third category and recorded **84.4 %** for the immature stages

The duration and survival rate of the developmenral stages of the insect on different solanaceous host plants under free choice feeding conditions show no significant differences in the incubation period or the pupal stage for the tomato leaf miner *T. absoluta* on different solanaceous host plants . Meanwhile , the larval stage recorded he lowest average duration on tomato plants followed by egg plant and potato plants and presented by **8.0 ± 0.1** , **9.3 ± 0.8** and **10.2 ± 1.2** days with significant differences. Pepper plants recorded no eggs , larvae or pupae during the

Summary

experiments . Tomato plants exhibited the highest survival rates for all the immature stages of the insect and recorded **98.8 , 95.7 and 95.5 %** for larval stage , pupal stages and total immature stages , respectively . Egg plant ranked the second category and recorded **94.0%** for the immature stages .while potato came in the third category and recorded **85.0%** for the immature stages

Tomato plants recorded the highest female productivity under no choice feeding conditions and presented by **125.0 ± 5.0 larva / female** followed by egg plant and potato plants **101.3 ± 3.0 and 98.8 ± 5.0 larva / female** with no significant differences , respectively.

The female productivity reared on different solanaceous host plants under free choice feeding conditions show that,tomato plants recorded the highest female productivity under free choice feeding conditions and presented by **63.3 ± 3.2 larva / female** followed by egg plant and potato plants **39.5 ± 3.8 and 32.5 ± 5.2 larva / female** with no significant differences , respectively.