Indian Journal of Entomology 86(2): 351-355 (2024) DoI. No.: 10.55446/IJE.2024.1692

DIVERSITY OF COLEOPTERA ON CUCUMBER IN THE TONKPI REGION OF MAN, CÔTE D'IVOIRE

Dohouonan Diabate[1]*, Ehikpa Naomie Melinand N'guessan[2], Tenon Coulibaly[3] and Yao Tano[4]

[1]Department of Agronomy and Forestry, University of Man, Man, Côte d'Ivoire;
[2]Departement of Biosciences, University Alassane Ouattara, Bouaké, Côte d'Ivoire;
[3]Department of Animal Biology, UniversityPéléforo Gon Coulibaly, Korhogo, Côte d'Ivoire;
[4]University Nangui Abrogoua, Abidjan, Côte d'Ivoire
*Email: diabdoh@yahoo.fr (corresponding author): ORCID ID 0000-0003-1911-5628

ABSTRACT

Six coleopteran species were collected on cucumber from the Tonkpi Region of Man, Cote d'Ivoire *Aulacophora foveicollis*, *Alticini* sp, *Paranapiacaba tricincta* and *Acalymma vittatum* observed damaging the plants by making holes on the leaves and flowers. Maximum damage occurred during the dry season (34.66%) and the damage intensity was moderate (12%). In contrast, least damage was during the rainy season (24%) and the damage intensity was lower (6.6%). Predator species recorded were *Coccinella septempunctata* and *Harmonia dimidiata* and these were more abundant during the rainy season. Shannon's index ranged from 2.94 to 3.15 during the dry and rainy seasons, respectively. The occurrence frequencies during the dry and rainy season were varied from 62 to 99% and were classified as constant species.

Key words: *Acalymma vittatum*, *Aulacophora foveicollis*, *Coccinella septempunctata*, Côte d'Ivoire, *Cucumis sativus*, damage intensity, *Harmonia dimidiata*, occurrence frequency, *Paranapiacaba tricincta*, phytophagous pests, predators, relative abundance, seasonal abundance, Shannon's index

Cucumber *Cucumus sativus* L, (Cucurbitaceae) is an important vegetable (Mohammed, 2021; Ahmed et al., 2022). However, cucumber production is affected by a number of factors, including climate and insect pests such as beetles. Some coleopteran species are beneficial insects for crops, while others are pests (Premalatha et al., 2011; Diabaté et al., 2020b). Leaf beetles are one of the largest families among beetles and are economically important insects (Jolivet, 2015; Rekha et al., 2023). These insects are phytophagous and are agricultural pests (Yoboué et al., 2022). Adult damage affects cucurbits by damaging cucumber leaves (Khan, 2012; Rekha et al., 2023). These insect pests are real problems for farmers because of the damage they cause and pesticides are most often used to their control. *Acalymma vittatum*, for example, transmit the bacterium *Erwinia tracheiphila*, responsible for bacterial wilt and crop losses can be as high as 75% (Premalatha et al., 2011; Haber et al., 2021; Falade, 2022). The pesticides used by the farmers for the control phytophagous coleopteran species disrupt the ecological balance by eliminating predatory insects, pollinators and parasitoids in agroecosystems (Yi et al., 2012; Diabaté et al., 2020a; Diabaté et al., 2022; Falade, 2022). The toxic effects of pesticides reduce the activity of the fauna, which is essential for maintaining soil fertility. Temperature is one of the most important abiotic factors affecting the biological traits of many insects including fecundity, fertility, developmental rate and adult longevity (Mirhosseini et al., 2017; Razaei et al., 2020). Farmers are severely constrained by meteorological factors and the pests and diseases. Nowadays, farmers increasingly grow cucumber plants during the dry season. However, the yield of this crop was influenced by insects. Then, in Côte d'Ivoire, the impact of the meteorological factors on the infestation of the crops are under study. In order to guarantee food safety for consumers and to protect the environment, this study was conducted to assess the effect of season on the diversity and the attack of cucumber plants by the coleopteran species, in Tonkpi region, Côte d'Ivoire.

MATERIALS AND METHODS

The research was conducted in Man locality. Man is located in the Tonkpi region, West of Côte d'Ivoire, in the tropical zone (7°24'45''N and 7°33'13''W). The climate of this region is characterized by two seasons: a rainy season (April to October) and a dry season (November to March). The average annual rainfall is 1,632 mm, and the average annual temperature varies around 25°C (Saley, 2003; Diabaté and Tano, 2020a, b). Cucumber variety TOKYO F1 (TECHNISEM,

France) was grown under natural conditions. Cucumber seeds were sown two times, on January 25, 2021and on May 16, 2021 in half-hectare, respectively. The distance between the rows was 0.9 meter with plant to plant spacing to 0.5 meter. Three plots were treated with three different insecticides and the fourth plot was the control (untreated). Foliar applications of the three insecticides T1 (Cypercal 50 EC®: Cypermethrin 50 g/ L), T2 (K-OPTIMAL 35 EC: Lambdacyhalothrin 15 g/ L+ acetamiprid 20 g/ L) and T3 (K-TOTAL®35EC: Lambdacyhalothrin 15 g/ L+ acetamiprid 20 g/ L) were made on cucumber seedlings every two weeks from 6 to 8 a.m. using an insecticides sprayer. The first foliar applications in the field were made 10 days after sowing. Each plot measuring 2 m x 1 m were replicate five times. After emergence, the plants were pruned to obtain two plants per cluster, i.e. 12 plants per square meter. The plots established on January 25, 2021 were watered every evening at 5 p.m. Two weddings were performed, the first one week after sowing and the last one month after sowing. We used fertilizer (N-P-K) in very small amounts and rice compost to improve the soil. Sampling of coleopteran adults on cucumber plots was done using Barber traps and by direct observations. Coleopteran adults were recorded from the 10th day after sowing, just before the first treatment. The Barber traps were set 4 times, 3 days after the treatments, at two-week intervals (from day 10 to day 52 after sowing). In each treatment, on five elementary plots, two yellow tray traps were placed in the soil between the rows of cucumber plants, making 10 traps per treatment. Three days after setting the traps, the captured insects were collected. In addition, direct observations were made on 50 plants, taken in batches of 10 plants per treatment, three days after the treatments. During these observations, the number of coleopteran adults on the cucumber plants and their damage to the cucumber leaves were recorded. Coleopteran species collected with the trap and by direct observations, were then grouped by similarity and preserved in 70% alcohol, then identified using a binocular magnifying glass and the dichotomous keys of literature, such as Roth (1974), Delvare and Aberleng (1989).The specific richness (S) corresponds to the total number of beetle species sampled in an area were recorded.The abundance index (AR) and the occurrence frequency (Fo) were calculated according to the formula used by Dajoz (1982, 2006), Diabaté et al. (2020b) and Akpesse et al. (2022a, b). Based on the values obtained, a species is classified as rare (Fo< 5%), incidental (5% ≤ Fo< 25%), frequent (25% ≤ Fo< 50%), constant (50% ≤ Fo< 100%) or ubiquitous (Fo= 100%). The attack rate by the coleoptera on cucumber plants and fruits was calculated using the following formula of Diabaté et al. (2020b; 2023).The damage intensification index was used to determine the degree of insect attack on plants. It was calculated according to the formula used by Aléné et al. (2006), Kuate et al. (2019) and Diabaté et al. (2023). The damage intensification by phytophagous coleopteran were grouped into 4 classes (Aléné et al., 2006, Diabaté et al., 2023). The number of the coleopteran species recorded and the number of cucumber plants attacked and the attack rate were subjected to an analysis of variance (ANOVA main effect) at the 5% threshold using SPSS software version 22.0 (IBM, New York, USA). The means were discriminated using the Fisher test (LSD) with a significance level of 5% using XLSTAT 2016. Diversity indices such as Shannon diversity index (H') and equitability index (E) were calculated by using the statistical software Estimate (version 9.1.0, 2013).

RESULTS AND DISCUSSION

Six Coleopteran species were found on the stem, leaves and flowers of cucumber plants and were represented by the families of Coccinelidae and Chrysomelidae (Table 1). The number of coleopteran species recorded was lower than those of Falade (2022), who recorded 9 species of coleoptera from cucumber plants. This lowest number of coleoptera species collected in cucumber plots is thought to be related to the use of pesticides and by the cucurbitacin produced by the cucumber plants (Bruno et al., 2023). The coleoptera adults such as *Aulacophora foveicollis*, *Alticini* sp, *Paranapiacaba tricincta* and *Acalymma vittatum* damaged cucumber leaves and flowers despite the use of pesticides. This is leading to an ever-increasing use of pesticides to control these cucumber beetle pests by farmers. These insect pests are phytophagous and their damage on *C. cucumis* impact negatively the production. These coleopteran species were belonged to the group of defoliating insects. These defoliating insects have a direct effect on the photosynthetic rate of the plants and caused yield reduction of cucumber. Similar results were reported by Khan et al. (2012), Haber et al. (2021), Diabaté et al. (2022) and Falade (2022) on cucumber plants. While *Harmonia dimidiata* and *Coccinella septempunctata* were beneficial insects and have helped to improve cucumber yield. These two beetles are pollinators and predators of insect pests of cucumber plants, especially aphids and whiteflies. Shannon's index recorded with the coleopteran species on cucumber plants ranged from 2.91 to 3.15 during the dry and rainy seasons. The

Table 1. Abundance, Shannon' index (H') and equitability index (E) of coleopteran species recorded in cucumber plots

Coleopteran species	Family	Trophic level	Shannon's index (H')		Equitability index (E)		Means± SE of coleopteran species recorded	
			D S	R S	D S	R S	D S	R S
Aulacophora foveicollis Lucas	Chrysomelidae	P	3.11	3.08	0.966	0.958	6.760 cd± 1.860	4.480 ef± 0.770
Harmonia dimidiata Fabrice	Coccinelidae	Pre	3.14	3.13	0.977	0.973	4.640 ef± 1.424	6.640 cd± 1.583
Coccinella septempunctata Linnaeus	Coccinelidae	Pre	3.05	3.11	0.947	0.965	5.920 de± 1.751	9.960 a± 1.792
*Alticini*sp	Chrysomelidae	P	3.13	3.12	0.971	0.970	5.000 de± 2.078	4.960 de± 2.136
Paranapiacaba tricincta Say	Chrysomelidae	P	2.95	2.91	0.927	0.905	5.200 de± 1.275	2.880 f± 0.978
Acalymma vittatum Fabricius	Chrysomelidae	P	3.14	3.07	0.976	0.955	7.960 bc± 2.422	9.640 ab± 2.749
F	-	-	-	-	-	-	9.944	
p	-	-	-	-	-	-	< 0.0001	

DS= Dry season; RS= Rainy season; P= Phytophagous, Pre= Predators; SE= Standard error.
The means assigned to the same letter within the same column are not significantly different (Fisher test (LSD), p < 5 %).

lowest values of Shannon's index were 2.947 and 2.914 with *Paranapiacaba tricincta* during the dry and rainy season, respectively. The highest Shannon's index was obtained during the dry season with the coleopteran species *A. vittatum*, *P. tricincta*, *Alticini* sp, *H. dimidiata* and *A. foveicollis*. Their Shannon's index was 3.14, 2.95, 3.13, 3.14, and 3.11, respectively. The Shannon's index of *C. septempunctata* was higher during the rainy season with a value of 3.11. The equitability index (E) was higher than 0.9 for all of the coleopteraspecies collected from cucumber plots during the dry and rainy seasons (Table 1). The relative abundance of *A. vittatum*, *P. tricincta*, *Alticini* sp, *C. septempunctata*, *H.dimidiata* and *A. foveicollis* were 22.43, 14.66, 14.09, 16.69, 13.08 and 19.05% during the dry season, and 25, 7.47, 12.86, 25.83, 17.22 and 11.62% during the rainy season, respectively (Fig. 1). Similar results were reported by Rekha et al. (2023), who showed that, the relative abundance of Coleoptera was 12.35% in an agricultural ecosystem. The occurrence frequencies of Coleoptera species recorded on cucumber plants during the dry and rainy season were varied from 62 to 99% and were classified as constant species (50% ≤ Fo< 100%). The occurrence frequencies of *A. vittatum*, *P. tricincta*, *Alticini* sp, *C. septempunctata*, *H. dimidiata*, *A. foveicollis* were 98.66, 66.66, 80.00, 90.66, 88.00 and 77.33% during the dry season and were 93.66, 62.66, 82.66, 92.00, 97.33 and 85.33% during the rainy season, respectively (Fig. 2). Similar results were reported by Falade (2022) on cucumber plots. According to Srinivas et al. (2022), cucumber beetles' occurrence rate was higher than 60%.

The average number of coleoptera species recorded on cucumber plants were between 4 to 10 coleoptera per species. The average number of the beetle pests *A. foveicollis*, *Alticini* sp and *P. tricincta* were higher during the dry season. However, the predatory coleopterans *H.*

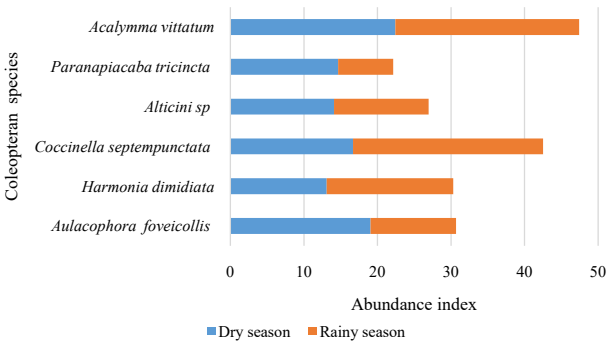

Fig. 1. Abundance index of coleopteran species recorded in cucumber plants during the dry and rainy seasons

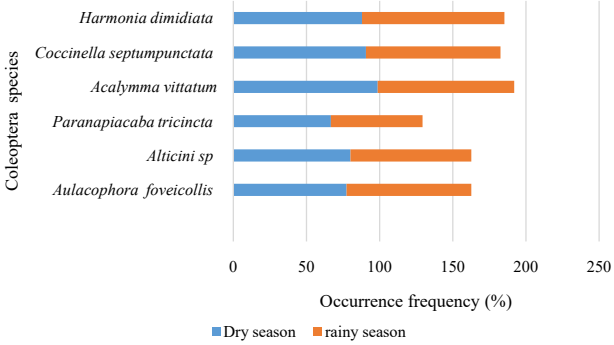

Fig. 2. Occurrence frequency of coleopteran species recorded on cucumber plants during the dry and rainy seasons

Table 2. Healthy plants rate, damage rate and damage intensification index on cucumber plants by coleopteran pests

Season	Average number of healthy plants	Healthy plants rate (%)	Average number of damaged plants	Damage rate (%)	Damage intensification index (%)
Dry season	32.667b± 0.577	65.333b	17.333b± 0.577	34.667b	12
Rainy season	38.000a± 1.000	76.000a	12.000a± 1.000	24.000a	6.66
F	8.195	8.195	8.195	10.648	-
p	0.004	0.004	0.004	0.001	-

SE= Standard error; The means assigned to the same letter within the same column are not significantly different (Fisher test (LSD), p < 5 %).

dimidiata and *C. septempunctata*, and the phytophagous *A. vittatum* populations were higher during the rainy season on cucumber plants. The number of *Alticini* sp on cucumber plants was statistically identical in both seasons on cucumber plants. (F=9.944; p< 0.0001) (Table 1). Similar results were reported by Saljoqi and Khan (2007), who showed an average number of 7.29 to 8.48 of *A. foveicollis* on eleven varieties of cucumber. According to Kumar and Saini (2018) and Pansara et al. (2022), several coleoptera species such as *A. foveicollis* population's showed positive correlation with mean temperature but negative correlation with mean relative humidity and rainfall. The results also showed that when the population of the predators *C. septempunctata* and *H. dimidiate* increased, the phytophagous beetle population's decreased. Similar results were reported by Falade (2022) on cucumber plants. The coleoptera *A. foveicollis*, *Alticini* sp, *P. tricincta*, *A. vittatum* adults feeds on foliage of cucumber plants, which kill young seedlings and weaken older plants. The highest damage rate by the phytophagous coleopteran on cucumber plants occurred during the dry season with a value of 34.66%, while the lowest damage rate was recorded during the rainy season with a value of 24% (F=10.648; p=0.001). The damage intensification index on cucumber plants by the coleopteran species *A. foveicollis*, *Alticini* sp, *P. tricincta*, *A. vittatum* during the dry season was moderate with a value of 12%. While it was lower during the rainy season with a value of 6.66% (Table 2). The lowest attack rates and attack intensities on cucumber plants during the rainy season were related to the highest number of the predatory beetles and to the lowest number of phytophagous beetles during this season. Similar results have been reported by Falade (2022) and Srinivas et al. (2022). According to Premalatha et al. (2011), Ahmad et al. (2020), Haber et al. (2021), Falade (2022) and Srinivas et al. (2022), the coleopterans *A. foveicollis*, *Alticini*sp, *P. tricincta* and *A. vittatum* are major pests of cucumber plants. These insect pests create holes on cucumber leaves and inhibit pollination. Adults of *C. septempunctata* and *H. dimidiate* are major predators of *Aphis* sp on young plants and these predators help to increase cucumber yield (Kumari, 2018). The findings of this study revelated that the coleopteran species *A. foveicollis*, *Alticini* sp, *P. tricincta*, *A. vittatum* were phytophagous beetle that damaged the cucumber plants by making holes on the leaves and flowers in cucumber farms of Man locality. The highest damage and damage intensity were occurred during the dry season. The number of predatory beetle's *C. septempunctata* and *H. dimidiate* were lower on cucumber plants during the dry season.

ACKNOWLEDGEMENTS

The authors thank the farmers' for providing facilities to carry out this work.

FINANCIAL SUPPORT

This work was not supported by any funding agency.

AUTHOR CONTRIBUTION STATEMENT

All authors contributed equally to the conception and design of the study. All authors read and approved the final manuscript.

CONFLICT OF INTEREST

No conflict of interest.

REFERENCES

Ahmad M H, Afzal M, Ullah M I, Mehmood N, Ali S, Arshad M, Raza A B M. 2020. Preferences of red pumpkin beetle, *Aulacophora foveicollis* Lucas (Chrysomelidae: Coleoptera) on different cucurbit cultivars. Egyptian Academic Journal of Biological Sciences A Entomology 13(2): 295-3030.

Ahmed I, Rohman M A, Molla M R, Azam M G, Hazam M G, Gaber A, Albogami B, Hossain A. 2022. A study on the phenotypic

variation of 103 cucumbers (*Cucumus sativus* L.) landraces for the development of desirable cultivars suitable for the changing climate. Life 12: 1235. https://doi.org/10.3390/life12081235

Akpesse A A M, Diabaté D, Coulibaly T, Kouadja Y O, Koua K H, Kouassi K P. 2022a. Termitic diversity of the Dalhia Fleurs Partial Natural Reserve (Bingerville, Côte d'Ivoire). Journal of Agriculture and Ecology Research International 23(6): 82-92. DOI: 10.9734/JAERI/2022/v23i6501

Akpesse A A M, Ochou G E C, Diabaté D, Fofana M, Coulibaly T, Kissi T A P, Koua K H, Kouassi K P. 2022b. Diversity and termite damage on coconut plots (Cocos nucifera L. 1753) at Marc Delorme research Station in Port-Bouët (Côte d'Ivoire). American Journal of Innovative Research and Applied Sciences 14(2): 18-24.

Bruno P, Arce C C M, Machado R A R, Besomi G, Spescha A, Glauser G, Jaccard C, Benrey B, turlings T C J. 2023. Sequestration of cucurbitacins from cucumber plants by *Diabrotica balteata* larvae provides little protection against biological control agents. Journal of Pest Science 96: 1061-1075. https://doi.org/10.1007/s10340-022-01568-3

Delvare G, Aberleng P. 1989. Les Insectes d'Afrique et d'Amérique Tropicale. Clé pour la Reconnaissance des Familles. Laboratoire de Faunistique, Département GERDAT: Montpellier, France. pp. 194.

Diabaté D, Kouadio K N, Akpesse A A M, Tano Y. 2022. Effectiveness of the insecticide BioELIT on *Bactrocera cucurbitae* (Diptera: Tephritidae) in cucumber *Cucumis sativus* (Linné, 1753). Journal of Biodiversity and Environmental Sciences 21(6): 72-79.

Diabate D, Tah G T T, Ble Y C, Tano Y. 2023. Evaluation of the resistance of three maize varieties to *Spodoptera frugiperda* (J.E. Smith) and *Ostrinia nubilalis* Hübner in the Tonkpiregion (Man, Côte d'Ivoire). Bulletin of the National Research Centre 47: 157. https://doi.org/10.1186/s42269-023-01116-8

Diabaté D, Tano Y. 2020a. Attaque de *Analeptestrifasciata* Fabricius 1775 (Coleoptera: Cerambycidae) en culture d'anacarde (*Anacardium occidentale* Linnaeus 1753) à l'ouest de la Côte d'Ivoire. Revue Ivoirienne des Sciences et Technologies 36: 1-10.

Diabaté D, Tano Y. 2020b. Efficiencies of three insect collection methods in Lamto, Côte d'Ivoire. International Journal of Biodiversity and Conservation 12(3): 153-158. DOI: 10.5897/IJBC2020.1415

Dajoz R. 1982. Précis d'écologie. Écologie fondamentale et appliquée. Ed. Gauthier Villars, Paris 503 p.

Dajoz R. 2006. Précis d'écologie, 8e Edition, Ed. Dunod, Paris 631 p.

Falade M J. 2022. Investigation on the entomological and beneficial insect pests associated with cucumber (*Cucumis sativus*) production in South Western Nigeria. Journal of Entomology and Zoology Studies 10(2): 57-61. https://doi.org/10.22271/j.ento.2022.v10.i2a.8979

Haber A I, Wallingford A K, Grettenberger I M, Ramirez Bonilla J P, Vinchesi-Vahi, Weber D C. 2021. Striped cucumber beetle and western striped cucumber beetle (Coleoptera: Chrysomelidae). Journal of Integrated Pest Management 12(1): 1-10. doi: 10.1093/jipm/pmaa026

Jolivet P. 2015. Together with 30 years of symposia on chrysomelidae! Memories and personal reflections on what we know more about leaf beetles. ZooKeys 547: 35-61.

Khan M M H, Alam M Z, Rahman M M, Miah M I, Hossain M M. 2012. Influence of weather factors on the incidence and distribution of red pumpkin beetle infesting cucurbits. Bangladesh Journal Agricultural Research 37: 361-367.

Kumari M. 2018. Studies on the biology and predatory potential of Harmonia dimidiate, a major predator of *Aphis pomi* DeGeer on Apple host in India. Advances in Entomology 6: 170-175.https://doi.org/10.4236/ae.2018.62013

Kumar R, Saini A. 2018. Population dynamics of red pumpkin beetle, *Aulacophora foveicollis* infesting cucumber. Journal of Entomology and Zoology Studies 6(6): 1023-1025.

Mirhosseini M A, Fathiopur Y, Reddy G V. 2017. Arthropod development's response to temperature: a review and new software for modeling. Annals of the Entomological Society of America 110(6): 507-520.

Mohammed M. 2021. Biology of the malonworm, *Diaphania hyalinata* L. (Lepidoptera: Pyralidae), on cucurbits in Gezira state, Soudan. Black Sea Journal of Engineering and Science 4(1): 1-7. doi:10.34248/bsengineering.767887

Pansara Z, Patel J J, Gami P. 2022. Population dynamics of red pumpkin beetle, *Aulacophora foveicollis* Lucas on cucumber, *Cucumis sativus* Linneaus. The Pharma Innovation Journal 11(4): 556-559.

Prematatha M, Abbasi T, Abbasi SA. 2011. Energy efficient food production to reduce global warming ecodegradation: The use of edible insects. Renewable Sustainable Energy Review 15(9): 4357-4360.

Rekha Y, Goswami D, Arya D, Kaushal B R. 2023. Insect diversity in an agrosystem of Bhabar region of Uttrakhand. Indian Journal of Entomology 85(2): 372-380.

Rezaei M, Talebi A A, Fathipour Y, Karimzadeh J, Mahrabadi M, Reddy G V P. 2020. Effects of cold storage on life-history traits of *Aphidius matricoriae*. Entomologia Experimentalis et Applicata 168: 800-807.

Roth M. 1974. Initiation à la morphologie, la systématique et la biologie des insectes. Editions de l'Office de la Recherche Scientifique Outre-Mer, France 212 p.

Saley MB. 2003. Cartographie thématique des aquifères de fissures pour l'évaluation des ressources en eau. Mise en place d'une nouvelle méthode d'extraction des discontinuités images et d'un SIHRS pour la région semi-montagneuse de Man (Nord-Ouest de la Côte d'Ivoire). Thèse de Doctorat d'Université de Cocody-Abidjan. 209 p.

Saljoqi A U R, Khan S. 2007. Relative abundance of the red pumpkin beetle, *Aulacophora foveicophora* Lucas, on different cucurbitaceous vegetables. Sarhad Journal of Agriculture 23(1): 109-114.

Srinivas T G, Ravi G, Balakrishnan N, Raja D L, Kennady N R. 2022. Distribution of insect pests and pesticide usage pattern on cucumber in southern districts of Tamil Nadu. The Pharma Innovation 11(8): 1695-1700.

Yi Z, Jinchao F, Dayuan X, Weiguo S, Axmacher J C. 2012. A comparison of terrestrial arthropods sampling methods. Journal of Research Ecology 3: 174-182.

Yoboué N L, Tra B S C, Fondio D, N'Goran P A. 2022 : Inventaire des papillons (Insecta : Lepidoptera) ravageurs du concombre (*Cucumis sativus* L.) à Daloa (Centre-ouest, Côte d'Ivoire). International Journal of Biolological and Chemical Sciences 16(4): 1522-1535. https://dx.doi.org/10.4314/ijbcs.v16i4.14

(Manuscript Received: October, 2023; Revised: November, 2023;
Accepted: February, 2024; Online Published: February, 2024)
Online First in www.entosocindia.org and indianentomology.org Ref. No. e24692