Trials for mass rearing and release of some predaceous insects fore controlling the pink and spiny boolworms

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Experiments were carried out to study the effect of different temperatures, (15, 20, 25 and 30 °C) and the kind of prey (eggs of E. insulana, C cephalonica, S. cereaella, S. lifforalis and P. gossypiella) on the biological aspects of C. carnea. Also, the feeding preference of C. carnea larvae on three host species was studied. Other experiments studies were bionomics and feeding capacity of some predaceous insects species and storage of eggs and adults of C. cornea, at two low temperatures were conduct. In addition, filed studies were carried out throughout two cotton seasons (2000 & 2001) in Moshtohor district (Qalubiya Governorate) to survey the common insect predators in cotton fields. Weekly counts of predators were taken by the insect sweeping net and direct counting throughout two seasons. C cornea (second instar larva) were released in field-cages in cotton field at Moshtohor during 2000 and 2001 seasons to find out the efficacy of these predator in reducing the infestation rates by pink & spiny bollworms . The obtained results may be summarized as follows : I- Effect of temperatures on the biology of C. carnea: I-I-Durations of immature stages : Egg stage : In laboratory, the durations of the egg stage, different larval instars and pupal stage in addition to the different biological aspects were estimated when rearing on Pgossypiella eggs as prey took place at 4 different temperatures (15, 20, 25 and 30°C).The eggs stage hatched after 14.3 ± 0.80, 5.4 ± 0.68 , 3.6 ± 0.68 and 3.1 ± 0.31 days at 15, 20, 25 & 30 °C. Larval stage : The duration of each of the three larval instars was estimated under the same mentioned conditions (15, 20, 25 & 30 °C). The duration of the first instar larva lasted 10.5 ± 0.69, 5.3 ± 0.47, 3.4 ± 0.50 and 2.5 ± 0.51 days at the four temperatures , respectively. The second one occupied 9.4 ± 0.50, 3.9 ± 0.72, 2.5 ± 0.51 and 2.0 ± 0.00 day, while that of the third instar occupied 11.1± 0.85, 4.7 ± 0.80, 3.5 ± 0.69 and 2.9 ± 0.72 days, respectively. The total larval period of C. carnea averged 31.3 ± 1.16, 13.5 ± 0.97 , 9.4 ± 1.43 and 7.4 ± 0.70 days by rearing onP. gossypiella eggs at the 4 mentioned temperatures, respectively.Pupal stage : Duration of pupal stage at the same temperatures were 23.8 ± 1.23, 10.6 ± 0.84, 7.6 ± 0.70 and 5.6 ± 0.84 days, respectively. Total developmental period :The total developmental period lasted 69.4 ± 1.27, 28.5 ± 0.97, 20.6 ± 1.65 and 16.2 ± 1.23 days, respectively.1-2-Consumption of pink bollworm eggs by C. carnea larvae at different temperature : The daily number of P. gossypiella eggs consumed during each of the three larval instars at the tested temperatures (15, 20, 25 and 30 °C) were estimated.The first instar larva of C. carnea consumed 13.92 ± 2.29, 21.46 ± 3.46, 27.00 ± 3.61 and 30.62 ± 4.27 eggs, and that of the second instar fed on 105.77 ± 10.39, 143.00 ± 15.23 , 156.00 ± 17.62 and 173.62 ± 17.84) eggs by rearing the larva on P. gossypiella eggs at 15, 20, 25 & 30°C, respectively. While, the third instar larva consumed 311.77± 22.92, 391.07 ± 23.153, 443.69 ± 21.257 and 477.92 ± 24.489 P. gossypiella eggs, when reared at the mentioned 4 temperatures, respectively. The thrid instar larva consumed the greatest amouts of eggs, at different temperatures than the two preceding instars. Throughout, the larval stage, a C. carnea larva fed on the averages of 431.46±25.21, 555.53±39.82, 629.69±32.20 and 682.15±31.45 eggs at 15, 20, 25 and 30°C, respectively.The mean amount of P. gossypiella eggs consumed by one C. carnea larva increased successively by the increase of temperature at which larvae were reared so that the highest feeding

capacity was recorded at 30°C, and the lowest at 15°C.1-3-Relationship between temperature and fecundity & longevity of C. carnea :The effects of each 3 constant temperatures; 20, 25 and 30°C on the fecundity and longevity of C. carnea adults, whenrearing took place on P. gossypiella , were investigated. No deposition occurred when C. carnea was reared at 15°C.The pre-oviposition period for C. carnea female was prolonged by decreasing temperature. So, the longest periodrecorded at 20 °C , while the shortest one (5.4±0.52 days) was recorded at 30°C.The oviposition period averaged 13.9 ± 2.03 , 24.3 ± 1.34 and 17.5 ± 1.08 days at 20, 25 and 30°C, respectively, while, the post-oviposition period of C. carnea females averaged 28.9 ± 1.20, 5.8 ± 1.03 and 3.6 ± 0.70 days, respectively.Reproduction of eggs / female :When rearing of C. carnea took place on P. gossypiella eggs, the total number of deposited eggs / female was affected by temperature. The highest number (151.3 ± 19.64 eggs / female)was obtained by rearig at 25 °C, while the lowest (66.2 ± 11.42 eggs/female) was produced when the predator was reared at 20 °C. When rearing took place at 30°C, a C. carnea female deposited 120.4±12.11 eggs.A C. carnea female lived for 54.0± 7.59, 70.4 ± 3.75, 34.6 ± 4.20 and 26.5 ± 1.354 days at 15, 20, 25 and 30°C respectively. Data indicated also that the female lived, generally, for longer period than the male which showed a life-Span of41.2 ± 4.13, 49.8 ± 4.08, 22.1 ± 2.50 and 19.7 ± 2.50 days at the same temperatures, respectively.1-4-Lower, upper temperatures threshold and thermal requirements of C. carnea:from the relationship between the rate of development (dependent variable) and temperature (independent variable), the lower thresholds of development (LTRS) of C. carnea immature stages (eggs, l' instar larva , 2nd instar larva, 3rd instar larva, total larval period and pupal period) were estimated as 9.93, 10.51, 10.58, 8.56, 9.79 and 10.01°C, respectively. The degree — days — Celsius (DDC) of immature stages were 58.78, 49.03, 37.75, 59.73, 146.26 and 111.88 degree—days, respectively, while the lower thresholds (LTRS) for preoviposition period and generation were 16.57 and 15.79°C, respectively and DDC's were 69.69 and 359.06 degree — days , respectively. On the other hand , the relationship between developmental period (dependent variable) and temperature (independent variable), provided upper temperature thresholds (UTRS)of 31.82, 32.97, 31.93 , 33.26 , 32.83 and 32.83 °C, for the immature stages of C carnea , respectivly and 30.9388 and 32.4639 °C for preoviposition period and generation, respectively.II-Effect of different prey on some biological aspects of C carnea:The effect of the kind of prey (eggs of E. insulana, C. cephalonica, S. cereaella, S. littoralis and P. gossypiella) on the biology of the predator (C carnea) was studied Egg stage : The incubation period of C. carnea eggs averaged 3.4 ± 0.50, 3.12± 0.33, 3.52 ± 0.51, 3.5 ± 0.51 and 3.6± 0.66 days when reared at 25±1°C and 65-75 R.H. on E. insulana, C.cephalonica, S. cerelella, S. littoralis and P. gossypiella eggs respectively Larval period : The total larval period varied by feeding C. carnea larvae on eggs of different prey species. Feeding on eggs of C. cephalonica or S. cerealella or P. gossypiella led significantly, to shorter total larval period (8.72±0.94, 8.88±0.78& 9.4±1.43 days, respectively) than those recorded by feeding the larvae oneggs of E. insulana (10.08±0.95 days) or S. littoralis (10.68±0.63days).Pupal period : The shortest pupal period of C. carnea (7.6±0.70 days) was obtained when larvae of C. carnea were fed on P. gossypiella eggs . This period was, statistically , found significantly shorter than those recorded by rearing on C. cephalonica, S. cerelella ,E. insulana and S. littoralis eggs(8.4±0.84, 8.7±0.68, 9.1±0.74 & 9.4±0.70 days, respectively.The shortest total developmental period of C. carnea (20.5±1.27 days) was obtained by rearing on C. cephalonica eggs followed, insignificantly, by S. cerelella, P. gossypiella then significantly, by feeding on eggs of E. insulana and S. littoralis. II-1-Feeding capacity of C. carnea larvae on eggs of five lepidopterous pest species:The total consumption of eggs of the mentioned five lepidopterous species throughout the larval stage were 293.32± 20.55, 444.08±34.40, 633.12±50.28, 367.36±31.53 and 629.69±32.20 eggs, respectively.11-2-Fecundity and adults' longevity of C. carnea in relation to larval food :The best results were obtained always when C. carnea was reared on C. cephalonica eggs. Adults resulted from this treatment manifested the shortest preoviposition period (5.2±0.79, days), but with insignificant difference than those of larvae fed on S. cerealella and P. gossypiella eggs (5.3±0.95& 6.0±0.82 days, respectively) and significant difference than those of females resulted from larvae fed on E. insulana and S. littoralis eggs (6.7±1.06 and 7.4±1.35 days, respectively). The oviposition period of females from rearing on eggs of C. cephalonica and P.

gossypiella (24.6±1.58 & 24.3±1.34 days)were significantly longer than in case of feeding on S. cerealella (21.3±2.58 days), E. insulana (15.2±2.86) and S. littoralis (11.3±2.22 days;). As for the postoviposition period, the shortest period (3.7±1.06 days), resulted from females from larval feeding on S. cerealella, and the longest (6.5±2.5 days) after rearing on S. littoralis.Throughout the oviposition period, a C. carnea female resulted from rearing on C. cephalonica and P. gossypiella eggs deposited 157.9±25.62 & 151.3±19.65 eggs, respectively, showing, siginificantly, the highest reproductivity of eggs, compared to those produced by female reared, in the larval stage, on eggs of E. insulana (77.5±20.31) and S. cerealella (104.5±23.39 eggs/female). While rearing of C. carnea larvae on eggs of S. littoralis led to females that deposited, significantly, the fewest total number of eggs (48.8±21.87eggs/female).C. carnea females lived always longer than males. For both sexes, adults resulted from larvae fed on C. cephalonica and P. gossypiella eggs, had the longest longevity (22.2±5.44 & 22.1±2.51days for males and 32.8±4.08& 34.6±4.20 days for females, respectively), being insignificantly, longer than those recorded for adults developed from rearing on S. cerealella (19.1±4.89 &30.7±2.91 days) and significantly longer than those of adults resulted after rearing the larvae on eggs of S. littoralis (15.4±4.06 and 25.2±5.49 days, respectively) or E. insulana (16.2±4.77 days for males and 26.7±4.00 days for females).III-Preference of C. carnea larvae to feed on eggs of P. gossypiella & E. insulana and nymphs of Aphis durantaTwo sets were used to determine the feeding preference of C. carnea larvae on three host species. In the first set, C. carnea larva was offered the choice between P. gossypiella eggs and A. duranta nymphs. While, in the second one it was offered the choice between the eggs of P. gossypiella and E. insulana. III-1-The first set (P. gossypiella eggs +A. duranta nymphs):The total consumption from each of the two prey species by each of the three larval instars of C. carnea reached 9.0, 92.5 and 212.1 A. duranta nymphs during the 1st, 2nd and 3rd instars of the predator, opposed to 18.8, 68.8 and 218.0 P. gossypiella eggs, respectively. These numbers of nymphs represented 32.4, 57.3 and 49.3% of the total number of consumed individuals, while, in case of P. gossypiella eggs, those represented 67.6,42.7 & 50.7% of the total preys consumption during the 1st, 2nd & 3rd instars, respectively. Throughout the total larval period, a C. carnea larva consumed 313.6 A. duranta nymphs (50.4 %) in addition to 305.6 P. gossypiella eggs (49.4% of the total consumed individuals).III-2-The second set (P. gossypiella eggs + E. insulana eggs):The total consumed eggs by each of the three larval instars averaged 30.6, 185.4 and 450.4 P. gossypiella eggs, representing 91.34, 84.17 and 87.1% of the total consumed eggs, opposed to 2.9, 29.8 and 66.7 eggs of E. insulana; i.e., 8.66, 15.83 and 12.9% of total consumed eggs, respectively. Throughout the total larval period, a C. carnea larva consumed an average of 666.4±23.24 P. gossypiella eggs in addition to 99.8±5.37 E. insulana eggs. These values of total consumed eggs represent 87.5 and 12.5% for P. gossypiella and E. insulana, respectively.Regarding the total consumed individuals in the two experimental sets throughout the larval stage of C. carnea, it may be indicated that eggs of P. gossypiella were the mostpreferred, followed by A. durania, while, E. insulana eggs may be considered as the least preferred prey.IV-Functional responseAt 25°C and 70-80 % R.H., the functional response of the predator, C. carnea larvae (1st , 2nd and 3rd instars) to eggs of was estimated. Larval (1st2nd and 3rd instars) stages exhibited type II functional response, where the number of P. gssypiella eggs taken per one larva at a continually decreasing rate, and leveledoff to a plateau at higher prey densities. V-Effect of storage for 4 and 8 weeks at 5°C on the longevity and fecundity of C. carnea adults:In this experiment, freshly emerged adults of C. carnea were fed on bee honey solution containing yeast for 48 h., then kept at 5 °C for different periods (4 and 8 weeks). After storage period had completed, the fecundity and longevity of thepredator adults were recorded .After storage for 4 weeks, the preoviposition period of mated females was 8.6±0.84 days. After that, a single female deposited an average total number of 115.6±9.87 eggs throughout an oviposition period of 20.3±1.89 days. Amon the deposited eggs, the percentage of hatching was 79.8 %. gAn average total number of 73.9±22.85 eggs was deposited by a single mated female that had been stored for 8 weeks at 5°C. These eggs were deposited throughout an oviposition period of 16.2±2.08 days. from these eggs, a meanpercentage of 59.4 % hatched. These total numbers of eggs, that were obtained from C. carnea adult female after storage are less than of those produced by normally, reared adults (151.3±19.65 eggs throughout an oviposition period of 24.3±1.34 days). from these eggs of control,

a mean percentage of 88.7% hatched.Effect on longevity of the obtained adults.The averages of females and males' longevity were 33.1±2.68 and 18.6+3.56 days, respectively, for adults stored for 4 weeks at 5°C. The correspondent period after 8 weeks of storage were 27.4+3.81 and 13.1+3.48 days , respectively, confirming the harmful effect of long storage (About two months)on adult's life-span. Storage of C. carnea adults at low temperature led to reduction in the longevity of females and males, than of normal adults which lived for 35.4+4.81 in case of females and 22.1+2.51 days for males.VI-Feeding capacity of C. undecimpunctata : VI-1-Feeding capacity of C. undecimpunctata larvae :The consumption rates of P. gossypiella eggs by each of the three larval instars of C. undecimpunctata were 38.8 eggs during the 1st, 107.8 eggs during the second and 79.3 eggs during the third instar larva. It is clear that the larva in its third instar fed on fewer numbers of P. gossypiella eggs than did that of the second instar. This may be due to that the few number that could survive to reach the third instar became weak due to unsuitability of P. gossypiella eggs as sole food andconsequently the predator larvae became unable to reach the pupal stage.VI-2-Feeding capacity of C. undecimpunctata adults :A C. undecimpunctata adults male consumed a total mean number of 1724.88±225.83 S. cerealella eggs. While, the female fed on more amounts (2361.25±293.86 eggs). The daily mean number of consumed eggs was estimated as 42.18±1.11 eggs/male/day and 49.04±2.26 eggs/female/day.In case of feeding on P. gossypiella eggs, an adult male of C. undecimpunctata consumed a mean total number of 1701.83±221.20 opposed to 2295.00±295.85 eggs/female. The overall mean of daily number of consumed eggs was estimated as 41.02±1.28 (38.89-42.59) eggs/male and 44.69±2.59 (39.5-46.28) P. gossypiella eggs/female.When newly emerged C. undecimpunctata adults were fed on S. cerealella eggs, the male lived for 39.88±4.49 days, while, the female lived for a longer period (48.00±3.93) days. The correspondent periods recorded by feeding on P. gossypiella eggs were 41.33±4.13 and 51.17±4.07 days, respectively. It is clear that females lived for longer than male and fed on more amounts of eggs from either of the two prey species. VII-Seasonal abundance of total population ofpredators in cotton fields:Cotton seeds of Giza- 85 variety were sown at the Experimental Farm of the Faculty of Agriculture at Moshtohor, Qalubiya Governorate during two cotton seasons, 2000 and 2001. Weekly counts of predators on cotton plants were made by means of 100 double strokes of an insect sweeping. At the same time, weekly counts of predators were made by direct counts on 100 cotton plants.VII-1-Abundance of total predators(using sweep-net): The total population of insect predators was, generally, higher in cotton season 2000 (total counts of 931 individuals) than 2001 (608 individuals) by using the insect sweeping net. The same observation was also noticed when counting was made directly on 100 plants (318 individuals in season 2000 opposed to 226 in season 2001).This may be due to the environmental conditions, which, normaly, vary from one year to another, or to any other factors.Eight predators were concerned in this study. Those included a neuropteran, Chrysoperla carnea (Chrysopidae); five coleopterous, Coccinella undecimpunctata, Coccinellaseptempunctata, Cydonia vicina nilotica, Scyrnnus spp. (Coccinellidae), and Paederus alfierii (Staphylinidae), and a hemipteran, Orius spp. (Anthocoridae). True spiders were also taken into consideration.Chrysoperla carnea Steph C. carnea was always the most abundant predator on cotton plants throughout the two years of study (Total 345 & 142 adults in seasons 2000 and 2001, respectively). These total counts represented 37.06 & 23.35% of the total collected predators in the two cotton seasons, respectively.Coccinella undecimpunctata:The ladybird beetle, C. undecimpunctata was found, during the two years of study (2000 and 2001) as the most abundant coccinellid species on cotton plants. Adults of this predator were detected in the sweeping net in all of the collected samples. C. undecimpunctata, was the fourth in the order of abundance after C. carnea, Paederus allierii and Orius spp. The total numbers of captured C. undecimpunctata on cotton plants were 127 & 87 adults/100 double net strokes during the two seasons, respectively. Thus indicating that the predator was generally more abundant in season 2000 than 2001. These total counts represented 13.64 & 14.31%, of the total counts of all predators collected on cotton of the two seasons2000 and 2001, respectively.Coccinella septempunctata :Throughout the whole periods of 2000 and 2001 cotton seasons the total number of C. septempunctata adults counted on cotton plants using sweeping net were 15 and 13 adults, respectively. These counts represented 1.39 and 2.47 % of totally collected adult predators, during the two seasons, respectively. These

results showed much lower abundance of C.167septempunctata than other predators.Cydonia vicina nilotica:The total counts of C. vicina nilotica throughout 2000 and 2001 cotton seasons were 6 and 7 individuals, respectively representing 0.64 and 1.15 % of the total predators. Thus indicating that the predator was the least abundent than other predators Scymnus spp. :the total numbers of Scymnus spp. Adults counted throughout the seasons 2000and 2001 were 54 and 33 individuals that represented 5.8 and 5.43% of the total counts of all predators ,respectively.Paederus alfierii (Koch) :Total of 161 & 162 P. alfierii adults were captured throughout 2000 and 2001 cotton seasons, representing 17.29,and 26.64 % of the total counts of all predators, respectively. P. alfierii was the third abundant predator after C. carnea and Orius spp.adults in season 2000 and the highest abundant predator in 2001 Orius spp. :The whole season total counts of Orius spp. -on the cotton plants were 163& 103 individuals in the two seasons (2000 and 2001) , respectively. Orius spp. occupied 17.5 and 16.94 % of the total counts of all predators, respectively. Also, Orius spp. was the second abundant predaceous species after C.carnea on cotton of 2000, while it came the third in the order ofgeneral abundance after P. alfierii and C. carnea on cotton plants of season 2001 True spiders:The total numbers of 62 and 59 individuals of true spiders were counted throughout 2000 and 2001 seasons , respectively . Percentage of totally collected adults of true spiders occupied9.70oand 6.66 %of total numbers of the collected predators in the two seasons.VII-2-Counts of predators in cotton fields by direct count:Seasonal abundance of predators was studied during 2000 & 2001 cotton seasons by direct weekly counts of the predators on 100 randomly chosen cotton plants. The total numbers of each species throughout the whole season were counted, and subsequently the percentage of each one related to the total count of all the species was calculated. During the two seasons, the total numbers of predator individuals were 318 and 226 adults.Five predaceous insect species were surveyed in this investigation. Those belong to 4 insect families, i. e. Chrysopidae (C. carnea Coccinellidae (C'. undecimpunctata, C. septempunctata, Cydonia vicina nilotica, and Scymnus spp.), Staphylinidae (P. alfierii), and Anthocoridae (Orius spp.). True spiders were also counted on cotton plants.VIII- Releasing the second instar larvae for controlof pink and spiny bollworms in field cages : C. carnea were released as 2nd instar larvae were released on July, 3rd & 5th of two successive seasons 2000 & 2001 at different densities (20, 30 and 40 larvae/ cage) in cages constructed on Giza 85 cotton plants cultivated in the experimental Farm of the Faculty of Agriculture at Moshtohor. Cotton plants were artificially infested by releasing 20 pairs of the pink or spiny bollworms moths 2 days before releasing the predator. Five days after releasing the predator, weekly samples of cotton bolls were collected to estimate the percentages of infestation. A second release of C. carnea larvae was conducted on August, 1StVIII-1-Pink bollworm.According to the two seasons' data, releasing of C. carnea 2nd instar larvae led to reduction in percentages of bolls' infestation by the pink bollworm. These reductions ranged from 6.67 to 37% in 2000 season and 45.52 — 63.93 % than control in season 2001.VIII-2-spiny bollworm:The mean reduction percentages of bolls infested by the spiny bollworm were 7.53, 12.26 and 21.16% in the first season opposed to 19.99, 39.15 and 60.68% than control in the second one due to releasing C. carnea at 20, 30 and 40 larvae/cage, respectively.esults of the effect of release on the bolls' infestation % by pink and spiny bollworms clarified the following:a-C. carnea larvae were more efficient in controlling the two pest species in the second season than the first one. This may be due to the differences in population densities of eggs ofthe two pests at the time of release.b-the predator's larvae were more efficient in reducting infestations by the pink bollworm than the spiny bollworm.c-C. carnea larvae may be considered in any future I.P.M. program for controlling bollworm, but more studies have to be carried out by releasing the predator's larvae at higher densities in the open cotton fields in order to determine, accurately, the best times and densities for release to reach considerables measures in controlling the two pest species understudy in Egyptian cotton fields.