Sarhad J. Agric. Vol. 23, No.1, 2007

EFFECTIVE MONITORING OF CIGARETTE BEETLE *LASIODERMA SERRICORNE* (F.) COLEOPTERA: ANOBIIDAE IN TOBACCO WAREHOUSES OF NWFP PAKISTAN

Muhammad Saeed *, Said Mir Khan* and Muhammad Shahid**

ABSTRACT

For effective monitoring of cigarette beetle, *Lasioderma serricorne*, five different types of monitoring traps i.e., STORGARD® THINLINE™ CB and COMBI™, STORGARD DOME® CB, New Serrico trap baited with sex pheromone 4S, 6S, 7S - serricornin and Diamond trap were compared with traditionally used Light Beetle trap for their efficacy in three tobacco warehouses of Lakson Tobacco Company Ltd. Mardan, NWFP, Pakistan during 2003-04. The experiment was laid out in Randomized Complete Block Design with four replications. Population dynamics of beetles trapped on each type of trap throughout the year showed that STORGARD® THINLINE™ CB was the most effective trap for close monitoring of *Lasioderma serricorne* with highest (3.35) beetles followed by New Serrico trap with the value of 2.47. Minimum (0.58) beetles were documented for Light Beetle trap. The results further showed that maximum beetles were trapped during the month of August, 2003. Hence for effective monitoring of *L. serricorne*, use of STORGARD® THINLINE™ CB trap and application of control measures like fumigation, temperature manipulation, insect growth regulators, and use of conventional insecticides in the month of August is recommended for preservation of tobacco products in factories, retail stores, and warehouses.

INTRODUCTION

The cigarette beetle, *Lasioderma serricorne* (Fabricius), is arguably the most ubiquitous of all stored-product insects. It occurs throughout the tropical and subtropical regions of the world, and although low temperature and humidity restrict its growth, yet it occurs commonly in warm buildings throughout the temperate regions (Arbogast *et al.* 2003). It breeds on a wide variety of commodities, including both plant and animal materials (Howe, 1957; LeCato, 1978; Ashworth, 1993), and is one of several beetle pests that commonly infest warehouses and retail stores (Arbogast *et al.* 2000, 2002). It is the most serious threat to cured tobacco during storage, manufacture, and at retail outlets. Worldwide yearly loss of stored tobacco due to *Lasioderma serricorne* is estimated conservatively at 1%. It is found in tobacco products such as cigarettes, cigars, and even chewing tobacco (Ryan, 1995). In Pakistan, 73% of tobacco is grown in NWFP (Anonymous, 2003). Therefore most of the cigarette manufacturing companies run their business here. Cigarette beetle is a major insect damaging both raw and manufactured product in warehouses of these companies. The foundation of a successful pest management program is an effective monitoring system that supplies information not only on the number and type of pests present but also detects changes in pest populations over time, locates foci of infestation and routes of entry (Burkholder, 1990). Early detection and location of infestation through improved monitoring reduces risk by permitting application of pesticides only when and where they are needed.

Research over the last two or three decades has produced a variety of traps that are effective in detecting insect pests (Burkholder, 1984, Vick *et al.* 1990, Mullen, 1992). Pheromone lures have been identified for many of the stored-product insects. Some synthesized lures have been commercially developed and a variety of trap designs are available. Ryan (1995) recommended conducting trials before choosing a particular trap. Traps have been very effective for monitoring stored-product pests of commodities having few species e. g. tobacco (Anonymous, 2000).

Taking the above studies into consideration, an experiment was designed to effectively monitor *L. serricorne* by using different beetle traps and to study population dynamics of the beetle over time so as to identify proper time of preventive and control measures implementation in the tobacco warehouses.

* Gomal University, D. I. Khan - Pakistan.
** NWFP Agricultural University, Peshawar - Pakistan.

MATERIALS AND METHODS

Studies on effective monitoring of Cigarette Beetle - *Lasioderma serricorne* in tobacco storages of NWFP, Pakistan were conducted from July, 2003 to June, 2004 in three tobacco warehouses of Lakson Tobacco Company Ltd. Mardan, NWFP Pakistan namely GLT, Ismaila and Adina.

Following Six types of traps were used to detect and monitor *L. serricorne*:-

A. STORGARD® THINLINE™ CB, TRE´ CE´® , Salinas, CA
B. NEW SERRICO TRAP Pheromone Baited, manufactured by Fuji Flavor Co. Ltd., Japan
C. LIGHT BEETLE TRAP applied with Sticky material (3 Volume of Non-medicated Castor Oil with 1 Volume of Brown Resin).
D. STORGARD® THINLINE™ COMBI™, TRE´ CE´®, Salinas, CA, baited with cigarette beetle and confused flour beetle/red flour beetle pheromone lures.
E. STORGARD® DOME™ TRAP TRE´ CE´®, Salinas, CA, baited with mixture of plant oil and CB lure.
F. DIAMOND TRAP, Cooper Mill Ltd. RR3, Madoc, Ontario Canada K0K 2K0

The trap density was maintained at a rate of 1 trap per 25,000 cubic feet (708 m^3) of covered area. Beetle traps were distributed throughout the warehouse & attached to the walls at the heights of 1–2.5 meters for easy counting of trapped beetles. Temperature and relative Humidity (R.H) of the area was measured through thermo-hydrograph. All traps & lures were replaced after 6 weeks period (Ryan, 1995). The experiment was laid out in Randomized Complete Block (RCB) design with four replications. Observations on the number of beetles trapped on each trap were recorded weekly by removing beetles carefully from sticky traps, counted on-site and preserved in Formaldehyde solution min. 37% (E. Merck, Germany). The data thus obtained were subjected to Analysis of variance and means were separated using Least Significant Difference (LSD) test.

RESULTS AND DISCUSSION

Number of Beetles Trapped

Table I showed that trapping efficiency of different traps as significant. Maximum (3.35) numbers of *L. serricorne* were captured on STORGARD® THINLINE™ CB trap followed by New Serrico trap with 2.47 beetles. Minimum (0.58) number of trapped beetles was recorded on Light beetle trap. Beetles attracted by Light beetle trap and Diamond trap were statistically similar i.e., 0.58 & 0.74 respectively. Similarly no significant difference was observed between the trapping efficiency of STORGARD® THINLINE™ COMBI™ (1.88 beetles) and STORGARD® DOME™ (1.79 beetles) trap. Population at GLT (1.45 beetles) and Adina (1.41 beetles) did not differ significantly while the population at Ismaila (2.55 beetles) was maximum and significantly different from the rest of warehouses. Ryan (1995) reported the use of New Serrico trap with 90% trap of *L. serricorne* males. He further reported Flit-Trak® CB (presently STORGARD® DOME™ CB) with high trap catch efficiency.

The STORGARD® THINLINE™ CB traps were the most effective, since they are manufactured specifically for cigarette beetles (CB: Cigarette Beetle). Light beetle trap was least effective due to its traditional use since a long time in the warehouses. *L. serricorne* became used to it and it is no more effective in monitoring this insect. Ryan (1995) recommended the use of pheromone trap for effective monitoring of *L. serricorne.* Pheromone traps are now the industry standard and most perform equally well. These results are strongly supported by the findings of Buchelos and Papadopoulou (1999) who captured 95.4% *L. serricorne* with use of pheromone-baited traps. Pierce (1994) used pheromone-baited traps to locate infestations of cigarette beetle. Heeman (1995) compared light traps with pheromone traps. He found that for every beetle caught in the light trap, between 10 and 15 were caught in the pheromone traps (1:12.5). Davis *et al.* (1999) reported pheromone traps superior to light traps due to their small size, no electricity requirement, and low maintenance. Sannino *et al.* (2003) and Papadopoulou (2001) reported no significant difference in the efficiency of adhesive traps. However, a significant difference was observed between the adhesive traps and control. Mean population of *L. serricorne* in Ismaila warehouse was high due to the nearby presence of tobacco centers and sheds for tobacco handling.

Table I ***Mean number of L. serricorne captured on traps in different locations***

Location	Traps						Mean
	A	B	C	D	E	F	
GLT	3.11	1.67	0.38	1.46	1.47	0.60	1.45 b
Ismaila	4.33	3.92	0.92	2.46	2.39	1.26	2.55 a
Adina	2.62	1.82	0.44	1.73	1.50	0.35	1.41 b
Mean	3.35 a	2.47 b	0.58 d	1.88 c	1.79 c	0.74 d	

Means within a row and column followed by different letters differ significantly at 5% level of significance using LSD test.

Table II ***Cumulative population dynamics of L. serricorne over time***

Month	Cumulative population of trapped beetles
Jul, 03	1.71 cd
Aug.	4.56 a
Sep.	3.05 b
Oct.	0.91 de
Nov.	0.16 ef
Dec.	0.04 ef
Jan. 04	0.01 f
Feb.	0.08 ef
Mar.	0.28 ef
Apr.	1.42 cd
May	1.83 c
June	1.20 cd

Means within a column followed by different letters differ significantly at 5% level of significance using LSD test.

Population Dynamics of L. serricorne Over Time

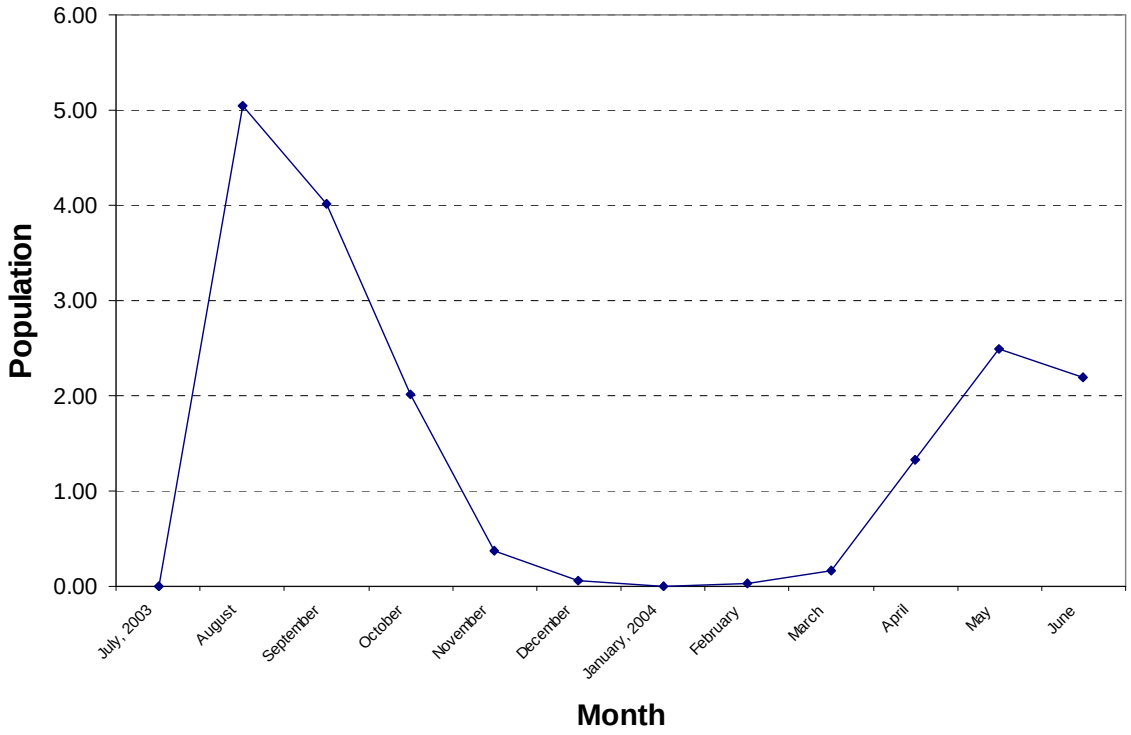

Fig. 1. Cumulative population dynamics of L. serricorne overtime.

The data revealed significant difference in the population of *L. serricorne* over time. Table II indicates that maximum population (4.56 beetles) was recorded during the month of August, 2003. Minimum (0.01 beetles) population was recorded during the month of January, 2004, which did not differ significantly from the population recorded during the month of November, December, 2003, February, and March, 2004 (Fig. 1). Table III shows a highest temperature (42˚C) was recorded during August 2003. Relative humidity was 65 and 64% during August and September, 2003 respectively. Lowest temperature (20˚C) and highest R.H (76%) was recorded during the month of January 2004. These findings show that lower temperature and higher R.H suppressed the population build up of *L. serricorne*. Population increased as R.H increased from 59% till maximum at 65% and then gradually decreased till minimum at 76% R.H. Ryan (1995) reported 65% R.H as the most favorable standard for development of *L. serricorne* population.

These findings are in agreement with those of Buchelos and Trematerra (1998) who observed *L. serricorne* in tobacco stores from June to October with a marked increase between August and early September. Sannino *et al.* (2003) also reported maximum *L. serricorne* flying activity in summer, reflecting its higher temperature requirements. Similarly Athanassiou *et al.* (2002) carried out survey and mass trapping of *L. serricorne* from January to December, 1998 with weekly data collection. Catches were recorded from the end of April up to the first week of November with a population peak in the middle of August. These findings are also in agreement with Howe (1957) who reported 28-32˚C as optimum temperature for 100% increase in *L. serricorne* population per week.

Table III *Mean Temperature & Relative Humidity data of the area*

Month	Temperature (˚C)		Relative Humidity (%)
	Min.	Max.	
(2003)			
July	19	41	61
August	21	42	65
September	14	37	64
October	12	38	59
November	4	34	68
December	1	25	74
(2004)			
January	2	20	76
February	2	27	66
March	9	34	51
April	12	38	51
May	16	41	38
June	18	42	43

Based on the above discussion, it is concluded that STORGARD® THINLINE™ CB was the most effective trap for monitoring of *L. serricorne* while light beetle trap was least effective. Similarly, it is concluded from Fig. 1 that higher temperature (42˚C) and favourable Relative Humidity (65%) during the month of August have encouraged higher beetle population. Hence for close monitoring of *L. serricorne* round the year, use of STORGARD® THINLINE™ CB trap and control/preventive measures application during the month of August is recommended for preservation of tobacco products in factories, retail stores, and warehouses.

ACKNOWLEDGMENTS

The authors are indebted to the owners and managers of Lakson Tobacco Company Limited for provision of research facilities, Shaukat Ali Shah for his cooperation in the research work and Falak Naz for provision of related literature. Many thanks to Richard Terry Arbogast of USDA-ARS Center for Medical, Agricultural and Veterinary Entomology for his helpful guidance, suggestions, critical review and provision of related research material and Bill Lingren and Angel Parks of Trece Incorporation, USA for provision of traps used in this research project and critical review of research work.

REFERENCES

Anonymous. 2000. Technical Information Memorandum No.27. Detection / Monitoring Methods. Armed Forces Pest Mgt. Board 2-15.

Anonymous. 2003. Tobacco Statistical Bulletin. Pakistan Tobacco Board. 28: 3-17.

Anthanassiou, C.G., C.T. Buchelos, P. Witzgall, B. Mazomenos and M. Konstantopoulou. 2002. Effectiveness of a pheromone-baited multi-Lasiotrap in surveying and mass trapping of the tobacco beetle in Greek stores. Proc. working group meeting, Sep. 25-29, 2000. Samos, Greece. Bulletin-OILB-SROP. 25: 181-186.

Arbogast, R.T., P.E. Kendra, R.W. Mankin and J.E. Mcgovern. 2000. Monitoring insect pests in retail stores by trapping and spatial analysis. J. Econ. Entomol. 93: 1531-1542.

Arbogast, R.T., P.E. Kendra, R.W. Mankin and R.C. Mcdonald. 2002. Insect infestation of a botanical warehouse in north-central Florida. J. Stored Prod. Res. 38: 349-363.

Arbogast, R.T., P.E. Kendra and S.R. Chini. 2003. *Lasioderma serricorne* (Coleoptera: Anobiidae): Spatial Relationship between Trap Catch and Distance from an Infested Prod. Florida. Entomol. 86(4): 437–444.

Ashworth, J.R. 1993. The biology of *Lasioderma serricorne*. J. Stored Prod. Res. 29: 291-303.

Buchelos, C.T. and P. Trematerra. 1998. Monitroring of stored tobacco insect pests by means of pheromones: the case of *Ephestia elutella* (Hubner) and *Lasioderma serricorne* Fabricius in South Europe. Anzieger-fur-schadlingskunde,-pflanz-enschutz,-umweltschutz. 71: 113-116.

Buchelos, C.T. and S.C. Papadopoulou. 1999. Evaluation of the effectiveness of new pheromonic trap for monitoring *Lasioderma serricorne* (F.) in tobacco stores. Anzeiger-fur-schadlingskunde. 72:92-94.

Burkholder, W.E. 1984. Stored product insect behavior and pheromone studies: keys to successful monitoring and trapping, pp. 20-23. In Anonymous [cd]. Proc. 3rd Int.' 1. Working Conf. of Stored Prod. Entomol. 23-28 Oct. 1983, Manhattan, KS. The Permanent Committee of Int. Working Conf. on Stored Prod. Entomol. Manhattan, KS.

Burkholder, W.E. 1990. Practicaluse of pheromones and other attractants for stored-product insects, 497-516. In R.L. Ridgway, R.M. Silverstein and M.N. Inscoe (eds.), Behavior-modifying chemicals for insect management: applications of phermones and other attractants. Marcel Dekker, New York.

Davis, D.L. and M.T. Nielsen. 1999. Stored tobacco: insect and their control. Tobacco Production, Chemistry and Technology. pp.241-249.

Heeman, V. 1986. Insect control: natural chemicals attack beetles. Tob. Rep. 113: 30-40.

Howe, R.W. 1957. A laboratory study of the cigarette beetle, *Lasioderma serricorne* (F.) (Col., Anobiidae) with a critical review of the literature on its biology. Bull. Entomol. Res. 48: 9-56.

Lecato, G.L. 1978. Infestation and development by the cigarette beetle in spices. J. Georgia Entomol. Soc. 13: 100-105.

Mullen, M.A. 1992. Development of a pheromone trap for monitoring *Tribolium castaneum*. J. Stored Prod. Res. 28: 245-249.

Papadopoulou, S. 2001. Trapping efficacy of different coloured adhesive traps for *L. serricorne* (F.) adults in a tobacco store. Bulletin-del-Laboratorio-di-entomologia-Agraria-"Fillippo-Silvestri". 57:129-134.

Pierce, L.H. 1994. Using pheromones for location and supression of phyeitid moths and cigarette beetles in Hawaii-a five year study, pp. 439-443. In E. Highly, E. J. Wright, H.J. Banks, and B. R. Champ [cds], Proc. 6th Int. Working Conf. on Stored Prod. protection, 17-23 April 1994, Canberra, Australia, 1994. CAB, Wallingford, Canberra, Australia.

Ryan, L. 1995. Post-harvest tobacco infestation control Chapman and Hall, UK. pp.1-35.

Sannino, L., B. Espinosa and P. Burattini. 2003. Monitoring the tobacco moth and the cigarette beetle with pheromone traps. Informatore Agrario. 59: 105-107.

Vick, K.W., R.W. Mankin, R.R. Cogburn, M. Mullen, J.E. Throne, V.F. Wright and L.D. Cline. 1990. Review of pheromone-baited sticky traps for detection of stored-product insects. J. Kans. Entomol. Soc. 63: 526-558.