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Pest Status of Stored Chickpea Beetle, *Callosobruchus chinensis* Linnaeus on Chickpea

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Abstract: To determine the pest status of *Callosobruchus chinensis* Linnaeus (CCL) (Coleoptera:Bruchidae) on chickpea, samples of chickpea were collected from different sources (the farmers, the villagers and general public homes). From each area/location three points were selected to collect the samples with the help of probe. From each collected sample 100 grains were examined. While collecting the samples, the temperature and humidity of the site from where the samples were collected were recorded with the help of portable thermohygrometer. Based on the samples collected, the percent infestation to the chickpea by this pest recorded was 12.18 with standard deviation of 05.42. Based upon the percent infestation, the insect was declared as major pest of chickpea, as it caused more than 10% damage to chickpea. Moreover, it was also concluded from the discussion that the damaged grains did not remain fit for human as well as animal consumption due to the bad smell created by the attack of the pest.

Key words: Extent of damage, percent damage, probe, pest status, portable thermohygrometer

INTRODUCTION

Pulses contain 20-30% of protein, which is almost three times higher than that found in cereals[1]. Among the pulses, chickpea (*Cicer arietinum* L.) belonging to family Leguminosae is the fifth most important legume crop in the world and it ranks third among the world's pulse crops after dry bean and dry pea[2]. Chickpea is cultivated over one million hectares in Pakistan and alone contributes about three forth of the pulses grown in the country[3]. Chickpea is the third largest food grain legume of the world and on an average the production of chick pea in Pakistan is 0.37 million tones per annum[4].

In Pakistan among the pulses chickpea occupies 75% (1.75 million ha) of the total area under cultivation of pulses[5]. Chickpea is also a major and cheap source of protein (20%), which meets the protein requirement of the majority of rural people in Pakistan[4]. The total area under cultivation for chickpea during 1986-1987 was 1.08 million ha with a total production of 0.583 million tones[6]. While during 2002-2003 in Pakistan the total area under chickpea cultivation was 0.96 million ha with a total production of 0.582 million tones. CCL is a destructive pest of chickpea in storage[7]. The pulse seeds suffer a great damage during storage due to insect attack[8]. Among the insect pests attacking stored products, pulse beetle is a serious one[9]. CCL has been reported to cause serious damage to pulses in Bangladesh, India and many countries of the world[10-14]. As it is evident that *Callosobruchus* spp. cause heavy losses every year and affect the economy of the country, suitable control measures should be taken against them.

Das[15] carried out a research to study the infestation of bruchid beetle (CCL) on different pulse seed treated with neem (*Azadirachta indica*) and til (*Sesanum indicum*) oils. After five months of storage, the infeststion by pulse beetle under free choice test in neem and til oil treated seeds of Khesari, lentil and chickpea @10 mL oil kg^{-1} of seeds was 9.30, 36.67, 22.50, 31.53, 27.03 and 36.37%, respectively, while it was 69.13, 64.97 and 67.13%, respectively in control. Neem oil was found to be superior to til oil for its surface protectant activity. The weight loss in neem and til oil treated seeds of khesari, lentil and chickpea due to CCL was 1.63%, respectively while it was 12.73, 34.36 and 2.85% in control. No adverse effect on the germination of the oil treated seeds was observed. Chickpea in the world is grown over an area of 12009 thousand ha, having the average yield of 742 kg ha^{-1} and total production of 8908 thousand metric tons[16]. In Pakistan gram alone contributes about three fourth of the pulses grown and as a result determines the production of pulses[3]. It is a conventional pulse crop of Pakistan. It is grown over an area of 1090 thousand ha, with an average yield of 586 kg ha^{-1} and total production 638 metric tons[16]. It plays a vital role in cropping system of subsistence growers of barani regions. Chickpea grains are stored in godowns and warehouses and are attacked by various insect pests. CCL is a destructive pest of chickpea in storage[7]. It is cosmopolitan in distribution, found in the countries where tropical and subtropical conditions

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prevail[17]. Beetle infestation usually originates from the farm stores[18]. Damage caused to stored chickpea by CCL is of utmost importance in terms of economic loss. A single larva of CCL can destroy several mature seeds[19,20].

In case of heavy infestation of grains by CCL, the grains lose their germination capacity and become unfit for human consumption. Severe infestation leads to 100% damage thus leaving the seed coat. In addition to quantitative losses, the CCL also causes qualitative losses[21]. In grub stage, the beetle lives inside the grain and fills the burrows with their excrement and dead bodies[22].

Millers are of the view that grains with more than 0.5% of insects infested kernels are unfit for milling[23]. Pingale *et al.*[24] found that chickpea when infested with CCL, total quantity of thiamine was reduced roughly proportional to the amount of pest damaged seeds.

In Syria infestation ranged from 0-79%, screening did not reveal any acceptable degree of resistance but some wild accessions were resistant[25]. The pulses are susceptible to the attack of insects before and after harvest, the extent of infestation has been reported as high as 70%[26]. The damage caused to such an extent renders the grains totally unfit for human and animal consumption.

Qayyum and Zafar[27] calculated 90% losses in gram. Storage facilities in Pakistan are inadequate and pulses are kept in gunny bags, earthen structures (pitchers), old sacks, or store bins, which are not safe and are easily deplorable by stored insect pests. These stores and bins are neither built properly nor they can be fumigated or sprayed against the insect pests concealed. The losses due to the insect pests often become enormous and cannot be neglected.

The heavy infestation of grains by CCL, loses their germination capacity and grains become unfit for human consumption. Both quantitative as well as qualitative losses occur due to CCL infestations. Since the last several years, a dire need was being felt by the entomologists that a current figure be available which could indicate the percent damage by CCL to chickpea. To meet that need a simple study of farmers' houses, stores of Sukhu, Sohan, Pind Gondal, Dhoke Wajjan, Chakwal and Attock during February, March 2002 concluded that it caused about 13.83% damage to the stored chickpea. This simple study could not authenticate the results. Therefore more information on the extent of damage of this pest to stored chickpea was got during the project work during 2003-2004 to find out the pest status of CCL on chickpea. Hence in the present investigations, attempts was being made to study the extent of damage of CCL to stored chickpea more comprehensively so as to find out the current pest status of CCL on chickpea.

MATERIALS AND METHODS

Samples of chickpea were collected from different sources (the farmers, the villagers and general public homes). From each area/location three points were selected to collect the samples of chickpea with the help of probe. While collecting the samples, the temperature and humidity of the site from where the samples were collected were recorded with the help of portable thermohygrometer. From each collected sample 100 grains were examined. Based on the samples examined, the percent infestation to the chickpea by this pest was recorded so as to determine the status of this pest on chickpea.

The samples collected were stored in the incubator with maintenance of temperature at 30±2°C. The culture of the insect pest was maintained in the Laboratory of the Department of Entomology, University of Arid Agriculture, Rawalpindi to perform the other tests.

RESULTS AND DISCUSSION

The % damage to chickpea by CCL was 12.18 with standard deviation of 5.42 (Table 1). A simple study of farmers' houses, stores of Sukhu, Sohan, Pind Gondal, Dhoke Wajjan, Chakwal and Attock during February, March 2002 concluded that it caused about 13.83% damage to the stored chickpea. A single larva of CCL can destroy several mature seeds[19,20]. In case of heavy infestation of grains by CCL, the grains lose their germination capacity and become unfit for human consumption. Severe infestation leads to 100% damage thus leaving the seed coat. In addition to quantitative losses, the CCL also causes qualitative losses[21]. In grub stage, the beetle lives inside the grain and fills the burrows with their excrement and dead bodies[22]. The dead bodies of insects and their excrement within the kernels are ground into flour or meal. Millers are of the view that grains with more than 0.5% of insects infested kernels are unfit for milling[23]. Chickpea when infested with CCL, total quantity of thiamine was reduced roughly proportional to the amount of pest damaged seeds[24]. In Syria infestation ranged from 0-79%, screening did not reveal any acceptable degree of resistance but some wild accessions were resistant[25]. The pulses are susceptible to the attack of insects before and after harvest, the extent of infestation has been reported as

Table 1: Showing percentage of chickpea grains damaged by *Callosobruchus chinensis* Linnaeus during 2003-2004

Dates	Area/ Location/ Point	Entry no.	T (°C)	H (%)	No. grains examined	No. grains damaged by CCL	% damage to chickpea by CCL	Time of taking samples (h)	TC	Weather conditions	Remarks
25/07/2003	Chakwal	1. M. Akbar (city)	26	40	100	05	05	1100	b	PC	Temperature
		2. Muhammad Ali Dhudial)	24	43	100	10	10	2100	b	PC	and
		3. M. Nasir A. (C.Naurang)	27	44	100	10	10	1400	b	PC	Humidity %
27/07/2003	Gujrat	4. M. Yousaf (Kunjah)	24	45	100	15	15	1150	b	C	were
		5. Muhammad Yar (Saroki)	26	47	100	23	23	1310	k	C	recorded
		6. Muhammad Hussain (city)	25	46	100	14	14	1500	b	C	using
30/07/2003	Lahore	7. M. Ashraf (Gari Shahu)	27	50	100	12	12	1500	b	C	portable
		8. M. Suleman (Garden Town)	30	48	100	10	10	1600	b	C	Thermo-
		9. Nasir Ali (Ishra)	26	47	100	05	05	1700	b	C.	Hygrometer
31/07/2003	Lahore	10. M. Ramzan (Harbenspura)	30	40	100	11	11	O900	b	PC	PC=Partly
		11. A. Latif (Moghal Pura)	25	42	100	06	06	1100	b	PC	cloudy
		12. M. Akmal (Wagha)	28	39	100	13	13	1300	b	PC	C=Cloudy
07/08/2003	Sohawa	13. M. Bashir Malik (Sohawa)	27	49	100	05	05	1120	b	S	S=Sunny
		14. Abdul Latif (Sohawa)	25	51	100	11	11	1130	b	S	TS=Thunder
		15. Ali Akbar (Domeli)	30	45	100	13	13	1400	b	S	storm
10/08/2003	Attock	16. Malik Allah Yar (city)	30	55	100	03	03	1100	b	PC	MC=Mostly
		17. Nabi Ahmad (Kamra)	32	56	100	15	15	1300	b	PC	cloudy
		18. Muhammad Asad (Burhan)	31	58	100	09	09	1420	b	PC	CR=Clear
17-08-2003	Jhelum	19. Karim Dad (city)	35	58	100	25	25	1200	k	TS	
		20. Umar Din (city)	31	60	100	10	10	1240	b	TS	
		21. M. Akram (city)	35	62	100	13	13	1310	b	TS	
23-08-2003	Wazirabad	22. Ch. M. Arshad (KI Khan)	30	63	100	15	15	1430	b	MC	
		23. Ch. M. Yousaf (Dadan Chak)	32	60	100	14	14	1510	b	MC	
		24. Ch. M. Baksh (Nat Kalan)	34	58	100	21	21	1600	b	MC	
24-08-2003	Wazirabad	25. Ch. M. Akram (Garah)	35	60	100	0	0	1100	b	PC	
		26. M. Hussain Ch.(Ojla Khurd)	36	65	100	0	0	1300	b	PC	
		27. Ch. M. Bashir (Ojla Kalan)	40	67	100	0	0	1400	b	PC	
07/09/2003	Hafizabad	28. M. Yaqub (city)	25	48	100	22	22	1300	k	CR	
		29. Bashir Ahmad (city)	27	50	100	0	0	1330	b	CR	
		30. Muhammad Iqbal (city)	26	58	100	12	12	1400	b	CR	
14/09/2003	M.B.Din	31. M. bashir (Gura Mohallah)	26	42	100	14	14	1215	b	CR	Temperature
		32. M. Baksh (Kutchery Rd.)	24	39	100	09	09	1320	b	CR	and
		33. Nazir Hussain (Main Bazar)	22	41	100	12	12	1510	b	CR	Humidity %
21/09/2003	Faiasalabad	34. M. Bashir (Chak 267 R.B)	26	44	100	13	13	1415	b	PC	were
		35. M. Ataurehman (Dijkot)	25	40	100	16	16	1500	b	PC	recorded
		36. Ahmad Din (Dhudiwala)	23	43	100	09	09	1600	b	PC	using
22/09/2003	Rahwali	37. Ali Muhammad	23	43	100	13	13	1410	b	PC	portable
		38. Muhammad Miskeen	24	40	100	18	18	1510	b	PC	Thermo-
		39. Abdul Sattar	22	42	100	12	12	1605	b	PC	Hygrometer
17/10/2003	Kharian	40. Muhammad Shafique	18	41	100	04	04	1210	b	CR	PC=Partly
		41. Muhammad Ashfaq	19	42	100	14	14	1320	b	CR	cloudy
		42. Ijaz Hussain	18	42	100	17	17	1405	b	CR	C=Cloudy
26-10-2003	Hazro	43. M.Suleman	17	36	100	05	05	1340	b	D	S=Sunny
		44. Malik M. Iqbal	16	40	100	10	10	1420	b	D	CR=Clear
		45. M. Arshad	18	42	100	11	11	1510	b	D	D=Dry
14/11/2003	Fateh Jang	46. M. Ramzan	13	37	100	10	10	1200	b	S	F=Fog
		47. M. Bashir	13	35	100	13	13	1300	b	S	
		48. Muhammad Ilyas	14	37	100	15	15	1410	b	S	
16/11/2003	PindiBhattian	49. M. Bbabar (Kot Nikka)	13	38	100	05	05	1350	b	S	
		50. Ghulam Rasool (Kot Nikka)	12	37	100	10	10	1440	b	S	
		51. Muhammad Iqbal (PB)	14	38	100	15	15	1500	b	S	
23/11/2003	Dina	52. Muhammad Yaqoob	12	35	100	06	06	1100	b	CR	
		53. Maqbool Hussain	13	35	100	17	17	1200	b	CR	
		54. Muhammad Asif	12	35	100	15	15	1250	b	CR	
30/11/2003	Okara	55. Muhammad Ramzan	13	36	100	14	14	1450	b	D	
		56. CH.Abdul Qadir	13	35	100	17	17	1500	b	D	
		57. Muhammad Naveed	13	36	100	13	13	1530	b	D	
20/12/2003	Kmokee	58. Ch. Abdul Karim	08	32	100	12	12	1200	b	CR	
		59. Ch.Fateh Muhammad	09	32	100	11	11	1230	b	CR	
		60. Muhammad Naseer	09	30	100	17	17	1310	b	CR	
21/12/2003	Daska	61. Muhammad Yousaf	09	32	100	18	18	1250	b	F	
		62. Muhammad Akbar	08	30	100	17	17	1320	b	F	
		63. Aakhtar Ali	08	32	100	12	12	1430	b	F	

Table 1: Continue

Dates	Area/ Location/ Point	Entry no.	T (°C)	H (%)	No. grains examined	No. grains damaged by CCL	% damage to chickpea by CCL	Time of taking samples (h)	TC	Weather conditions	Remarks
26/12/2003	Sahiwal	64. Mushtaq Ahmad (G.Mandi)	07	32	100	10	10	1400	b	D	Temperature
		65. M. Peelo (Gala Mandi)	08	33	100	14	14	1415	b	D	and
		66. M. Bashir (Pakpattan Bazar)	07	33	100	16	16	1450	b	D	Humidity %
28/12/2003	Sheikhupura	67. M. Arif	08	31	100	12	12	1400	b	PC	were
		68. A. Rashid Khan	08	30	100	10	10	1430	b	PC	recorded
		69. Ch. A. Qadoos	08	32	100	12	12	1540	b	PC	using
16/01/2004	Qutabal	70. Muhammad Ashraf	11	50	100	15	15	1100	b	C	portable
		71. Muhammad Iqbal	12	50	100	11	11	1200	b	C	Thermo-
		72. Basharat Ali	10	50	100	11	11	1250	b	C	Hygrometer
18/01/2004	Seraialamgir	73. HabibAhmad	13	55	100	01	01	1200	b	C	PC=Partly
		74. M.Jehangir	14	55	100	14	14	1250	b	C	cloudy
		75. Abdul Rashid	14	55	100	13	13	1400	b	C	C=Cloudy
19/01/2004	Rawalpindi	76. Mohabbat Khan	11	55	100	19	19	1610	k	C	S=Sunny
		77. Shabbir Ahmad	10	56	100	13	13	1630	b	C	CR=Clear
		78. M. Rizwan	10	55	100	22	22	1700	k	C	D=Dry
22/01/2004	Islamabad	79. Liaquat Ali(Poona Faquiran)	09	91	100	11	11	1520	b	C/RN	CRN=Cloudy
		80. Zameer Hussain (do)	09	91	100	17	17	1550	k	C/RN	/rain
		81. M. Sarwar (Noor Poorshahan)	08	90	100	12	12	1650	b	C/RN	
25/01/2004	G. Mandi	82. Ch. M. Munir (Noora Kot)	13	54	100	12	12	1325	b	CR	
		83. M. Ashraf (Noora Kot)	13	54	100	21	21	1420	k	CR	
		84. M. Akram (Ghakhar Mandi)	12	53	100	13	13	1520	b	CR	
31/01/2004	Muridke	85. Abdul Latif	15	70	100	18	18	1510	k	CR	
		86. Muhammad Ali	14	75	100	21	21	1600	k	CR	
		87. Ch. M. Mukhtar	14	70	100	18	18	1620	k	CR	
05/02/2004	Rajan Pur	88. MalikMurid Hussan(T.wala)	10	60	100	0	0	1220	k	CR	
		89. M. Sajjad Ali (Jampur)	12	60	100	0	0	1420	k	CR	
		90. M. Nawaz Pasha (Jampur)	13	60	100	0	0	1500	k	CR	
07/02/2004	D.G.Khan	91. S. Haider	14	50	100	17	17	1200	b	S	
		92. Umran Haider	14	48	100	15	15	1400	b	S	
		93. Muhammad Tariq	13	48	100	18	18	1500	k	S	
08/02/2004	Layyiah	94. Atif Ali (Rafiqabad)	12	30	100	09	09	1025	b	C	
		95. M. Aslam (Chowk Azam)	14	32	100	23	23	1240	b	C	
		96. Basshir Ahmad (Nawan Kot)	14	32	100	14	14	1500	b	C	
22/02/2004	Gujar Khan	97. Muhammad Bashir	13	50	100	15	15	1100	k	PC	Temperature
		98. Liaquat Ali	14	50	100	17	17	1210	k	PC	and
		99. Muhammad Hussain	14	50	100	12	12	1450	b	PC	Humidity %
28/02/2004	Lala Musa	100.Muhammad Nazir	20	40	100	18	18	1410	k	PC	were
		101. Muhammad Arshad	20	40	100	12	12	1420	b	PC	recorded
		102. Ch. Abdullah	20	40	100	11	11	1440	b	PC	using
29/02/2004	Jatli	103. Muhammad Tufail	20	30	100	14	14	1320	k	PC	portable
		104. Muhammad Shahbaz	21	30	100	09	09	1340	b	PC	Thermo-
		105. M.Asif Zafar	21	30	100	11	11	1450	b	PC	Hygrometer
03/03/2004	Sargodha	106. Ch. Nazir Hussain	21	40	100	13	13	1440	b	PC	PC=Partly
		107. Muhammad Akbar	21	40	100	14	14	1455	k	PC	cloudy
		108. Salim Haider	21	40	100	10	10	1530	k	PC	CR=Clear
10/03/2004	Jand	109. Muhammad Umran	22	50	100	12	12	1310	k	PC	k=kabli
		110. Muhammad Hanif	22	50	100	21	21	1420	k	PC	b=brown
		111. Muhammad Anwar	22	50	100	12	12	1500	b	PC	AV=Average
20/04/2004	Dudial	112. Muhammad Bashir	28	37	100	13	13	1210	b	CR	St.Dev.=
		113. Ch.M.Anwar	28	37	100	15	15	1320	b	CR	Standard
		114. Abdul Rashid	28	37	100	12	12	1400	b	CR	Deviation
24/05/2004	Mandra	115. Ghulam Ahmad	32	36	100	05	05	1100	b	PC	n=number
		116. Muhammad Munir	32	36	100	04	04	1130	b	PC	
		117. Noor Muhammad	32	36	100	15	15	1210	b	PC	
01/06/2004	P.D. Khan	118. Ali Ahmad	35	35	100	13	13	1400	b	CR	
		119. Muhammad Ali	35	35	100	0	0	1425	b	CR	
		120. Abdul Karim	35	35	100	16	16	1520	b	CR	
AV = 12.18 %		St.Dev. = 05.42		n = 120							

high as 70%[26]. The damage caused to such an extent renders the grains totally unfit for human and animal consumption. Khare and Johari[21] calculated 90% losses in gram. The correlation between % damage and temperature and % damage and humidity was negative but was not significant (Table 2). The correlation between temperature and humidity was positive but was not significant.

Table 2: Correlation between % damage, temperature and humidity collected from different locations during 2003-2004

	% Damage	Temperature	Humidity
% Damage	0.00	-0.19258902	-0.015012612
Temperature	-0.19258902	0.00	0.092770842
Humidity	-0.015012612	0.092770842	0.00

In the light of the above discussion, the pest status of CCL on chickpea could easily be identified/declared. It can be concluded safely that CCL is a major pest of chickpea as it does more than 10% damage to chickpea and renders the grains unfit for human consumption due the bad odour of insect excrements in the grains.

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REFERENCES

1. Doharey, R.B., R.N. Katiyar and K.M. Singh, 1983. Ecotoxicological studies on pulse beetles infesting green gram. Bull. Grain Tech., 21: 110-114.
2. Aslam, M., K.A. Khan and M.Z.H. Bajwa, 2002. Potency of some spices against *Callosobruchus chinensis* Linnaeus. OnLine J. Biol. Sci., 2: 449-452.
3. Ali, A., M. Aftab and M. Tufail, 1991. Criterion for the selection of high yielding genotypes and pure lines of chickpea. Pak. J. Agric. Res., 12: 241-245.
4. Ahmed, K., F. Khalique, I.A. Khan, M. Afzal and B.A. Malik, 1991. Studies on genetic resistance in chickpea (*Cicer arietinum* L.) to bruchid beetle (*Callosobruchus chinensis* L.) attack. Pak. J. Sci. and Ind. Res., 34: 449-452.
5. Ahmed, K., F. Khalique, I.A. Khan, M. Afzal and B.A. Malik, 1993. Genetic differences for susceptibility of chickpea to bruchid beetle (*Callosobruchus chinensis* L. attack. Pak. J. Sci. Ind. Res., 36: 96-98.
6. Khattak, S.U., M. Alam, S.K. Khalil and N. Hussain, 1991. Response of chickpea cultivars to the infestation of pulse beetle *Callosobruchus chinensis* (L.). Pak. J. Zool., 23: 51-55.
7. Aslam, M. and M. Suleman, 1999. Pest management of stored farm commodities. The Nation, XI (53): 5.
8. Sherma, S.S., 1889. Review of literature of the losses caused by *Callosobruchus* species (Bruchidae:Coleoptera) during storage of pulses. Bull. Grain Technol., 22: 62-68.
9. Alam, M.Z., 1971. Pest of stored grain and other stored products and their control. Publ.Inform. Service, 3, R. K. Mission Road, Dhaka, Bangladesh, pp: 361.
10. Qayum, H.A., 1977. Research on the stored grain pests in Pakistan. Final Report, PL-480 Project, University of Agriculture, Faisalabad, Pakistan.
11. Farooq, S., 1978. Evaluation of nutritional losses caused by *Callosobruchus* spp. M.Sc.Thesis, University Of Agriculture, Faisalabad, Pakistan.
12. Islam, M.A., 1980. Moong bean cultivation in Bangladesh. R.A.E "A"68-21- 23.
13. Saleem, M.A. and M.S. Saleem, 1982. Quantitative loss of some new varieties of pulses caused by *Callosobruchus maculatus* F. Proc. Pakistan Congr. Zool., 3: 82-93.
14. Ahmad, H., 1984. Losses incurred in stored food grains by insects. A review. PARC Grain Storage Res. Lab. Karachi, Pakistan.
15. Das, G.P., 1985. The infestation of bruchid beetle (*Callosobruchus chinensis* L. Bruchidae Coleoptera) on different pulse seed treated with neem *(Azadirachta indica* A.Juss) and till (*Sesanum indicum* L.) oils. Bangladesh J. Agric., 10: 51-55
16. FAO of the United Nation, 1996. Year Book. Volume 50, pp: 650.
17. Applebaum, S.W., B.J. Southgate and H. Podoler, 1968. The comparative morphology, specific status and host compatibility of two geographical strains of *Callosobruchus chinensis* L. (Coleoptera: Bruchidae). J. Stored. Prod. Res., 4: 135-146.
18. Hill, D.S., 1979. Agricultural Insects Pests of Tropics and Their Control. Cambridge University Press, Cambridge, pp: 668.
19. Howe, R.W. and J.E. Currie, 1964. Some laboratory observations on the rates of development, mortality and oviposition of several species of Bruchidae breeding in stored pulses Bull. Ent. Res., 55: 437-477.
20. Singh, H., 1964. *Pachymerus chinensis* (L.) its biology and extent of damage to grains. Pl. Prot. Bull., 16: 23-28
21. Khare, B.P. and R.K. Johari, 1984. Influence of phenotypic characters of chickpea (*Cicer arietinum* L.) cultivarson their susceptibility to *Callosobruchus chinensis* (L.). Legume Res., 7: 54-56.
22. Atwal, A.S., 1976. Agricultural Pests of India and South East Asia . Kalyani Publishers Ludhiana, India, pp: 407-409.
23. Cotton, R.T., 1941. Pests of Stored Grain and Grain Products. Burgess Publishing Company 426 South 6th Street Minneopolis 15, Minn pp: 318.

24. Pingale, S.V., S.B. Kakol and M. Swaminathan, 1956. Effect of insect infestation on stored bengal gram (*Cicer arietinum* L.) and green gram (*Phaseolus radiatus* L.) Bull. Cent. Fd. Technol. Res. Inst. Mysore, 15: 211-213.
25. Weigand, S. and O. Tahhano, 1990. Chickpea insects pests in the Mediterranean zones and new approaches to their management Chickpea in the nineties: Proceedings of the 2nd International Workshop on Chickpea Improvement, Patancheru India; ICRISAT, pp: 169 175.
26. Munroo, J.W., 1966. Pests of Stored Products Hutchinson and Co. Pub. Ltd., England, 34.
27. Qayyum, H.A. and M.A. Zafar, 1978. Research on Stored Grain Pests in Pakistan. Final Report PL-480. Project, Dept. Entomol., Univ. Agric. Fsd., pp: 67-112.