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Effect of different aphid species on the biological aspects of *Wesmaelius navasi* (Andréu) (Neuroptera: Hemerobiidae) as new lacewing species in Egypt under laboratory conditions

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Abstract
The predator *Wesmaelius navasi* (Andréu) (Neuroptera: Hemerobiidae) was recorded as a new species in Egypt. The predator was identified by the Natural History Museum of London, UK. Laboratory experiments were carried out at Department of Plant Protection, Faculty of Agriculture, Zagazig University under constant temperature of 25 ± 1 °C and 65 ± 5% RH. to investigate the effect of some prey species on biological aspects of the predator. These prey species were *Hyalopterus pruni* (Geoffroy), *Schizaphis graminum* (Greenbug) and *Aphis nerii* Boyer. The obtained results indicated that the shortest and longest total larval duration of *W. navasi* were 14.84 ± 0.24 and 21.69 ± 0.24 days on *H. pruni* and *S. graminum*, respectively. The results showed that, the shortest developmental period was obtained when the larvae of the predator were reared on *H. pruni* (26.21 ±0.40 days), while the longest one was recorded when the larvae were fed on *A. nerii* (40.50 ± 0.54 days). The total consumption aphids during the larval stage varied according to aphid species as it averaged 322.11 ± 8.58**,** 154.67 ± 5.87 and 125.92 ± 4.49 aphids on *H. pruni*, *S. graminum* and *A. nerii*, respectively. The mean percentages of adults emergence attained 94.74, 87.50 and 80.00%, with a sex ratio of 61.11, 57.14 and 62.50% were recorded on *H. pruni*, *S. graminum* and *A. nerii*, successfully. Results indicated an average progeny of 288.45 ± 10.88, 238.88 ± 15.87 and 179.00 ± 3.14 eggs/female when reared on the respective preys: *H. pruni*, *S. graminum* and *A. nerii*. Longevity of female was prolonged (36.63±1.67 days) on *S. graminum* and was shortened (29.18±1.87 and 29.20 ±1.24 days) on *H. pruni* and *A. nerii*, successfully.

Keywords: *Wesmaelius navasi*, new record, *Hyalopterus pruni*, *Schizaphis graminum*, *Aphis nerii*, biological aspects, predation efficacy

1. Introduction
The family Hemerobiidae Latreille, 1803, brown lacewings, is a cosmopolitan group of predaceous insects containing approximately 550 species distributed among 27 extant genera and placed in 10 living subfamilies [1]. The larvae of many hemerobiid species, especially of the genera *Wesmaelius*, *Hemerobiella*, *Hemerobius*, *Nesobiella* and *Sympherobius* commonly prey upon economically important pest insects in agricultural, horticultural, and forest environments [2]. However, despite their significance as predators in these situations and their potential usefulness for ecological and biodiversity studies. Hemerobiids posses the following preimaginal stages: egg, three instars, and a pupa. They lay sessile (not stalked) eggs that are deposited singly or in small groups. Most known hemerobiid larvae relatively active, plant-frequenting predators of soft-bodied insects or their eggs [3, 4]. Most species of hemerobiids are predaceous in both imaginal and preimaginal stages, and many are of considerable value as biological control agents [5, 6]. *Wesmaelius* is one of two hemerobiid genera that is commonly found in agricultural situations, especially in temperature regions; it is also frequently encountered in forests. Some species are active under relatively low temperatures and thus have potential as biological control agents when other natural enemies are inactive. Several *Wesmaelius* species commonly occur in agricultural situations where they feed on economically important pests. Hemerobiids are always predacious, adults as well as larvae, feeding on slow-moving soft-bodied arthropods.The gut content of all species that have been analysed included aphid remains [7]. The *Wesmaelius navasi* (Andréu) (Neuroptera: Hemerobiidae) is found in most of the environments throughout the world. *W. navasi* is an important predator of a number of economically important pests such as aphids.

Larvae of *W. navasi* are voracious predators of exposed eggs, small soft-bodied arthropods, such as aphids, jassids, whitefly, thrips, scale insects, mealy bugs and spider mites [4, 2]. The larvae are called aphid lions and have been reported to eat between 100 to 400 aphids each [8]. Adults feed only on pollen, nectar and aphid honeydew. *W. navasi* is a hemerobiid predator recorded for the first time in Egypt on apricot and peach trees infesting with aphid, *Hyalopterus pruni* (Geoffroy) [9] according to the geographical distribution map no. 106 provided by the Natural History Museum of London [10]. The present work aimed to study the effects of three aphid species, *H. pruni*, *S. graminum* and *A. nerii* on the biological aspects *viz.*, immature development, survival percentage, pupation percentage, predation rate, adult emergence percentage, sex ratio, fecundity, fertility and hatchabilaty and predation efficacy of *Wesmaelius navasi* (Andréu) under laboratory conditions.

2. Materials and methods

The experiments were conducted in Plant Protection Department, Faculty of Agriculture, Zagazig University, Egypt, under constant temperature of 25 ± 1° C and 65 ± 5% RH. Three aphid species namely, *Hyalopterus pruni* (Geoffroy), *Schizaphis graminum* (Greenbug) and *Aphis nerii* Boyer were used as preys for *Wesmaelius navasi* (Andréu). The predator and the prey individuals were obtained from a maintained culture in the insectary.

Adults of *W. navasi* were collected from mango and apricot orchards infested with aphids in the newly reclaimed sandy area at El-Khattara district, Sharkia Governorate, Egypt. Adults (females and males) were placed in a glass chimney cage measured 17cm height, 7 cm top diameter and 8.5 cm bottom diameter. Each chimney cage was placed on 9 cm diameter Petri dish. Filter paper was placed on the bottom of the Petri dishes, and the upper open end of glass chimney was covered with black muslin cloth tightened with rubber band. The adult diets were provided inside the glass chimney with the help of small paper strips. The artificial diet for adults was prepared by adding honey, yeast extract and maize pollen as ratio 1:1:1. Each strip being drilled at three points from artificial diet was offered as adults food to make pits for holding drops of diet. The diets were provided with the interval of 24 hours. Each chimney was provided with a piece of cotton soaked in distilled water placed at the top of glass chimney, over muslin cloth, to maintain moisture. Laid eggs on the bottom and walls of the chimney were harvested daily**.** Sixty newly hatched larvae of the predator were kept separately in plastic vial (7 x 2 cm). Twenty replicates were used for each prey. Known sufficient numbers from each prey was offered and the devoured were replaced daily. Number of consuming aphid individuals were recorded daily until each larva was developed into a pupa in the spherical silky cocoon. Percentages of survival of larval instars, larval durations, cocooning percentages, total developmental period, percentages of the adults emergence and sex ratio as percentage of adult females were recorded. In all treatments, newly emerged adults, male and female, of *W. navasi* were paired in glass chimneys as previously described and were provided with 10% honey solution in impregnated cotton in glass chimneys. The adults were provided also by the diet consisted of honey, yeast extract and maize pollen. The effect of prey species during the predator larval stage of the adult was determined considering the following parameters: Fecundity, fertility, hatchability, incubation period of the eggs, pre-oviposition, oviposition and post-oviposition periods, and longevity.

The differences among treatments averages and their variances were appraised through F test (ANOVA) according to COSTAT [11].

3. Results and Discussion

3.1 Biological aspects and predation efficacy of the brown lacewing, *Wesmaelius navasi* (Andréu) under laboratory conditions

3.1.1 Larval stage

3.1.1.1 Predation efficacy

Data obtained in Table 1 and Figure 1 Showed that the averages of the daily feeding capacity of the 1st larval instar were 7.26 ± 0.32, 2.91± 0.13 and 2.62±0.15 preys of *H. pruni*, *S. graminum* and *A. nerii*, respectively. The 2nd larval instar consumed an average of 10.65± 0.57,4.42± 0.23 and 3.42± 0.18 preys of the previously prey species, respectively. The 3rd instar fed on 35.57± 1.48, 13.62± 0.77 and 9.92± 0.50 individuals of *H. pruni*, *S. graminum* and *A. nerii*, respectively. The daily consumed aphids during the total larval stage averaged 21.83 ± 0.69, 7.55 ± 0.31 and 5.82 ± 0.23 individuals when larvae were fed on *H. pruni*, *S. graminum* and *A. nerii*, respectively. The total consumed aphids during the 1st larval instar were of 26.0 ± 0.70, 16.42 ± 0.55 and 14.82 ± 0.48 preys of *H. pruni*, *S. graminum* and *A. nerii*, respectively. The 2nd larval instar consumed 41.35 ± 1.26, 30.42 ± 1.25 and 25.00 ± 1.25 individuals of the previously prey species, respectively. The 3rd instar fed on 254.47 ± 8.17, 105.44± 5.18 and 86.15± 4.17 individuals of *H. pruni*, *S. graminum* and *A. nerii*, respectively.Throughout the total larval stage, the larva fed on the mean numbers of 322.11 ± 8.58, 154.67 ± 5.87 and 125.92 ± 4.49 aphids of *H. pruni*, *S. graminum* and *A. nerii*, successively. The 1st, 2nd and 3rd larval instars consumed 8.41, 13.38 and 78.21% of the total consumed preys during the whole larval stage when larvae were fed on *H. pruni*, respectively. The three larval instars consumed 11.19, 20.73 and 68.08%, respectively of the total consumed preys during the whole larval stage when reared on *S. graminum*. The 1st, 2nd and 3rd consumed 14.42. 21.47 and 64.11% of the total consumed numbers of *A. nerii* throughout the whole larval stage, respectively. These findings indicated that the greatest number of aphids was consumed by the 3rd larval instar. Withycombe [12] revealed that the total number consumed aphids during the total larval stage of *Hemerobius nitidulus* Fabricius ranged between 55.5 and 80.0 of *Aphis rumicis* L. per larva. Obtained results agree with the findings of Laffranque and Canard [13] who mentioned that during the development of *Wesmaelius subnelosus* (Stephens), each larva consumed an average of 175.0 *Aphis fabae* (Scop.) and the third instar larvae consumed the major portion of the total number consumed (70 – 80%). These results are similar with those of Laffranque and Canard [13] found that first larval instar of *W. subnelosus*, fed on 30.05 nymphs of *Myzus persicae* (Sulzer) and the total larval stage consumed 160.40 nymphs. Takahiko and Hajimu [14] who reported that the daily consumption by *Wesmaelius* Sp. at was 18.9 instars, 47.2 instars, 57.7 instars, and 91.0 adults of the glasshouse potato aphid, *Aulacorthum solani*. Statistical analysis of the data indicated highly significant differences among the means.

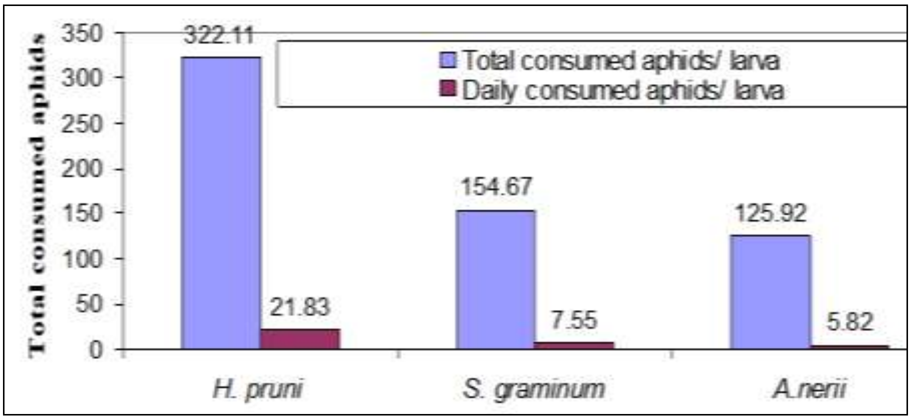
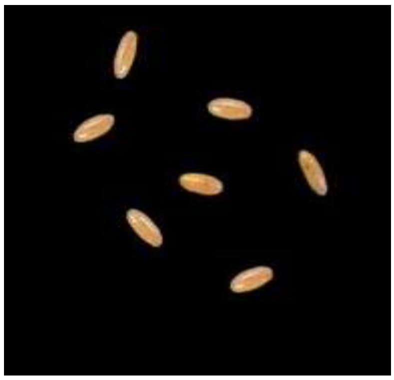


Fig 1: Effect of three prey species on the consumed aphids by *Wesmaelius navasi* (Andréu) under laboratory conditions of 25 + 1 °C and 65 + 5% RH

3.1.1.2 Larval durations

The predator had three larval instars; the first instar was active and run fast; moving the head from side to side when it moves. Smith [15] in (Plate 1).



Adult stage | Newly deposited eggs | Eggs after three days

Cocoon (Pupal stage) | Larval stage

Plate 1: Different stages of *Wesmaelius navasi* (Andréu).

3.1.1.2.1 First larval instar

Data obtained in Table 2 indicated that the first larval instar lasted 3-4, 5-7 and 5-8 days, with averages of. 3.65 + 0.11, 5.74 + 0.18 and 5.59 + 0.19 days, when the larvae were fed on *H. pruni*, *S. graminum* and *A. nerii*, respectively. These results are similar with those of Syrett and Penman [16] stated that the first larval instar *Wesmaelius* Sp.lasted 7.6 days, when the larvae were reared on aphid**,** *A. fabae***.** Analysis of variance indicated that the differences between *A. nerii* and each *H. pruni* and *S. graminum* were highly significant.

3.1.1.2.2 Second larval instar

Data compiled in Table 2 cleared that the mean durations of the second larval instar were 4.00 + 0.15, 7.00 + 0. 19 and 7.30 + 0.13 days, with ranges of 3-5, 6-8 and 7-8 days, when larvae were fed on *H. pruni*, *S. graminum* and *A. nerii*, respectively. Analysis of variance indicated that the differences between *A. nerii* and the other prey species were highly significant.

3.1.1.2.3 Third larval instar

The results in Table 2 revealed that the mean durations of the third larval instar were 7.26 + 0.21, 7.83 + 0. 20 and 8.69 + 0.13 days, with ranges of 6-9, 6-9 and 8-9 days, when the *W. navasi* larvae were fed on *H. pruni*, *S. graminum* and *A.nerri*, respectively. Statistical analysis of the data indicated highly significant differences among the means.

3.1.1.3 Total larval durations

Data in Table 2 and Figure 2 cleared that the mean total duration periods of larval stage reached 14.84 ± 0.24, 20.56 ± 0.28 and 21.69 ± 0.24 days, with ranges of 13-16, 18-23 and 20-23 days, on *H. pruni*, *S. graminum* and *A. nerii*, respectively. The shortest and longest larval periods of *W. navasi* were 14.84 ± 0.24 and 21.69 ± 0.24 days on *H. pruni* and *S. graminum*, respectively. Smith [15] mentioned that, the life history of *Wesmaelius* Sp. was 22.2 days for larvae. Statistical analysis of the data revealed that there were highly significant differences among the means.

3.1.1.4 Larval survival

Data in Table 3 showed that the survival rates of the first larval instar were 100.0, 95.0 and 85.0%, when fed on *H. pruni*, *S. graminum* and *A. nerii*, respectively. The survival rates of the second larval instar were 100.0, 100.0 and 88.24% when larvae were fed on the previously mentioned prey species, successively. The third larval instars indicated survival rates of 95.0, 94.73 and 86.67%, when were reared on *H. pruni*, *S. graminum* and *A. nerii*, successively. The mean survival rates of larval stage were 95.0, 90.0 and 65.0%, when larvae were fed on *H. pruni*, *S. graminum* and *A. nerii*, respectively.

3.1.2 Pupal stage

3.1.2.1 Pupal durations

Data given in Table 2 revealed that the mean durations of pupal stage were 7.32 ± 0.19, 10.63 ± 0.47 and 12.20 ± 0.29 days, with ranges of 6-8, 9-14 and 10-13 days, when larvae were fed on *H. pruni*, *S. graminum* and *A. nerii*, respectively. These results are agree with those of Smith [15] mentioned that, the life history of *Wesmaelius* Sp. was 10.1 days for pupal stage. Syrett and Penman [16] stated that the pupal duration of *Wesmaelius* Sp.was 11.3 days, when the larvae were reared on aphid**,** *A. fabae***.** The differences among means were highly significant.

3.1.2.2 Percentages of cocooning

As shown in Table 3 the mean percentage of cocooning of *W. navasi* were 100.0, 88.89 and 76.92% when the larvae were reared on *H. pruni*, *S. graminum* and *A. nerii*, respectively. The maximum pupation, 100.0%, was recorded when larvae were fed on *H. pruni*, while the minimum value of 76.92%, when they were fed on *A. nerii*.

3.1.3 Adult stage

3.1.3.1 Percentages of emergence

Data in Table 3 cleared that the mean percentages of adult emergence attained 94.74, 87.50 and 80.0%, when larvae were fed on *H. pruni*, *S. graminum* and *A. nerii*, respectively.

3.1.3.2 Sex ratio

As shown in Table 3 the mean percentage of sex ratio (expressed at the ratio of female adult to the total number of emerged adults), attained 61.11, 57.14 and 62.50% when the predator larvae were reared on *H. pruni*, *S. graminum* and *A. nerii*, successively.

3.1.3.3 Pre- oviposition period

Data presented in Table 4 showed that the pre- oviposition period varied from 3-6, 3-7 and 6-8 days, with averages of 4.27 ± 0.36, 5.38 ± 0.42 and 7.00 ± 0.45 days, when larvae were reared on *H. pruni*, *S. graminum* and *A. nerii*, respectively. Analysis of variance indicated that the differences between the *A. nerii* and the other two prey species were highly significant.

3.1.3.4 Oviposition period

Data presented in Table 4 cleared that the oviposition period lasted 17-21, 20-33 and 14-17 days, with averages of 18.82 ± 0.40, 27.50 ± 1.45 and 15.80 ± 0.85 days, when larvae of *W. navasi* were fed on *H. pruni*, *S. graminum* and *A. nerii*, respectively. obtained results are similar with those of Takahiko and Hajimu [14] who reported that The oviposition period for *Wesmaelius* sp. was 28.7 days, in which it laid a total number of 515.2 eggs during its life span. Statistical analysis showed that the differences among means were highly significant.

3.1.3.5 Post-oviposition period

As shown in Table 4 the post-oviposition period varied from 5-8 days, with an average of 6.40 ± 0.60 days on *A. nerii* whereas, they lasted 4-8 and 3-6 days, with averages of 6.09 ± 0.41 and 4.13 ± 0.35 days, when larvae were fed on *H. pruni* and *S. graminum*, successively.

Analysis of variance indicated that the differences between the *S. graminum* and the other two prey species were highly significant.

3.1.3.6 Fecundity

Data presented in Table 5 and Figure 3 cleared that the mean numbers of eggs laid per female were 288.45 ± 10.88, 238.88 ± 15.87 and 179.00 ± 3.14 eggs, with ranges of 250 - 370, 185 – 311 and 152 – 220 eggs, when larvae were fed on *H. pruni*, *S. graminum* and *A. nerii*, respectively. The highest means, 288.45 and 238.88 eggs, were recorded on *H. pruni*, *S. graminum*, respectively, Statistical analysis of the data revealed highly significant differences among the means. Concerning the number of deposited eggs per day, data in Table 5 and (Figure 3) indicated that the mean numbers of laid eggs per day were 15.31 ± 0.40, 10.26 ± 0.83 and 10.06 ± 0.64 eggs, when larvae were fed on *H. pruni*, *S. graminum* and *A. nerii*, respectively. These results are in disagreement with those of Takahiko and Hajimu [14] who stated that The maximum number of eggs laid by a female in a day was 54.8. Statistical analysis of the data revealed highly significant differences among the means.

3.1.3.7 Fertility

Data in Table 5 indicated that the mean percentages of laid fertilized eggs per female were 82.25±2.59, 69.38 ± 3.59 and 62.00± 2.50%, when larvae of *W. navasi* were reared on *H. pruni*, *S. graminum* and *A. nerii*, successively.

Statistical analysis cleared that insignificant differences between means of each of *S. graminum* and *A. nerii*. The differences among means of the previously mentioned prey species and mean of *H. pruni* was highly significant.

3.1.3.8 Female longevity

As indicated in Table 4 and Figure 3 the adult female longevities averaged 29.18 ± 0.87, 29.20 ± 1.24 and 36.63 ± 1.67 days, with ranges of 25-35, 25-32 and 29-42 days, when the predator larvae were reared on *H. pruni*, *A. nerii* and *S. graminum*, respectively. These results are similar with those of Takahiko and Hajimu [14] who mentioned that the longevity of an adult female *Wesmaelius* Sp. was 34.9 days. Statistical analysis revealed highly significant differences among mean values.

Table 1: Predation efficacy of *Wesmaelius navasi* (Andréu) larvae reared on three prey species under laboratory conditions of 25± 1 °C and 65± 5% RH

prey species	Daily consumed aphids								Total consumed aphids								Consumption (%)		
	1st instar		2nd instar		3rd instar		Total larval stage		1st instar		2nd instar		3rd instar		Total larval stage		1st instar	2nd instar	3rd instar
	Range	Mean ±S.E	Range	Mean ±S.E	Range	Mean ±S.E	Range	Mean ±S.E	Range	Mean ±S.E	Range	Mean ±S.E	Range	Mean ±S.E	Range	Mean ±S.E			
H. pruni	5.25 - 10.00	7.26 ± 0.32 **a**	7.00 - 16.67	10.65 ± 0.57 **a**	25.00 - 44.43	35.57 ± 1.48 **a**	16.50 - 25.38	21.83 ± 0.69 **a**	20-30	26.00 ± 0.70**a**	28-50	41.35 ± 1.26 **a**	200 - 311	254.47 ± 8.17 **a**	264 - 380	322.11 ± 8.58 **a**	8.41	13.38	78.21
S. graminum	2.14 - 4.00	2.91 ± 0.13 **b**	2.50 - 6.00	4.42 ± 0.23 **b**	9.50 - 12.50	13.62 ± 0.77 **b**	5.48 - 9.74	7.55 ± 0.31 **b**	11-20	16.42 ± 0.55b	18-36	30.42 ± 1.25b	66 - 139	105.44 ± 5.18b	122 - 190	154.67± 5.87 b	11.19	20.73	68.08
A.nerii	1.30 - 3.80	2.62 ± 0.15 **b**	2.29 - 4.29	3.42 ± 0.18 **b**	6.11 - 13.13	9.92 ± 0.50 **c**	4.73 - 7.36	5.82 ± 0.23 **c**	13-19	14.82 ± 0.48 b	16-30	25.00 ± 1.25 c	55 - 120	86.15 ± 4.17b	104 - 162	125.92 ± 4.49 c	14.42	21.47	64.11
F. value		138.394**		97.592**		159.680**		315.168**		104.750**		43.174**		204.509**		233.217**			
L.S.D. 0.01		0.66		1.25		3.59		1.62		1.77		3.92		21.14		22.69			

Values are means of three replicates ± standard Error. Values in the same column with a different superscript letter differ significantly at *P* ≤0.01

- ** indicates that the differences between treatments are significant and highly significant at 0.05 and 0.01 level of probability.

Table 2: Effect of prey species on the durations of *Wesmaelius navasi* (Andréu) immature stages under laboratory conditions of 25 ± 1° C and 65 ± 5% RH

prey species	Mean duration (days)													
	Egg stage		Larval stage								Pupal stage		Total developmental period	
			First instar		Second instar		Third instar		Total larval stage					
	Range	Mean±S.E.	Range	Mean±S.E.	Range	Mean±S.E.	Range	Mean±S.E.	Range	Mean±S.E.	Range	Mean±S.E.	Range	Mean±S.E.
H. pruni	3-5	4.05 ± 0.15 c	3-4	3.65 ± 0.11 b	3-5	4.00 ± 0.15 b	6-9	7.26 ± 0.21 c	13-16	14.84 ± 0.24 c	6-8	7.32 ± 0.19 c	23-29	26.21 ± 0.40 c
S. graminum	5-9	5.80 ± 0.20 b	5-7	5.74 ± 0.18 a	6-8	7.00 ± 0.19 a	6-9	7.83 ± 0.20 b	18-23	20.56 ± 0.28 b	9-14	10.63 ± 0.47 b	34-40	37.06 ± 0.64 b
A. nerii	5-8	6.50 ± 0.21 a	5-8	5.59 ± 0.19 a	7-8	7.30 ± 0.13 a	8-9	8.69 ± 0.13 a	20-23	21.69 ± 0.24 a	10-13	12.20 ± 0.29 a	37-42	40.50 ± 0.54 a
F. value		44.117**		52.782**		137.315**		11.970**		162.979**		52.466**		197.646**
L.S.D. 0.01		0.538		0.485		0.495		0.640		0.915		1.193		1.871

Values are means of three replicates ± standard Error. Values in the same column with a different superscript letter differ significantly at *P* ≤0.01

- ** indicates that the differences between treatments are significant and highly significant at 0.05 and 0.01 level of probability.

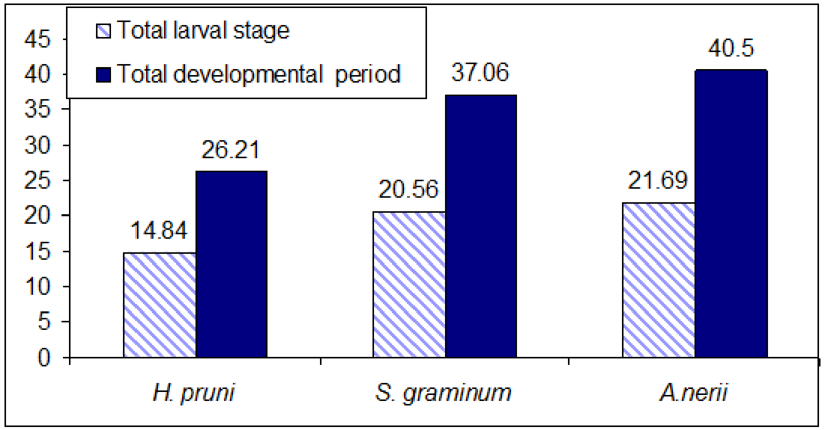


Fig 2: Effect of three prey species on the total larval duration and total developmental period of *Wesmaelius navasi* (Andréu) under laboratory conditions of 25 ± 1 °C and 65 ± 5% RH

Table 3: Effect of prey species on the larval survival, pupation, emergence and sex ratio percentages of *Wesmaelius navasi* (Andréu) under laboratory conditions of 25 + 1 °C and 65 + 5% RH

prey species	Larval survival %				Cocooning %	Emergence %	Sex ratio (Females %)
	1st instar	2nd instar	3rd instar	Mean			
H. pruni	100.0	100.0	95.0	95.0	100.0	94.74	61.11
S. graminum	95.0	100.0	94.73	90.0	88.89	87.50	57.14
A. nerii	85.0	88.24	86.67	65.0	76.92	80.00	62.50

Table 4: Effect of prey species on the pre –oviposition, oviposition, post –oviposition periods and longevity of *Wesmaelius navasi* (Andréu) adults under laboratory conditions of 25 + 1 °C and 65 + 5%RH

Biological charactersitics	Mean /range of values			F. value	L.S.D.
	H. pruni	*S. graminum*	*A. nerii*		0.01
Female Pre – oviposition period	4.27 +0.36 b 3-6	5.38+0.42 b 3-7	7.00+0.45 a 6-8	9.693**	1.52
Oviposition period	18.82+0.40 b 17-21	27.50+1.45 a 20-33	15.80+0.85 c 14-17	38.730**	3.42
Post - oviposition period	6.09+0.41 a 4-8	4.13+0.35 b 3-6	6.40+0.60 a 5-8	7.326**	1.64
Longevity	29.18+0.87 b 25-35	36.63+1.67 a 29-42	29.20+1.24 b 25-32	11.459**	4.71
Male longevity	16.29+1.38 ab 11-20	19.17+1.62 a 15-25	12.33+0.88 b 11-14	3.782 ns	6.24

- ** indicates that the differences between treatments are significant and highly significant at 0.05 and 0.01 level of probability.
- NS indicates that the differences between treatments are not significant.
Values are means of three replicates ± standard Error. Values in the same column with different superscript letter differ significantly at *P* ≤0.01

3.1.3.9 Male longevity

Data given in Table 4 revealed that the male longevities lasted 15-25, 11-20 and 11-14 days, with averages of 19.17 + 1.62, 16.29 + 1.38 and 12.33 + 0.88 days, when the larvae were reared on *S. graminum*, *H. pruni* and *A. nerii*, respectively. Statistical analysis cleared that the differences among the means were insignificant.

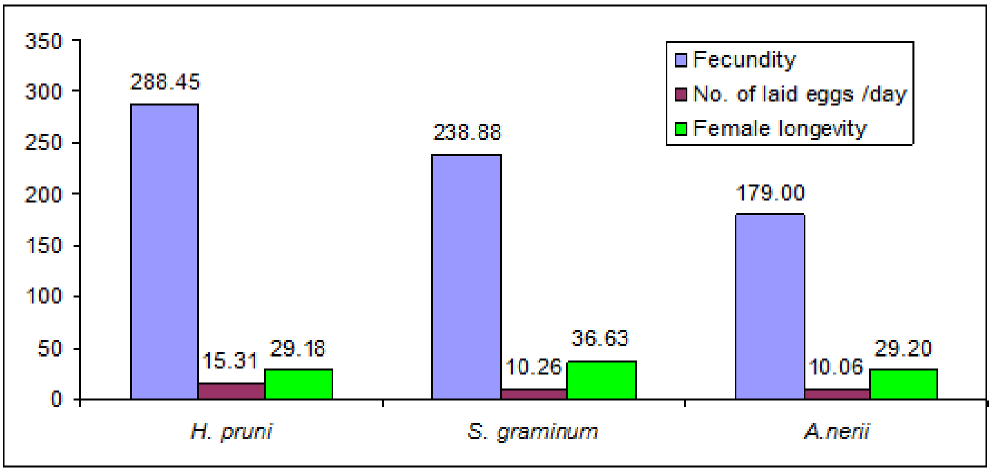


Fig 3: Effect of three prey species on the fecundity, number of laid eggs per day and female longevity of *Wesmaelius navasi* (Andréu) under laboratory conditions of 25 + 1 °C and 65 + 5% RH

Table 5: Effect of prey species on the fecundity, fertility and hatchability of *Wesmaelius navasi* (Andréu) under laboratory conditions of 25 + 1 °C and 65 + 5%RH

Prey species	Fecundity			Fertility %	Hatchability %
	Range	Mean	No. of laid eggs /day		
H. pruni	250-370	288.45+10.88 a	15.31+0.40 a	82.55+2.59 a	91.47+1.04 a
S. graminum	185-311	238.88+15.87 b	10.26+0.83 b	69.38+3.59 b	87.54+2.07 a
A. nerii	152-220	179.0+3.14 c	10.06+0.64 b	62.00+2.50 b	80.74+0.83 b
F. value		15.031**	25.702**	9.498**	6.809**
L.S.D. 0.01		49.41	2.29	12.42	7.10

- ** indicates that the differences between treatments are significant and highly significant at 0.05 and 0.01 level of probability.

3.1.4 Egg stage

3.1.4.1 Incubation period

Mated females lay non stalked eggs, usually singly or in small groups of 5 to 15 eggs / cluster in (Plate 1).

Data presented in Table 2 indicated that the incubation period of laid eggs by the adults of *W. navasi* were highly significantly differed owing to the species of prey during the larval stage. They were 4.05 + 0.15, 5.80 + 0.20 and 6.50 + 0.21 days, with ranges of 3 - 5, 5-9 and 5 – 8 days when the larvae were fed on *H. pruni*, *S. graminum* and *A. nerii*, respectively. obtained results are in disagreement with those of Smith [15] mentioned that, the life history of *Wesmaelius* Sp. was 9.15 days for eggs. These results are agree with those of Syrett and Penman [16] stated that the incubation period of the eggs of *Wesmaelius* Sp.was 6.0 when the larvae were reared on aphid**,** *A. fabae***.**

3.1.4.2 Hatchability
Data presented in Table 5 cleared that the highest mean percentages of hatchability 91.47 ± 1.04 and 87.54 ± 2.07%, were obtained when the larvae were reared on *H. pruni* and *S. graminum*, respectively. The lowest value 80.74± 0.83%, were recorded when the larvae were reared on *A. nerii*. Highly significant differences were found between means of each *H. pruni*, *S. graminum* and *A. nerii*.

3.1.5 Total developmental period
Data presented in Table 2 and Figure 2 showed that the total developmental period of the predator lasted 23-29, 34-40 and 37-42 days, with averages of 26.21± 0.40, 37.06 ± 0.64 and 40.50 ± 0.54 days, when the predator was reared on *H. pruni*, *S. graminum* and *A. nerii*, respectively. In addition, the total developmental period of the predator was clearly affected by rearing on different prey species. The maximum mean total developmental period was 40.50 and 37.06 days, recorded on *S. graminum* and *A. nerii*, respectively. While the minimum mean was 26.21 days on *H. pruni*. Dobosz [17] reported that the total developmental period of the predator lasted 37-42 days, when the larvae reared on aphids. Statistical analysis showed that the differences among means were highly significant.

4. Conclusion
The effects of three aphid species, *H. pruni*, *S. graminum* and *A. nerii* on the biological parameters of *W. navasi* were studied in the laboratory. The results indicated that rearing of the predator on the aphid species, *H. pruni* improved the most biological parameters *viz.*, immature development, survival percentage, pupation percentage, predation rate, adult emergence percentage, sex ratio, fecundity, fertility and hatchabilaty hoping to mass rear it in the laboratory to be utilized as a bio-control agent.

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5. References
1. Mc Ewen PK, New TRR, Whittington A. Lacewings in the crop management. Cambridge University Press. 2001; p.546.
2. Oliveira AC, Lara RIR, Fonseca AR, Perioto NW. Hemerobiidae (Neuroptera) in the Midwestern region of Minas Gerais State, Barazil., Revista Colombiana de Entomologia. 2013; 39(2):256-259.
3. Oswald JD. Review of the brown lacewing genus Bi-ramus (Neuroptera: Hemerobiidae: Hemerobiinae), with the description of a new species from Costa Rica and Panama. Tijd- schrift voor Entomologie. 2004; 147(1):41-47.
4. New TRR. The biology of Chrysopidae and Hemerobiidae (Neuroptera) with reference to their use as biological agents: a review. Transactions of the Royal Entomological Society of London.1984; 127:115-140.
5. Lara RIR, Freitas S, Perioto NW, Paz CCP. Amostragem, diversidade e sazonalidade de Hemerobiidae (Neuroptera) em *Coffea arabica* L. cv Obatã (Rubiaceae). Revista Brasileira de Entomologia. 2008; 52(1):117-123.
6. Lara RIR, Perioto NW, Freitas S. Diversidade de hemerobiídeos (Neuroptera) e suas associações com presas em cafeeiros. Pesquisa Agropecuária Brasileira. 2010; 45(2):115-123.
7. Lara RIR, Freitas S. Caracterização morfológica de espécies deHemerobiusLinnaeus, 1758 (Neuroptera, Hemerobiidae) associadas a cultivo de café (*Coffea arabica* L.), milho (*Zea mays* L.) e erva-mate (*Ilex paraguariensis* St. Hill.). Re-vista Brasileira de Entomologia. 2003; 47(3):427-434.
8. Eilenberg J, Hajek A, Lomer C. Suggestions for unifying the terminology in biological control. Biocontrol. 2015; 46:387-400**.**
9. Youssif MAI. Studies on aphid-lion species and their natural enemies. Ph.D. Thesis, Faculty of Agriculture Zagazig University 2015; 266.
10. British Museum. Distribution Maps of Aphid lion species. December, 2013 Map no. 106.
11. COSTAT (Computer Program). Version 6.311, Copyright (C), Coltart Software 798 Lighthouse Ave. PMB 320, Monterey, CA, 2005, 93940, USA.
12. Withycombe CL. Notes on the biology of some British Neuroptera (Planipennia). Transactions of the Entomological Society of London. 2014, 501-594.
13. Laffranque JP, Canard M. Biologie du predateur aphidophage *Boriomyia* (*Wesmaelius* =) *subnebulosa* Stephen (Neuroptera: Hemerobiidae) :etudes au laboratoire et dans les conditions hivernales du sud – oust de la france. Annales de Zoologie – ecologie Animale. 2012; 7:331-343.
14. Takahiko S, Hajimu T. Effect of Temperature on the Biological Attributes of the Brown Lacewing *Wesmaelius* Sp. (Neuroptera: Hemerobiidae). Article in Applied Entomology and Zoology. 2004; 39(3):417-425·
15. Smith RC. The life histories and stages of some hemerobiids, and allied species. Ann. Entomological Society of America. 1923; 16:129-151.
16. Syrett P, Penman DR. Developmental threshold temperatures for brown lacewing, *Wesmaelius* sp. New Zealand Journal of Zoology. 2011; 8:281-283.
17. Dobosz R. Lacewings (Neuroptera) of the Polish Baltic coast with remarks on *Wesmaelius* (Kimminsia) *balticus* (Tjeder, 1931) a new species of Hemerobiidae to the fauna of Poland. 97-112 in Devetak, D.; Lipovšek, S.; Arnett, A. E. (eds.). Proceedings of the 10th International Symposium on Neuropterology (22-25 June 2008; Piran, Slovenia). University of Maribor, Maribor, Slovenia. 307.