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Infestation and Population Growth of Stored Grain Pest *C. chinensis* in Two Varieties of Arhar during Different Seasons

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Abstract:

Pulses are cheapest source of dietary proteins in developing countries like India where per capita consumption of animal protein is very low. Dietary proteins are important for growth repair and development. *Callosobruchus chinensis*, pulse beetle, is a serious pest of pulses. The insect pest damages the pulse grain in agriculture field as well as in storage. Present work has been done to assess the population growth of pulse beetle in important pulse whole grains during different seasons, at different temperature and relative humidity. Significant population growth of pulse beetle was observed during different months of the year. Pulse selected for study was Arhar. Population growth was found to be affected by parental population as well as atmospheric temperature and humidity. Infestation was observed from the end of the month of March. Bold variety of pulse was more susceptible for infestation as compared to the smaller one. Significant growth of insect population was observed from end of the month of March to October. Population growth was found to be increased with the increasing temperature and RH %. Average no. of eggs emerged was more at higher parental population. Maximum Average number of eggs laid /female was found to be 78.8-85.4 in pulses of present study at atmospheric temperature Min. 23.6^{0}C-32^{0}C Max. 33.6^{0}C-33.7^{0}C and RH 62%. Maximum growth of insect population was observed during Rainy season when temperature varies from min-23.6^{0}C-25.9^{0}C and max 33.6^{0}C-33.7^{0}C and RH 62%-71%

Keywords: Arhar, Relative humidity, Infestation, Population growth, Damage, Consumption

1. INTRODUCTION

Pulses are cheapest source of dietary proteins in developing countries like India where per capita consumption of animal protein is very low. Dietary proteins are important for growth repair and development of human body and lack of protein in diet is responsible for deficiency diseases especially in children. Other dietary proteins are fish, eggs, and meat and milk products. All these are consumed in lesser amount as compared to pulses. The major and cheapest source of protein is often

threatened by the attack of large number of stored grain pests among which *Bruchus* is one. Bruchids are serious pest of stored grain pulses all over the world .It is commonly known as pulse beetle having single genus Bruchus with many species. Presence of only one species of genus Bruchus renamed as *Callosobruchus chinensis* is common in India, has been reported by Raina (1970) *C. chinensis* has differential preference to certain pulses. *C. chinensis* was found to be highly selective for their host. The development period of the pest varies in different pulses. The preferred food of this pest are green gram, red gram, Bengal gram. Cowpea Pea and khesari are less preferred whereas Black gram and French bean were found to be not suitable for *C. chinensis* at all. *(*Srivastava and J.C. Pant, 1989). During storage the insect causes great damage (Sherma, 1989) *Callosobruchus* species feed on legume protein causing a potential loss by damaging about 12-30% (FAO, 1994). About 35% legume grain loss is caused by *C. chinensis* in Central America and Africa (Singh, 1990). Annual stored grain loss due to insect pest is estimated to 13 million tons. *C. chinensis* is notorious pest of chickpea, mung, matar pea, cowpea, lentil and arhar (Aslam et al., 2002). An insect has varied fecundity on different varieties of pulses. It was studied by (Mohammad Abass, M.S. Khan and Meena, 2016) after their studies on about 11 varities of pulses. Insect population growth rate is affected by temperature as it affects the natality and mortality of insect. Temperature affects the oviposition and development (Burshell, 1974a). Boriker and Puri (1985) found that the temperature and Species of grains both have effect on the population and therefore damage and weight loss of infested grains. The reproductive physiology is more affected by temperature than any other physiology of insects. The effect is different in different species. It was confirmed in Tobacco worm, that oviposition was maximum at 21^0C and 27^0C whereas at 10^0C there was no oviposition at all (Henneberry and Clayton, 1991). In cotton tip worm the favorable temperature for oviposition and development was noticed as 21^0C. Whereas, at 34^0C eggs became non viable. Optimum temperature for development in *Callosobruchus maculatus* was recorded as 35^0C (Adhikary et al., 2012) Likewise humidity was also found as the factor affecting the growth and development of different insect pest. An optimum humidity is required for proper rate of oviposition. Humidity influences the oviposition rate through content of water of the body (Burshell, 1974 b). India is an agriculture based country. Pulses are major crop plant in many part of the country. Pulses are important part of regular diet and also main source of protein diet in large group of population. The insect pest like *Callosobruchus chinensis* causes 100% loss of pulse grain in agriculture field as well as in storage (Pruthi and Singh, 1950), thus affects the economy and loss of cheapest protein diet available to common people. In the light of this fact, present work has been done to assess the growth of pulse beetle on two varieties of Arhar grains in different season .The effect of different temperature on the development of pulse beetle was studied by (Yasmin, Khalil et al., 1999) in which temperature was maintained by electric bulb in the laboratory. The fecundity and longevity both were found to be significantly less at higher temperature. In the present work the population growth of *Callosobruchus chinensis* was studied during different months of the year at different atmospheric temperature and humidity.

2. MATERIALS AND METHOD

In present study two varieties of and Arhar grains were selected. All pulse grains were cleaned with fine cloth then sun dried for a period of about 5-6 hrs for two consecutive days depending upon the moisture content of the pulses. To observe the population growth of *C. chinensis* in different seasons a stock culture of insect pest was prepared.

Preparation of stock culture: Medium sized round glass jars covered properly with thin cloth were used for stock culture preparation. 500 g of both varieties of arhar grains were taken in separate jars. Pulse beetles collected from local grocery shops were introduced into it. In a period of 31 to 33 days first eggs then nymph and then adults appeared in the jars subsequently. To maintain a healthy culture two things were taken into account- regular change of the insect and grains. This was done to avoid the overcrowding of the insect population. For this the fresh population of insect was transferred to another jar at regular intervals. Removal of damaged grains was done periodically to ensure a healthy culture.

Experimental sets preparation: A set of three plastic containers for each variety of grain was taken. 12 containers were taken. 100 g of seeds of each grain were taken in these jars. All jars were labeled properly. 5, 10 and 15 pairs of one day old insects were introduced in the previously marked jars. First observation was taken after appearance of the eggs and then adults in these jars after 12-14 days and 31 days and 35 days respectively. The experiment was carried during different months of the year under varied average room temperature and relative humidity. The experiment was replicated twice for each variety of grains.

Observation: Observations were taken during months of March- April, May - June when average room temperature ranged between 34^0C to 36.5^0C maximum and 27.5^0C-14.5^0C minimum and humidity was less. Second phase of observation was carried in the month of July- August, September – October; average room temperature ranged from 31.5^0C to 34.5^0C maximum and 28.5^0C to 16^0C minimum and humidity was higher. Third observation was carried in the month of November, December, January and February when average room temperature ranged from 10^0C to 18^0C maximum and 3^0C-14^0C minimum. Hundred seeds were taken randomly from each set of the experimental jar number of egg was counted .Number of adults emerged in all the three sets of different pairs of parental population was also counted by sampling method. The data was recorded during all seasons of the year at varying temperature and moisture. Data thus obtained were analyzed.

3. RESULTS AND DISCUSSION

In present studies the growth of insect pest was observed in two varieties of two pulses. Growth rate was observed at different parental population during month of March to October. Observation indicates that variety of pulses, parental population temperature and percentage RH all had effect on the population growth of the insect. Bold varieties of pulse grains were more susceptible for infestation as compared to the smaller one. Significant growth of insect population was observed from end of March. Population growth was found to be increased with the increasing temperature and RH %. Average no. of egg emerged was more at higher parental population. Maximum Average number of eggs laid/female was found to be 78.8-85.4 in both varieties of pulse grains of present study at atmospheric temperature Min. 23.6^0C -32^0C and Max. 33.6^0C -33.7^0C and RH 62%. This result was found to be in conformity with the work of S. Chakraborty et al. who recorded data of total no. of eggs laid/female on different pulses ranging from minimum 79.2 eggs/female to 160.2 eggs/female. Growth was observed during Maximum growth of insect population was observed during Rainy season when temperature varies from min- 23.6^0C-25.9^0C and max 33.6-33.7^0C and RH 62%. Growth was observed during summer season also but when max temperature exceeds 39 then population and hatchability i.e. emergence of adults become lesser. This result of present study was also recorded by Y. Khalil et al. *C. chinensis* of present studies is very selective for its host and it has its own order of preference. The most preferred pulse grain is Cow pea then Red gram and Bengal gram. Data collected in different seasons showing population of insect pests in different experimental set is presented in Table 1 and 2. Number of eggs laid and adults emerged were more at 10, and 15 pairs of parental population as compared to 5 pairs of parental population. However average no. of eggs laid was found to be in correlation at different parental population. In the present studies the insect population started to emerge from end of March and found to be more and more in successive months of the year. During July August, September and October maximum infestation was observed. During July, August, September and October Temperature during these months was favorable having average temperature of 32^0C but relative humidity was very high 62-71%. In months of winter season November, December, January and February growth of insect pest was not observed .The average temperature was 9.5^0C and RH 55-63%; very little infestation was observed along with some fungal growth during these months. Similar result was found by J Alice, R.P. Sujeetha (2013) who studied the effect of hot and cold treatment on pulse beetle.

Table 1: **Population growth of *C. chinensis* in smaller variety of Arhar**

S. No.	Pulse	Month	Eggs laid at parental population (pairs)/ female			Eggs/ female	Adults emerged at parental population /female			Adults/Female		Average Temperature (°C)		Average relative Humidiy (%)
			5	10	15	Average	5	10	15	Average	% hatchability	Low	High	
1.	Arhar Smaller	March	70	67.6	66.5	68	40.6	37	34	37.2	54.6	13.8	28.7	37
2.		April	72	71	70	71	40.3	38.4	38.5	39.04	39.06	19.9	36.3	27
3.		May	60	63.8	66.3	63.3	45.5	44.5	43.7	44.5	41.8	24.3	39.1	29
4.		June	78.8	75.8	73.3	75.9	51.2	60	61	57.4	75.6	26	37.6	38
5.		July	76.8	77	76.8	76.8	65	68	71	68	88.5	25.9	33.6	66
6.		August	77.6	75.9	74.6	76.0	62.4	65.6	68.6	65.5	86.1	25.5	32.6	71
7.		September	78.6	78.4	79.8	78.9	71.8	69	71	70.5	89	23.6	33.7	62
8.		October	76	77	77.6	76.8	66	67	60	64.3	83.7	18.2	32.8	45

Table 2: **Population growth of *C. chinensis* in Bold Variety of Arhar**

S. No.	Pulse	Month	Eggs laid at parental population (pairs)/female			Eggs/ female	Adults emerged at parental population /female			Adults/Female		Average Temperature (°C)		Average relative Humidiy (%)
			5	10	15	Average	5	10	15	Average	% hachibility	Low	High	
1.	Arhar Bold	March	72	75	66.5	71.1	65	62	56	61	56	13.8	28.7	37
2.		April	75.8	78.6	69.3	74.5	71.2	73.5	63,6	68.1	42	19.9	36.3	27
3.		May	55	60	60.6	58,5	73.6	74.2	65.3	69.6	43	24.3	39.1	29
4.		June	79.6	79.6	79.8	79.6	75.6	76.6	68	72.1	79	26	37.6	38
5.		July	80	82	79.6	80.5	76.4	75.4	74	74.8	82	25.9	33.6	66
6		August	82	81	78.6	80.5	78	79	78.4	78.5	84	25.5	32.6	71
7.		September	88.8	88.8	78.6	85.4	80	78	76	78	88	23.6	33.7	62
8.		October	79.8	77	76	77.6	75.6	74.6	68	72.7	87	18.2	32.8	45

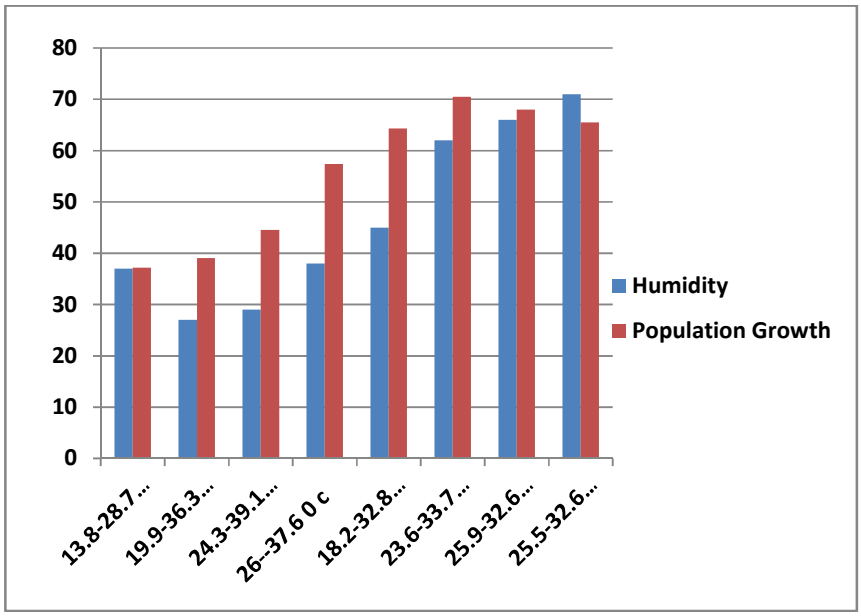

Figure 1: Population growth of *C.chinensis* in Arhar (Smaller Variety)

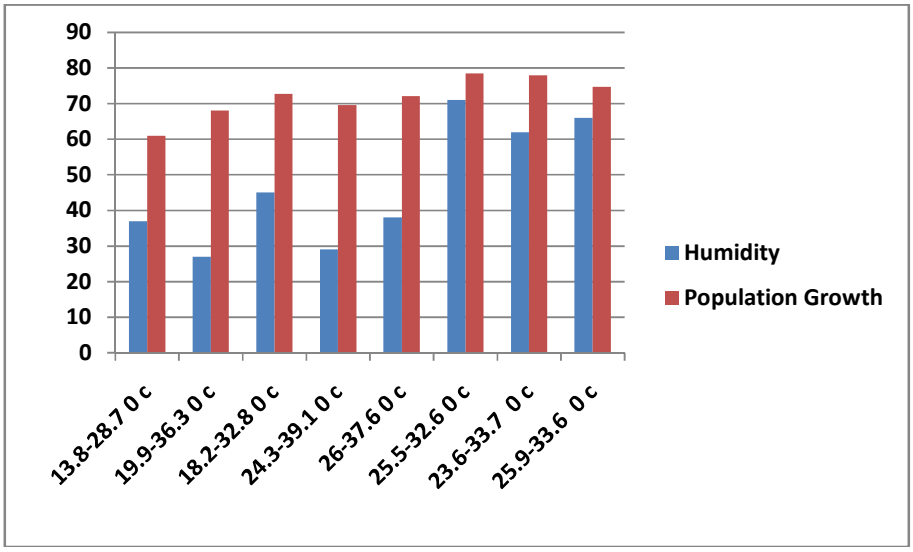

Figure 2: Population growth of *C. chinensis* in Arhar (Bold Variety)

4. CONCLUSION

The Present studies suggest that the stored grain pest infestation at normal room temperature and humidity occurs during eight months of the year. Infestation mostly starts immediately after harvesting. The insect population increases with increase in atmospheric temperature and humidity. An average temperature range of 30^0C -33.3^0C and moisture of 62-71% is optimum for its maximum

growth. However insects are exposed to normally a variable range of temperature and humidity in nature so the study of their population growth under laboratory condition provides some insight to get the understanding of their growth in these pulses grains. Some preventive measures should be taken for the grains in storage during this period. Further work to check the insect growth in stored grain is suggested to prevent the infestation during susceptible months of the year.

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