SUMMARY

Legumes are characterized by the high protein content and nutritive value of their seeds in addition to the roots possessing nodules containing rhizobia that are capable of fixing nitrogen. The work in this Thesis carried out in the Experimental farm, Sids region, Beni-Suef Governorate during the two successive seasons of 1984/85 and 1985/86 included studies on the insects associated with five leguminous crops; broad bean, fenugreek, chickpea, lentil and lupin. Results could be divided into 4 main parts and may be summarized as follows :

I. Survey studies :

By early December 1984, quarter monthly samples were obtained by 30 double strokes of an insect sweeping net and manual inspection of five plants/plot. Sampling took place until May, 10th. The captured insects were killed, identified and counted. The survey of insects revealed the presence of 85 species belonging to 34 families and 9 orders.

I.1. Faba bean insects :

A number of 76 species belonging to 34 families and 8 orders were surveyed on faba bean plants. Twelve of these species were found as foliage feeders, 12 sap

suckers, 2 leaf-miners, 5 fed on seeds, 13 predators and 12 parasites. Surveyed insect species included also the bee honey and 2 other pollinators. In addition to these species, 17 species were also surveyed, but they were found in very low numbers.

I.2. Fenugreek insects :

A total of 59 insect species belonging to 32 families and 9 orders were surveyed on fenugreek plants. From these species 7 species were found as foliage feeders, 10 fed on the plant sap, 2 leaf miners, 4 fed on seeds, 10 insect predators and 12 were found as insect parasites. In addition to these species, 13 were also surveyed, but individuals of these species were found of very low occurrence.

I.3. Chickpea insects :

Fifty-two insect species belonging to 26 families from 9 orders could be surveyed on chickpea plants. These insect species included 18 pest species of which 6 were found as foliage feeders, 7 fed on the plant sap, 3 fed on the seeds, and 2 were found as leaf-miners. The beneficial insect species surveyed on chickpea plants included 2 pollinators, and 9 predaceous and 9 parasitic insect species. Besides, 16 insect species were surveyed, but

in very low numbers on chickpea plants. Those included 4 lepidopteran, 6 homopteran, 4 heteropteran and 2 coleopteran insects.

I.4. Lentil insects :

A total number of 51 insect species belonging to 27 families from 9 orders could be surveyed from lentil fields. From these species 21 were found as pests on lentil plants. Those included 6 species that fed on the plant foliage, 11 sap suckers, 2 leaf-miners and 2 fed on the crop seeds. Nine insect predators and 8 parasitic species were also surveyed on lentil plants, while 3 species were surveyed as pollinators. Beside to these species, other 10 insect species were found in very low numbers. Those included 2 heteropterous, 6 homopterous, and two lepidopterous species.

I.5. Lupin insects :

Fourty-four insect species belonging to 22 families and 8 orders could be surveyed on lupin plants throughout the two successive seasons 1984/85 and 1985/86. These species included 15 pest species of which 3 were foliage feeders, 10 sap suckers and 2 fed on the seeds. On the other hand, beneficial insects included 10 predators,

5 parasites and 3 pollinators. In addition to these species, other 11 insect species could be surveyed but in very low numbers. From these species, 3 belonged to Heteroptera and 6 to Homoptera, in addition to one lepidopteran, one coleopteran and two dipteran species.

II. Population studies :

Population studies were carried out on the most common pests on bread bean, fenugreek, chickpea, lentil and lupin throughout 1984/85 and 1985/86 growing seasons in the Agricultural Experimental Station at Sids region. Insect species that were taken into consideration included : Empoasca decipiens, Aphis fabae, A. craccivora, Hypera brunneipennis, Liriomyza trifolii, and Gymnoscelis pumilata on broad bean plants; E. decipiens, A.craccivora, Acyrthosiphon pisum, H. brunneipennis and L. trifolii on fenugreek plants; A. craccivora, Techius seriestrosus and L. trifolii on chickpea; A. craccivora, A. pisum and L. trifolii on lentil plants; and E. decipiens and A. craccivora on lupin plants. The obtained data may be summarized in the following :

II.1. Faba bean insects :

II.1.A. Empoasca decipiens :

This leaf hopper prevails in faba bean fields during December till May at Sids region. The maximum

abundance of that species took place between mid-March and mid-April where the highest peak of 673 individuals/ sample was detected on March, 29th (25°C & 33 % R.H.) throughout the first season, while, in the second season, there were two peaks of 85 individuals/sample detected on January, 5th (14°C & 76 % R.H.) and 141 individuals on April, 12th (20°C & 21.2 % R.H.).

II.1.B. The bean aphid, Aphis fabae :

In 1984/85 season, the aphid infested the plants from late January till mid-April, where two peaks of 187 and 289 individuals on March, 1st (21°C & 64 % R.H.) and March, 29th (25°C & 53 % R.H.). However, one peak of abundance was detected during the second season 1985/86 (204/sample on April, 5th; 21°C & 44 % R.H.).

II.1.C. Aphis craccivora :

The legume aphid A. craccivora is capable of existing in faba bean field from February to April throughout the two successive seasons, and its infestation was considerably higher in 1984/85 than 1985/86 season. Two peaks of 290 and 287 individuals/sample were detected during March, 1st (21°C & 64 % R.H.) and March, 22th (21°C & 51 % R.H.), respectively, in former season. The same two peaks of abundance were detected

throughout the second season (120 and 150 aphids) on February, 23rd (22°C & 50 % R.H.) and March, 29th (25°C & 53 % R.H.), respectively.

II.1.D. Egyptian alfalfa weevil, Hypera brunneipennis :

Larvae and adult weevils of H. brunneipennis occurred in the faba bean field during the two seasons 1984/85 and 1985/86. Adults appeared throughout the period that elapsed from February, 2nd till April, while larvae were first detected on the plants in late February. One peak of larval abundance per season was detected (17 larvae/sample by March, 15th; 17°C & 40 % R.H.) and 14 larvae/sample on March, 8th (18°C & 53 % R.H.) during the two successive seasons.

II.1.E. The serpentine leafminer : Liriomyza trifolii :

Adults of L. trifolii were detected on the plants in January until May. During the 1984/85 season, one peak of the insect abundance (195 adults/sample) was detected on March, 29th (25°C & 53 % R.H.), while two peaks of 35 and 119 adults/sample, took place on March, 1st (21°C & 64 % R.H.) and 29th (25°C & 53 % R.H.) during 1985/86 season.

II.1.F. The lopping corn ear-worm, Gymnoscelis pumilata :

During two successive seasons, adult insects of G. pumilata were found by January, or February as first appearance on the plants and disappeared by end of the season. One peak of 28 adults/sample was detected on March, 22nd (21°C & 51 % R.H.) during 1984/85, while, in 1985/86 season, two peaks of 17 and 42 adults/sample were detected by March, 1st (21°C & 64 % R.H.) and, 22nd (21°C & 51 % R.H.), respectively. The maximum abundance of this insect usually took place throughout mid-March.

II.2. Fenugreek insects :

II.2.A. Empoasca decipiens :

The leaf hopper, E. decipiens attack fenugreek plants during the period extending from late December to late April, in both two successive seasons 1984/85 and 1985/86. In the former season, the leaf hopper counts demonstrated four peaks in the insect abundance (37, 104, 244 and 466 individuals) on February, 2nd &9th and March, 8th & 22nd, respectively. In the latter season, also, four peaks of 30, 36, 108 and 170 individuals took place on January, 12th, February, 16th, March, 15th and April, 5th, respectively.

II.2. B. Aphis craccivora :

During the two successive seasons, the legume aphid, A. craccivora infested the plants from January or February till April. Throughout the former season, the highest peak of 242 individuals was detected on March, 8th, 1985 (16°C & 66 % R.H.), while in the second season, three peaks in the aphid abundance could be detected (160, 294 and 300 individuals on February, 23rd, March, 15th and April, 5th (21°C & 44 % R.H.), respectively.

II.2. C. The pea aphid Acyrthosiphon pisum :

The population dynamics of nymphs and adults of this aphid in fenugreek fields were lower in 1984/85 season than 1985/86 season. During the former season, the period of this aphid infestation extended from February till April. Three peaks of 182, 81 and 75 individuals were detected on March, 15th (17°C & 40 % R.H.), 29th and April, 12th, respectively. The aphid infestation, in the second season, started from January till May. During that period of infestation, three peaks in the insect abundance could be detected (60, 195 and 275 aphids) on February, 23rd, March, 15th and April, 12th (20°C & 21.6 % R.H.), respectively.

II.2.D. Egyptian alfalfa weevil, Hypera brunneipennis :

Adults and larvae of the weevil H.brunneipennis may occur on fenugreek plants during the period extending from February till April. The maximum abundance was detected on the plants in March and April during the flowering and seed growth stages of the plants in both two seasons. In 1984/85 one peak of adult abundance (66 adults/sample) took place on April, 5th (19°C & 50 % R.H.) while a peak of larval abundance (30 larvae/sample) was detected on March, 15th (17°C & 40 % R.H.). In 1985/86, one peak of 62 adults was detected on April, 5th (21°C & 44 % R.H.) and another for larval abundance of 89 larvae on February, 23rd at 21.2°C & 65 % R.H.

Data indicate that the fenugreek plants are subjected to infestation with adults and larvae of the weevil, H. brunneipennis. The infestation becomes more active under the moderate temperature and high relative humidity.

II.2.E. The serpentine leaf miner,Liriomyza trifolii :

During the two seasons 1984/85 and 1985/86, adults and larvae of the leaf miner, L. trifolii appeared on fenugreek plants from January till May. In the former season, two peaks of adult abundance were detected. The highest peak of 30 adults took place on March, 29th

(25°C & 53 % R.H.). In the second season, also, two peaks of 58 and 73 adults were detected on February, 23rd and March, 29th (26°C & 27.1 % R.H.), respectively. The population of adults, in the two seasons, was higher throughout March and April (flowering and seed growth stages of the plants).

II.3. Chickpea insects :

II.3.A. The legume aphid, Aphis craccivora :

In 1984/85 season, the occurrence period of this aphid on chickpea plants extended from December till late April. Two peaks of 112 and 162 aphids were detected on March, 22nd (21°C & 51 % R.H.) and April, 12th (26°C & 42 % R.H.), respectively. In 1985/86 season, aphid infestation started in chickpea fields from December till May. Four peaks of abundance were detected during this season. These peaks estimated 187, 229, 257 and 315 aphids on January, 19th, February, 23rd, March, 15th and April, 12th, respectively. Data revealed that the maximum abundance took place during March and April. The infestation to chickpea plants was higher during flowering and seed stages than during the vegetative and maturity stages.

II.3. . The weevil, Techius seriestrosus :

The adult weevils of T. seriestrosus started their activity on the plants in February until May. The maximum abundance of the weevils during the whole season was observed by March. Three peaks of 58,113 and 49 adults were counted on February,23rd, March,15th and April,19th in 1985/86 season, while, in 1984/85 season, the population of this weevil was very low.

II.3.C. The bean fly, Liriomyza trifolii :

Infestation of the plants by this pest extended from late January till May, Both flowering and seed growth stages are characterized with high population of the pest during March and April. Three peaks of the adult abundance are of possible occurrence throughout chickpea growing season. The highest peak of 29 adults was detected on April, 26th 1985,(20.3°C& 53% R.H.) and 69 adults were count as highest peak on April, 5th 1986 at 21°C and 44 % R.H. .

II.4. In lentil fields :

II.4.A. The legume aphid A. craccivora :

In 1984/85 season, the first observation of this aphid on lentil plants was detected in February and continued till April. Two peaks of 27 and 97 individuals were counted on March, 22nd and 29th, respectively. In 1985/86 season, the first appearance of aphid on plants was detected during December and

extended till May. Two peaks of 265 and 850 aphids were counted on February, 9th and April, 5th (21°C & 44 % R.H.).

II.4.B . The pea aphid, Acyrthosiphon pisum :

The population of the pea aphid on the lentil plants was relatively higher during the season 85/86 (909) than the season 1984/85 (1204 aphids). The infestation by this aphid reached its maximum in both seasons during March (during vegetative and flowering growth stages). Two peaks in the insect abundance could be detected during the whole season on lentil plants.The higher peak, in both seas were 230 (March,29th at 25°C & 53% R.H. and 250 aphids (March, 22nd: 16°C & 50.9 % R.H.)

II.4.C. The bean fly, L. trifolii :

The occurrence period of this pest on lentil plants was extending from February till April throughout the season of 1984/85. One peak of 42 adults was counted on March, 1st (21°C & 64 % R.H.). In the second season, the first appearance of the fly was detected on January and the period of occurrence extended until May. One peak of 38 adults was detected on April, 5th (21°C & 44 % R.H.). The adults of fly reached their maximum occurrence on lentil plants during the flowering and seed stages.

II.5. Lupin insects :

II.5.A. The leaf hopper, Empoasca decipiens :

Data revealed that the higher population of this

pest was in the 1985/86 season than the former season 1984/85. The occurrence period of the pest on lupin plants extended from January till May throughout the former season. Three peaks of insect abundance were detected during the first season. They were of 23, 59 and 29 individuals on March, 1st, 29th (25°C & 53 % R.H.) and April, 26th, respectively. In the second season, the infestation period started on lupin plants, from December till May. Three peaks of 20, 37 and 66 individuals (as the highest peak of abundance) on February, 19th, March, 8th and April, 5th (21°C & 44 % R.H.), respectively.

II.5.B. The legume aphid, Aphis craccivora :

The population of this aphid appeared to be lower in the season 1984/85 than the second season 1985/86 (1478 and 2744 individuals ,respectively). The insect started its activity during January or the beginning of February and disappeared on plants by the end of April. Throughout the former season, two peaks of the insect abundance were detected as 190 and 283 individuals on February, 23rd (22°C & 50 % R.H.) and March, 29th (25°C & 53 % R.H.). In the second season, the period of infestation extended from January till April. Throughout this season, two peaks of 250 and 570 aphids were detected on February, 9th and April, 5th (21°C & 44 % R.H.). The highest infestation level to plants may be detected throughout the flowering growth stage (March).

III. Biological studies :

Biological studies were carried out on three of the main insect pests infesting leguminous plants. Those insect species were; the Egyptian alfalfa weevil, Hypera brunneipennis; the serpentine leaf-miner, Liriomyza trifolii and the lopping corn ear-worm, Gymnoscelis pumilata. The damages caused by these insect pest are described.

III.1. The Egyptian alfalfa weevil, Hypera brunneipennis :

Annual generations :

Under the prevailing laboratory conditions, one complete generation of H. brunneipennis could be followed throughout a year (1985/86) on five leguminous host plants, broad bean, fenugreek, lentil and chickpea. An aestivation period in the adult stage was detected through the period of generation.

III.1.A. The adult stage :

III.1.A.a. Feeding period for adult weevils :

Adults of H. brunneipennis have two feeding periods, the first started from the time of emergence and extended till the beginning of aestivation, and the second began from the end of aestivation period

until the adult mortality. In all treatments, females started egg laying during the second feeding period. Under laboratory conditions, the first feeding period elapsed 52.5±1 (42-58) days on broad bean, while 79±2.3 (56-88) days on fenugreek, 66.3±1.41 (56-77) days on chickpea, and 59.08±1.63 days on lentil plants. The second feeding period was also estimated for weevils reared on different leguminous plants. This period lasted 86.9±5.6 (28-129), 99.6±5.3 (31-127), 78.9±3.8 (43-105) and 90.4±5.1 (51-132) days in case of females, on faba bean, fenugreek, lentil and chickpea, respectively. In the case of males, this period estimated 79±6.5 (74-89), 82.7±6.6 (77-91), 74.3±4.1 (67-120) and 86.1±2.9 (88-95) days on the four host plants, respectively.

III.I.A.b. Aestivation :

In the laboratory, adult weevils stopped feeding and started aestivation period by the increase of temperature during April & May. Reactivity of adults occurred, on the other hand, when temperature decreased during November & December. This aestivation period varied by rearing on different host plants and also between males and females. It lasted 241.6±1.85 (199-260), 212.4±6.31 (180-224), 254.9±2.4 (231-283) and 194.8±2.17 (176-229) days in case of females on the four host plants, respectively

while in males, it lasted 235.9±2.3 (190-250), 210±3.3 (190-231), 221.8±2.1 (197-239) and 190±2.6 (161-210) days, respectively.

III.1.A.c. Preoviposition period :

This period varied amongst insect females reared on different host plants. It elapsed 299.7±3.33 (251-329), 294.1±5.43 (271-331), 291.1±3.95 (271-321) and 296.7±5.33 (235-327) days for females resulted after rearing on broad bean, fenugreek, chickpea and lentil, respectively. It was the longest on broad bean while the shortest was on chickpea, but differences between the obtained periods were, statistically, insignificant.

III.1.A.d. Oviposition :

Females made punctures for oviposition measuring 3-8 mm.long and 1-3 mm. wide, in the leaf petioles, stems or branches. Inside these punctures, eggs are laid in groups stuck to the inner tissues. Each group of eggs consisted of 8 to 33 eggs in broad bean, 6-29 in fenugreek, 6-23 in lentil and 10-44 eggs in chickpea. At 21.5±0.6 (15-23)°C and 77±0.1 (62-91)% R.H. , the oviposition period lasted 38.9±5.67 (14-60), 53±4.62 (18-68), 32±1.99 (15-44) and 21.5±0.6 (15-23) days on the mentioned host plants, respectively.

Throughout the oviposition period, females laid their highest total number of eggs (183.8±8; 45-270) by rearing on fenugreek, followed by broad bean (132.6±11.8; 20-240 eggs), chickpea (116.8±7.5; 31-208 eggs) and lentil (94.6± 6.01 ; 21-162 eggs). The differences between means were always, statistically, significant.

III.1.A.e. Postoviposition period :

Significant differences occurred by rearing on different host plants at 23.7±0.5 (19-28)°C and 74.1±6.3 (63-90)% R.H. . This period lasted 23.8±2.9 (15-39), 28.6±3.5 (18-42), 14.9±1.8 (11-21) and 18.6±3.25 (13-38) days on faba bean, fenugreek, lentil and chickpea, respectively.

III.1.A.f. Adult longevity :

By rearing under the prevailing laboratory conditions, the life-span of females and males and that of both sexes together estimated 347.9±5.58 (333-387), 331.6±6.2 (321-340) and 341.6±9.63 (321-387) days by rearing on faba bean. On fenugreek, this period lasted 370.4±8.64 (301-418), 339±6.1 (306-350) and 361.1±10.12 (301-418) days. The respective durations on lentil were 325.7±5.13 (239-378), 310±4.4 (267-351) days and

316.4±8.61 (239-378) days, while on chickpea these durations estimated 348.2±4.4 (319-376), 328±8.1 (314-358) and 339.92±6.7 (314±374) days, respectively. The obtained data indicated, on all host plants, longer life-span of females than males and also longest life-span by rearing on fenugreek plants followed by broad bean, chickpea and lentil, respectively.

III.1.A.g. Sex-ratio :

The sex-ratio amongst adult weevils emerged in the laboratory from 220 larvae collected from the field were 1.0

III.1.B. Immature stages :

III.1.B.a. The egg stage :

The egg was described. At 20.9±0.61°C and 82.3±6.01 R.H., the incubation period elapsed 8.5±0.9 (7-10), 8.1±0.9 (7-10), 9.1±0.8 (8-11) and 9.6±0.3 (8-11) days by rearing on faba bean, fenugreek, lentil and chickpea, respectively.

III.1.B.b. Hatchability percentage :

Amongst eggs resulted after rearing on different host plants, the higher hatching percentage (77.2±3.09; 75-99)% was obtained by rearing on fenugreek, followed by faba bean (76.3±3.13; 60-93 %), chickpea (72.4±4.3; 46-86 %) and lentil (64.6±6.01; 35-90 %).

III.1.B.c. Larval stage :

Four instars were detected for the larvae of H. brunneipennis.At 20.9±0.61(17-23°C) and 82.3±6.01(44-91) % R.H. ; the respective durations on broad bean, fenugreek, lentil and chickpea lasted 6.3±0.5 (4-7), 6.3±0.5 (3-7), 7.3±0.6 (4-8) and 7.8±0.3 (6-9) days for the first instar; 4.8±0.25 (4-6), 4.5±0.31 (3-6), 5.7±0.3 (4-7) and 5.5±0.5 (5-6) days for the second instar; 5±0.3 (3-6), 5.1±0.3 (4-6), 6.3±0.26 (5-8) and 5.8±0.23 (5-7) days for the third instar; and 10.9±0.43 (8-13), 8.1±0.34 (7-10), 12.1±0.6 (9-14) and 11.8±0.44 (9-13) days for the fourth instar, respectively.

Under the mentioned laboratory conditions, the total larval period estimated its longest period (32.9±1.6; 23-42)days by rearing on lentil plants. That was followed by chickpea (30.5±1.1; 35-36)days , broad bean (28.3±1.06; 20-36)days and fenugreek (25±1.1; 20-33)days . Significant differences were detected only, between the means of this period on fenugreek and both on lentil and chickpea treatments.

III.1.B.d. Pre-pupa :

Pupation took place inside an oval delicate, whit silken coccon. At 20.9±0.61(17-23)°C and 82.3±6.01 (44-91) :

R.H. . The prepupal stage lasted 2.5±0.27 (1-4), 2.5± 0.17 (2-3), 2.8±0.24 (2-4) and 2.5±0.27 (1-3) days, on broad bean, fenugreek, lentil and chickpea, respectively.

III.1.B.e. Pupal stage :

The pupa of H. brunneipennis was described. In the laboratory (at 20.9±0.61;17-23°C and 82.3±6.01, 44-91 % R.H.). The pupal period was estimated for each sex on each of the four host plants. This period lasted 9.6±1.5 (5-12), 6.1±0.4 (5-9), 7.9±0.7 (5-11) and 7.2±0.7 (7-13) days for females,and 8.9±0.98 (5-11), 5.6±0.5 (5-8), 7.1±0.4 (5-11) and 6.5±0.3 (7-12) days for males. Significant difference was detected only between female pupae reared on broad bean and those on fenugreek.

Weight of pupae :

The heaviest pupae (17.5±1.9; 10-26.5 mg./pupa) resulted after feeding the larvae on fenugreek plants. That was followed by broadbean (15.9±1.6; 9.4-25.6 mg./ pupa) and chickpea (12.9±1.5; 7.1-25.6/pupa) while the lightestwere on lentil plants (11.4±1.5; 5.9-13.9 mg./ pupa). Differences were always, statistically, insignificant except the difference between means of treatments of fenugreek and lentil which was significant.

III.1.C. Parasites :

The larval parasite, Bathyplectus curculionis Thoms. (Hymenoptera : Ichneumonidae) was the only detected emerging from the larvae of the Egyptian alfalfa weevil, H. brunneipennis. The parasite population was noticed, in fields, to increase gradually in March in the same time of which its host larvae were increasing.

III.2. The serpentine leaf-miner Liriomyza trifolii :

The leaf-miner L. trifolii was found as one of the serious pests infesting leguminous crops. The lower leaves of plants were found the most preferred for deposition of eggs, and consequently larval feeding inside the resultant mines. Larvae bore linear serpentine mines, feeding on the mesophyll tissues of leaves. The number of mines ranged from 1 to 15 mines/leaf on broad bean, 1-4, 1-4 and 1-8 mines/leaf on fenugreek, lentil and chickpea, respectively. On the other hand, lupin plants were found not to be infested by this fly.

III.2.A. Parasites :

Four hymenopterous parasites were surveyed from Liriomyza trifolii individuals infesting the four leguminous crops. Two of these parasites Diglyphus sp. and

Hemiptarsenus zilahisebossi (Erdos) parasitised externally, the larvae, and the remaining two species Opius sp. and Halticoptera sp. were bred from the host pupae. Parasitism with the four mentioned parasites, started soon after the plant infestation with this pest.

III.2.A.a. Rate of parasitism :

- On the faba bean plants :

The rate of parasitism increased with increasing pest infestation. In 1984/85 season, the percentage of parasitised larvae ranged from 8.5 % during January to an average of 64.1 % during April. While on pupae, this percentage ranged from 0 % in January to 57.8 % in April. Maximum percentages of parasitised larvae and pupae estimated 66.6 % on mid-April and 60 % on mid-April, respectively. In 1985/86 season, the averages of parasitised larvae and pupae reached 24 % and 13.4 % in January as minimum, and 65.7 % and 34.9 % as the maximum averages during March, while the maxima percentages of larval and pupal parasitism (70.3 % and 36.5 %) were detected in the sample of March, 30th.

- On the fenugreek plants :

The percentages of parasitized larvae and pupae averaged 6.7 % and 3.6 %, respectively, during

January, 1985. In this season (1984/85), the averages of highest percentages of parasitized larvae and pupae estimated 45.8 and 43.3 %, respectively and was detected on March 1985. In 1985/1986 season, the average of parasitised larvae and pupae averaged 15.4 % and 6.7 %, respectively in January. While the maxima averages in these percentages were 62.6 % on larvae and occurred during March and 40.4 % on pupae and was detected during April 1986.

III.2.B. Adult stage :

Male and female adults of L. trifolii were described. A premating period of 1-2 days was detected amongst the emerged females at 19 °C and 60 % R.H. The mating process was described.

III.2.B.a. Preoviposition period

At 21.5±1.1 (18-25°C) and 78.7±6.2 (51-85 % R.H.), this period varied slightly according to the host plant. It estimated 5.9±0.32 (3-7), 5.1±0.26 (3-6), 6±0.37 (4-10) and 6±0.2 (5-7) days on faba bean, fenugreek, lentil and chickpea, respectively.

III.2.B.b. Oviposition period :

Mated females deposited their eggs singly inside the cellular tissue under the upper or lower epidermis of the leaves. At 21.5±1.1(18-25)°C and 78.7±6.2 (51-85)% R.H., the oviposition period averaged 14.6±1.2 (8-20), 13.2±1.5 (10-18), 12.6±1.5 (8-20) and 12.3±1.2 (6-18) days on faba bean, fenugreek, lentil and chickpea plants, respectively, showing, statistically, insignificant differences.

III.2.B.c. Oviposition rate :

The highest total number of eggs deposited/ mated female (51.1±3.32, 35-70 eggs) was recorded by rearing on faba bean leaves. That was followed by rearing on fenugreek (42.8±3.95; 21-60 eggs), lentil (41.3±4.04; 28-62 eggs) and chickpea leaves (38.1±3.82; 15-55 eggs/ female).

III.2.B.d. Postoviposition period :

At means of 21.5±1.1 (18-25°C) and 78.7±6.2 (51-85 % R.H.), this period estimated 4.2±0.2 (2-6), 3±0.12 (1-4), 2.9±0.2 (1-3) and 2±0.01 (1-3) days, for flies reared on broad bean, fenugreek, lentil and chickpea, respectively.

III.2.B.e. Adult longevity :

Longevity of male and female adults was estimated for individuals reared on the four mentioned host plants under laboratory conditions of 21.5±1.1 (18-25)°C and 78.7±6.2 (51-85)% R.H. . This period lasted 12.6±0.91 (9-17) and 21.9±1.36 (14-29) days, 11.6±0.9 (8-16) and 20.8±1.07 (17-25) days, 12.4±1.01 (7-17) and 19±1.9 (12-23) days, and 11±1.38 (6-18) and 15.1±1.48 (10-23) days for male and female adults resulted from rearing on faba bean, fenugreek, lentil and chickpea, respectively. It was detected that female adults of L. trifolii lived for a longer period than males. On different host plants, the differences were significant between females from rearing on chickpea and both faba bean and fenugreek.

III.2.C. Immature stages :

The egg, the three larval instars and the pupa were described. The durations of immature stage were estimated for individuals reared on each of the four leguminous host plants (broad bean, fenugreek, chickpea and lentil) and the obtained durations were as follows ;

III.2.C.a. The incubation period :

Under laboratory conditions of 20.9±1.3(18-25°C) and 77.8±3.6 (45-85)% R.H. this period lasted 3.9±0.16

(2-7), 4.1±0.46 (2-6), 4.6±0.45 (3-7) and 4.9±0.48 (3-8) days, when the fly was reared on faba bean, fenugreek, lentil and chickpea, respectively.

III.2.C.a. Larval stages :

In the laboratory at 20.9±1.3 (18-25)°C and 77.8±3.6 (45-85)% R.H. , the respective durations, estimated on the four mentioned host plants were 5.3±0.21 (4-7) days on fenugreek, 5.5±0.26 (4-7) days on faba bean, 6.4±0.3 (5-8) days on lentil and 7±0.29 (5-8) days on chickpea.

III.2.C.b. Pupal stage :

At 20.9±1.3 (18-25°C) and 77.8±3.6 (45-85 % R.H.) the pupal period, in case of females, lasted 11.7±1.01 (9-15) days on faba bean. Longer period was detected on fenugreek and lentil (11.9±0.07; 9-15 and 12.3±0.95; 8-16 days, respectively). The longest period 13.6±0.48 (10-18) days occurred by rearing on chickpea. In case of males, this period estimated 10.6±0.9 (9-14), 11±0.91 (6-16), 12±1.01 (8-15) and 11.9±1.1 (9-17) days on faba bean, fenugreek, lentil and chickpea, respectively.

III.2.C.d. Total developmental period :

At means of 20.9±1.3 (18-25)°C and 77.8± 3.6 (45-85)% R.H., this period, in case of males and

females, lasted 22.8±0.81 (19-24) & 23.5±1.3 (19-25) days, respectively on faba bean plants, while on fenugreel, it lasted 22.1±0.9 (16-24) for males and 23±1.1 (16-25) for females. On lentil plants, the total developmental period lasted 23.1±0.6 (16-26) and 24±0.9 (16-26) days for males and females, respectively. Whereas on chickpea plants, this period estimated 23.4±0.1 (17-26) days for males and 24.8±1.3 (18-29) days for females.

III.2.C.c. Duration of the whole life-cycle :

Under the prevailing laboratory conditions of 20.9±1.3 (18-25)°C and 77.8±3.6 (45-85) % R.H., the reduction of the whole life-cycle of females lasted 44±1.9 (33-49); 43.8±0.8 (40-47), 37±1.8 (29-46) and 43±1.8 (29-46) days on faba bean, fenugreek, lentil and chickpea, respectively. The longest period of female life-cycle was on faba bean, while the shortest was on chickpea.

III.3. The lopping corn ear worm, Gymnoscelis pumilata :

The lopping corn ear worm, G. pumilata attacks many of crops such as faba bean, fenugreek, lupin, maize and ornamental plants. Larvae caused damage in the reproductive organs, terminal parts of the plants and immature seeds. A characteristic symptom of the damage caused by the larvae is the presence of the rounded spots or sites on the leaves of the infested plants particularly on the soft and terminal leaves.

III.3.A. Adult stage :

III.3.A.a. Mating :

Mating took place three to twelve hours after emergence of adults. The copulation process was detected during the evening and lasted for 30-45 minutes.

III.3.A.b. Preoviposition period :

Rearing of G. pumilata on faba bean or fenugreek did not effect this period as it lasted 2.8±0.3 (1-5) days on both host plants at 18.9±0.8 (17-20)°C and 44.5±2.1 (32-50)% R.H. .

III.3.A.c. Oviposition period and eggs productivity :

In the laboratory (at 18.9±0.8, 17-20 °C and 44.5±2.1, 32-50 % R.H.), the oviposition period of

females resulted after rearing on broad bean and fenugreek plants averaged 12.1±0.6 (8-19) and 10±0.5 (7-16) days, respectively. On faba bean plants, at the mentioned conditions, the daily number of eggs ranged from 1.5 to 17.7 eggs; while on fenugreek, it ranged from 2 to 11.3 eggs/day. In the first case, females laid higher number of eggs throughout the first five days (11.6 eggs on 4th day to 17.8 eggs on 5th day), while in case of fenugreek, it was 8.2 eggs on the 5th day to 11.4 eggs on the second day. The average total number of eggs laid/female was, significantly, higher on broad bean plants (122±6.5; 62-172 eggs) than fenugreek plants (77±7.6; 40-165 eggs).

III.3.A.d. Postoviposition period :

This period did not vary on both faba bean and fenugreek. It lasted 1±0.15(1-2) days under the previous conditions.

III.3.A.e. Sex ratio :

The sex ratio (♀♀ : ♂) estimated 1.7 : 1 on broad bean and 2 : 1 on fenugreek plants.

III.3.A.f. Longevity :

Longevities of males and females were estimated, individually, on moths from each sex resulting after

rearing on faba bean and fenugreek. At 18.9±0.8(17-20)°C and 44.5±2.1 (32-50) % R.H . In all cases, females lived for a, significantly, longer period than males. In faba bean and fenugreek treatments, females lived for 16±0.3 (9-20) and 12.2±0.57 (7-14) days, respectively, while males'life- span lasted 11.2±0.45 (6-15) and 9.5±0.36 (6-13) days, respectively. The adults resulted after rearing on faba bean lived, significantly, longer period than those emerged after rearing on fenugreek (14.3±0.65; 6-20 and 10.7±0.3; 6-14) days, respectively.

III.3.B. Immature stages :

The egg, the five larval instars, the prepupa and the pupa were described. Also, the durations of the immature stages were estimated in the laboratory and results were as follows :

III.3.B.a. Incubation period :

At 19.5±0.2 (17-21)°C and 49±2.6 (41-53)% R.H. , this period lasted 5.6±0.05 (4-8) days and 5.9±0.3 (4-9) days by rearing the insect on faba bean and fenugreek, showing insignificant difference between both treatments.

III.3.B.b. Larval stage :

The durations of the five larval instars and the total larval period were estimated at 19.5±0.2 (17-21)°C and 49±2.6 (41-53)% R.H. by rearing on faba bean and fenugreek leaves.

The first instar larvae preferred to feed and burrow in the leaf buds at the upper part of plants. The duration of this instar occupied 4.7±0.06 (3-6) and 5.1±0.2 (3-7) on faba bean and fenugreek, respectively. Larvae of the second instar fed on the terminal leaf buds of the host plants and its duration lasted 4±0.2 (3-5) and 6.1±0.12 (5-8) days on faba bean and fenugreek, respectively. The third instar larvae fed greedily on the exposed parts of faba bean or fenugreek leaves, leaving only the leaf veins. Duration of this instar on faba bean lasted 4±0.2 (3-6) days, while by feeding on fenugreek leaves, this instar lasted 5.3±0.2 (4-9) days. Duration of the fourth instar larva lasted 4.1±0.03 (3-6) days on faba bean and 5.8±0.06 (4-7) days on fenugreek. The larva in fifth instar is very greedy and feed on the whole exposed leaves and stems, leaving only the leaf veins. Duration of this instar lasted 5.6±0.11 (4-8) and 6.1±0.17 (4-9) days on faba bean and fenugreek, respectively.

The total larval period averaged 20.4±0.4 days on faba bean, while rearing on fenugreek leaves led to larvae spent this stage throughout 25.6±0.8 days, indicating, significantly, longer period.

III.3.B.c. Prepupa :

The insect spent the prepupal and pupal stages in the leaf rolled by silken threads secreted by the full grown larva. The prepupal stage lasted 1.1 (1-3) days on both two host plants.

III.3.B.d. Pupal stage :

At 19.5±0.2 (17-21) °C and 49±2.6 (41-53) % R.H. the duration of pupal stage for individuals resulted after rearing on faba bean and fenugreek lasted 12.3±0.23 (9-15) and 12.6±0.32 (11-16) days in males and 12.9±0.27 (10-17) and 13.4±0.4 (10-18) days in females, respectively. This period for both sexes lasted 12.05±0.3 (9.5-14) and 13.28±1.03 (11.5-16) days on faba bean and fenugreek, respectively, being, insignificantly, shorter in the former case.

Effect of host plant on pupal weight :

Data indicated that the weight of female pupa exceeded significantly, in both treatments of host plants that

of male pupa. The average weight of female pupa estimated 15.3±0.16 (13.6-18.2) and 15.2±0.25 (12.8-17.7) mg. in broad bean and fenugreek, respectively, while in male, it was 11.7±0.14 (10-13.7) and 12.7±0.18 (10.9-13.6) mg., respectively. The effect of host plant appeared to be insignificant on the weight of resultant pupa.

III.3.B.a. Total developmental period :

Under laboratory conditions of 19.5±0.2 (17-21°C) and 49±2.6 (41-53 % R.H.), the total developmental period lasted 36±0.98 (32-39) days for males and 39.7±1.8 (36-42) days for females, and the life-cycle averaged 58±1.3 (57-64) days for females, on faba bean. The total developmental period on fenugreek, elapsed 44.8±1.3 (39-51) days in males, and 45.3±1.1 (41-50) days in females and 61±1.5 (54-68) days for the insect life-cycle.

IV. Screening of local and foreign commercial varieties for infestation with the three important insect pests:

Eight commercial varieties and strains of leguminous crops represented by faba bean (Vicia faba L.) var. Giza 2, Giza 3 and Giza 402, Lentil (Lens esculenta) var. Giza 9 and Giza 370, and chickpea (Cicer arietinum)

var. Giza 1, S 1919 and S 266 were evaluated for their infestation by the bean leaf-miner Liriomyza trifolii, the Egyptian alfalfa weevil, Hypera brunneipennis, and the lopping corn ear worm, Gymnoscelis pumilata Hb.

IV.1. Liriomyza trifolii :

The obtained results in 1984/85 season, revealed that, in faba bean, Giza 2 was the most infested variety by this pest (31.5 % infested leaflets), while Giza 402 was least susceptible (25.75 %). However, Giza 3 variety was subjected to moderate infestation. In 1985/86, larval population is visible from the 2nd week of January till harvest. Maximum population occurred from late March to 3rd week of April.

On lentil varieties, it was found that variety Giza 370 was higher infested and harboured more larvae during the two years of investigation. The maximum population of larvae was observed in the last two inspections on 15th and 30th of April.

Evaluation of chickpea varieties for infestation by L. trifolii in two seasons indicated that Giza 1 showed lowest infestation (3.38 and 4.63 % infested leaflets during 1984/85 and 85/86 seasons, respectively). S 266 was the most susceptible to the leaf miner infestation

(13 and 16.88 larvae/15 plants and percentages 10.25 % and 8.63 % infested leaflets during the two seasons, respectively).

IV.2. Gymnoscelis pumilata :

In faba bean varieties, it was found that the variety Giza 2 showed lowest infestation, that particular figures were 2.12 & 4.37 larvae and pupae/15 plants and 2.25 & 4.5 infested leaflets during two successive seasons, while variety Giza 3 was more susceptible (8.125 and 14 larvae & pupae/15 plants and showed 7.63 % and 13 % infestation during 1984/85 and 1985/86, respectively).

IV.3. Hypera brunneipennis :

It was obvious that faba bean variety Giza 3 was more susceptible, that the infestation in the leaflets of this variety reached 22.6 and 15 %, whereas number of larvae and adults were 11.75 and 7/15 plants during the two successive seasons. On the other hand, Giza 402 was less infested, while variety Giza 2 showed reasonable resistance to the insect attack.