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Life Table Studies of Cigarette Beetle, *Lasioderma Serricorne* on Different Varieties of Dry Ginger

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ABSTRACT

An age specific, life and fertility tables of Lasioderma serricorne on different varieties of ginger (Kerala, Mahima, Malini, Local siddipet and Rajitha) were constructed and various life parameters were calculated at the dept. of Entomology, S.V. Agricultural college, Tirupati, at prevailing room temperature of 30 ± 2° C and 65 ± 5 % RH. Among the varieties, the insect when reared on Local siddipet showed high survival rate, life expectancy, net reproductive rate (40.08), fecundity (57.14), intrinsic rate of natural increase (0.06185) and with low mortality rate, mean generation time (61.43) and doubling time (11.21) was assessed as a susceptible variety. Similarly, the insect when reared on Malini showed low survival rate, life expectancy, net reproductive rate (14.24), fecundity (36.71), intrinsic rate of natural increase (0.03315) and with high mortality rate, mean generation time (80.33) and doubling time (20.91) was assessed as a tolerant variety.

Key words: *Lasioderma serricorne, Ginger, Cigarette beetle*

INTRODUCTION

Cigarette beetle, *Lasioderma serricorne* (Fabricius) (Coleoptera: Anobiidae) is a serious pest of high valued stored products such as spices, condiments, tobacco *etc.* This insect pest occurs throughout the tropical and subtropical regions of the world and is known to infest and consume all stages of the product, resulting in spoilage of at least one per cent (US$ 300 million) of stored tobacco stocks annum^{-1} USDA[13]. Cigarette beetle breeds on a wide variety of commodities, including both plant and animal materials Lecato[9] and Ashworth[3] and is one of the several beetle pests that commonly infest warehouses and retail stores Arbogast *et al*[2]. Ginger, *Zingiber officinale* (F: Zingiberaceae) is inherent ingredient of Indian culinary which possesses insecticidal properties also acts as an important host for *L. serricorne.* Life table is a representation of the survivorship of a defined population. It is also called as mortality table. Natural mortality is an important determinant of the population dynamics of a species and an understanding of mortality forces should aid development of better management strategies for insect pests. The lowest r_m value which is a part of life table studies value indicates that the particular cultivar is relatively insusceptible compared with the other cultivars tested and this information could be used in IPM of *L. serricorne.*

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MATERIALS AND METHODS

The studies on varietal influence of ginger on life tables of Cigarette beetle, *Lasioderma serricorne* (Fabricius) were carried out at the Department of Entomology, S.V. Agricultural College, Tirupati during 2014-2015. The ginger varieties used in the experiment were Kerala, Mahima, Malini, Local siddipet and Rajitha.Freshly emerged adults of *L. serricorne* were collected from the nucleus culture and were released into the plastic jar secured with a lid provided with grounded powder of fennel. After two days the eggs were removed from the powdered fennel with the help of camel brush and used for the estimation of the life table parameters. The experiment were conducted at room temperature 30 ± 2° C and 65 ± 5 % RH. Two types of life tables, Age-specific survival or mortality life table, Age-specific survival and fecundity table of female were constructed for *L. serricorne* in this study by the methods suggested by Deevey[8], Morris and Miller 1954[10].Different varieties of dry ginger (Kerala, Mahima, Malini, Local siddipet and Rajitha) were powdered and used for studying life tables. The study was initiated with a cohort of 75 eggs which were laid in a single day. The total of 75 eggs was placed on each variety of dry ginger in petri plates. The newly hatched grubs were allowed to develop till pupation and adult emergence. Mortality from hatching of eggs to emergence of adults were recorded daily. Fecundity of the female was noted daily from adult emergence to death. Considering the ratio of females to males and the fecundity, the number of female births were calculated. Survived and dead count for both immature and adult stages were taken on every fifth day. Based on survived and dead count recorded, the death and survival rates (x and lx) were calculated. The adult beetles that emerged from each variety of dry ginger were paired and observed regularly to record the daily egg laying and survival. Based on which per cent distribution was obtained.The techniques for computing various life parameters and observations, for constructing the life tables were followed as specified by Birch[6], Chaudhary and Bhattacharya[7]. An accurate estimate of r (r_m) was calculated by Lotka-Euler equation, S (e^{-rx} lxmx) = 1. The procedure to calculate r_m from the above equation became more practical by multiplying either side of the equation with e^7 which was equal to 1096.6. Then the equation became S (e^{7-rx} lxmx) = 1096.6. Taking two trial values on either side of r_c differing in the second decimal place, the two trial e^{7-rx} lxmx were plotted on horizontal axis against their respective r values on the vertical axis with a line drawn from the value of e^{7-rx} lxmx =1096.6. The point of intersection gave the precise value of r_m which was expressed as female progeny / female / day.

Life parameters of *Lasioderma serricorne:*

Net reproductive rate (R_0) =$\sum$ lxmx

Mean Generation Time (T_c) in days = $\frac{\sum lxmx\ x}{\sum lxmx}$

Intrinsic rate of increase-appx.(r_c) (Females/female/day):$r_c = \frac{\log_e R_0}{T_c}$

Intrinsic rate of increase(r_m) (Females/female/day):

$\sum e^{7-r_m}$ x lxmx =1096.6

Corrected Generation Time (T) in days: $T = \frac{\log_e R_0}{r_m}$

Finite rate of increase (λ) (Females/female/day): λ = anti $\log_e r_m$

Doubling time (DT): $DT = \frac{\log 2}{\log \lambda}$

Weekly multiplication of population = λ^7

Annual rate of increase ARI = $(\lambda)^{365}$

Hypothetical F_2 females = R_0^2

RESULTS AND DISCUSSION

Life table studies on *L. serricorne* on different varieties of ginger

Results of present study indicated that the age specific survival and duration of different stages of *L. serricorne* were different on different varieties of ginger. The egg stages lasted for 6, 7, 8, 6 and 6 days on Kerala, Mahima, Malini, Local siddipet and Rajitha respectively (Table 1). Larval stages varied

significantly on different hosts. The larval stages were completed on 50th and 52nd day after egg laying when reared on Local siddipet and Kerala while they were extended up to 54nd, 60th and 64th day on Rajitha, Mahima and Malini, respectively (Table 1). Similarly, the pupal stage lasted up to 58th day after egg laying when reared on Local siddipet and Rajitha whereas, they were completed on 60th, 70th and 77th day on Kerala, Mahima and Malini, respectively. On the whole, *L. serricorne* required 58 and 62 days to emerge as adults when reared on Local siddipet and Rajitha, whereas on Kerala, Mahima and Malini, they took 60, 70 and 77 days. Per cent survival of the egg, larvae and pupa were 82.66, 40 and 33.33 on Kerala, 80, 37.33 and 26.66 on Mahima, 78.66, 24 and 13.33 on Malini, 88, 37.33 and 33.33 on Local siddipet and 88, 37.33 and 33.33 on Rajitha, respectively. The more per cent of survival till the end of pupal stage was observed when reared on Local siddipet, Kerala and Rajitha followed by Mahima and then Malini (Table 1).The life expectancy of newly deposited eggs were nearly similar on all the varieties of ginger that was 24.9, 27.5, 28.6, 27.5 and 24.5 days on Kerala, Mahima, Malini, Local siddipet and Rajitha respectively. The computation of life table expectancy data (Table 1) clearly indicated that the life expectancy of *L. serricorne* on all the five different varieties of ginger declined gradually with the advancement of age. From the life and fertility table of female *L. serricorne* (Table 2) given the information about fecundity (mx), net reproductive rate (R_o) and gross reproductive rate. The fecundity of *L. serricorne* reared on Local siddipet (57.14) was higher than the Kerala (53.28) and Rajitha (50.85). The lowest fecundity was observed when reared on Malini (36.71) and Mahima (41.71).Correspondingly, the net reproductive rate (R_o) was higher (40.08) when reared on Local siddipet as compared to Kerala (33.43) and Rajitha (25.64) and R_o was least when reared on Malini (14.24) followed by Mahima (19.39) indicating the status of potential pest for the insect was Local siddipet (Table 8). The mean length of generation (T_c), was low on Local siddipet (61.43 days) followed by Rajitha (65.04) and Kerala (73.36) and was longest when reared on Malini (80.33) followed by Mahima (73.08 days) (Table 8).Innate capacity for increase (r_c), Intrinsic rate of increase (r_m) and finite rate of increase (λ) were 0.048, 0.04780 and 1.0489 females/female/day on Kerala, 0.041, 0.04060 and 1.041 females/female/day on Mahima, 0.033, 0.03315 and 1.0337 females/ female/day when reared on Malini, 0.060, 0.06185 and 1.0638 on Local siddipet and 0.050, 0.04980 and 1.051 females/female/day on Rajitha, respectively (Table 8).The shorter generation time (59.66) and higher intrinsic rate of increase (0.060) shortened the population doubling time of *L. serricone* to 11.21 days when reared on Local siddipet. The doubling time of *L. serricone* when reared on Local siddipet followed by 13.94 days on Rajitha and 14.53 days on Kerala. The longer generation time (80.12 days) and lower intrinsic rate of increase (0.03315 females/female/day) with longest population doubling time of *L. serricorne* to 20.91 days was observed when reared on Malini (Table 8). Based on the r_m values and doubling time (DT), the host suitability of the *L. serricorne* was assessed and recorded as Local siddipet (most suitable) followed by Rajitha, Kerala, Mahima and Malini (least suitable). Accurate measure of intrinsic rate of natural increase (r_m) was higher in all the varieties of ginger when compared to approximate estimate of intrinsic rate of natural increase (r_c) indicating the tendency of population to have overlapping generations Southwood, 1966[12]. The annual rate of increase was highest in Local siddipet followed by Rajitha, Kerala, Mahima and Malini respectively (Table 8). Thus the present study confirmed the preference of *L. serricorne* for Local siddipet as most preferred was evidenced by higher R_o and r_m values and least preference of *L. serricorne* for Malini as evidenced by lower R_o and r_m values.Prasad and Nandagopal, 2008[11] constructed the life table of *Caryedon serratus* (Coleoptera: Anobiidae) reared on seeds of three different hosts *viz.*, groundnut, tamarind, and Bengalgram. They reported that based on the r_m values and doubling time, the most suitable host for multiplication of *Caryedon serratus*

was assessed and reported that tamarind was the most suitable host followed by groundnut and Bengalgram. The computation of life table expectancy data clearly indicated that the life expectancy of *Caryedon serratus* declined gradually with the age which was in tune with the results of present study.In the current study, among ginger varieties, the net reproductive rate (R_o) was higher (40.08) when reared on Local siddipet followed by Kerala (33.43), Rajitha (25.64), Mahima (19.39) and Malini (14.24) (least net reproductive rate) (Table 8). At the temperature of 28 ± 1°C, the net reproduction rate (R_0) was 47.46, 42.125, 31.75, 32.625 and 6.00 female/female/day when reared on chicken stock powder (maggi), Baker's yeast, grains millo, dried ficus, and dried tobacco leaves respectively Alaa saleh[1] which were nearly in tune with the present results. Net reproductive rate was higher (4.8595) in natu tobacco compared to chewing tobacco (3.1658) Bharathi *et al*[5]. The lower net reproductive on tobacco might be due to its higher Nicotine content.In the present study intrinsic rate of increase (r_m) was 0.04780, 0.04060, 0.03315, 0.06185 and 0.04980 female/ female/day when reared on Kerala, Mahima, Malini, local Siddipet and Rajitha, respectively among ginger varieties (Table 8). According to Alaa saleh[1] intrinsic rate of increase (r_m) was 0.096, 0.11, 0.088, 0.087 and 0.027 female/ female/day when reared on chicken stock powder (maggi), Baker's yeast, grains millo, dried ficus, and dried tobacco leaves respectively. This Age-specific fecundity schedules reflect *L. serricorne* ability for doubling its population faster on Baker's yeast than on (powdered chicken stock (Maggi), grains milo, dried ficus and dried tobacco leaves at same temperature 28± 1°C. In the present study, among ginger varieties, the doubling time of population was 14.53, 17.28, 20.91, 11.21 and 13.94 days respectively (Table 8). According to Alaa saleh[1], the doubling time of population (DT) was 7.22, 6.30, 7.88, 7.97 and 25.67 days when reared on chicken stock powder (maggi), Baker's yeast, grains millo, dried ficus, and dried tobacco leaves respectively. The population took 22.93 and 33.07 days to double itself in Natu and chewing tobacco respectively Bharathi *et al*[5]. The population took 15.63, 22.82 and 24.41 days to double itself on FCV, burley and cigar wrapper respectively Bharathi *et al*[4].

Table 1: Age specific survival of *L. serricorne* on different varieties of ginger

Treatments	Age interval	Deaths	Surviving	lx	nx	dx	qx	Tx	ex	ex (days)
Kerala	0-6 (E)	13	75	1.00	1000.00	173.33	0.17	4146.67	4.15	24.9
	7-21 (L)	17	62	0.83	826.67	226.67	0.27	3146.67	3.81	53.3
	22-32 (L)	7	45	0.60	600.00	93.33	0.16	2320.00	3.87	38.7
	33-52 (L)	8	38	0.51	506.67	106.67	0.21	1720.00	3.39	64.5
	53-60 (P)	5	30	0.40	400.00	66.67	0.17	1213.33	3.03	21.2
	61-70 (A)	7	25	0.33	333.33	93.33	0.28	813.33	2.44	22.0
	71-80 (A)	0	18	0.24	240.00	0.00	0.00	480.00	2.00	18.0
	81-90 (A)	0	18	0.24	240.00	240.00	1.00	240.00	1.00	9.0
Mahima	0-7 (E)	15	75	1.00	1000.00	200.00	0.20	3933.33	3.93	27.5
	8-22 (L)	17	60	0.80	800.00	226.67	0.28	2933.33	3.67	51.3
	21-40 (L)	4	43	0.57	573.33	53.33	0.09	2133.33	3.72	70.7
	41-60 (L)	11	39	0.52	520.00	146.67	0.28	1560.00	3.00	57.0
	61-70 (P)	8	28	0.37	373.33	106.67	0.29	1040.00	2.79	25.1
	71-80 (A)	5	20	0.27	266.67	66.67	0.25	666.67	2.50	22.5
	81-90 (A)	0	15	0.20	200.00	0.00	0.00	400.00	2.00	18.0
	91-100 (A)	0	15	0.20	200.00	200.00	1.00	200.00	1.00	9.0
Malini	0-8 (E)	16	75	1.00	1000.00	213.33	0.21	3573.33	3.57	28.6
	9-23 (L)	19	59	0.79	786.67	253.33	0.32	2573.33	3.27	45.8
	24-42 (L)	4	40	0.53	533.33	53.33	0.10	1786.67	3.35	60.3
	43-64 (L)	14	36	0.48	480.00	186.67	0.39	1253.33	2.61	54.8
	65-77 (P)	4	22	0.29	293.33	53.33	0.18	773.33	2.64	31.6
	78-90 (A)	8	18	0.24	240.00	106.67	0.44	480.00	2.00	24.0
	91-100 (A)	2	10	0.13	133.33	26.67	0.20	240.00	1.80	16.2
	100-110(A)	0	8	0.11	106.67	106.67	1.00	106.67	1.00	9.0

Local siddipet	0-6 (E)	9	75	1.00	1000.00	120.00	0.12	4586.67	4.59	27.5
	7-20 (L)	8	66	0.88	880.00	106.67	0.12	3586.67	4.08	53.0
	21-35 (L)	18	58	0.77	773.33	240.00	0.31	2706.67	3.50	49.0
	36-50 (L)	8	40	0.53	533.33	106.67	0.20	1933.33	3.63	50.8
	51-58 (P)	4	32	0.43	426.67	53.33	0.13	1400.00	3.28	23.0
	59-70 (A)	3	28	0.37	373.33	40.00	0.11	973.33	2.61	28.7
	71-80 (A)	5	25	0.33	333.33	66.67	0.20	600.00	1.80	16.2
	81-90 (A)	0	20	0.27	266.67	266.67	1.00	266.67	1.00	9.0
Rajitha	0-6(E)	12	75	1.00	1000.00	160.00	0.16	4080.00	4.59	24.5
	7-21(L)	18	63	0.84	840.00	240.00	0.29	3080.00	4.08	51.3
	22-36(L)	7	45	0.60	600.00	93.33	0.16	2240.00	3.67	52.3
	37-54(L)	9	38	0.51	506.67	120.00	0.24	1640.00	3.73	55.0
	55-62(P)	9	29	0.39	386.67	120.00	0.31	1133.33	3.24	20.5
	63-70(A)	2	20	0.27	266.67	26.67	0.10	746.67	2.93	19.6
	71-80(A)	0	18	0.24	240.00	0.00	0.00	480.00	2.80	18.0
	81-90(A)	0	18	0.24	240.00	240.00	1.00	240.00	2.00	9.0

Lx= proportion alive at the beginning of age interval ; nx=Number alive at the beginning of age interval; dx=Number dying during age interval; qx= Mortality rate during age interval(qx=dx/nx); ex= Expectation of further life of an individual of age x; E=egg stage; L=larval stages; P=pupal stages and A=adult stages

Table 2: Life and fertility table of female *L. serricorne* on different varieties of ginger

Treatments	Age in days	No of individuals in age class	Survival rate (lx)	Fecundity (mx)	Net reproductive rate (lxmx)	Lxmx.X	Per cent contribution
Kerala	71.5	12	0.16	55.00	8.80	629.20	26.33
	72.5	11	0.15	52.00	7.63	552.93	22.82
	73.5	9	0.12	52.00	6.24	458.64	18.67
	74.5	6	0.08	53.00	4.24	315.88	12.68
	75.5	5	0.07	55.00	3.67	276.83	10.97
	76.5	3	0.04	54.00	2.16	165.24	6.46
	77.5	1	0.01	52.00	0.69	53.73	2.07
				Mean=53.28	**Total=33.43**	**Total=2452.46**	
Mahima	71.5	10	0.13	42.00	5.60	400.40	28.89
	72.5	9	0.12	40.00	4.80	348.00	24.76
	73.5	7	0.09	40.00	3.73	274.40	19.26
	74.5	5	0.07	45.00	3.00	223.50	15.47
	75.5	3	0.04	43.00	1.72	129.86	8.87
	76.5	1	0.01	40.00	0.53	40.80	2.75
	77.5	0	0.00	42.00	0.00	0.00	0.00
				Mean=41.71	**Total=19.39**	**Total=1416.96**	
Malini	78.5	8	0.11	35.00	3.73	293.07	26.22
	79.5	6	0.08	39.00	3.12	248.04	21.91
	80.5	5	0.07	38.00	2.53	203.93	17.79
	81.5	5	0.07	36.00	2.40	195.60	16.85
	82.5	3	0.04	38.00	1.52	125.40	10.67
	83.5	2	0.03	35.00	0.93	77.93	6.55
	84.5	0	0.00	36.00	0.00	0.00	0.00
				Mean=36.71	**Total=14.24**	**Total=1143.97**	
Local siddipet	59.5	14	0.19	58.00	10.83	644.19	27.01
	60.5	11	0.15	55.00	8.07	488.03	20.13
	61.5	10	0.13	56.00	7.47	459.20	18.63
	62.5	8	0.11	56.00	5.97	373.33	14.90
	63.5	5	0.07	57.00	3.80	241.30	9.48
	64.5	3	0.04	60.00	2.40	154.80	5.99
	65.5	2	0.03	58.00	1.55	101.31	3.86
				Mean=57.14	**Total=40.08**	**Total=2462.16**	
Rajitha	63.5	11	0.15	50.00	7.33	465.67	28.60
	64.5	10	0.13	51.00	6.80	438.60	26.52
	65.5	8	0.11	50.00	5.33	349.33	20.80
	66.5	5	0.07	52.00	3.47	230.53	13.52
	67.5	3	0.04	50.00	2.00	135.00	7.80
	68.5	1	0.01	53.00	0.71	48.41	2.76
	69.5	0	0.00	50.00	0.00	0.00	0.00
				Mean=50.85	**Total=25.64**	**Total=1667.54**	

Table 3: Determination of intrinsic rate of natural increase (r_m) of *L.serricorne* reared on Kerala

X	lxmx	rx(r=0.048)	7-rx	e7-rx	e^{7-rx} lxmx	rx(r=0.046)	7-rx	e7-rx	e^{7-rx} lxmx
71.5	8.8	3.432	3.568	35.44563	311.9216	3.289	3.711	40.89468	359.8732
72.5	7.62	3.48	3.520	33.78443	257.6626	3.335	3.665	39.05614	297.8681
73.5	6.24	3.528	3.472	32.20108	200.9347	3.381	3.619	37.30025	232.7536
74.5	4.24	3.576	3.424	30.69194	130.1338	3.427	3.573	35.6233	151.0428
75.5	3.66	3.624	3.376	29.25352	107.2629	3.473	3.527	34.02175	124.7464
76.5	2.16	3.672	3.328	27.88252	60.22625	3.519	3.481	32.4922	70.18315
77.5	0.69	3.72	3.280	26.57577	18.42587	3.565	3.435	31.03141	21.51511
					1086.568				1257.982

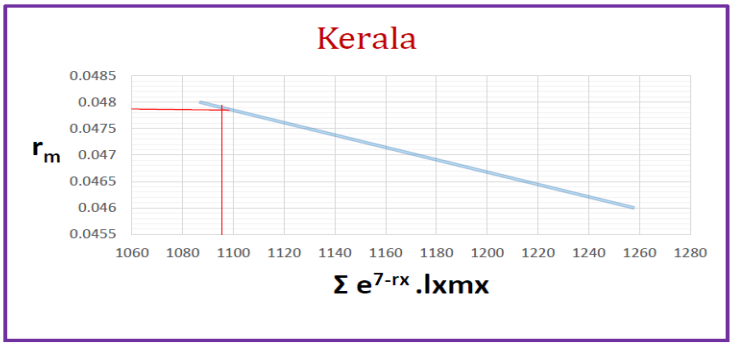


Table 4: Determination of intrinsic rate of natural increase (r_m) of *L.serricorne* reared on Mahima

X	Lxmx	rx(r=0.041)	7-rx	e7-rx	e^{7-rx} lxmx	rx(r=0.039)	7-rx	e7-rx	e^{7-rx} lxmx
71.5	5.60	2.9315	4.0685	58.46919	327.4275	2.7885	4.2115	67.45765	377.7628
72.5	4.80	2.9725	4.0275	56.12043	269.3781	2.8275	4.1725	64.87744	311.4117
73.5	3.73	3.0135	3.9865	53.86603	201.0998	2.8665	4.1335	62.39593	232.9448
74.5	3.00	3.0545	3.9455	51.70218	155.1065	2.9055	4.0945	60.00933	180.028
75.5	1.72	3.0955	3.9045	49.62526	85.35545	2.9445	4.0555	57.71401	99.2681
76.5	0.53	3.1365	3.8635	47.63177	25.40361	2.9835	4.0165	55.50649	29.60346
77.5	0.00	3.1775	3.8225	45.71836	0	3.0225	3.9775	53.38341	0
					1063.771				1231.019

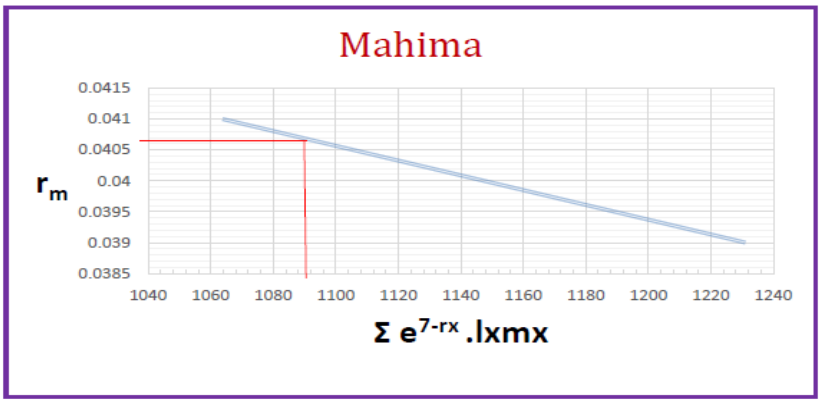


Table 5 Determination of intrinsic rate of natural increase (r_m) of *L.serricorne* reared on Malini

X	lxmx	rx(r=0.033)	7-rx	e7-rx	e^{7-rx} lxmx	rx(r=0.035)	7-rx	e7-rx	e^{7-rx} lxmx
78.5	3.73	2.5905	4.4095	82.22834	306.9858	2.7475	4.2525	70.2809	262.382
79.5	3.12	2.6235	4.3765	79.55909	248.2244	2.7825	4.2175	67.8636	211.7345
80.5	2.53	2.6565	4.3435	76.97649	195.0071	2.8175	4.1825	65.5294	166.008
81.5	2.40	2.6895	4.3105	74.47772	178.7465	2.8525	4.1475	63.2756	151.8615
82.5	1.52	2.7225	4.2775	72.06006	109.5313	2.8875	4.1125	61.0992	92.8709
83.5	0.93	2.7555	4.2445	69.72089	65.07283	2.9225	4.0775	58.9977	55.0646
84.5	0	2.7885	4.2115	67.45765	0	2.9575	4.0425	56.9685	0
					1103.568				939.9215

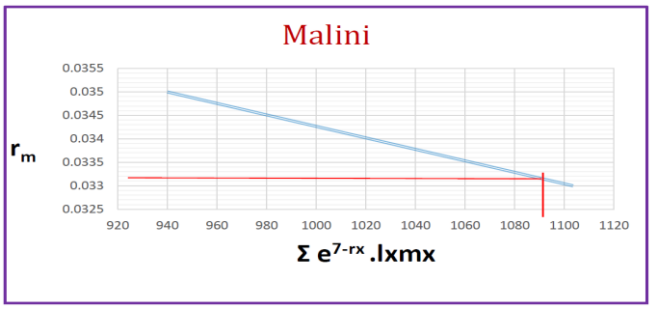


Table 6: Determination of intrinsic rate of natural increase (r_m) of *L.serricorne* reared on local Siddipet

X	lxmx	rx(r=0.060)	7-rx	e^{7-rx}	e^{7-rx} lxmx	rx(r=0.062)	7-rx	e^{7-rx}	e^{7-rx} lxmx
59.5	10.82	3.57	3.43	30.87664	334.2911	3.689	3.311	27.4125	296.7863
60.5	8.066	3.63	3.37	29.07853	234.5668	3.751	3.249	25.7645	207.8341
61.5	7.466	3.69	3.31	27.38513	204.4756	3.813	3.187	24.2156	180.8103
62.5	5.973	3.75	3.25	25.79034	154.0543	3.875	3.125	22.7599	135.9524
63.5	3.800	3.81	3.19	24.28843	92.29602	3.937	3.063	21.3916	81.28822
64.5	2.400	3.87	3.13	22.87398	54.89755	3.999	3.001	20.1056	48.25352
65.5	1.546	3.93	3.07	21.5419	33.31814	4.061	2.939	18.8969	29.22727
					1107.9				980.1522

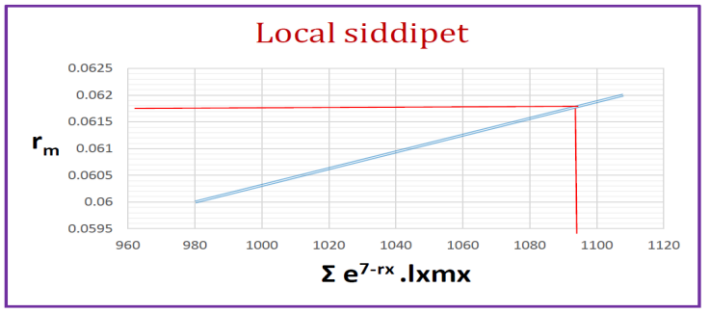
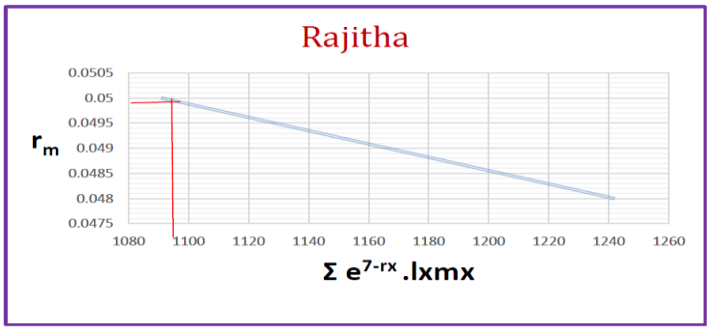


Table 7 Determination of intrinsic rate of natural increase (r_m) of *L.serricorne* reared on Rajitha

X	lxmx	rx(r=0.050)	7-rx	e^{7-rx}	e^{7-rx} lxmx	rx(r=0.048)	7-rx	e^{7-rx}	e^{7-rx} lxmx
63.5	7.33	3.175	3.825	45.8328	336.1072	3.048	3.952	52.03934	381.6218
64.5	6.80	3.225	3.775	43.59751	296.4631	3.096	3.904	49.60045	337.2831
65.5	5.33	3.275	3.725	41.47123	221.1799	3.144	3.856	47.27587	252.138
66.5	3.46	3.325	3.675	39.44866	136.7553	3.192	3.808	45.06023	156.2088
67.5	2.00	3.375	3.625	37.52472	75.04945	3.24	3.760	42.94843	85.89685
68.5	0.70	3.425	3.575	35.69462	25.2242	3.288	3.712	40.9356	28.92782
69.5	0.00	3.475	3.525	33.95377	0	3.336	3.664	39.0171	0
					1090.779				1242.076



Taking two trial values on either side of r_c differing in the second decimal place, the two trial e^{7-rx} lxmx were plotted on horizontal axis against their respective rvalues on the vertical axis with a line drawn from the value of e^{7-rx} lxmx =1096.6. The point of intersection gave the precise value of r_m which was expressed as female progeny / female / day.

Table 8: Life parameters of *L. serricorne* when reared on different varieties of ginger

Life parameters	Kerala	Mahima	Malini	Local Siddipet	Rajitha
Net reproductive rate (R_o)	33.43	19.39	14.24	40.08	25.64
Mean generation time ($T_c=\sum lxmx.X/R_o$)	73.36	73.08	80.33	61.43	65.04
$\log_e R_o$	3.509	2.964	2.656	3.69	3.244
Intrinsic rate of increase. approx (r_c)	0.048	0.041	0.033	0.060	0.050
Intrinsic rate of increase (r_m)	0.0478	0.0406	0.03315	0.06185	0.0498
Corrected Generation Time ($T= \log_e R_o/ r_m$)	73.41	73.00	80.12	59.66	65.14
Finite rate of increase(λ = Anti $\log_e r_m$)	1.0489	1.041	1.0337	1.0638	1.051
$\log_e 2$	0.693	0.693	0.693	0.693	0.693
$\log_e \lambda$	0.0477	0.0401	0.03314	0.0618	0.0497
Doubling Time ($DT = \log_e 2/ \log_e \lambda$)	14.53	17.28	20.91	11.21	13.94
Weekly multiplication of population (λ^7)	1.39681	1.32481	1.26114	1.54177	1.41651
Annual Rate of Increase ($ARI = \lambda^{365}$)	$36.97x10^6$	$2.34x10^6$	$0.17x10^6$	$636.6x10^7$	$76.73x10^6$
Hypothetical F_2 females ($R_0^{2)}$	1117.56	375.97	202.78	1606.41	657.41

CONCLUSION

The ultimate aim to develop the life-table of an insect under laboratory conditions was to decide the expected life span of particular insect with its reproductive potential in a specific set of weather conditions with abundance of space and food supply. The present study showed that chemical composition of different varieties could have significantly influenced the development and reproduction of *L. serricorne* and the growth parameters described in the present study could be used to predict population density on different varieties of ginger to workout suitable management strategy.

Life table studies gives the complete information about an insect *viz.,* survival rate, mortality rate, life expectancy, net reproductive rate, fecundity, mean generation time, doubling time and intrinsic rate of natural increase. The intrinsic rate of increase is the true measure of the reproductive potential of an organism. By using all the above life parameters, host suitability can be assessed. The insect with high survival rate, life expectancy, net reproductive rate, fecundity intrinsic rate of natural increase and with low mortality rate, mean generation time and doubling time when reared on a particular variety can assessed as tolerant variety. Similarly, The insect with low survival rate, life expectancy, net reproductive rate, fecundity, intrinsic rate of natural increase and with high mortality rate, mean generation time and doubling time when reared on a particular variety can assessed as a susceptible variety. From the above findings, among ginger varieties, it can be assessed that Malini was most tolerant variety.

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