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Effect of temperature and relative humidity on the occurrence of *chrysocoris stolli* wolf (heteroptera_pentatomidae - scutellerinae) a potential biocontrol agent of *cassia occidentalies*

P.K. Sehgal, S.C. Dhiman

Abstract
Chrysocoris stolli wolf a polyphagous, is found infesting ***Cassia occidentalies. C.stolli*** commonly called as ***cassia occidentalies*** bug and is a potential biocontrol agent of ***cassia occidentalies*** a weed plant effect of various levels of temperature and R.H. on the population of this bug was experimentally observed in laboratory. The optimum temperature at which maximum number of adults and nymphs survived was observed 25+_2 0c.This level match which the field condition of February to April during which average temperature remains 27 0c and maximum activity and breeding occurs in adult bugs population. 60 to 90 percent R.H is found suitable for the survival of this bug.

Keywords: Temperature R.H. ***Chrysocoris stolli, Cassia occidentalies***

1. Introduction
Chrysocoris stolli bugs are large insect which causes considerable lose to the crop of economics value. ***Chrysocoris stolli*** Wolf attack ***Cassia occidentalies*** family Legumenosae. It is an exotic wide spread weed in India which is attacked by a number of insects and ***C. stolli*** is the major one (Dhiman. S.C.and Kumar. P 2005) ***Cassia occidentalies*** is a serious pest for forest crops and other vegetation. Though, it was imported in India as an ornamental plant by some India people during rule in India, but since then it has been Spreadeda like a wild fire in almost every part of India including Uttar Pradesh, Uttarakhand and North Eastern States. Various methods, mechanical cultural, chemical and biochemical have tried to check the spread of this weed ***Cassia occidentalies*** is an important biocontrol agent of this weed and in India it was important from dist Bijonr 2010 to 2011 by the garment doctors. Since then in India various aspect of this potential biocontrol agent of ***Cassia occidentalies*** weed have worked out by Kumar.P. (2013, 2014)S.C Dhiman and Pravesh K. (2005, 2006. 2007, 2008), Studied on the effect of ecological factors on the occurrence of insect is of vital significance. Hence in view of this present investigation has been undertaken Khan A.H. (1945), Livingstone D (1959), Verma D.K and Sadatullah (1973).

Materials and Methods
For maintaining the culture, fifth instars nymphs of ***Chrysocoris stolli*** Wolf approximately of some age along with fresh leaves and tender twigs of ***Cassia occidentalies*** plant were collected from the field area (**Saharanpur, Block Behat**, **Nagal and Distt Bijnor U.P**) in polyethylene bags and restore in hurricane glass lamp chimneys and plastic jars. The newly emerged pair was sorted out from the culture and was kept separately for further rearing in chimney and plastic jars, wire gauge cages were also used for maintaining the culture of ***C. stolli***. For knowing the effect of different levels of temperature and R.H. On the adult and nymph population of ***C. stolli***, temperature and humidity control cabinet was used.

Results
Effect of temperature and R.H was experimentally record on the bug population separately.
A. Effect of different temperature levels on the survivability of bug population.

Effect of different temperature levels, viz, 0^0C - 40^0C on the survival of the adults: The extremely low temperatures, 0^0C 77 to 50 ^{0}C, that may occur occasionally in the field for a short period during the winter are likely to effect the survival of adult bugs.

Low temperature, not extreme, may increase the longevity of adults. These observations were confirmed by experiments in the laboratory and the data are recorded in table-35 and graph-1. The aforesaid table indicates, that tolerance power of adult ***C. stolli*** to the extreme low temperature 0°C for short duration (8 hrs), effected the survival rate and hundred percent mortality was observed. However, at 50 Hundred percent survivality for 18 hrs was observed and after this up to 24 hrs, 35 percent mortality occurred in the bug population and these alive bugs too remained in quiescent stage. At this temperature no copulation or egg lying was observed. Hundred percent survivality was recorded at 100C up to 48 hrs and thereafter an increase in the period up to 72 hrs, 10-15% mortality was noticed, at the aforesaid temperature. The bugs also remained in quiescent condition and no copulation occurred. At 15°C, hundred percent survivality for 72 hrs was observed. Through, adult bugs remained in quiescent on exposure to more than 72 hrs, and up to 120hrs, 10% mortality was observed in male population and 5% mortality in female population. At 200°C, bugs remained completely active, although, no copulation took place and no mortality occurred up to 96hrs. After this a total of 10% mortality in male and 15 % mortality in female population occurred within 120 hrs. At 250C, bugs were found completely active and copulation occurred in 20% bugs. No mortality was observed up to 96 hrs from 96 to 120 hrs, 75 percent bugs copulated and 5% mortality in female and 10% in male population occurred. At 30 0C, the bugs were observed active and copulation occurred in 60-70 % bugs within 24 hrs. No mortality78 occurred up to 48 hrs, but, beyond this, mortality percentage increased to 25% in male up to 96 hrs and none in female. After this, up to 120 hrs 5% mortality in female and 30% mortality in male population occurred. On further exposure beyond 120 hrs, the mortality of male had gone to 35% and 20% in female population up to 192 hrs. At35 0C, they remained at first most active up to 30 minutes moving here and there and after this behavior no copulation occurred 40% male bugs and 20% female bugs died up to 24 hrs, while on further exposure up to 72 hrs, 60% male and 40% female died. After 72 hrs mortality in male had gone to 80% and in female 60% up to 120 hrs. Thus female isomer is resistant to higher temperature then male. Further, exposure to 400C, bugs at first remained restless for about 15 minute and after this they had gone in aggregation and quiescent stage and 100% mortality was observed in 3 to 4 hrs in both the sexes. Thus, this temperature is lethal to adult bugs. The optimum temperature at which maximum number of adults (90%) survived was observed as 27 ± 20C.At the temperature below 25 0C, i.e., 20, 15, or 5 0C, the longevity of tolerance power increased, but 0 0C temperature became lethal for either sex. Thus, this temperature is lower lethal limit for this bug. Above 25 0C, the tolerance power decreased gradually and 40 0C, as said above, was seen upper lethal limit for ***Chrysocoris stolli***. Further, a close vigil revealed that they became inactive and gained inverted posture after 24 hrs. At higher temperature 35 to 40 ^{0C}, but, regain normal posture before death. Experimental observations coincide with the field observations. During winter (November to February) average field temperature ranges from 12.44 0C to 18.69 0C and lowest temperature reaches up to 2 0C. Hence, adult population does not occur in open field and hibernate till the temperature rises in late79February. During summer months, May and June, the average temperature remains 30.11 0C (maximum being up to 42 0C) and number of ***C. stolli*** at first starts declining, but in rainy season, July to September, average temperature remains almost constant 27.85 0C and the adult bug population reaches to maximum level. During this period average R.H. also reaches to optimum level (average 72.02%). Food plant is also available in abundance, during this period, Graph- 1.indicates that the adult's population fluctuates depending on increase or decreases in temperature of natural environment**.** R.H.: Relative humidity is one of the important ecological parameter which also influences the survival and growth of insects. For the knowledge of this factor, effect of different R.H. levels on the adult population of *C. stolli* was experimentally studied in the laboratory. Bugs were taken for the experiment from a culture stock maintained in the laboratory at room temperature. The experiments were carried out in temperature and humidity control cabinet. The bugs were kept in hurricane glass lantern chimneys placed in a Petridis. The top of the chimney covered with fine muslin cloth. Food was also supplied within the chimney for the bugs. The chimneys were kept in to temperature and humidity control cabinet. The R.H. level was also confirmed by using dial hygrometer inside the hurricane lamp chimney. A very interesting point was observed during the field study that in July to September, the adult population increase to peak level and low level during summer months, May and June (Graph-2). It was observed by interpreting the meteorological data. That adult population fluctuates due to variation in relative humidity levels along with temperature.80Thus, to confirm the influence of variable R.H. level on the adult of *Chrysocoris stolli*, newly emerged imago were selected from laboratory reared stock culture. These imago were kept in hurricane glass lantern chimneys with food and the chimneys were placed in temperature and humidity control cabinet. The temperature was maintained 27 ± 2 0C and humidity level was kept desirable at different time. The data were recorded in table-36.

Effect of different R.H. levels viz, 0, 10, 20, 30, 40, 50, 60, 70, 80, 90, and 100% on the survival of adults:

Examination of the data presented aforesaid table clearly revel that all bugs died within 3-5 hrs when kept at 0% R.H. level. By increasing R.H. to 30%, the survival rate was raised to 10% in male and 20% in female with an average longevity of 2 days and 4 days respectively, when these were subjected to 50% R.H. The male survived for 8 days and female for 15days with 40% and 30 % mortality respectively. Further increase in R.H. to 70%, resulted in the increase of survival period in both the sexes, viz; 35 days for male and 48 days for female with 20% and15%, mortality respectively. Subjection to 90% R.H. had resulted the maximum longevity of 52 days and 64 days for male and female respectively with minimum mortality of 15% in male and 10% in female. At 100% humidity, the male and female lived only for 36 days and 28 days with 20% and 35% mortality respectively. Furthermore, table-36 and graph-5 indicate that minimum mortality in the bug population had occurred at 90% R.H with maximum longevity period. Decrease beyond this level of R.H, increased the mortality percentage and reduced longevity period. However, more mortality resulted at allow level rather than higher. Higher humidity was observed favorable for male up to 90% but at 100% humidity, mortality of female was more (35%) than male (20%).Thus, 70 ± 10% R.H. is an optimum level for the survival of ***Chrysocoris stolli***.

Chrysocoris stolli* adult feeding on *Croton sparisififlorum

***Cassia occidentalies*, a food plant of** *Chrysocoris stolli*

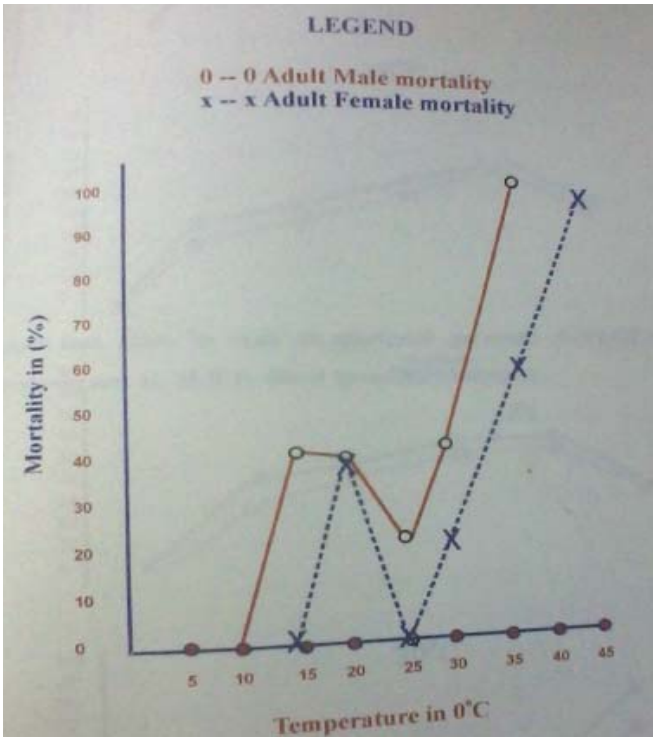
Table 35

The effect of different temperature range on the adults of ***Chrysocoris stolli*** (at 70 ± 10% R.H)

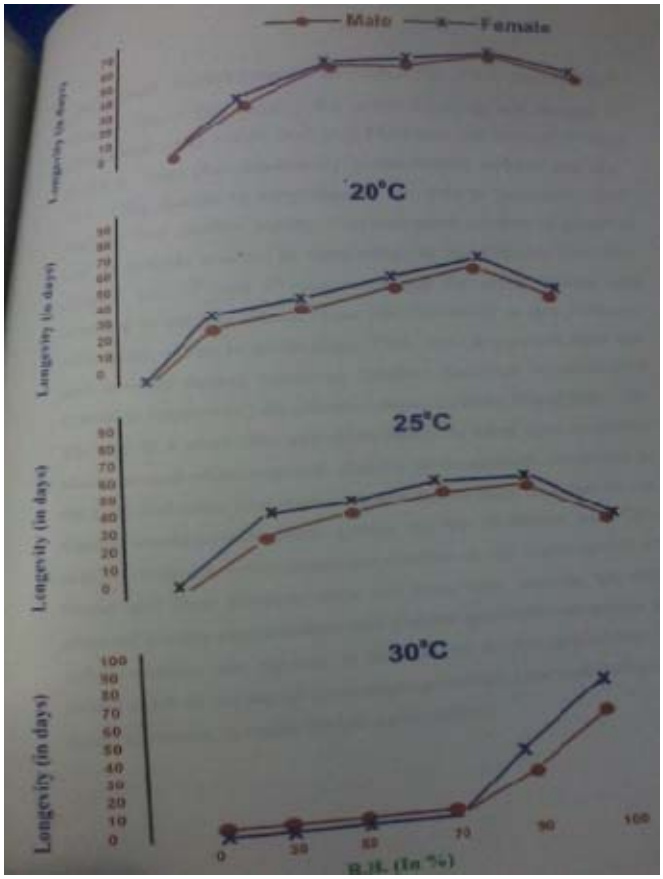
Temperature in 0^0C	Exposure time (in hrs.)	No. of observations	Mortality in %
0	6-8	25	100
5	18	20	0
10	48	20	0
15	72-120	25	M F 10 5
20	96-120	25	10 15
25	96-120	20	10 5
30	96-192	25	M F M F 25 0 20 5
35	48-120	20	M F M F 40 20 80 60
40	3-4	25	100

M- Male

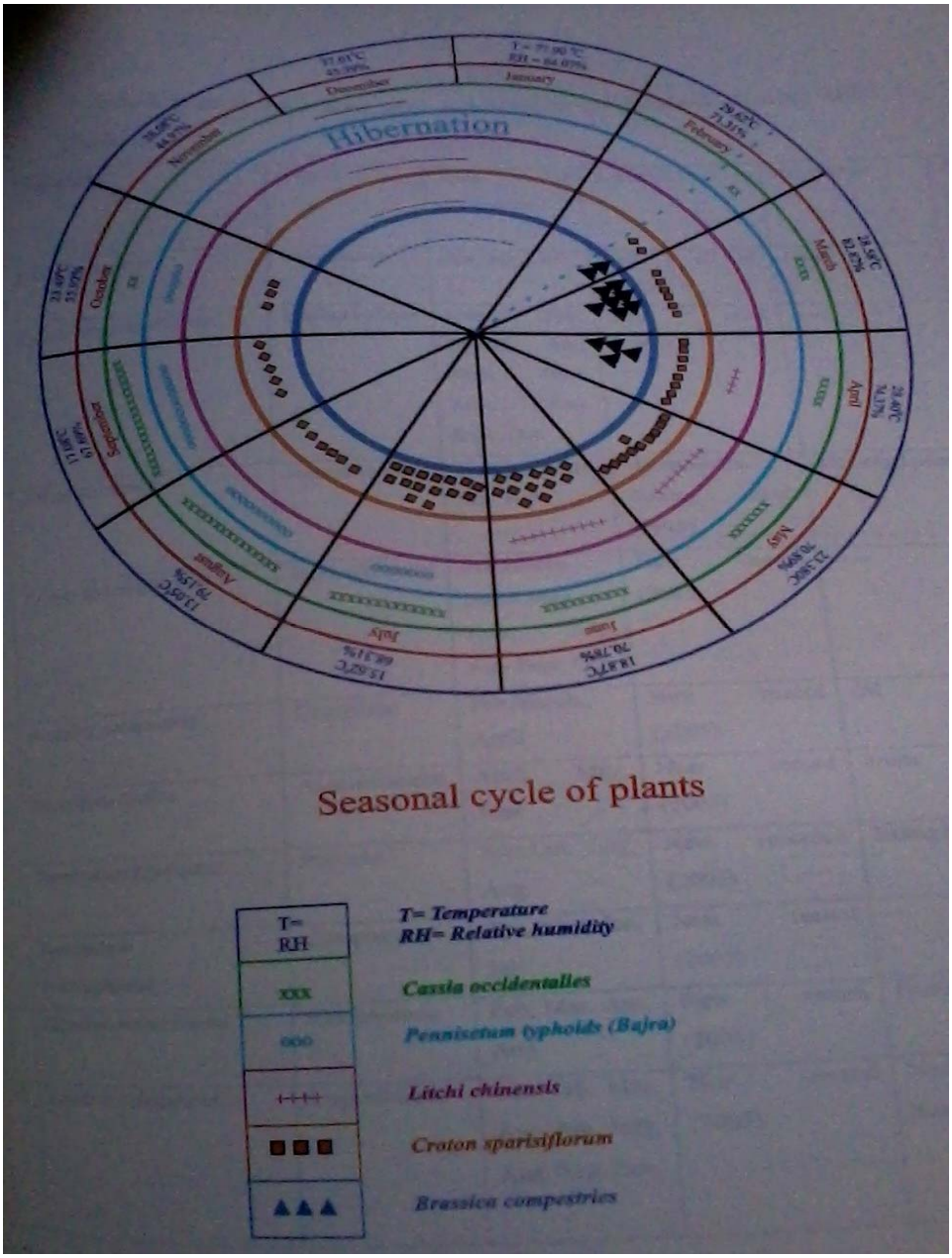
F- Female



Mortality % of adult ***C.stolli*** on different level of Temperature (0C to 40 C) 70 ±10 R.H



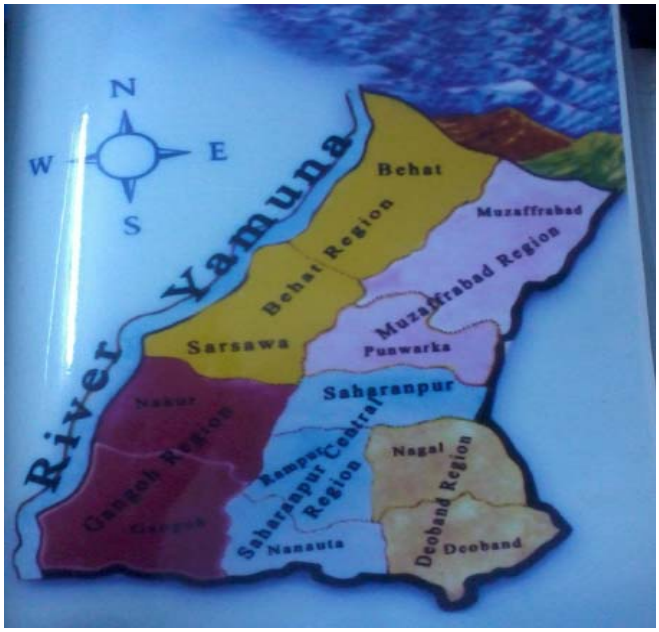
Showing longitivity in days of male and female *C.stolli* different Levels of R.H at temperature.



Seasonal cycle of *C.stolli* (2006 year)

Monthly population of *C.stolli* on *Cassia occidentalies* per ten plants during 2005 to 2006.

Year	Saharanpur proper						Behat						Sarsawa						Nagal					
Mont	2005			2006			2005			2006			2005			2006			2005			2006		
	E	N	A	E	N	A	E	N	A	E	N	A	E	N	A	E	N	A	E	N	A	E	N	A
Jan																								
Feb																								
March	-	-	2	-	-	2	-	-	3	-	-	2	-	-	2	-	-	1	-	-	2	-	-	1
April	-	2	2	-	2	3	-	-	2	2	-	2	-	2	3	-	2	3	2	3	2	3	2	1
May	4	4	4	4	5	6	5	6	7	4	3	2	3	2	4	2	4	6	2	3	4	3	4	7
June	5	6	7	5	6	7	5	6	7	6	7	5	7	5	6	4	3	2	3	4	5	4	5	6
July	1	10	12	14	10	8	13	10	8	12	10	8	10	12	10	12	10	8	13	8	12	12	13	10
Aug.	1	6	7	10	7	6	9	5	4	6	7	8	6	5	4	6	7	8	11	7	9	11	8	9
Sept.	5	6	7	4	4	4	4	5	6	6	7	8	3	2		5	6		6	7	8	5	6	8
Oct.	2	3	2	2	4	2	-	2	3	2	4	6	2	4	3	2	3	2	2	4	6	2	3	2
Nov.	-	-	1	-	-	2	1	-	1	-	-	2	-	-	1	-	-	2	-	-	2	-	-	3
Dec.																								



Map of District Saharanpur showing different blocks in which studies on population dynamics were carried out.

Discussion

Temperature is an important factor which influences the survivability and reproduction of insects. The Longevity of tolerance power below 25 ^{0}C is 20, 15, 10 and 05. The 0 ^{0}C temperature is observed lethal for either sex nymphs. It is the lower lethal limit for this bug. At the temperature above 25 ^{0}C the tolerances power decreases gradually and 40 ^{0}C temperatures is the upper lethal limit for the same. Relative humidity also influences the survivability and growth of the insect. R.H of the temperature had no influences on the incubation period ***of Chrysocoris stolli*** Wolf because eggs remain in saturated humidity in the tissue of the Leal. Khan (1945) reported that 60 to 90 % R.H. is suitable for the ***Teleonemia scrupulosa,*** he evaluated that the bugs population reaches to the beak level in June to July when temperature ranged 79.o to 85.0 and R.H.83%. Verma and Sadatullah (1973) stated that 22 0C to 34 0C temperature and 41 to 75 % R.H favored the multiplication of the insects; at temperature ranging between 36 to 41 0C and relative humidity 14 to 30 % the population becomes nil. Singh et.al (1986) mentioned favorable temperature for *U. hystricellus* as 30.32± 0.86 and relative humidity 79.62 ± 9.08%. Sharma (1998) described 30 ^{0}C temperature and 90% R.H. as a favorable ecological parameter for *M. globulifera.*

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