Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(4): 1846-1850
Received: 22-05-2019
Accepted: 24-06-2019

K Naveena
Research Scholar, Department of Agricultural Entomology, Agricultural College and Research Institute, Tamil Nadu Agricultural University, Madurai, Tamil Nadu, India

R Philip Sridhar
Professor (Entomology), Directorate of Open and Distance Learning, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

S Sheeba Joyce Roseleen
Assistant Professor (Entomology), Department of Plant Protection, Anbil Dharmalingam Agricultural College and Research Institute, Tamil Nadu Agricultural University, Tiruchirappalli, Tamil Nadu, India

Correspondence
K Naveena
Research Scholar, Department of Agricultural Entomology, Agricultural College and Research Institute, Tamil Nadu Agricultural University, Madurai, Tamil Nadu, India

Host suitability for mass multiplication of the cigarette beetle, *Lasioderma serricorne* (F.) (Coleoptera: Anobiidae) under stored conditions

K Naveena, R Philip Sridhar and S Sheeba Joyce Roseleen

Abstract
The cigarette beetle (*Lasioderma serricorne* F.) is a serious pest of stored turmeric as they can infest a wide range of stored products. An experiment was conducted to determine the development of the cigarette beetle on different food sources *viz.*, turmeric rhizomes, turmeric powder, coriander powder, chilli powder, wheat flour, dried yeast, wheat four + 5% dried yeast, chewing leaf tobacco, cigar tobacco and broiler feed. The developmental period of the beetle *viz.*, incubation period, larval period and pupal period, was recorded. Adult emergence at 1st, 2nd and 3rd generations were also calculated. The results revealed that, dried yeast was significantly better than all other treatments evaluated whereas chewing leaf tobacco and cigar tobacco were consistently served as a poor substrate for the development of the cigarette beetle. They had the ability to complete its lifecycle from the egg stage to the adult stage on all the different food sources.

Keywords: *Lasioderma serricorne*, food sources, development

Introduction
The cigarette beetle, *L. serricorne* (F.) (Coleoptera: Anobiidae) is an economically serious pest of stored turmeric and tobacco, hence it is known as tobacco beetle or cigarette beetle. The damage by cigarette beetle in terms of quantitative weight loss at three and six months after storage was recorded as 7.15 and 22.75 per cent in turmeric [41][31]. Besides turmeric and tobacco, it also infests a wide range of commodities such as spices, dried yeast, wheat flour, corn flour, chilli powder, granular feed for pets, grains, cereals, beans, cotton seeds, black sesame seeds, onion seeds, saffron, dried fruits such as raisins, figs and dates, cocoa, dried vegetables, dried bread, biscuits, chocolate, herbarium specimens, insecticides containing pyrethrum, herbal products, dehydrated bee pollen, *Metricaria recutita*, animal matter such as dried insects, dried fish, leather and even non-food materials during storage, manufacturing and at the retail level [18, 5, 7, 14, 1, 33, 9, 20, 2, 34, 8, 6, 19, 24, 35, 40, 17, 29, 42, 25, 4].
The newly hatched larvae are extremely active [16] and feed heavily [6]. Adult beetles are capable of flight, do not feed but create holes on the substrates to locate a suitable oviposition site [28, 38, 4]. The longest developmental stage is usually recorded at the larval stage where most feeding is done. The rate of development and longevity of the adult insect is usually dependent on the type and quantity of food consumed during the larval stage [32, 28, 24, 4].
It is a well-known fact that food constituents play a vital role in the survival and reproduction potential of the insects and different physico-chemical properties of the commodity also interfere with the normal biology of the pest [38]. Carbohydrate diet seemed a better substrate for *L. serricorne* reproduction and development than oil crops, legumes and dried fruits [3]. Still host preferences of *L. serricorne* was not clearly understood. Keeping this in view an attempt has been made to find the suitable host for mass multiplication which could be helpful for laboratory studies.

Materials and methods
Food materials
The ten categories of food materials *viz.*, turmeric rhizomes, turmeric powder, coriander powder, chilli powder, wheat flour, dried yeast, wheat flour + 5% dried yeast, chewing leaf tobacco, cigar tobacco and broiler feed were tested for their influence on biological parameters of *L. serricorne*. These were sterilized in hot air oven at 60 ˚C for 4 hrs to kill the infestation of insects and stored in labeled plastic containers.

Test insect collection

Adults of cigarette beetle along with the infested turmeric rhizomes were collected from godowns of Ulavan farmers' producers company, Erode and Indian Institute of Food Processing Technology (IIFT), Thanjavur, Tamil Nadu, India.

Maintenance of Stock culture

The collected insects were maintained in the PG Laboratory, Department of Plant Protection, Anbil Dharmalingam Agricultural College and Research Institute, Tiruchirappalli. The mass multiplication of test insect was made on wheat flour + 5% dried yeast. The collected test insects were released into the plastic container (21 × 15 cm) containing culture material. The top of the plastic container was covered with muslin cloth and secured with rubber band. The plastic container was fully covered with black sheet to create the darkness favourable for storage insects. The culture was maintained in the laboratory throughout the experimental period at room temperature. The adults emerged from the stock culture were used for further studies.

Experimental setup

Total developmental period

Ten grams of powdered food materials were transferred to each test tube covered with muslin cloth and secured with rubber bands. Test tube was fully covered with black sheet to create darkness. Pair of adults were released into each test tube containing food source and were maintained at room temperature. Test tubes were observed every day until egg hatch, and days required for egg development was recorded. The larval developmental period was counted from the day of emergence of the first instar to the day on which the larva constructed the protective case to initiate pupation, and was recorded by observing the test tubes every other day. The pupal period was counted from the time the larva constructed a protective case, or when detectable changes occured in larval to pupal morphology to the emergence of the adult. Observations were made under a stereozoom trinocular microscope by emptying the contents of the test tube onto a piece of black paper. The total developmental period was calculated by the summation of egg, larval and pupal period. The study was conducted with 100 test tubes that represented 10 test tubes per food source.

Adult emergence

Five hundred grams of insect free different commodities were taken into each plastic container separately. Then 10 pairs of newly emerged adult beetles were released carefully into each container. The plastic container (21 × 15 cm) were kept undisturbed till the emergence of F_1 adults. Total number of adults were counted by gently shaking the plastic containers using test tubes and then adults are removed. Again 10 new pairs of adults were released to record the adult emergence in second generation and simultaneously for third generation. The experiment was replicated thrice.

Statistical analysis

All experiments were conducted in randomized complete block design with food sources as treatments and 3 replications were maintained for each treatment. Prior to data analysis, number of adults emerged were transformed to a $\sqrt{x} + 0.5$ scale to satisfy the assumption of normality and homogeneity of variances (Zar, 1984). All data were subjected to analysis of variance (ANOVA) by using the AGRES software to determine the significant differences between treatments. Fischer's Least Significant Difference (LSD) test was used to separate significant means at 1%, 5% probability level. Actual means and SEs are presented in the text, table, and figures.

Results and Discussion

Table 1: Developmental period of *L. serricorne* reared on different host materials

Host Materials	Incubation Period (days)	Larval Period (days)	Pupal Period (days)	Developmental Period (days)
Turmeric rhizomes	7.4 ± 0.49^{a}	37.8 ± 0.71^{d}	12.6 ± 0.61^{c}	57.8 ± 0.91^{e}
Turmeric powder	9.4 ± 0.4^{bc}	28.2 ± 1.45^{bc}	14.0 ± 0.71^{de}	51.6 ± 2.06^{cd}
Coriander powder	9.0 ± 0.47^{bc}	32.0 ± 0.55^{c}	12.1 ± 0.43^{c}	53.1 ± 0.92^{d}
Chilli powder	7.2 ± 0.51^{a}	28.6 ± 0.79^{bc}	14.7 ± 0.47^{e}	50.5 ± 1.15^{cd}
Wheat flour	8.2 ± 0.44^{ab}	26.3 ± 0.36^{ab}	12.8 ± 0.24^{cd}	47.3 ± 0.76^{bc}
Dried yeast	7.0 ± 0.29^{a}	23.8 ± 0.55^{a}	8.3 ± 0.44^{a}	39.1 ± 0.84^{a}
Wheat flour + 5% Dried yeast	8.3 ± 0.76^{ab}	28.5 ± 0.77^{bc}	7.3 ± 0.42^{a}	44.1 ± 0.9^{b}
Chewing leaf tobacco	9.3 ± 0.55^{bc}	79.7 ± 1.64^{g}	12.0 ± 0.47^{c}	101.0 ± 1.84^{g}
Cigar tobacco	9.9 ± 0.37^{c}	72.0 ± 1.76^{f}	10.0 ± 0.47^{b}	91.9 ± 1.64^{f}
Broiler feed	9.3 ± 0.36^{bc}	42.6 ± 3.22^{e}	10.2 ± 0.41^{b}	62.1 ± 3.36^{e}

Means having similar letter in a column are not significantly different (P = 0.01, 0.05)
Numeric data represents the mean value of three replications.

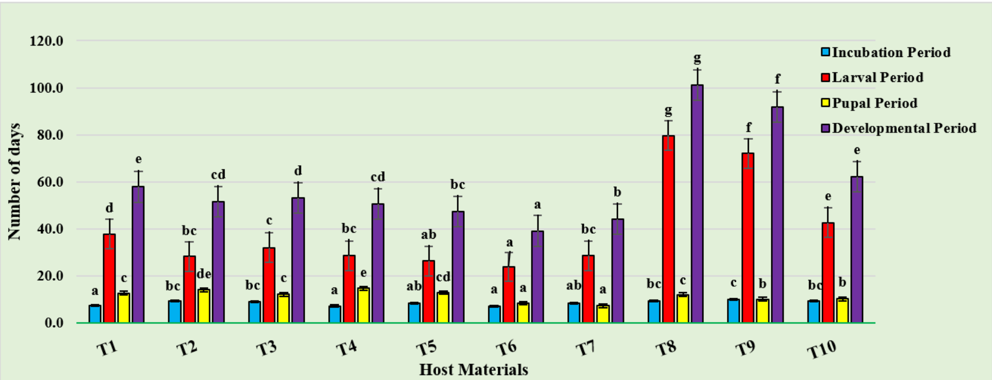

Fig 1: Development of *L. serricorne* on various host materials

Developmental period

The incubation period of *L. serricorne* varied significantly ($p<0.05$) among various treatments (Table 1). Eggs laid on yeast recorded the shortest incubation period of 7.0 days which was statistically on par with the chilli powder (7.2 days), turmeric rhizomes (7.4 days), wheat flour (8.2 days) and wheat flour + 5% dried yeast (8.3 days) whereas cigar tobacco recorded the longest incubation period of 9.9 days. The larval period of *L. serricorne* varied significantly ($p<0.05$) among various food sources (Table 1). The shortest larval period was observed in dried yeast (23.8 days) which was statistically on par with wheat flour (26.3 days) and the chewing leaf tobacco (79.7 days) recorded the longest larval period. The pupal period in various food sources differed significantly ($p<0.05$) and ranged from 7.3 to 14.7 days (Table 1). The shortest pupal period was observed in wheat + 5% dried yeast (7.3 days) which was statistically on par with dried yeast (8.3 days) and the longest pupal period was observed in chilli powder (14.7 days). The overall immature developmental period differed significantly among the treatments ($p<0.05$) and ranged from 39.1 to 101 days (Table 1). Dried yeast recorded the shortest developmental period of 39.1 days which was followed by wheat flour + 5% dried yeast (44.1 days), wheat flour (47.3 days), chilli powder (50.5 days), turmeric powder (51.6 days), coriander powder (53.1 days), turmeric rhizomes (57.8 days), broiler feed (62.1 days), cigar tobacco (91.9 days) and chewing leaf tobacco (101 days).

The variation in the egg incubation period suggested that, the time required for hatching of eggs was influenced by the type of host materials on which eggs were laid. Considerable variation in the larval period showed that larval development was influenced by the specific food source, which could affect pupal development [23]. Shortest developmental period of *L. serricorne* in dried yeast may be because of the balanced and essential nutrients present in the dried yeast. Baker's yeast comprises of 69-97.7% *Saccharomyces cerevisiae* (as dry matter), 0.1-10% salt of C_{12}-C_{24} fatty acid, 0-5% formulation aid, 0-10% dough processing aid and 2-8% water [15], hence they may promote the growth and development of *L. serricorne*. Mutualism between the yeast like symbionts (YLS) and anobiid beetles were discussed by various authors *viz.*, Fukatsu & Ishikawa, 1996 [12], Noda & Kodama, 1996 [26], Sasaki *et al.*, 1996 [36], Francisco, 2014 [11]. YLS may acts as a nutrition source, detoxifying agent, protection from biotic stresses and can aid in chemical communication of insects [37, 13, 21, 39]. The ability of *L. serricorne* to utilize toxin-rich hosts as food may be correlated symbiotic yeast, *Symbiotaphrina kochii* [37]. The symbionts of *Lasioderma* and *Stegobium* had a nutritional effect similar to that of yeast in a synthetic diet, namely to supply vitamins of the B-complex [27]. Yeast cells are the sources of B vitamins (e.g. B_3 and B_5), proteins, trace metals and amino acids that could be easily assimilated through simple digestion. Yeasts contain 7.5 - 8.5% nitrogen by dry weight, thus in many cases feeding on yeasts represents a better source of nitrogen and other dietary requirements than the plant tissue itself [13, 39]. The prolonged *L. serricorne* development time in chewing leaf tobacco and cigar tobacco was similar to the earlier findings of Mahroof & Philips, 2007 [23], Mahroof & Philips, 2008 [24] and they consistently performed as a poor attractant for *L. serricorne.*

Table 2: Effect of different host materials on adult emergence of *L. serricorne* over a period of three generations

S. No.	Host Materials	Adults emergence (No's)			Grand mean
		1st generation	2nd generation	3rd generation	
1.	Turmeric rhizomes	180.0 (13.41)*c	205.0 (14.31)b	220.0 (14.83)c	201.7 (14.20)
2.	Turmeric powder	230.0 (15.16)bc	235.0 (15.32)ab	240.0 (15.49)c	235.0 (15.32)
3.	Coriander powder	232.0 (15.23)bc	241.0 (15.52)ab	242.0 (15.55)c	238.3 (15.43)
4.	Chilli powder	286.0 (16.91)ab	291.0 (17.05)a	304.0 (17.43)b	293.7 (17.13)
5.	Wheat flour	230.0 (15.16)bc	277.0 (16.64)ab	290.0 (17.02)b	265.7 (16.29)
6.	Dried yeast	350.0 (18.70)a	320.0 (17.88)a	372.0 (19.28)a	347.3 (18.63)
7.	Wheat flour + 5% dried yeast	297.0 (17.23)ab	313.0 (17.69)a	315.0 (17.74)b	308.3 (17.55)
8.	Chewing leaf tobacco	25.0 (5.00)d	32.0 (5.65)c	35.0 (5.91)e	30.7 (5.53)
9.	Cigar tobacco	42.0 (6.48)d	49.0 (7.00)c	55.0 (7.41)d	48.7 (6.97)
10.	Broiler feed	175.0 (13.22)c	199.0 (14.10)b	218.0 (14.76)c	197.3 (14.04)
SEd		1.30	1.26	0.65	
CD (0.05)		2.71	2.63	1.36	
CD (0.01)		3.70	3.59	1.85	
CV (%)		11.75	10.99	5.51	

Means having similar letter in a column are not significantly different (P = 0.01, 0.05)
Numeric data represents the mean value of three replications.
*Figures in the parentheses are square root transformed values.

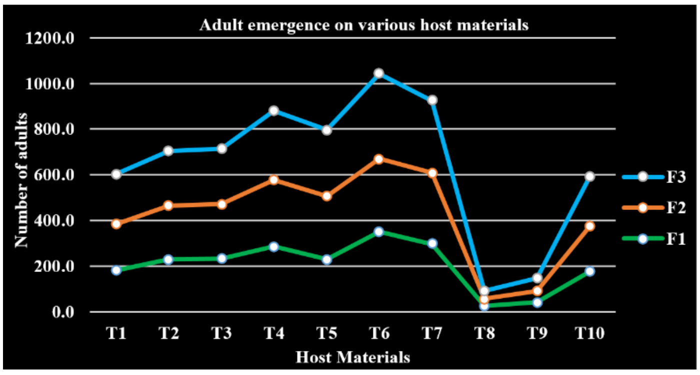

Fig 2: Observations on the adult emergence over a period of three generations

Adult emergence

During first generation, the highest number of adults were recorded in dried yeast (350.0 No's) which was statistically on par with wheat flour + yeast (297.0 No's) and chilli powder (286.0 No's) respectively (Table 2). The lowest number of adults were recorded in chewing leaf tobacco (25.0 No's) which was statistically on par with cigar tobacco (42.0 No's). At second generation, highest number of adults were recorded in dried yeast (320.0 No's) which was statistically on par with chilli powder (291.0 No's), wheat flour (277.0 No's) and coriander powder (241.0 No's) respectively. The lowest number of adults were recorded in chewing leaf tobacco (32.0 No's) which was statistically on par with cigar tobacco (49.0 No's). At third generation, highest number of adults were recorded in dried yeast (372.0 No's) and the lowest number of adults were recorded in chewing leaf tobacco (35.0 No's).

Adult emergence varied on the different type of host materials provided, and therefore they are able to discriminate among different food sources as shown in Fig 2. Maximum number of adult emergence was observed on dried yeast and statistically significant than other food materials. Powell (1931) [30] reported that the completion of the life cycle required typically 18-20 days longer in tobacco than in yeast, for example, at 28°C and 75% R.H. the development time was 36 days in yeast and 55 days in tobacco. Hori *et al.*, (2011) [17] observed that tobacco, cocoa, soybean flour, black tea, and wheat flour significantly attracted the beetles. Although tobacco was described as a suitable host for *L. serricorne* (Howe, 1957) [18], in the present study, the lowest number of adult emergence was observed in chewing leaf tobacco and cigar tobacco. Least preferences of tobacco as a host was also evident from the studies of Fletcher & Long, 1971 [10], Mahroof & Philips, 2007 [23], they showed that the higher oviposition was observed in wheat compared to tobacco. Magd El-Din (2003) [22] also proved coriander seeds as appropriate diet of *L. serricorne*

References

1. Allotey J, Unanaowo IE. Aspects of the biology of *Lasioderma serricorne* (F.) on selected food media under tropical conditions. International Journal of Tropical Insect Science. 1993; 14(5-6):595-601.
2. Ashworth JR. The biology of *Lasioderma serricorne*. Journal of Stored Products Research. 1993; 29:291-303.
3. Babarinde SA, Adebayo TA, Pitan OOR, Folorunso JT. Host influence on population growth and damage by cigarette beetle (*Lasioderma serricorne* Fabricus) in Ogbomoso, Nigeria. Crop Research. 2008; 35(3):268-272.
4. Boateng BA, Azalekor W, Boamah EA, Nwankwo EN. Development of *Lasioderma serricorne* (F.) (Coleoptera: Anobiidae) on dried root and tuber chips. ARPN Journal of Agricultural and Biological Science. 2017; 12(4):2006-2017.
5. Bry RE, Boartight RE, Lang JH. Damage to cotton textile bag sewing thread by larvae of the cigarette beetle (Coleoptera: Anobiidae). Journal of the Georgia Entomological Society, 1974.
6. Cabrera B J. Cigarette beetle, *Lasioderma serricorne* (F.) (Insecta: Coleoptera: Anobiidae), University of Florida, 2001-2007.
7. Cox PD, Simms JA. The susceptibility of soya bean meal to infestation by some storage insects. Journal of Stored Products Research. 1978; 14(2-3):103-109.
8. Dimetry NZ, Barakat AA, El-Metwally HE, Risha EME, El Salam AME. Assessment of damage and losses in some medicinal plants by the cigarette beetle *(Lasioderma serricorne*). Bulletin of National Research Center of Egypt. 2004; 29:325-333.
9. Dowd PF, Shen SK. The contribution of symbiotic yeast to toxin resistance of the cigarette beetle (*Lasioderma serricorne*). Entomologia experimentalis et applicate 1990; 56(3):241-248.
10. Fletcher LW, Long JS. Influence of food odors on oviposition by the cigarette beetles on non-food materials. Journal of Economic Entomology. 1971; 647:70-771.
11. Francisco G. Symbiosis between yeasts and insects. Introductory paper at the Faculty of Landscape Architecture, Horticulture and Crop Production Science, 2014.
12. Fukatsu T, Ishikawa H. Phylogenetic position of yeast-like symbiont of *Hamiltonaphis styraci* (Homoptera: Aphididae) based on 18S rDNA sequence. Insect Biochemistry and Molecular Biology. 1996; 26(4):383-388.
13. Gibson CM, Hunter MS. Extraordinarily widespread and fantastically complex: comparative biology of endosymbiotic bacterial and fungal mutualists of insects. Ecology Letters. 2010; 13(2):223-234.
14. Gopalachari NC. Tobacco. Indian Council of Agricultural Research. New Delhi. 1984, 200-235
15. Groen DJ, Adrianus CJ. 2005. US/ 0106287 A1
16. Gunasekaran N. Insect control in selected spice products using carbon dioxide. Ph.D. Thesis, University of Mysore, Mysore, 2001.
17. Hori M, Miwa M, Iizawa H. Host suitability of various stored food productsfor the cigarette beetle, *Lasioderma serricorne* (Coleoptera: Anobiidae). Applied Entomology and Zoology. 2011; 46(4):463.
18. Howe RW. A laboratory study of the cigarette beetle, *Lasioderma serricorne* (F.) (Col., Anobiidae) with a critical review of the literature on its biology. Bulletin of Entomological Research. 1957; 48:119-135.
19. Imai T, Tsuchiya S. The suitability of herbal medicines for the growth of the cigarette beetle, *Lasioderma serricorne* (F.) (Coleoptera: Anobiidae). House Househ Insect Pests. 2007; 29:27-37.
20. Jacob S. Host food preference of the cigarette beetle, *Lasioderma serricorne* (F.) to few stored spices. Plant protection bulletin. 1993; 44:16-16.
21. Janson EM, Stireman JO, Singer MS, Abbot P. Phytophagous insect-microbe mutualisms and adaptive evolutionary diversification. Evolution. 2008; 62(5):997-1012.
22. Magd El-Din MA. Studies on diets and population dynamics of the cigarette beetle *Lasioderma serricorne* F. (Col., Anobiidae). Anzeiger für Schädlingskunde 2003; 76(1):14-16.
23. Mahroof RM, Philips TW. Orientation of the cigarette beetle, *Lasioderma serricorne* (F.) (Coleoptera: Anobidae) to plant derived volatiles. Journal of Insects Behaviour. 2007; 20:99-115.
24. Mahroof RM, Philips TW. Life history parameters of *Lasioderma serricorne* (F.) as influenced by food sources. Journal of stored products research. 2008; 44(3):219-226.
25. Moura EDS, Zanuncio JC, Faroni LRDA, Heleno FF, Federico Wilcken C, Plata-Rueda A *et al*. *Lasioderma*

serricorne (Coleoptera: Anobiidae): First Report on Black Sesame (*Sesamum indicum).* Journal of food protection. 2017; 80(11):1941-1943.
26. Noda H, Kodama K. Phylogenetic position of yeast-like endosymbionts of anobiid beetles. Applied and Environmental microbiology. 1996; 62(1):162-167.
27. Pant NC, Fraenkel G. Studies on the symbiotic yeasts of two insect species, *Lasioderma serricorne* F. and *Stegobium paniceum* L. Biological Bulletin. 2016; 107(3):420-432
28. Papadopoulou SC. Observations of the mating behaviour of *Lasioderma serricorne* (F.) adult sand experiments on their nutritional requirements in dried tobacco. The Coleopterists Bulletin. 2006; 60(4):291-296.
29. Poderoso JCM, Correia-Oliveira ME, Vieira JM, Ribeiro GT, Ribeiro RC, Zanuncio JC. *Lasioderma serricorne* (Coleoptera: Anobiidae): first record in dehydrated bee pollen in Sergipe State, Brazil. Florida Entomologist. 2013; 96(2):682-685.
30. Powell TE. An ecological study of the tobacco beetle, *Lasioderma serricorne* (F.) with special reference to its life history and control. Ecological Monographs. 1931; 1:333-393.
31. Ravi Kumar K, Narendra Reddy C, Vijayalakshmi K, Rameash K, Keshavulu K, Rajeswari B. Management of cigarette beetle (*Lasioderma serricorne* Fabricius) in turmeric (*Curcuma longa* Linnaeus) by using of gamma radiation. Journal of Entomology and Zoology studies. 2017; 5(3):1723-1727.
32. Rees D. Insects of Stored Products. CSIRO Publishing, Collinwood, Australia, 2004.
33. Retief E, Nicholas A. The cigarette beetle *Lasioderma serricorne* (F.) (Coleoptera: Anobiidae): a serious herbarium pest. *Bothalia.* 1988; 18(1):97-99.
34. Ryan L. Post-harvest tobacco infestation control. Chapman & Hall, London. 1995, 5-15
35. Saeed M, Khan SM, Shahid M. Food preferences of *Lasioderma serricorne* (F.) (Coleoptera: Anobiidae) on four types of tobacco. Sarhad Journal of Agriculture. 2004; 24(2):2008.
36. Sasaki T, Kawamura M, Ishikawa H. Nitrogen recycling in the brown planthopper, *Nilaparvata lugens*: Involvement of yeast-like endosymbionts in uric acid metabolism. Journal of Insect Physiology. 1996; 42(2):125-129.
37. Shen SK, Dowd PF. Detoxification spectrum of the cigarette beetle symbiont *Symbiotaphrina kochii* in culture. Entomologia experimentalis et applicate 1991; 60(1):51-59.
38. Soroja Tamang. Biology and management of cigarette beetle, *Lasioderma serricorne* (F.) on turmeric powder. M.Sc. (Ag.) Thesis, Navsari Agricultural University, Gujarat, 2015.
39. Vega FE, Dowd PF. The role of yeasts as insect endosymbionts. Insect-Fungal Associations: Ecology and Evolution. 2005, 211-243.
40. Verma SC. Record of cigarette beetle *Lasioderma serricorne* F. (Coleoptera: Anobiidae) on onion seeds. International Journal of Farm Sciences. 2012; 1(1):59-60
41. Vidya H, Awaknavar JS. Host suitability of different spices to cigarette beetle, *Lasioderma serricorne* Fab. (Anobiidae: Coleoptera). Insect Environment. 2004; 10(4):176-177.
42. Zanuncio JC, Tavares WDS, Faroni LRDA, Wilcken CF, Serrao JE. *Lasioderma serricorne* (Coleoptera: Anobiidae) in stored *Matricaria recutita* (Asteraceae) in Brazil. Florida entomologist. 2014; 97(2):807-808.