IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)
e-ISSN: 2319-2380, p-ISSN: 2319-2372. Volume 12, Issue 2 Ser. I (February 2019), PP 09-13
www.iosrjournals.org

Entomofauna and phytosanitary practices in cabbages production (*Brassica oleracea* L. 1753) in the township of Korhogo of Northern Côte d'Ivoire.

KlanaKoné[1], Yalamoussa Tuo [2]*, Tenon Coulibaly[2] and KouakouHervéKoua[1]
[1]*Unité de Formation et de Recherche (UFR) Biosciences, Département de Zoologie, Biologie Animale et Ecologie, Université Felix Houphouet-Boigny de Cocody, 22 Bp 1611 Abidjan 22, Abidjan, Côte d'Ivoire.*
[2]*Unité de Formation et de Recherche (UFR) des Sciences Biologiques, Département de Biologie Animale, Université Peleforo Gon Coulibaly, BP 1328 Korhogo, Côte d'Ivoire.*
[2]*Unité de Formation et de Recherche (UFR) des Sciences Biologiques, Département de Biologie Animale, Université Peleforo Gon Coulibaly, BP 1328 Korhogo, Côte d'Ivoire.*
[1]*Unité de Formation et de Recherche (UFR) Biosciences, Département de Zoologie, Biologie Animale et Ecologie, Université Felix Houphouet-Boigny de Cocody, 22 Bp 1611 Abidjan 22, Abidjan, Côte d'Ivoire.*
Corresponding Author:Yalamoussa TUO

***Abstract**: Cabbage is important component of human diet. However, this plant is appreciated by a lot of bugs who cause a lot of losses. Struggle against these bugs results in the use of pesticides. In order to increase the production of the cabbage, by the respect of the good phytosanitary practices, a survey has been undertaken in Korhogo on the sites of Waraniéré and the Dam of Kôkô. The entomofauna of the cabbage has been evaluated by the methods of the swoop net and the colorful traps, and an investigation permitted to census the phytosanitary practices in culture of the cabbage. Of the inventory of the bugs, it came out that among the 15 harvested species, the most abundant was the cabbage maggot D. radicum. The investigation on the phytosanitary practices in Korhogo revealed that the treatment by broom was the more used method and the main used insecticide was the TIHAN 175 O-TEQ that is not ratified on the cabbage in Côte d'Ivoire.*

***Keywords:** Entomofauna, phytosanitary practices, cabbage, Korhogo*

Date of Submission: 20-01-2019 Date of acceptance:04-02-2019

I. Introduction

Cabbage is a vegetable of great importance in the diet of man. With a low energy content, it is a valuable source of vitamins A, C and E. Cabbage is a provider of mineral salts with a dominance of iron and cellulose. It has curative, digestive and nourishing properties [1], thus constituting a vegetable allied of well-being. Cabbage is consumed in different ways, combined with rustic and traditional dishes as well as more refined preparations. Most often steamed, it is quick and easy to prepare. In addition, of its culinary value, it has a good market value [2]. In Côte d'Ivoire, demand for cabbage is increasing and prices are attractive, except during periods of overproduction (October - November). The unit price of cabbage can vary from 100 to 400 FCFA / kg[3] . In thetownship of Korhogo (Côte d'Ivoire), women practice this culture, which represents for many of them, the first source of income for the family. However, the action of pests is one of the major constraints to the production of cabbage. Indeed, the plant is appreciated by insects that depreciate production very quickly and thus cause great losses. However, there is few data on cabbage entomofauna in Korhogotownship. To ensure lasting production of cabbage in this municipality, knowledge of the entomofaunaconstitutes a previous. In order to protect their plantations, the farmers have resort to use of all-round pesticides which could harm not only the health of the producers, but also that of the consumer. The objective of this study is to know the cabbage entomofauna in Korhogo, in order to propose axes for a better production by a good management of the pests. To achieve this objective, the inventory of cabbage pests in Korhogotownship has been carried out and phytosanitary practices currently in use in cabbage crops have been identified.

II. Material and methods

Study area

The present study was carried out in the township ofKorhogo,locatedbetween8°26and10º27 N, and 5º17 and 6º19 W, 600 km fromAbidjan in the north of the Côte-d'Ivoire. Thislocality belongs to the Sudano-Sahelian drytropical climate regime in which the rhythm of the seasons is regulated by the displacement of the Intertropical Front [4] This climate is characterized by two seasons. The rainy season extends from May to October with a maximum of precipitation in September. The dry season lasts from November to April and is characterized by the harmattan that settles from December to February. The average annual rainfall is 1,200 mm with an average annual temperature of 27 ° C.

Methodology

Experimental device

This study carried exclusively on varieties of KK Cross, Super Cross and Pruktor of B. oleracea cabbage. The study took place from October to December 2015. At the two sites of Korhogotownship, the study took place in 56 plots of producers, which constituted the elementary parcels. The average area of the plots was one (1) are. Each parcel contained an average of 25 cabbage planks, and the average plank area was 1 m wide by 3 m long.

Pestssampling

Three methods were used to harvest the bugs. The first was to use a swoop net to dislodge the insects colonizing the plots. The method consisted of sweeping by rapid or lateral movements over the cabbage plants. The contents of the net were regularly examined to remove insects with fingers or soft forceps. Then they were placed in 70% alcohol for later identification and counting. In each elementary plot, sweep sample was carried out for 10 minutes.In the second method, colorful traps were placed in each elementary parcel for 48 hours, at the rate of one (1) plate per parcel. As[5] each plate contained soapy water (soap powder mixed with water). The trapped insects were kept in 70% alcohol. The third method consisted in prospecting 10plants randomly selected in each elementary plot to detect the presence of larvae and aphids. Plants were choosen from the inner rows, excluding borders plants. Harvested larvae were incubated in plastic boxes until adult emergence. Harvested aphids were collected and stored in 70% alcohol. Each of these operations was performed once a month in each elementary plot throughout the study period.

Identification of insects

The identification was made using binocular loupe, based on morphological characteristics. The key of[6] ,[7],[8] and [9] were used.

Phytosanitary practices

Aninvestigation was carried out on the phytosanitary practices of the members of the cooperative of Waraniéré and the producers of cabbage installed close to the dam of Kôkô. The survey took place from October to December 2015 on a total of 56 farmers. It consisted of identifying the pesticides used for pest control, the methods of treatment as well as the frequency of treatment.

Statistical Analyses

Variance analyses and diversity indices were calculated. Variance analyses were performed using Statistica software(version 7.1). Single-factor variances (ANOVA, $p<0.05$) were performed. Homogeneous averages were pooled using the Newman-Keuls test. They permit to determine separately whether certain variables (abundance, species richness) were significantly different. From the data of the colored traps, two diversity indices were calculated to describe the populations of the species in the two study sites. Thus the Shannon indice H '= - Σ pi x log2 (pi), pi = probability of encounter of species i; as well as the equitability indice E = H '/ log2 (s) H' = Shannon diversity index; S = specific wealth were calculated.

III. Results

EntomofaunaDiversity

The insects harvested at the Waraniéré site and the Kôkô dam belonged to seven (7) Orders (Coleoptera, Diptera, Lepidoptera, Hymenoptera, Orthoptera, Homoptera and Thysanoptera), 13 families (Chrysomelidae, Cecidomyidae). , Agromyzidae, Anthomyiidae, Syrphidae, Noctuidae, Pyralidae, Plutellidae, Tenthredinidae, Aphididae, Cicadellidae, Thripidae and Acrididae) and 15 species: Delia radicum, Liriomyza sp., Ischiodonaegyptius, Cicadellaviridis., Lipaphiserysimi, Phyllotreta sp., Cecidomyiasp, Thripssp, Spolodearecurvalis, Crocidolomiabinotalis, Plutellaxylostella, Agrotisipsilon, Athalialugens, Trichoplusiani and Melanoplus sp., (Table I).

Relative abundance of harvested insects

General Distribution

Fifteen (15) insect species were harvested from all plots in the study area. The number of insects harvested, all study areas combined, varies according to the species ($\alpha = 0.05$, $p = 0.0000$, ddl = 825).The Newman-Keuls test reveals that *D. radicum* (16.67 ± 1.44 individuals) is the main species found in culture of cabbage in the township. It is followed by the species *Liriomyza sp.* (5.66 ± 0.62). The least abundant species are *Cicadellaviridis* (1.58 ± 0.39), *I. aegyptius* (1.42 ± 0.27), *Phyllotreta sp.* (1.41 ± 0.27), *L. erysimi* (0.78 ± 0.48), *Cecidomyie sp.* (0.66 ± 0.14), *Melanoplus sp.* (0.57 ± 0.13), *Thrips sp.* (0.46 ± 0.11), *S. recurvalis* (0.35 ± 0.17), *T. ni* (0.21 ± 0.10), *P. xylostella* (0.16 ± 0.08), *A. ipsilon* (0.07 ± 0.04). With an average abundance of 0.017 ± 0.01 each, *C. binotalis* and *A. lugens* are the most weakly represented species (Table 1).

Distribution by study area

Waraniéré

AtWaraniéré, cabbage entomofauna consists of 13 species. Highly significant statistical analyses ($p = 0.0000$, ddl = 390) and the Newman-Keuls test identified three homogeneous groups. With an average of 15.87 ± 2.27 individuals, *D. radicum*.was the most abundant species. *Liriomyza sp*. is the second group with an intermediate abundance of 4.29 ± 0.64 individuals. The most weakly represented group is composed of the species*Phyllotreta sp*.(2.25 ± 0.43), *I. aegyptius* (2.16 ± 0.39), *Cicadellaviridis* (1.64 ± 0.60), *L. erisymi* (0.90 ± 0.77), *Thrips sp.* (0.45 ± 0.11), *T. ni* (0.32 ± 0.16), *H. recurvalis* (0.29 ± 0.16),*Melanoplussp.*(0.29 ± 0.11), *P. xylostella* (0.06 ± 0.04) and *A. ipsilon* (0.03 ± 0.03) (Table 1).The biological diversity of this site is weak. This results in weak values for the Shannon Diversity Index (0.97) and the Equitability Index (0.44) (Table 2).

Kôkô Dam

At the Kôkô dam, a total of 782 insects distributed in 15 species were collected. Statistical analyses ($p = 0.0000$, df = 360) showed a significant difference between three homogeneous groups based on the average abundance of species. The species *D. radicum* was the most abundant group (17.68 ± 1.62 individuals).The second group is represented by *Liriomyza sp.* (7.36 ± 1.07 individuals). Species of *Cicadellaviridis* (1.52 ± 0.47), *Cecidomyie sp*. (1.12 ± 0.29), *L. erysimi* (0.64 ± 0.23), *Melanoplus sp*. (0.60 ± 0.21)), *I. aegyptius* (0.52 ± 0.27), *Thrips sp.* (0.48 ± 0.22), *S. recurvalis* (0.44 ± 0.36), *Phyllotreta sp*. (0.36 ± 0), 15), *P. xylostella* (0.28 ± 0.17), *A. ipsilon* (0.12 ± 0.08), *T. ni* (0.08 ± 0.08), *C. binotalis* (0.04 ± 0.04) and *A. lugens* (0.04 ± 0.04) compose the third group that is the least abundant (Table 1). With values of 1.13 and 0.47, respectively, the Shannon diversity index and the Equitability index showed that the biological diversity of this site is weak (Table 2).

Table no 1: Cabbage entomofauna

Ordres	Famille	Espèces	Abondance relative (%)		
			Général	Waraniéré	Barrage Kôkô
Coléoptères	Chrysomelidae	*Phyllotretasp*	4,69[c]	7,75[c]	1,15[c]
Diptères	Cecidomyidae	*Cecidomyiesp*	2,20[c]	1[c]	3,58[c]
	Agromyzidae	*Liriomyzasp*	18,81[b]	14,73[b]	23,53[b]
	Anthomyiidae	*Delia radicum*(Linnaeus, 1758)	55,43[a]	54,49[a]	56,52[a]
	Syrphidae	*Ischiodon aegyptius*(Wiedemann, 1830)	4,75[c]	7,42[c]	1,66[c]
Lépidoptères	Noctuidae	*Trichoplusia ni* (Hübner, 1803) *Agrotis ipsilon*(Hufnagel, 1766)	0,71[c] 0,24[c]	1,11[c] 0,11[c]	0,26[c] 0,38[c]
	Pyralidae	*Spolodea recurvalis*(Fabricius, 1775) *Crocidolomia binotalis*Zeller, 1852	1,19[c] 0,06[c]	1[c] -	1,41[c] 0,13[c]
	Plutellidae	*Plutella xylostella*(Linnaeus, 1758)	0,53[c]	0,22[c]	0,90[c]
Hyménoptères	Tenthredinidae	*Athalia lugens* (Klug ,1815)	0,06[c]	-	0,13[c]
Orthoptères	Acrididae	*Melanoplussp*	1,90[c]	1,88[c]	1,92[c]
Homoptères	Aphididae	*Lipahis erysimi*(Kaltenbach, 1843)	2,61[c]	3,1[c]	2,05[c]
	Cicadellidae	*Cicadellaviridis*	5,28[c]	5,65[c]	4,86[c]
Thysanoptères	Thripidae	*Thripssp*	1,54[c]	1,55[c]	1,53[c]

Table no 2: Comparison of study areas

	Nombre d'espèces	Nombred'individus	Pourcentaged'individus (%)	Indice de Shannon (H)	Indice d'équitabilité (E)
Waraniéré	13	903	53,59	1,13	0,47
Barrage de Kôkô	15	782	46,41	0,97	0,44

Comparison of study areas

A total of 1685 insects were harvested in the township. Of this total, 53.59% was harvested at Waraniéré against 46.41% at the Kôkô Dam. In terms of number of species, 15 were harvested at the Kôkô Dam site. At Waraniéré site 13 species were harvested. Shannon's diversity index at Waraniéré is 0.97 against an index of 1.13 at the Kôkô dam. Waraniéré equitability index is 0.44 while that of the Kôkô dam is 0.47 (Table 2).

Phytosanitary practices

Methods of treatment

AtKorhogotownship, pesticide application ways used by the producers were the sprayer and the broom. The survey of these methods of treatment showed that the majority of producers (55%) resorted to traditional methods. These consist of using a container to prepare the insecticide and the broom to achieve the treatment by aspersion of the cabbage plantations. The sprayer was used by 36% of the producers for their treatments and 9% alternately combined the 2 methods of treatment. At the Waraniere site, only 6% of the planters used the sprayer, while 94% of them used the broom. At the Kôkô dam, 100% of the planters used the sprayer for their treatments. This treatment was carried out by phyto-caterers for the sum of 25 FCFA per board. However, among these producers, some (22%) associated the use of the sprayer with the broom method, compared to 78% using only the sprayer.

Insecticides used

The survey of insecticides used in the culture of cabbage revealed the use of different insecticidal molecules: Spirotetramate-Flubendiamide, Lambdacyhalothrin / Acetamiprid combination, Cypermethrin, Lambdacyhalothrin, Bacilusthurigiensis. For the set of production sites, Spirotetramate-Flubendiamide (45%) is the main insecticide solution used by growers. In contrast, 34% associate with Spirotetramate-Flubendiamide the use of Lambdacyhalothrin. The least used molecules are Lambdacyhalothrin (7%), Cypermethrin (7%), Lambdacyhalothrin-Acetamiprid combination (4%), Bacillus thurigiensis (2%) and Deltamethrin (2%) (Figure 7a). On the site of Waraniere, the main insecticide solution used was Spirotetramat-Flubendiamide (77%). Other insecticides used were Lambdacyhalothrin (6%), Cypermethrin (6%), Bacillus thurigiensis (3%) and Deltamethrin (3%). At the Kôkô dam site, the combination of Spirotetramate-Flubendiamid and Lambdacyhalothrin (76%) was the most commonly used formula. It was further noted the use of Lambdacyhalothrin (8%), Cypermethrin (8%), Spirotetramate-Flubendiamide (4%), and Lambdacyhalothrin-Acetamiprid combination (4%).

Characteristics of the products used

The main insecticide used in culture of cabbage was Spirotetramat-Flubendiamide, marketed under the name TIHAN 175 O-TEQ. This insecticide is ratified on cotton, pepper, okra and eggplant, but not on cabbage. On the other hand, the other insecticides used are approved by the State of Côte d'Ivoire on the market gardener.

IV. Discussion

This survey permitted to identify different species of bugs in cabbage production. These are *D. radicum, Liriomyzasp, I. aegyptius, Cicadellaviridis, L. erysimi, Phyllotretasp, Cecidomyiesp, Thripssp, H. recurvalis, C. binotalis, P. xylostella, A. ipsilon, A. lugens, T.ni and Melanoplus sp*. The great diversity of insects observed in the plots of cabbage, could be explained by the fact that this plant would contain attractive compounds for these insects. These results are similar to those of [10]. These authors have also highlighted a great diversity of insects on cabbage in Bukavu in the DRC. The general distribution and that by study area, showed that the main pest was the cabbage maggot*D. radicum*. The larvae of this fly attack the cabbage roots. Thus causing the destruction of young plants, the weakening and slowing of vegetation. The strong pressure of this fly on cabbage in Korhogo, could be due to the dry tropical climate that would encourage its outbreak. These results are different from those of[11], achieved in the region of Yamoussoukro. These authors showed that the main pests of cabbage were in order of importance Aphids, Acrididae, *P. xylostella* and Diptera. This difference could be explained by the strong presence of hoverflies in Korhogo. Hoverflies are predators of aphids. They kill and prevent the spread of these. The difference observed between our work and those of [11] could also be explained by the fact that these last works were conducted during the rainy season, contrary to our work that was conducted in dry season. In addition, Korhogo and Yamoussoukro are different agro-ecological areas. In terms of comparison of the study areas, the Kôkô site with 15 species has a higher species richness than the Waraniéré site which recorded 13 species. This strong diversity observed on the Kôkô site could be explained by the proximity of this site to the dam. Indeed, this site is close to the dam and is constantly wet. It would be more favorable to the proliferation of several species of insects, unlike that of Waraniéré which is distant from the water points. Otherwise on the two zones, the biologic diversity was weak. This would be

explained by the predominance of some species in these environments.Indeed, flies *D. radicum* and *Liriomyza sp*. had a very high abundance compared to other harvested species. The predominance of these two species would be due to the fact that they would have developed a resistance to insecticides used in the market gardener. This resistance would confer on them a capacity of proliferation superior to that of other insects, despite the persistence of insecticide treatments. The investigation of treatment methods identified one method using the sprayer and another using a broom. The method of broom is the most used in the towmnship. The weak use of the sprayer could be explained by the lack of financial resources of the producers. Indeed, the average price of a sprayer is 20,000 FCFA, and the use of phyto-caterers requires money because the treatments are weekly, for the sum of 25 FCFA per board. On the other hand, the treatments with the broom are done by the farmer himself and do not induce additional costs besides that of the insecticide. This method of treatment seems more economic, however the use of the broom induces a wrong dosage and a wrong application of the insecticide unlike the use of the sprayer. This could have a negative impact on the crop yield and on the user's health. Similar results were observed by [12] in Côte d'Ivoire. In addition, [13] also mentioned the existence of wrongphytosanitary practices in vegetable farming in Togo. In addition, the investigation revealed that the main insecticide used is a cotton insecticide which is not ratified on cabbage. This high utilization could be explained by the high efficiency noted by growers against cabbage pests. This could also be due to the easiness of access to cotton insecticides. Indeed Korhogotownship is a large cotton production area. Insecticides are distributed to farmers at the beginning of their cultivation to encourage them to grow cotton[14]

V. Conclusion

This study showed that the entomofauna of cabbage*B. olearacea* cabbage is rich and varied. It consists of 15 species distributed in 13 families belonging to seven (7) orders. Flies *D. radicum* and *Liriomyza sp.*, were the principals species on cabbage in Korhogotownship. Concerning treatment methods, the study showed a high use of the broom for the application of insecticide treatments. Insecticide the more used in the township of Korhogo in culture of the cabbage is the Spirotétramate-Flubendiamide, insecticide not registered on this plant.

References

[1]. Depezay L. Les légumes dans l'alimentation : leurs effets nutritionnels, fiche technique. Fondation Louis Bonduelle,2006 ; 7p.
[2]. Youdeowei A. La pratique de la lutte intégrée en production maraîchère. Edition MOFA,2004 ; 26 p.
[3]. Dao D., Kouakou A., Cissé G., & Girardin O. Programme de développement descultures maraîchères intensives en Côte d'Ivoire. Centre Suisse de Recherches Scientifiques en Côte d'Ivoire, rapport d'activités, 2003 ; 101 p.
[4]. Jourda J.P., Saley B.M., Djagoua E.V., Kouamé K.J., Biémi J., &RazackM.,.Utilisation des données ETM+ de Landsat et d'un SIG pour l'évaluation du potentiel en eau souterraine dans le milieu fissuré précambrien de la région de Korhogo (Nord de la Côte d'Ivoire) : Approche par analyse multicritère et test de validation. *Télédétection*, 5(4) ; 2005 : 339-357.
[5]. Soro S., &Hgaza V.K.,. Propriétés insecticides et fertilisantes de l'engrais organiqueLiquide "ErgofitoDefense" en culture de chou à Djekanou (Côte d'Ivoire). *Agronomie Africaine*, 26(3) ; 2014: 261-273.
[6]. Delvare G. et Aberlenc P. 1989. Les insectes d'Afrique et d'Amérique tropicale. Clés pour la reconnaissance des familles. 1989, Prifas, Cirad-Gerdat, Montpellier, 302 pages. ISBN 2-87614-023-3
[7]. James B., Atcha-Ahowé C., Godonou I., Baimey H., Goergen G., Sikirou R., &TokoM.. Gestion intégrée des nuisibles en production maraîchère : Guide pour les agents de vulgarisation en Afrique de l'Ouest. Institut International d'Agriculture Tropicale (IITA), Ibadan, Nigeria, 2010; 120 p.
[8]. Hammes C., Putoa R.. Catalogue des insectes et acariens d'intérêt agricole en Polynésie Française. Entomologie agricole, notes et documents N°02.1986 ; 264p.
[9]. A.C.T.A. Guide pratique de défense des cultures, reconnaissance des ennemis : notion de protection des cultures. A.C.T.A. 1982. Paris, 418 pp.
[10]. Walangululu J.M., &Mushagalusa G. N. Les principaux ravageurs des choux pommés *Brassicaoleracea var capitatasubssabouda*) à Bukavu et ses environs. *Tropicultura*, 18(2) ; 2000 :55-57.
[11]. Ouali-N'goran S.W.M., Yao K.P., Kra K.D., Kouassi K.P., & Tano Y. Évaluation de l'efficacité de l'insecticide Tricel 480 EC comparée à la Deltamétrine et à la Cyperméthrine contre les ravageurs du chou (*Brassicacae L. sp*.) en milieu paysan dans la région de Yamoussoukro en Côte d'Ivoire. *Afrique SCIENCE*, 10(1) ; 2014. : 194 – 207.
[12]. Doumbia M. etKwadjo K.E,. Pratiques d'utilisation et de gestion des pesticides par les maraîchers en Côte d'Ivoire : Cas de la ville d'Abidjan et deux de ses banlieues (Dabou et Anyama). J. Appl. Biosci., 18; 2009 : 992-1002.
[13]. Kanda M., Djaneye-Boundjou G., Wala K., Gnandi K., Batawila K., Sanni A., &Akpagana K.,. Application des pesticides en agriculture maraichère au Togo. *VertigO-La revue électronique ensciences de l'environnement* 13 (1) ; 2013. 17p.
[14]. Tuo Y., Dago N.D.,Yapo M.L and KouaK.H..Screening of Phytosanitary Practices in Vegetable Growth Activities Northern of Côte D'ivoire. *Int J RecentSciRes.* 8(6) : 17396-17402. DOI: http://dx.doi.org/10.24327/ijrsr.2017.0806.0346

KlanaKoné. "Entomofauna and phytosanitary practices in cabbages production (Brassica oleracea L. 1753) in the township of Korhogo of Northern Côte d'Ivoire.. "IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS) 12.2 (2019): PP- 09-13.