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# Life table and population parameters of *Diacrisia casignetum* Kollar (Lepidoptera: Arctiidae) on jute, *Chorchorus capsularis* (cv. Sonali; JRC-321), leaves

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**Abstract**
The life table study of the arctiid moth, *Diacrisia casignetum* was conducted on young, mature and senescent jute, *Chorchorus capsularis* (cv. Sonali; JRC-321), leaves in the laboratory condition. The demographic parameters of *D. casignetum* on mature leaves were significantly differed ($P< 0.05$) from the other leaves with higher intrinsic ($r_m$) and finite ($\lambda$) rate of increase (0.123 and 1.131, respectively) through shorter mean generation time ($T_c$) of 39 days and the doubling time (DT) of 5.653 days. The generation survival (GS) of *D. casignetum* on the three jute leaves can be arranged in order of mature>young>senescent leaves, whereas total generation mortality (K) are in the reverse order. These differences in the demographic parameters are due to the variation in their phytochemical regime of respective jute leaves which may help to understand how food quality influences the life table parameters of *D. casignetum* for appropriate control measures at their most vulnerable stage.

**Keywords:** *Diacrisia casignetum*, *Chorchorus capsularis*, demographic parameters, phytochemical regime.

## 1. Introduction

Jute (*Chorchorus capsularis*; Family: Tiliaceae) is the second most important natural fiber after cotton and accounts for more than 80% of the world's annual production. The cultivation of jute in India is mainly confined to the eastern region states - West Bengal, Bihar, Assam, Tripura, Meghalaya, Orissa and Uttar Pradesh. Nearly 50% of total raw jute production in India alone figures in West Bengal. A diverse group of harmful insect species has been seen associated with this crop at different stages worldwide. In India, over two dozens insect and mite species have been reported to attack this crop [1]. As a result, both the quality and quantity of the crop is affected [2]. Among the insect pests, advanced instars of the major defoliator, *Diacrisia casignetum* cause severe defoliation of leaves [3, 4]. There is a little account available on the jute variety (cv. Sonali; JRC-321) having any resistance against its major defoliator, *D. casignetum* in the field.

Life table study is a central theme in ecological research to understand the temporal and spatial patterns in population dynamics [5, 6], which was first applied to insect population by Morris and Miller (1954) [7]. Life tables are used to calculate the vital statistics on pest population dynamics and also give a comprehensive description of the survivorship, development, fecundity, mortality and life expectancy [8-15]. These tables can describe duration and survival at each life stage, which allow prediction of the population size and age structure of a pest insect at any time [9, 10]. Life table is widely useful technique in insect pest management, where developmental stages are discrete and mortality rates may vary widely from one life stage to another [16]. It is very helpful to determine the key mortality factors responsible in a particular stage within which the maximum mortality of the pest is obtained. Thus, by knowing such most vulnerable stages from life table, one can make time based application of different control measures for proper management of the pest population.

Rizvi *et al.* (2009) [17] were conducted both, age-specific (horizontal) and stage-specific (vertical) life-table of the cabbage butterfly, *Pieris brassicae* on various cole crops. But, in my current study, I have used only the stage-specifc life table approach as it is with lower biasness and more useful in the field condition. There are several reports on the life table study of different pest species like, *Plutella xylostella* on cauliflower [18], *Trichoplusia ni* on okra [19], *Helicoverpa armigera* on arhar [20] and *Spodoptera litura* on cotton and groundnut [21, 22].

Though, some of the life table study of *Spilosoma obliqua* on sunflower and jute [23, 24] were also conducted but none of them concerned with the influence of host phytochemicals in their life table parameters. So, the development of life tables for *D. casignetum* on different types of jute leaves will help to assess the relative contribution made by the various leaf constituents to the adult population pool. Despite the extensive literature documenting the effects of host plant quality traits on performance of *D. casignetum* and few publications have reflected directly on its population growth parameters. The Knowledge of life table parameters of *D. casignetum* and the resistance-susceptibility characteristics of jute crops will enable growers to employ the most appropriate control tactics towards integrated pest management (IPM) of a particular jute crop.

## 2. Materials and methods

### 2.1 Phytochemical analysis

The freshly harvested young (<1 week), mature (1-3 weeks), and senescent (4-5 weeks) leaves of *C. capsularis* (cv. Sonali; JRC-321) were collected randomly growing in jute fields near Chinsurah Rice Research Center (22°53' N, 88°23' E), Hooghly, West Bengal, India. Leaves were initially rinsed with distilled water and dried by paper toweling for phytochemical analysis. The leaves were dipped in different solvents for extraction of different primary and secondary chemicals. The chemicals were estimated by various biochemical analyses, such as total carbohydrates by DuBois *et al*. (1951) [25], proteins by Miller (1959) [26], lipids by Folch *et al*. (1957) [27], amino acids by More and Stein (1948) [28], phenolics Bray and Thorpe (1954) [29], Tanins and saponins by Trease and Evans (1983) [30] and alkaloids by Harborne (1973) [31]. Determination of each biochemical analysis was repeated for three times and expressed in percent dry weight basis.

### 2.2 Insect mass culture

The initial population of *D. casignetum* was collected from the same jute fields near Chinsurah Rice Research Center during April and May, 2014. The stock culture of *D. casignetum* was initiated on young, mature and senescent jute leaves at 27±1°C, 65±5% RH and a photoperiodism of 12:12 (L:D) hours in a growth chamber. Experiments began following the rearing of three generations of *D. casignetum* under laboratory conditions on each type of jute leaves used in the study. In order to obtain the same aged eggs of *D. casignetum* for the three types of jute leaves, three pairs of moths (male and female) were placed in an oviposition cage of fine nylon net (25×25×25 cm) with respective fresh foliage. The oviposition cage was modified so that it could be opened for either insertion or removal of plant leaves, moths and feed. One end of the case a cotton ball, soaked into 10% honey solution, was placed for feeding the adults. To maintain natural condition of leaves, a moist piece of cotton was placed around the cut ends of leaves followed by wrapping with aluminum foil to prevent moisture loss. Fresh leaves were given daily by replacing the previous one until eggs were laid by the test insects, and the fecundity recorded daily. The eggs with each type of jute leaves were placed in sterilized Petri dishes (8.0 cm diameter) separately for further experiments.

### 2.3 Development and survivability

Developmental time and survivability of *D. casignetum* was determined on each type of jute leaves under the same laboratory condition. The eggs of *D. casignetum* were taken from the surface of the respective type of jute leaves using a small brush and placed on the corresponding leaf disk in Petri dishes (8.0 cm diameter) separately. The leaf disk in each Petri dish was inserted in water soaked cotton to keep fresh for a time. Lids of Petri dishes were cut off and replaced with fine mesh gauze for the needed ventilation. The Petri dishes were placed in a growth chamber with similar condition for oviposition, the eggs being checked daily until all eggs either hatched or collapsed, and the numbers of daily emerged larvae were recorded. Development of larvae and pupae was observed in the growth chamber at similar conditions provided for eggs. To evaluate the development on jute leaves, neonate larvae of *D. casignetum* were placed on the respective jute leaves in new sterilized glass jars (2l) (20 larvae in each) separately. Fresh foliage was provided daily, until pupation stage. Survival rate and developmental time were recorded by daily monitoring for all immature stages while the sex of emerged adults including their survival and fecundity being also determined. Thus the constraction of *D. casignetum* life tables were conducted by a single generation with three cohorts for each kind of jute leaves.

### 2.4 Life table parameters

The construction of life table includes several parameters which were calculated with the formulae of Carey (1993) [9], Krebs (1994) [32] and Price (1998) [33]. These parameters include probability of survival from birth to age x (lx), proportion dying each age (dx), mortality (qx), survival rate (sx) per day per age class from egg to adult stages. Using these parameters, the following statistics like, average population alive in each stage (Lx), life expectancy (ex), exponential mortality or killing power (kx), total generation mortality (K), generation survival (GS), gross reproductive rate (GRR), net reproductive rate ($R_0$), mean generation time ($T_c$), doubling time (DT), intrinsic rate of population increase ($r_m$) and finite rate of population increase (λ) were also computed, using Carey's formulae [9].

### 2.5 Statistical Analysis

Effect of the jute leaves on the development and survival of *D. casignetum* were analyzed using one-way ANOVA. Means of different demographic parameters were compared by Tukey's test (HSD) when significant values were obtained [34]. All the statistical analysis was performed using the statistical program SPSS v. 13.0 [35].

## 3. Results

### 3.1 Phytochemicals

The biochemical constituents of the three types of jute leaves are presented in figure 1. The primary metabolites i.e., carbohydrates, proteins and lipids including amino acids content was varied significantly among the three jute leaves ($F_{2,6}$=58.528, 132.037, 67.101 and 32.792, respectively, $P <$ 0.001) which can be arranged in order of mature leaves> young leaves> senescent leaves (Figure 1). Among the secondary metabolites, phenolics concentration was lower in mature leaves and differed significantly ($F_{2,6}$=33.831, $P <$ 0.0001) with the other types of jute leaves (Figure 1). In senescent leaves, tannins were highest and significantly differed ($F_{2,6}$=228.055, $P <$ 0.001) followed by mature and young leaves (Figure 1). Whereas, saponins and alkaloids concentrations were also differed significantly among the three jute leaves ($F_{2,6}$= 103.939 and 165.258, respectively, $P <$ 0.0001) which can be arranged in order of young

<mature<senescent leaves (Figure 1). Ultimately, the ratio of primary to secondary metabolites was always higher in mature leaves (2.596) followed by young (2.320) and senescent (1.492) leaves. Thus, the nutritional factors (primary metabolites) along with the anti-nutritional factors (Secondary metabolites) were varied significantly in the three types of jute leaves.

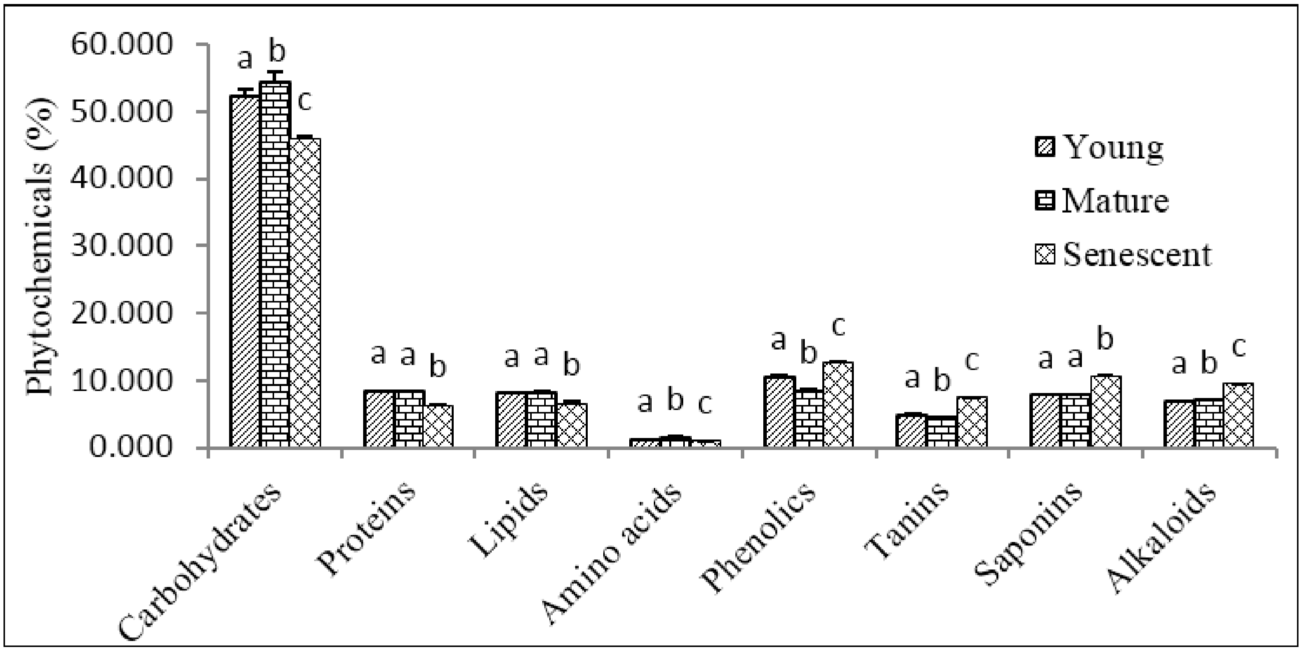


**Fig 1:** Phytochemical variations of the young, mature and senescent jute leaves. Different letters over the bars indicate that the means (Mean ± SE of 3 observations) are significantly different ($P < 0.05$, Tukey, HSD), while comparing one type of leaf with the other.

### 3.2 Life Table

The stage-specific life table of *D. casignetum* was investigated in the laboratory by providing three types of jute leaves separately and showed four distinct stages with six larval instars (i.e., egg, larva, pupa, and adult) (Figure 2). The three cohorts containing average of 342, 384 and 306 eggs were reared separately on the three types (young, mature and senescent) of jute leaves, respectively to construct the life table of *D. casignetum*. The demographic data of *D. casignetum* reared on the three types of jute leaves represent a similar pattern of development with significant variations ($P<0.05$) (Table 1, 2 and 3). The proportion of surviving (lx) and the survivorship (sx) of *D. casignetum* on each kind of leaves gradually decrease throughout the developmental stages. Whereas, proportion of dying (dx) and mortality (qx) increased, particularly in the early stages and subsequently decreased in advance stages with a rapid surge during pupation for all kinds of jute leaves (Table 1, 2 and 3). The average population alive in each stage (or, age structure) (Lx) was gradually decreased in the developmental stages from egg to adult stage when reared on the three types of jute leaves (Table 1, 2 and 3). Life expectancy (ex) also followed the same pattern of proportion of survival (lx) for each kind of leaves. The killing power (kx) was always higher in egg-stage than the larval stages for each kind of jute leaves. But during pupation, the killing power (kx) was highest relative to all stages, even in the egg-stage for the jute leaves (Table 1, 2 and 3). Thus, the total generation mortality (K) of *D. casignetum* was minimum on mature leaf (0.181) followed by young (0.303) and senescent (0.406) leaves, whereas the overall generation survival (GS) was in reverse order [i. e., mature (0.699) > young (0.559) >senescent (0.459) leaves] of K values.

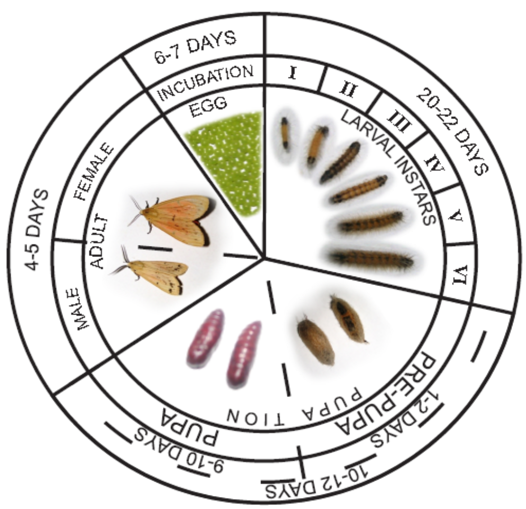


**Fig 2:** Schematic representation of the life cycle of *D. casignetum* Kollar.

The survival of *D. casignetum* indicated a gradual increased rate of mortality during initial developmental stages and then it relatively decreased in the advanced stages up to adulthood except pupation stage for each kind of jute leaves, which may reflect a type-III survivorship curve (Table 1, 2 and 3). The observed survival data of *D. casignetum* on three types of jute leaves indicated that the immature in early stages are more susceptible to the young and senescent leaves than mature one due to their anti-nutritional quality relative to the nutritional factors. The proportion of male to female was 1.3, 1.1 and 1.5 for young, mature and senescent leaf-fed insects, respectively. The first adults appeared on day 40, 38 and 46 for young, mature and senescent leaf fed insects, respectively. The females remained alive for a maximum of 4, 5 and 4 days when they reared on young, mature and senescent jute leaves, respectively. The maximum life span from egg to the death of adults was 43, 42 and 49 days for the three cohorts reared on the respective kind of jute leaves.

**Table 1:** Stage-specific pooled life table of *D. casignetum* on young jute leaves.

| Life Stage | lx | dx | qx | sx | Lx | ex | kx |
|---|---|---|---|---|---|---|---|
| Egg-0 | 1.000±0.000 | 0.091±0.008 | 0.091±0.008 | 0.908±0.008 | 0.954±0.004 | 7.141±0.371 | 0.041±0.003 |
| lnst- I -1 | 0.908±0.008 | 0.049±0.012 | 0.054±0.014 | 0.945±0.014 | 0.883±0.014 | 7.080±0.380 | 0.024±0.006 |
| lnst- II-2 | 0.859±0.021 | 0.052±0.008 | 0.061±0.011 | 0.938±0.011 | 0.833±0.024 | 6.448±0.297 | 0.027±0.005 |
| lnst- III-3 | 0.807±0.028 | 0.058±0.013 | 0.073±0.018 | 0.926±0.018 | 0.777±0.033 | 5.832±0.252 | 0.033±0.008 |
| lnst- IV-4 | 0.748±0.038 | 0.045±0.004 | 0.061±0.008 | 0.938±0.008 | 0.725±0.040 | 5.252±0.179 | 0.027±0.004 |
| lnst- V-5 | 0.702±0.042 | 0.044±0.003 | 0.063±0.004 | 0.936±0.004 | 0.680±0.041 | 4.561±0.150 | 0.028±0.002 |
| lnst- VI-6 | 0.658±0.040 | 0.044±0.006 | 0.069±0.015 | 0.930±0.015 | 0.636±0.044 | 3.837±0.167 | 0.031±0.007 |
| Prepup-7 | 0.613±0.047 | 0.023±0.004 | 0.040±0.010 | 0.959±0.010 | 0.601±0.049 | 3.083±0.126 | 0.017±0.004 |
| Pup-8 | 0.59±0.050 | 0.087±0.023 | 0.155±0.051 | 0.844±0.051 | 0.546±0.057 | 2.189±0.103 | 0.075±0.027 |
| Adult-9 | 0.502±0.066 | -- | -- | 1.000±0.000 | 0.502±0.066 | -- | -- |

**Table 2:** Stage-specific pooled life table of *D. casignetum* on mature jute leaves.

| Life Stage | lx | dx | qx | sx | Lx | ex | kx |
|---|---|---|---|---|---|---|---|
| Egg-0 | 1.000±0.000 | 0.067±0.007 | 0.067±0.007 | 0.932±0.007 | 0.966±0.003 | 8.009±0.060 | 0.030±0.003 |
| lnst- I -1 | 0.932±0.007 | 0.032±0.001 | 0.035±0.001 | 0.964±0.001 | 0.916±0.006 | 7.902±0.052 | 0.015±0.001 |
| lnst- II-2 | 0.899±0.006 | 0.036±0.003 | 0.040±0.003 | 0.959±0.003 | 0.881±0.006 | 7.173±0.043 | 0.017±0.001 |
| lnst- III-3 | 0.863±0.005 | 0.033±0.004 | 0.038±0.005 | 0.961±0.005 | 0.846±0.005 | 6.455±0.067 | 0.017±0.002 |
| lnst- IV-4 | 0.829±0.006 | 0.034±0.001 | 0.041±0.001 | 0.958±0.001 | 0.812±0.007 | 5.697±0.037 | 0.018±0.001 |
| lnst- V-5 | 0.794±0.008 | 0.031±0.003 | 0.039±0.004 | 0.960±0.004 | 0.779±0.008 | 4.923±0.040 | 0.017±0.002 |
| lnst- VI-6 | 0.763±0.009 | 0.032±0.005 | 0.041±0.007 | 0.958±0.007 | 0.747±0.008 | 4.104±0.023 | 0.018±0.003 |
| Prepup-7 | 0.731±0.009 | 0.014±0.002 | 0.020±0.003 | 0.979±0.003 | 0.724±0.010 | 3.261±0.004 | 0.008±0.001 |
| Pup-8 | 0.716±0.011 | 0.065±0.004 | 0.090±0.005 | 0.909±0.005 | 0.684±0.008 | 2.318±0.010 | 0.041±0.002 |
| Adult-9 | 0.651±0.006 | -- | -- | 1.000±0.000 | 0.651±0.006 | -- | -- |

**Table 3:** Stage-specific pooled life table of *D. casignetum* on senescent jute leaves.

| Life Stage | lx | dx | qx | sx | Lx | ex | kx |
|---|---|---|---|---|---|---|---|
| Egg-0 | 1.000±0.000 | 0.144±0.049 | 0.144±0.049 | 0.855±0.049 | 0.927±0.024 | 6.421±0.438 | 0.069±0.026 |
| lnst- I -1 | 0.855±0.049 | 0.060±0.007 | 0.071±0.008 | 0.928±0.008 | 0.824±0.049 | 6.645±0.212 | 0.032±0.004 |
| lnst- II-2 | 0.794±0.049 | 0.056±0.006 | 0.071±0.006 | 0.928±0.006 | 0.765±0.047 | 6.116±0.166 | 0.032±0.002 |
| lnst- III-3 | 0.737±0.045 | 0.054±0.010 | 0.074±0.014 | 0.925±0.014 | 0.710±0.045 | 5.545±0.154 | 0.033±0.006 |
| lnst- IV-4 | 0.683±0.047 | 0.043±0.004 | 0.064±0.008 | 0.935±0.008 | 0.661±0.048 | 4.948±0.095 | 0.029±0.003 |
| lnst- V-5 | 0.639±0.049 | 0.050±0.005 | 0.079±0.011 | 0.920±0.011 | 0.614±0.049 | 4.254±0.066 | 0.035±0.005 |
| lnst- VI-6 | 0.589±0.049 | 0.062±0.004 | 0.105±0.004 | 0.894±0.004 | 0.558±0.047 | 3.578±0.048 | 0.048±0.002 |
| Prepup-7 | 0.527±0.045 | 0.022±0.004 | 0.044±0.009 | 0.955±0.009 | 0.515±0.046 | 2.943±0.056 | 0.019±0.004 |
| Pup-8 | 0.504±0.046 | 0.111±0.007 | 0.222±0.016 | 0.777±0.016 | 0.448±0.044 | 2.055±0.032 | 0.109±0.009 |
| Adult-9 | 0.393±0.042 | -- | -- | 1.000±0.000 | 0.393±0.042 | -- | -- |

The average gross reproductive rate (GRR) always significantly higher in mature leaf fed insects (203.079) followed by young (190.941) and senescent (155.193) leaf fed insects ($F_{2,6}$=20.901, $P$<0.002). The net reproductive rate ($R_0$) on mature jute leaves (119.330) was significantly higher followed by young (85.333) and senescent (48.330) leaves ($F_{2,6}$=17.179, $P$<0.003) (Table 4). Ultimately, the fecundity was also varied significantly ($F_{2,6}$=46.563, $P$<0.0001) and higher in case of mature leaf fed insects (384 eggs per female) followed by young (359) and senescent (306) leaf feeders. The intrinsic rate of natural increase ($r_m$) and the daily finite rate of increase (λ) were also significantly ($P$<0.00001) higher on mature leaf fed insects followed by young and senescent leaf fed insects. The $r_m$ of *D. casignetum* on mature jute leaves was 0.123 per female per day and the λ was 1.131 female offspring per female per day with $T_c$ of 39 days and the DT of 5.653 days (Table 4). Thus, the population growth parameters of *D. casignetum* were significantly affected by the different developmental stages of jute leaves due to variation in their phytochemical regime.

**Table 4.** Population and reproductive life table of *D. casignetum* on young, mature and senescent jute leaves.

| Parameter | Young | Mature | Senescent | $F_{2,6}$ | $P$ |
|---|---|---|---|---|---|
| Gross reproductive rate (GRR) | 190.941±6.165[a] | 203.079±40.605[b] | 155.193±25.414[c] | 20.901 | 0.002 |
| Net reproductive rate ($R_0$) | 85.333±0.001[a] | 119.330±0.001[b] | 48.330±0.001[c] | 17.179 | 0.003 |
| Mean generation time ($T_c$) | 41.000±0.577[a] | 39.000±0.577[b] | 47.000±0.577[c] | 52.000 | 0.0001 |
| Doubling time (DT) | 6.391±0.090[a] | 5.653±0.083[b] | 8.401±0.103[c] | 235.525 | 0.00001 |
| Intrinsic rate of increase ($r_m$) | 0.109±0.001[a] | 0.123±0.001[b] | 0.083±0.001[c] | 186.461 | 0.00001 |
| Finite rate of increase (λ) | 1.115±0.001[a] | 1.131±0.002[b] | 1.086±0.001[c] | 182.817 | 0.00001 |

Different letters within the rows indicate that the means (Mean ± SE of 3 observations) are significantly different ($P$ < 0.005, Tukey, HSD), while comparing one type of jute leaf with the other.

## 4. Discussion

Host plant availability and quality may play a vital role in pest population dynamics by affecting immature as well as adult performance. In the case of *D. casignetum*, few life cycle studies as regards its various host plants have been published and only a few studies have examined the effect of host plants on the developmental stages or on the overall performance of this species. There is a range of innet capacity for individual of a population [36] but the variation in available food quality [4, 8, 37-43] along with environmental factors (geographic source, RH, temperature, rainfall etc.) [13, 15, 44-48] always influence the growth, reproduction, longevity and survival of those populations. Even, the host plant quality traits are the key determinants of the fecundity of herbivorous insects affecting insect reproductive strategies such as: egg size and quality, allocation of resources to eggs, the choice of oviposition sites, and egg or embryo resorption [49]. The effect of different food sources on population parameters were also observed in *P. xylostella* [8, 14], *Earias vitella* [50] and *D. casignetum* [4] on different host plants. The host plant quality during larval growth and development is a key determinant of both fecundity and fertility of adults [4, 51]. Shorter developmental time along with greater total reproduction of insects on a host indicate the greater suitability of a host plant [4, 52, 53]. Moreover, plant quality varies considerably depending upon external environmental factors (such as predictable changes between seasons and less predictable changes initiated from environmental stresses) and these could be cited as other reasons for the difference [51]. The different developmental stages of plant leaves differ greatly in suitability as food for specific insects when assessed in terms of survival, development and reproduction [53]. In this study, the overall generation survival (GS) of *D. casignetum* on the three kinds of jute leaves also varied significantly and can be arranged in order of mature>young>senescent leaves, whereas total generation mortality (K) are in the reverse order. Ultimately, the variation in the results of this study could be attributed to differences among nutritional and anti-nutritional factors present in the respective jute leaves.

In the present study, the incubation period on mature leaves was greatly less than that on the other types of jute leaves. This difference was probably a result of different food sources taken up by the moth during their larval stages. Similar inference has been reported for *P. Xylostella* reared on various cruciferous host plants [14, 54-56], for *Copitarsia decolora* reared on asparagus [57], and even for *D. casignetum* reared on four host plants, including jute [4]. This difference could be due to the presence of nutritional factors as well as defensive secondary metabolites that directly affect potential and achieved herbivore development and fecundity [4, 51, 53, 56, 58].

Survival rate (lx) of *D. casignetum* during the developmental stages (egg to adult) indicated a gradual decreased rate of survival during early stages and then it gradually increased with aging except pupation stage for all types of jute leaves. The overall accumulated survival rate on senescent leaves was lowest as compared with that on the other young and mature jute leaves. These results suggest that the survival curve of *D. casignetum* is of type III, with high mortality during the immature stages, according to the classification of Pearl [46] as found in most insect species [33]. The $r_m$ is a fundamental ecological parameter to predict the pest population growth under a given condition [59]. It would be a most appropriate index to evaluate the performance of an insect on different host plants or plant parts as well as the host plant's resistance [60, 61]. It represents the rate of potential increase of a population under optimal environmental conditions when fecundity and survival are maximal (optimal zone of development) and adequately summarizes the physiological qualities of an animal in relation to its capacity to increase [62]. The high value of $R_0$ on mature jute leaves is a reflection of high $r_m$. Thus, high $r_m$ value on mature jute leaves indicates that *D. casignetum* has a greater reproductive potential and more preference on it relative to the other types of leaves evaluated. The average generation time ($T_c$) and doubling time (DT) of *D. casignetum* was significantly shorter on mature leaves followed by young and senescent leaves. Thus, the $R_0$, $r_m$, $T_c$ and DT are useful indices of population growth under a given set of conditions [43]. This knowledge is very important when studying insect pest population dynamics for developing efficient pest management tactics [63].

In this study, differences in reproductive period and longevity of adult *D. casignetum* on three types of jute leaves were due to variation in their chemical as well as physical characteristics. Adult moth showed a prolonged longevity on mature leaves as compared to the other two types of jute leaves. The low number of eggs laid on a plant could have been affected by the more indirect route of reduced fecundity arising from larval feeding on nutritionally poor plants [4, 8, 56, 64, 65]. Thus, mature jute leaves had the lowest antibiosis resistance against *D. casignetum* and were the most favorable one relative to the other kinds of jute leaves evaluated as indicated by the short developmental time (leads to reduce exposure of the insect to its natural enemies), high survival of immature stages as reflected in a higher value of $r_m$. Such reduced antibiosis effects could cause an increase in survival fitness of *D. casignetum* on the mature jute leaves. This knowledge of how jute leaves quality influences the life table parameters of *D. casignetum* can help one to understand the population dynamics for proper measures in the management of this insect pest.

## 5. Conclusion

The life table study of *D. casignetum* on young, mature and senescent jute leaves showed four distinct stages with six larval instars and represents a similar pattern of development with significant variations ($P< 0.05$). The gross reproductive rate (GRR) and net reproductive rate ($R_0$) on mature jute leaves (203.079 and 119.333, respectively) was significantly higher followed by young and senescent leaves which ultimately influence the fecundity. The $r_m$ of *D. casignetum* on mature jute leaves was 0.123 per female per day and the $\lambda$ was 1.131 female offspring per female per day with a mean generation time ($T_c$) of 39 days and the doubling time (DT) of 5.653 days. The generation survival (GS) of *D. casignetum* on the three kinds of jute leaves can be arranged in order of mature>young>senescent leaves, whereas total generation mortality (K) are in the reverse order. These differences in the demographic parameters are due to the variation in their phytochemical regime of respective kind of jute leaves. High proportion of nutritional to anti-nutritional factors in mature (2.596) leaves relative to young (2.320) and senescent (1.492) leaves may reduce the antibiosis effect on *D. casignetum* larvae for better reproductive growth and survival with short generation time. Knowledge of how jute leaves quality influences the life table parameters of *D. casignetum* can help one to understand the population dynamics for most appropriate control tactics towards integrated pest management (IPM) of a particular jute crop.

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