

Jan Nawrot

POPULATION PARAMETERS FOR ALMOND MOTH (*CADRA CAUTELLA* WLK.) (LEPIDOPTERA: PHYCITIDAE) REARED ON NATURAL PRODUCTS

INTRODUCTION

The food of almond moth larvae influenced the rate at which their population increased. This species occurs on 53 natural products of plant origin (most often on seeds, dried fruits, fodders, biscuits and chocolate) and on two products of animal origin (bones and hides). Norris (1934) and Hagstrum and Tomblin (1975) showed that the longevity and fecundity of moths were about halved if they were deprived of drinking water. Mullen and Arbogast (1977) stated that females laid more eggs if they were placed above the moth rearing medium, peanuts or dates than above clean surface. Le Cato (1976) demonstrated that the standard moth medium was better for growth of population than any other 21 natural products.

The present study was made to determine the influence of food upon the population growth capacity of almond moth.

MATERIALS AND METHODS

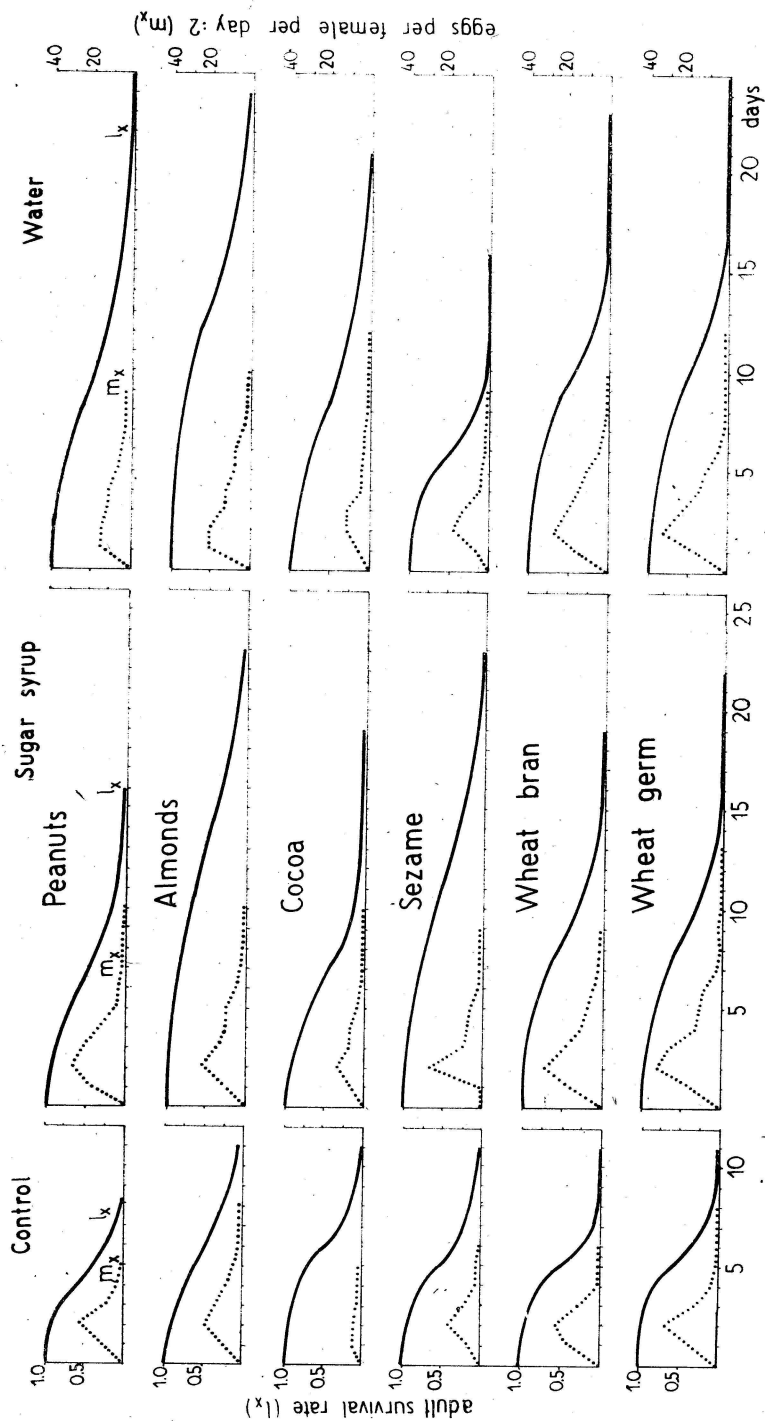
The first laboratory culture of *Cadra cautella* was set up with adults collected from infested groundnuts from Ghana. The larvae were reared on groundnuts, almonds, cocoa beans, pearl barley, oat flakes, sesame seeds, wheat bran, wheat germ, sorghum, buckwheat groats, rolled rice and biscuits. Newly emerged moths were taken from stock culture every day and placed into 250 cm³ plastic vials (ten unsexed moths in each vial). A quilted wicks soaked in water were threaded into one group of vials through the holes, similar wicks soaked in 10% sugar syrup were threaded into other vials. Third group of vials was as a control without any liquid or food. Each combination of moth diets was replicated at

Tab. 1

Biological and demographic statistics for *Cadra cautella* Wlk. reared on natural products at 26°C and 85% RHDane biologiczne i demograficzne dla *Cadra cautella* Wlk. na różnych produktach w 26°C i 85% wilgotności względnej

Food of larvae	Mean developmental time of larvae $\pm$ SE (days)	Survival % of immature stages	Food of adults	Mean adult life-span $\pm$ SE (days)	Mean number of eggs $\pm$ SE	Population parameters			
						T (days)	R ₀ ♀/♀ generation	r _m ♀/♀ week	λ ♀/♀ week
Pearl barley	40,72 $\pm$ 2,17	53,17	control	5,67 $\pm$ 0,84	104,3 $\pm$ 27,0	54,78	50,563	0,500	1,649
			water	9,93 $\pm$ 1,02	180,3 $\pm$ 34,0	54,67	88,902	0,573	1,773
			sugar syrup	11,01 $\pm$ 1,84	142,2 $\pm$ 30,6	54,66	70,618	0,544	1,723
Wheat germ	47,06 $\pm$ 2,42	72,22	control	6,53 $\pm$ 0,46	127,6 $\pm$ 13,2	61,31	64,353	0,475	1,608
			water	9,58 $\pm$ 0,61	237,6 $\pm$ 23,2	60,98	119,113	0,548	1,729
			sugar syrup	10,57 $\pm$ 0,72	217,1 $\pm$ 23,8	61,08	111,299	0,540	1,716
Wheat bran	49,36 $\pm$ 2,40	64,81	control	5,89 $\pm$ 0,36	102,6 $\pm$ 10,2	63,72	51,188	0,432	1,540
			water	10,84 $\pm$ 0,54	212,0 $\pm$ 25,4	63,50	105,580	0,513	1,670
			sugar syrup	9,38 $\pm$ 0,62	191,1 $\pm$ 20,8	63,56	95,749	0,501	1,650
Oat flakes	49,55 $\pm$ 2,73	38,89	control	6,01 $\pm$ 0,36	104,1 $\pm$ 21,6	63,86	51,292	0,430	1,537
			water	9,69 $\pm$ 0,70	215,6 $\pm$ 26,2	63,68	106,961	0,512	1,668
			sugar syrup	10,64 $\pm$ 0,86	176,0 $\pm$ 35,6	63,72	87,118	0,491	1,634
Biscuits	51,06 $\pm$ 2,65	50,93	control	5,77 $\pm$ 0,42	123,6 $\pm$ 16,8	65,38	61,600	0,440	1,553
			water	8,83 $\pm$ 0,96	172,7 $\pm$ 18,4	65,29	86,397	0,477	1,611
			sugar syrup	11,11 $\pm$ 1,22	179,5 $\pm$ 42,2	65,15	89,772	0,482	1,619
Buckwheat groats	53,00 $\pm$ 3,08	61,11	control	6,96 $\pm$ 0,66	122,8 $\pm$ 22,6	67,55	59,453	0,422	1,525
			water	10,74 $\pm$ 1,02	211,3 $\pm$ 40,0	67,24	105,388	0,484	1,623
			sugar syrup	9,31 $\pm$ 1,12	178,3 $\pm$ 30,6	67,41	88,026	0,465	1,592

Food of larvae	Mean developmental time of larvae $\pm$ SE (days)	Survival % of immature stages	Food of adults	Mean adult life-span $\pm$ SE (days)	Mean number of eggs $\pm$ SE	Population parameters			
						T (days)	R_0 $\frac{Q}{Q_0}$ / generation	r_m $\frac{Q}{Q_0}$ / week	λ $\frac{Q}{Q_0}$ / week
Sorghum	54,53 $\pm$ 2,61	33,33	control water sugar syrup	4,72 $\pm$ 0,70	74,7 $\pm$ 8,4	68,58	39,075	0,395	1,484
				8,26 $\pm$ 1,56	148,8 $\pm$ 15,1	68,43	82,310	0,451	1,570
				9,74 $\pm$ 1,82	159,5 $\pm$ 21,3	68,50	79,244	0,447	1,564
Rolled rice	65,11 $\pm$ 2,71	30,56	control water sugar syrup	5,21 $\pm$ 0,36	38,6 $\pm$ 5,4	79,25	19,005	0,194	1,214
				7,03 $\pm$ 0,82	144,1 $\pm$ 19,4	79,14	70,454	0,375	1,455
				7,10 $\pm$ 0,94	159,5 $\pm$ 21,8	79,25	79,250	0,386	1,472
Groundnuts	67,21 $\pm$ 3,86	38,89	control water sugar syrup	4,99 $\pm$ 0,70	92,7 $\pm$ 10,0	81,43	45,055	0,328	1,388
				11,18 $\pm$ 1,20	163,9 $\pm$ 27,3	81,31	69,508	0,365	1,441
				10,16 $\pm$ 1,38	183,5 $\pm$ 35,4	81,36	91,907	0,388	1,474
Almonds	67,31 $\pm$ 2,19	33,33	control water sugar syrup	6,97 $\pm$ 0,70	117,6 $\pm$ 25,4	81,49	52,581	0,339	1,403
				13,16 $\pm$ 1,13	186,7 $\pm$ 43,8	81,43	82,972	0,379	1,461
				12,35 $\pm$ 0,94	158,0 $\pm$ 34,2	81,28	74,315	0,370	1,448
Cocoa beans	68,11 $\pm$ 3,78	40,74	control water sugar syrup	5,45 $\pm$ 0,58	28,4 $\pm$ 6,3	82,53	14,230	0,139	1,149
				9,21 $\pm$ 0,98	90,3 $\pm$ 10,1	82,29	45,254	0,324	1,382
				7,65 $\pm$ 1,20	85,7 $\pm$ 8,9	82,36	46,365	0,326	1,385
Sesame seeds	87,01 $\pm$ 4,12	30,56	control water sugar syrup	5,94 $\pm$ 1,36	68,6 $\pm$ 8,7	100,96	34,064	0,244	1,277
				7,27 $\pm$ 1,56	104,4 $\pm$ 13,8	100,98	52,349	0,274	1,315
				10,55 $\pm$ 2,40	112,1 $\pm$ 16,3	100,97	60,735	0,286	1,331



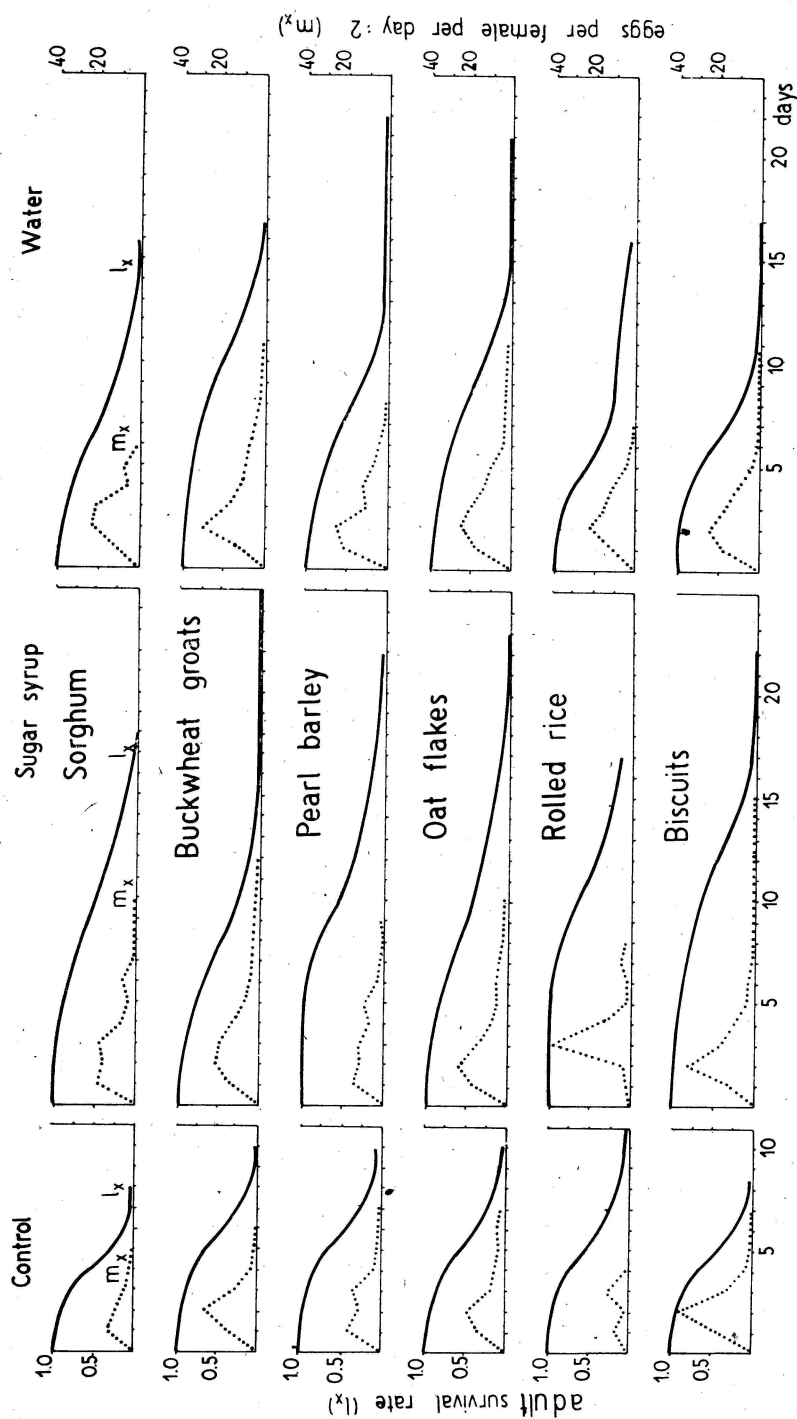


Fig. 1. Life-table (l_x) and age-specific fecundity (m_x) for *Cadra cautella* moths obtained from larvae reared on various products and fed sugar syrup or water at 26°C and 85% R.H.

Ryc. 1. Tabele życiowe (l_x) i tabele płodności (m_x) dla *Cadra cautella* Wlk. w 26°C i 85% wilgotności względnej na różnych produktach

least 10 times. The number of eggs laid per day and sex of dead moths were determined daily.

One-day old larvae were placed on adequate products (2 larvae on 5 g of food) and the number of days required for reaching of pupal stage on a given diet was recorded. At least 36 replicates were tested with each food.

The stock cultures were reared and all experiments were done at $26 \pm 1^\circ\text{C}$ and $85 \pm 5\%$ R.H.

The data obtained in the various tests were used to construct tables of l_x (life-tables) and m_x (age-specific fecundity). The population parameters were calculated with Odra 1204 computer (Nawrot, 1979).

RESULTS AND DISCUSSION

The diet of larvae had a significant effect on their development time and their survival as well as on longevity of adults and fecundity of females (Tab. 1). The shortest mean larval development period was stated on pearl barley, wheat germ, wheat bran and oat flakes and the longest one on groundnuts, cocoa beans, almonds and sesame. The larval survival was 33,33 — 72,22% and 30, 56—40, 76% on these two groups of products, respectively. There was no significant differences in longevity between males and females. Adults originated from larvae reared on rolled rice, sorghum, sesame and cocoa beans lived a short time and laid small number of eggs. Females given water or sugar syrup laid about 50% more eggs than females not given water regardless of the larval food.

On the basis of the data obtained in the tests the tables (l_x and m_x) from each commodity were prepared (Fig. 1).

The insects were capable of population increase on each examined product ($\lambda > 1$) and values of R_0 parameter increased rapidly as adults were provided with drinking water or sugar syrup.

The values of population parameters were higher for insects reared on starchy products (corn flakes, wheat bran, wheat germ, pearl barley, buckwheat groats) than for those reared on oily products (almonds, groundnuts, cocoa beans, sesame).

Mullen and Arbogast (1977) stated that oviposition by *Cadra cautella* was stimulated by the presence of moth rearing medium, peanuts or dates. It means that rate of population increase could be faster in natural warehouse conditions.

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Jan Nawrot

WSKAŹNIKI ROZWOJU POPULACJI MKLIKA DAKTYLOWCA
(*CADRA CAUTELLA* WLK.) (LEPIDOPTERA: PHYCITIDAE)
DLA RÓŻNYCH PRODUKTÓW POKARMOWYCH

STRESZCZENIE

Ułożono tabele życiowe i tabele płodności dla mklika daktylowca hodowanego w stałych warunkach 26°C i 85% wilgotności względnej powietrza na 12 produktach: kaszy jęczmiennej, zarodkach pszennych, otrębach pszennych, płatkach owsianych, herbatnikach, kaszy gryczanej, sorgo, płatkach ryżowych, orzechach ziemnych, migdałach, kakao i nasionach sezamu. Tabele posłużyły do obliczenia następujących wskaźników populacyjnych: wrodzonego tempa reprodukcji (r_m), tempa reprodukcji netto (R_0), czasu generacji (T), końcowego tempa reprodukcji (λ). Wyniki wskazują, że szkodnik może się rozwijać na wszystkich badanych produktach, jednak tempo wzrostu populacji na produktach skrobiowych jest wyższe niż na produktach zawierających duże ilości tłuszczu.

Ян Наврот

ПОКАЗАТЕЛИ РАЗВИТИЯ ПОПУЛЯЦИИ
ФЕНИКОВОЙ МОЛИ (*CADRA CAUTELLA* Wlk.,
LEPIDOPTERA, PHYCITIDAE) ДЛЯ РАЗНЫХ
ПИЩЕВЫХ ПРОДУКТОВ

РЕЗЮМЕ

Составлены жизненные таблицы и таблицы плодовитости для фениковой моли развивающейся в постоянных условиях 26°C и 85% относительной влажности воздуха на 12 продуктах: ячневой крупе, зародыщах пшеницы, пшеничных отрубях, овсяных хлопьях, печенках, сорго, гречневой крупе, рисовых хлопьях, арахисах, миндалях, какао и семенах сезама. Таблицы послужили для вычисления следующих популяционных показателей: врожденного темпа размножения (r_m), темпа размножения нетто (R_o), времени генерации (T), окончательно темпа размножения (λ). Результаты показывают, что вредитель может развиваться на всех исследуемых продуктах, однако темп развития популяции на крахмальных продуктах выше, чем на продуктах содержащих большое количество жира.