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Life Table Statistics of Sitophilus Oryzae in Milled Rice Grains under Coastal Climatic Condition of Odisha

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Abstract — An experiment was conducted on the study of life table statistics of rice weevil, *Sitophilus oryzae* in milled rice grains in the laboratory of Department of Entomology of College of Agriculture under Odisha University of agriculture and technology, Bhubaneswar in coastal climatic condition of Odisha indicated that the stage-specific life table study revealed that the sex ratio was 0.94: 1.00 with a generation survival rate of 0.569. The age specific (female fecundity) life table study revealed the net reproductive rate (R0) of 16.35 with the mean length of generation (T) of 36.65 days and the intrinsic rate of natural increase (rm) of 0.076.

Keywords — *Reproductive Rate; Age Specific Life Table Study; Stage-Specific Life Table Study; Milled Rice Grains.*

1. Introduction

Grain garage is a severe trouble confronted by means of every farmer and householder in growing countries like India by means of the insect pest attack wherein a sizable quantity of food grain is misplaced each 12 months. Its miles stated that around 9.33% loss happens during garage of food grains and approximately 6.fifty five% of the food grains, seeds and extraordinary stored merchandise are lost annually because of storage pests. Some of the several bugs attacking stored grains, Sitophilus oryzae L. (Coleoptera: Curculionidae) has got financial importance. It's far the maximum unfavourable insect pest of the stored raw cereal grains within the global (Champ and Dyte, 1976). Sitophilus oryzae reasons widespread losses to saved grain amounting 18.30 consistent with cent (Adams, 1976).

This species has a relatively short developmental period and a high population can easily be built up. Thus, unless control measures are taken, heavy infestation may take place. The female rice weevil oviposits directly into the seeds and completes larval development and emerge as adults.

2. Materials and Methods

2.1 Life table study of *Sitophilus oryzae* (L.)

At the beginning of experiments (to synchronize the age of eggs) ten pairs of mated *S. oryzae* were transferred from the stock culture to the vials internally lined with dark coloured crape paper for facilitating egg laying. After 12 hrs 100 laid eggs on crape paper were further investigated. The collected eggs were kept inside petridishes (10 cm diameter) which was covered with muslin cloth. The collected eggs were checked daily until the emergence of adults. Incubation and larval periods and their mortality were recorded. As the larvae were internal feeder, seeds were splitted out and each hatched larvae were carefully placed inside the grains using a fine Camlin brush to observe the stage of development of insect after certain intervals. Duration of adult longevity was also recorded daily until death of last female. After emergence of adults, each female with one male was placed into each plastic case (10 cm diameter) containing milled rice grains. The duration of oviposition and post- oviposition periods as well as longevity, daily fecundity (eggs per reproduction day) and total fecundity (eggs during reproduction period) were recorded of two successive generations. After the end of the life table experiment the insects which failed to come out from the seeds were observed minutely by splitting the seeds under the binocular microscope and the stages of the dead insects were also recorded.

Age-specific survival (lx) and mortility (dx) were used to construct the age-specific survivorship life table. Age-specific survival (lx) and average number of female offspring (mx) for each age interval (x) were used to construct age-specific female fertility life tables. Observations on mortality during different stages from hatching of eggs till the emergence of adults were recorded daily which provided the values for life table (lx). Life tables were constructed according to the method of Howe (1952) and Atwal and Bains (1974). The sum total of products 'lxmx' is the net reproductive rate (RO). The innate capacity of increase (rm), net reproductive rate (Ro) and mean generation time (T) were the basic parameters used to assess the population growth.

3. Result and Discussion

Stage specific life table study: The details of the data (Table 1) revealed that the stage specific survival (lx) of *Sitophilus oryzae* decreased at a regular interval from the day after egg laying. A total of 100 eggs have been taken initially for the study and out of those only 86 eggs were found to be the viable eggs. A sharp decline in survival

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Table 1. Stage specific life table study of *S. oryzae*

x	Lx	Dxf	Dx	100qx	Sx
Egg	100	Egg sterility, Low temperature (24.1 ± 1.06^0 C)	14	14.00	0.86
Viable eggs	86	-	-	-	-
1st instar (N1)	86	Low temperature (25.1 ± 1.26^0 C) & RH ($55\pm2.0\%$)	7	8.14	0.92
2nd instar	79	Low temperature (27.0 ± 1.13^0 C) & RH ($52\pm2.5\%$)	6	8.69	0.91
3rd instar	73	Low temperature (25.5 ± 1.32^0 C) & RH ($49\pm1.9\%$)	6	8.22	0.92
4th instar	67	Low temperature (26.1 ± 1.22^0 C) & RH ($54\pm2.5\%$)	5	7.46	0.93
Pupa	62	Low temperature (24.2 ± 1.27^0 C) & RH ($53\pm2.8\%$)	13	20.97	0.79
Adult (N3)	49	-	-	-	-
Female	25	-	-	-	-
Sex ratio	0.94:1.00				
Generation survival (N3/N1)	0.569				

was recorded from the very beginning of starting of its life *i.e.* at egg stage 14% death rate was recorded with survival index of 0.86. But towards the 1st instar stage the survival index increased to 0.92 and it remained between 0.91 to 0.93 upto the 4th instar stage. At pupal stage the survival index was recorded to be 0.79 and out of that only 49 adults emerged with 25 females. The sex ratio was found to be 0.94: 1.00 with generation survival rate of 0.569.

Table 2. Age specific (female fecundity) life table study of *S. oryzae*

X	Lx	Mx	lx.mx	x.lx.mx
Immature stages and pre-reproductive period = 0.5 to 32.5 days				
33.5	0.25	7.73	1.933	64.739
34.5	0.25	8.25	2.063	71.156
35.5	0.24	9.28	2.227	79.066
36.5	0.24	12.37	2.969	108.361
37.5	0.23	11.86	2.728	102.293
38.5	0.23	9.79	2.252	86.690

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39.5	0.23	6.19	1.424	56.236
40.5	0.21	3.61	0.758	30.703
-	-	-	Σlx.mx = 16.352	Σx.lx.mx = 599.244
Net reproductive rate (R_0) = Σlx.mx			16.35	
Mean length of generation (T) = Σx.lx.mx / Σlx.mx			36.65 days	
Intrinsic rate of natural increase (r_m) = Log_eR_0 / T			0.076	
Potential fecundity (Pf) = Σmx			69.08 females/ female	

Note: X – Age in days,lx – no. of insects alive at the beginning of age interval X, dx – no. of insects dead at age interval X, dxf – key mortality factors, 100qx – death rate , Sx – Survival index.

Age specific (female fecundity) life table study: The reproductive period of the insect was recorded from 33.5 to 40.5 days. At the beginning of the egg laying the proportional survival of female (lx) at age 'x' was 0.25. The natality rate (mx) *i.e.* the number of female offspring produced per female at the age 'x' was not similar during the whole length of reproductive period. At age 33.5 days the initial natality rate (mx) was 7.73 and it increased gradually at reached its peak of 12.37 at age 36.5 days. Then a declining was started in natality rate and at 40.5 days the lowest 'mx' of 3.61 was recorded. (Table 2)
The net reproductive rate (R_0) was estimated to be 16.35 while the mean length of generation (T) was 36.65 days. The potential fecundity was recorded to be 69.08 females per each female. The intrinsic rate of natural increase (r_m) was recorded as 0.076.

Note: X – Age in days, lx – survival fraction at age interval X (lx = total survival / 100; where 100 = total no. of eggs taken, mx = Nx/2 (where Nx – total natality at age x ; when sex ratio 1:1), lx.mx = total female birth.

4. Conclusion

4.1 Study of the lifetable study of rice weevil *S. oryzae* under ambient conditions of temperature and relative humidity

Stage specific life table study: The perusal of data of the Table 2 revealed that the stage specific survival (lx) of *S. oryzae* decreased at a regular interval due to egg mortality and subsequent reduction in survival was observed due to the mortality of the larval instars. A sharp decline in survival was recorded from the very beginning of starting of its life *i.e.* at egg stage 14% death rate was recorded with survival index of 0.86. However Howe (1952) reported that *S. oryzae* lay around 90% fertile eggs which is in agreement with the present study. Towards the 1st instar stage the survival index increased to 0.92 and it remained between 0.91 to 0.93 up to the 4th instar stage as the larvae grew older. The sex ratio was found to be 0.94: 1.00 with generation survival rate of 0.569. But Howe (1952) found the sex ratio is unity which substantiates the present findings. The key mortality factors at egg stage were due to sterility of the eggs and low temperature of 24.1 ± 1.06 ^{0}C. From 1st instar up to pupal stage the low temperature and low relative humidity were found to be the key mortality factors. It has been reported that for stored product insects 25-30^{0}C optimal for growth and reproduction, at 13-25^{0}C or 33-35^{0}C they are unable to complete their development, which strengthens the present findings.

Age specific (female fecundity) life table study: The reproductive period of the insect was recorded from 33.5 to 40.5 days. In the present study the net reproductive rate (R_0) was estimated to be 16.35 while the mean length of generation (T) was 36.65 days. The potential fecundity was recorded to be 69.08 females per each female and the intrinsic rate of natural increase (r_m) was recorded as 0.076. However Ryoo *et al.* (1988) reported the life table statistics of rice weevil *Sitophilus oryzae* and found that the intrinsic rate of increase and mean generation time were calculated to be 0.0052 ± 0.0006, and 715.2 ± 53.6 DD respectively. Choo and Ryoo (1988) reported the intrinsic rates of natural increase of the weevil and were estimated to be 0.6791, 0.4816 and 0.1898 on the brown rice, polished rice and rough rice, respectively which contradicts the recent findings. But the findings of Kangmontree (2005) that at temperature of 20°, 25° and 30°C the net reproductive rates (R_0) were 26.629, 32.748 and 32.140 with intrinsic rate of natural increase (r) being 0.052, 0.058 and 0.059 which is in partial agreement with our reports weevil and were estimated to be 0.6791, 0.4816 and 0.1898 on the brown rice, polished rice and rough rice,

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