



Journal Homepage: -www.journalijar.com
**INTERNATIONAL JOURNAL OF
 ADVANCED RESEARCH (IJAR)**

Article DOI:10.21474/IJAR01/8881
 DOI URL: <http://dx.doi.org/10.21474/IJAR01/8881>



RESEARCH ARTICLE

INSECT PESTS OF GUINEA SORREL (*HIBISCUS SABDARIFFA* L., 1753) AND FARMERS' CONTROL METHODS IN THE DISTRICT OF KORHOGO, NORTHERN CÔTE D'IVOIRE.

Yalamoussa Tuo¹, Mouhamadou Kone¹, Michel Laurince Yapo¹, Klana Kone² and Kouakou Herve Koua².

1. Peleforo Gon Coulibaly University, Faculty of Biological Sciences, Departement of Animal Science BP 1328 Korhogo, Côte d'Ivoire.
2. Felix Houphouet-Boigny University, Cocody (Abidjan Côte d'Ivoire), Faculty of Biosciences Departement of Zoology, Animal Science and Ecology 22 Bp 1611 Abidjan 22.

Manuscript Info

Manuscript History

Received: 11 February 2019
 Final Accepted: 13 March 2019
 Published: April 2019

Key words:-

Insect pests; Guinea sorrel; control method, flea beetle.

Abstract

In order to contribute to the effective management of guinea sorrel insect pests in Côte d'Ivoire, a study was carried out on 6 sites producing this plant in the District of Korhogo in the north of the country. The objective of this study was to inventory the insect pests of this plant and to evaluate the farmers' methods of managing these pests. A questionnaire survey was conducted with 99 female producers and pests were collected using mowing nets. A total of 2906 insects, divided into 8 Orders dominated by Coleoptera and 49 families outperformed by Alticinae, subfamily of Chrysomelidae were collected. A total of 27 types of pesticides were used by producers. These were mostly indicated for cotton cultivation but not for market gardening. Of the five (5) pesticide application methods used by farmers, the broom with 75.73% was the most used. Finally, this study claims that the flea beetle *Podagrada* sp is the main pest of sorrel and phytosanitary practices for this plant in the said District are not indicated.

Copy Right, IJAR, 2019,. All rights reserved.

Introduction:-

Guinea sorrel (*Hibiscus sabdariffa* L.), is a flowering plant of the Malvaceae family from tropical and subtropical regions [1] (Javadzadeh, 2015). Because of their wealth in mineral elements, proteins, fibres and vitamins[2] (Adanlawo and Ajibade, 2006), organs such as leaves, dried chalice and seeds are used in human food[3] (Sie et al., 2008). Sorrel is consumed in several forms. chalice are used to prepare a red drink called "bissap" (in Senegal) and "dawouleni" (in Côte d'Ivoire, Mali, Burkina Faso) (FAO, 1988). The leaves are used in Africa for the preparation of sauces (Cisse et al., 2008). The chalice, cooked in a muffled oven, are added as a condiment (béké) to rice in Senegal. In Benin, chalice are used to prepare tea and the local drink (bissap) that is widely consumed (Ross, 2003). This extract is also used to regulate blood pressure and to treat liver disorders and fever (Ross, 2003); it is an antioxidant, anticancerous (Chewonarin et al., 1999); it contains organic acids and other vitamin compounds (Salah et al., 2002); it is rich in polyphenols and three times higher in Vitamin C than orange (Fall, 2001). A distinction is made between the sabdariffa variety and the altissima variety. The stems of the altissima variety are used in the manufacture of textile fibres (Babalola, 2000). In Senegal, *Hibiscus sabdariffa* is classified in the first group of the agricultural sector with the most important forest fruits to ensure better food security and safety (Fall, 2001). Its leaves are widely consumed and marketed in Senegal (Diouf et al., 2007); its sector (local market and export)

Corresponding Author:-Yalamoussa tuo.

Address:-Peleforo Gon Coulibaly University, Faculty of Biological Sciences, Departement of Animal Science BP 1328 Korhogo, Côte d'Ivoire.

generated a sum of 480 million CFA francs in 2005 (Ternoy et al., 2006). In Côte d'Ivoire, fresh or dried leaves and chalice enrich peanut and Néré (Soumara in Malinke language) sauces. However, like other Malvaceae, sorrel is subject to many insect attacks that significantly reduce production and depreciate market value (Sarojini et al, 1985; Sanou et al., 2005). Moreover, in Côte d'Ivoire, very little data exists on the entomological problems of this plant, which makes it difficult to implement an effective pest management method. This is the justification for this study. The general objective of this work is to ensure a significant sorrel production in Côte d'Ivoire by implementing an effective pest management method. To achieve this, the inventory of insect pests of this plant as well as the methods of peasant management of these pests are a prerequisite.

Material and methods:-

The Guinea sorrel *Hibiscus sabdariffa* on which the study was based was a local variety whose seeds were acquired on the market in the city of Korhogo. Its seeds come from women's fields in the villages of the sub-prefecture of Korhogo.

The work was carried out in the baffles of the District of Korhogo, including Koko, Takali, Cocody, Logokaha, Natio and Ossiéné. At these different sites, phytosanitary practices and entomofauna were evaluated.

With regard to phytosanitary practices, a survey was carried out among 20 sorrel producers from each site already mentioned. During this survey, producers were asked about the names of the different types of insecticides used and their suppliers. When the producers did not arrive gave the names of the products, they were asked for the packaging. The type of equipment used to spread insecticides was also requested.

Concerning entomofauna, at each site, a survey was conducted among the 20 producers to assess their level of knowledge about sorrel insect pests in the first instance. Then, insects were collected using mowing nets and coloured plates on 10 plots within each site.

At the same time, a plot of sorrel was planted in the botanical garden of Peleforo Gon Coulibaly University to assess insect damage to the plant. To this end, 5 blocks of 5 boards of 1 m² each with 100 feet were formed. Observations were made on 500 feet (5 boards) of untreated sorrel compared to 500 feet (5 boards) treated with Lambda-cyhalothrin 30g/l, insecticide indicated for market gardening in Côte d'Ivoire. They focused on evaluating the number of leaves and plants attacked in the presence or absence of treatment.

The harvested insects were stored in pill boxes containing 70% diluted alcohol. Identification was performed up to the taxonomic rank of the family using the identification keys of Delvare and Aberlenc (1989), after observation of morphological characteristics using a binocular Motic magnifier at 10X20 magnification. For the most important species, identification has been pushed to the genre level.

Results:-

General Entomofauna

The inventory made it possible to collect 2906 specimens, divided into eight (8) orders including Hymenoptera, Coleoptera, Diptera, Lepidoptera, Hemiptera, Dictyoptera, Orthoptera and Dermaptera. These orders are divided into 49 families. Out of a total of 2906 insects collected, 2031 individuals were Beetles, 389 Diptera, 228 Hymenoptera, 131 Hemiptera and 62 specimens belonging to the orders Orthoptera and Lepidoptera. The least represented orders were Dictyoptera (2) and Dermaptera (1).

The order of Hemiptera consisted of 11 families: Coreidae, Anthocoridae, Pyrrhocoridae, Cercopidae, Ligaeidae, Reduviidae, Pentatomidae, Alydidae, Cicadellidae, Achilidae and Aphididae.

The Hymenoptera had 10 families, including Apidae, Formicidae, Vespidae, Halictidae, Ichneumonidae, Pompilidae, Scoliidae, Megachilidae, Bethyidae and Braconidae.

Concerning Coleoptera, the individuals harvested belonged to 8 families: Chrysomelidae, Curculionidae, Coccinellidae, Silphidae, Meloidae, Scarabaeidae, Elateridae, and Staphylinidae.

At the level of the Diptera Order, 7 families have been identified. These are those of Tephritidae, Calliphoridae, Muscidae, Culicidae, Stratiomyidae, Scatophagidae, and Syrphidae.

Orthopterans included 5 families: Acrididae, Gryllidae, Tettigonidae, Pyrgomorphidae and Tetrigidae.

The order Lepidoptera was represented by 5 families: Pyralidae, Hesperidae, Pieridae, Nymphalidae and Noctuidae.

As for the order of Dictyoptera, it consisted of only two families, the Blattidae and the Mantidae. Concerning the order of Dermaptera, it was represented by the only family of Forficulidae

Relative abundance of harvested insects

At the level of orders, out of a total of 2906 insects harvested, 69.89% are Coleoptera. The entomofauna of sorrel is therefore dominated by Coleoptera, followed by Diptera with 13.39%, Hymenoptera with 7.85%, Hemiptera with 4.51% and Orthoptera and Lepidoptera with 2.13% each. The least represented orders were Dictyoptera (0.07%) and Dermaptera (0.03%) (Table 1).

At the family taxonomic level, Chrysomelidae were the most represented. The number of specimens belonging to this family was 1985 individuals, representing 68.31% of the total number of individuals of all orders and 97.74% of the total number of Coleoptera. The Chrysomelidae family was followed by the Calliphoridae family represented by 242 individuals or 8.33% of the total workforce. The third most represented family was Formicidae. Only 153 (5.26%) specimens belonging to this family were collected. For the other Families, none of them had a rate of more than 2% (Table 1).

The specimens of the chrysomelidae family were divided into two sub-families. The Alticinae with the genre *Podagrica* (1910 specimens) and the Galerucinae with the genre *Aulacophora* (74 representatives). It appears from this analysis that the flea beetle *Podagrica* sp is the main pest of Guinea sorrel in the District of Korhogo.

Characterization of damage caused by flea beetles (*Podagrica* sp)

Flea beetles are small coleoptera that jump to escape as soon as they feel danger. The damage is caused by adults drilling many small holes on the sorrel leaves. In the absence of insecticide treatment, all leaves are attacked. For a total of 500 feet of untreated sorrel, analyses showed that all leaves in the 500 feet were attacked and perforated. Damage appears early as soon as the plants germinate. Adults drill many small round holes in the leaves. The holes increase in size as the leaves develop.

Table I:-Entomofauna of sorrel in the District of Korhogo

Orders	Families	Genres	Species	Numbers
	Apidae			5
	Halictidae			5
	Ichneumonidae			6
	Braconidae			38
HYMENOPTERA	Formicidae			153
	Pompilidae			14
	Scoliidae			1
	Megachilidae			2
	Bethylidae	<i>Bethylus</i>	B.sp	3
	Chrysomelidae	<i>Podagrica</i>	P.sp	1910
	Chrysomelidae	<i>Aulacophora</i>	A.sp	74
	Scarabaeidae			8
	Chrysomelidae			1
COLEOPTERA	Curculionidae			6
	Coccinellidae			20
	Silphidae			7
	Meloidae			2
	staphylinidae			2
	Elateridae			1

	Gryllidae			7
	Acrididae			39
ORTHOPTERA	Tettigonidae			12
	Pyrgomorphidae			3
	Tetrigidae			1
	Hesperiidae	<i>Pelopidas</i>	P.sp	20
	Noctuidae			27
LEPIDOPTERA	Pyralidae			2
	Pieridae			12
	Nymphalidae	<i>Acraea</i>	A.serena	1

Table I:-Entomofauna of sorrel in the District of Korhogo

ORDERS	FAMILIES	GENRES	SPECIES	NUMBERS
	Pyrrhocoridae	<i>Dysdercus</i>	D.sp	6
	Cercopidae			1
	Lygaeidae			24
	Reduviidae			4
	Pentatomidae			27
	Vestidae			1
HEMIPTERA	Alydidae			5
	Coreidae			6
	Anthocoridae			1
	Cicadellidae			1
	Achilidae			2
	Aphididae			7
	Cicadellidae			47
	Calliphoridae	<i>Calliphora</i>	C.sp	190
	Muscidae	<i>Atherigona</i>	A.sp	57
	Stratiomyidae	<i>Hermetia</i>	H.illucens	36
	Stratiomyidae			1
DIPTERA	Scatophagidae			36
	Calliphoridae	<i>Lucilia</i>		47
	Calliphoridae			5
	Syrphidae			6
	Tephritidae	<i>Dacus</i>	D.sp	9
	Culicidae			2
DERMAPTERA	Forficulidae			1

Phytosanitary survey

At the end of the survey, farmers described sorrel insect pests as fireflies, locusts and mosquitoes. Of the 300 producers surveyed, the majority (92.77%) stated that the insect pests of sorrel were fireflies (Coleoptera), while 6.02% assimilated the pests to locusts (Orthoptera) and only one (1) producer stated that the pests were mosquitoes (Diptera). This study therefore shows that farmers are well aware of the main pest of sorrel.

All producers interviewed stated that they use chemical treatment to control insect pests. Thus, 17 types of pesticides have been identified. These are K-optimal 35 EC, Tropistar P186, Polytrin 330 EC, Lamdac 46 EC, Capt 88 EC, Cayman B19 EC, Duel 336 EC, Cotalm P318 EC, Blast 52 EC, Curacron 500 EC, Tricel 480 EC, Tropittrin 30 EC, Stork P336 EC, Decis 12.5 EC, Nomolt 150 SC, Cypalm P186 EC, Thian 175 O-TEQ.

Of the 17 pesticide types identified, Lamdac 46 EC was the most widely used. A total of 115 sorrel producers, or 38.33%, reported using this insecticide. It is followed by Polytrin 336 EC with 68 producers (22.67%), Blast 52 EC with 25 producers (8.33%), Capt 88 EC with 23 producers (7.67%), Tropistar P186 EC with 17 producers (5.67%), K-optimal 35 EC and Cotalm P318Ec with 14 producers each for 4.67%. For the remaining insecticides, including

Cayman B19 EC, Duel 336 EC, Curacron 500 EC, Tricel 480 EC, Stork P336 EC, Decis 12.5 EC, Nomolt 150 SC, Cypalm P186 EC, Tropittrin 30EC and Thian 175 O-TEQ, the number of users did not exceed 5 producers.

Apart from Koptima 135 EC and tropittrin 30EC, which are insecticides registered in Côte d'Ivoire on food and vegetable crops, all other recurrent insecticides are indicated only on cotton crops.

The survey identified 5 ways of applying pesticides used by farmers. These are the sprayer (called a pump by the farmers), the broom, the watering can, the tufts of grass and a perforated bottle at the cork. Of all the pesticide application methods surveyed, brooms were the most commonly used, with 75.73% of farmers using them. Then comes the tufts of herbs with 13.59% of producers. The use of the sprayer was lower with only 5.83% of farmers. The watering can (2.91%) and the perforated bottle (1.94%) were the most poorly used means.

Discussion:-

Relative abundance of harvested insects

Analyses revealed that the main insect pests of sorrel are of the genre *Podagrica* and *Aulacophora*, coleoptera, chrysomelidae belonging to the subfamilies Alticinae and Galerucinae. This dominance could be explained by the fact that Guinea sorrel, of the Malvaceae family, is a plant appreciated by these Coleoptera. According to studies conducted by Jolivet in 1972, Malvaceae are highly valued by many genres in the Chrysomelidae family. They can cause total destruction in the event of a strong attack. Etienne et al (1992) reported that Chrysomelidae were the main pests of sorrel. According to Hala et al (2006), flea beetles are real pests of malvaceae family plants. Harvest losses due to flea beetles in cotton cultivation are estimated at 39.5% (Hala et al., 2005). The presence of Coleoptera on sorrel has also been reported by Sanou et al (2005), in Burkina Faso. According to these authors, Coleoptera are among the main sorrel pests in Burkina Faso.

Phytosanitary survey

With regard to the control of sorrel pests, the analysis showed that all farmers use chemical control methods. This may be related to the effectiveness of these insecticides. Indeed, according to Kanda et al (2013), the majority of market gardeners in Togo admit that the use of pesticides reduces pest losses and ensures good yields. According to Sougnagbe et al (2009) during a study carried out in Central Africa, for the majority of farmers surveyed, the use of pesticides ensures good yield and reduces pest losses. In addition, analyses have shown that the majority of insecticides used are not indicated for market gardening. This situation is said to be due to farmers' ignorance of the dangers associated with the use of unregistered insecticides and the availability of cotton insecticides on the market at a lower cost. In addition, the majority of producers cannot read or write. These results are close to those obtained by Tuo et al (2017). According to these authors, the use of pesticides not indicated could be explained by the high availability of insecticides in the area due to the porosity of the borders but also to the practice of cotton cultivation (high pesticide consumption). In addition, Tuo et al (2017) also reported that only 5% of market gardeners in this area had a first cycle level of school. This poor education, combined with the lack of training of producers in the dangers associated with the use of non-indicated pesticides, could be the cause of this high use of cotton insecticides.

In addition, according to these same authors, the use of insecticides registered for market gardening would be more expensive than cotton insecticides. Indeed, cotton producers most often brave cotton insecticides at very low prices to meet some of their financial needs. In addition, according to the field survey, cotton insecticides are more effective than those registered for market gardening. These results are close to those obtained by Koné (2015). According to this author, market gardeners in the Department of Korhogo greatly appreciate the pesticides registered for cotton cultivation in market garden crops. Similar observations were made by Kanda et al (2013) in Togo. In this country, market gardeners use very toxic and persistent products to protect their crops.

The analyses revealed a high rate of use of broomsticks to apply pesticides to plants at the expense of sprayers. According to Tuo et al (2017), this attitude of producers is linked to a lack of financial resources and a lack of awareness of the dangers associated with this practice. The use of these non-conventional means for pesticide application has also been reported by Doumbia and Kwadjo (2009) in Côte d'Ivoire and by Sougnabe et al (2010) in Cameroon. This result is in agreement with the one reported by Koné (2015). According to this author, the broom is the most widely used method by market gardeners for pesticide application in the Department of Korhogo.

Conclusion:-

At the end of this study, it should be noted that the main pests of guinea sorrel in Korhogo are of the Chrysomelidae family. They belong exclusively to the genus *Podagrica* of the subfamily Alticinae and the genus *Aulacophora* of the subfamily Galerucinae. These insects considerably depreciate the nutritional and market value of the sorrel. In response to market requirements, producers use cotton pesticides that are not listed. Instead of the equipment indicated for treatment, farmers use brooms that expose them to insecticides. This phytosanitary practice exposes both producers and consumers. It would therefore be important for future studies to focus on finding an alternative to the use of synthetic pesticides in sorrel farming.

Bibliographical References:-

1. Adanlawo I. G. et V. A. Ajibade (2006). Nutritive value of the two varieties of roselle (*Hibiscus sabdariffa*) Calyces Soaked with Wood Ash. *Pakist. Jour. Nut.* 5 (6) : 555 – 557
2. Babalola, S. O., (2000): Chemical composition of roselle (*Hibiscus sabdariffa* L.) leaf. *Proceedings of the 24th Annual Conference of the Nigerian Institute of Food Science and Technology*, 119-121.
3. Boonkerd T., Songkhla B. N., &Thephuttee W., (1994).*Hibiscus sabdariffa* L. *Plant resources of South-East Asia*, (8), 178-180.
4. Cisse, M., M. Dornier, M. Sakho, C. Mar Diop, M. Reynes, O. Sock, (2008) : La production de bissap (*Hibiscus sabdariffa* L.) au Senegal. *Fruits* vol. 64, (1) : 111–124.
5. Chewonarin, T., T. Kinouchi, K. Kataoka, (1999): Effects of roselle (*Hibiscus sabdariffa* Linn.), a Thai medicinal plant, on the mutagenicity of various known mutagens in *Salmonella typhimurium* and on formation of aberrant crypt foci induced by the colon carcinogens azoxymethane and 2-amino-1-methyl-6-phenylimidazo [4, 5-b] pyridine in F 344 rats. *Food Chem. Toxicol.*, 37: 571-601.
6. Delvare G., et Aberlenc P., (1989).*Les insectes d’Afrique et d’Amériquetropicale. Clé pour la reconnaissance des familles. Labo de faunistique,département GERDAT. Montpellier, France. 302p.*
7. Doumbia M. et Kwadjo K.E., (2009).Pratiques d’utilisation et de gestion des pesticides par les maraichers en Côte d’Ivoire : Cas de la ville d’Abidjan et deux de ses banlieues (Dabou et Anyama), *Journal of Applied Biosciences*, 18, pp. 992-1002.
8. Diouf, M., C. Lo, M. Gueye, N. B. Mbengue, (2007) : Selection participative de nouveaux cultivars de quatre (4) especes de legumes feuilles (*Hibiscus sabdariffa* L., *Amaranthus* L. spp., *Vigna unguiculata* (L.) Walp et *Moringa oleifera* Lam) au Senegal. *Afr. J. Food Agric. Nutr. Dev.*, 7(3) : pp.1-14.
9. Etienne J., Delvare G.,et Aberlenc H.P.,(1992). Contribution à la connaissance de l’anthropodofaune associée aux cultures de Casamance (Sénégal). *Boll. Zol. Agr. Bachic*, 24(2), 159-193.
10. FAO., (1988). *Traditional food plants.” Food and nutrition. FAO, ROME. 42p.*
11. Fall, T., (2001): Les fruits forestiers les plus importants au Senegal. In *Le potentiel agroalimentaire du Senegal pour une meilleure securite et surete alimentaire. Fete de la Science, Novembre 2013, Dakar, Institut Francais.*
12. Hala N., Ochou O. G., Foua Bi K., Allou K. et Kouassi P. (2006). Dynamique spatio-temporelle des populations d’altises, *podagrica* spp. (coleoptera : chrysomelidae) : implications agronomiques en zones cotonnieres de Côte d’Ivoire. *Agronomie Africaine* 18 (1) 41 - 57
13. Hala N., Ochou O. G., Ouraga Y. et Allou K. (2005). Incidence des Altises (Coleoptera : Agronomie Africaine 18 (1) : 41 - 57 (2006) 56. Chrysomelidae, Alticinae) sur le cotonnier glandless en Côte d’Ivoire. *Sciences et Nature* 2 (1) : 9 – 17
14. Javadzadeh, S.M. (2015). The Effects of Irrigation Intervals on Yield, Yield Components and Water Use Efficiency of Roselle (*Hibiscus sabdariffa* L.). *Direct Research Journal of Agricultural and Food Science (DRJAFS)* Vol.3 (5), pp. 98-105.
15. Jolivet P. (1972). Recherches sur *Nisotra Gemella* (Erichson, 1834), l’altise du Kenaf (*Hibiscus sabdariffa* L) en Thaïlande. Sélection throphique du complexe *Nisotra /Podagrica* (Col. Chrysomelidae Alticinae). *Bulletin mensuel de la Société linnéenne de Lyon. Volume 41 numero 7* pp 138-148.
16. Kanda M., Djaneye-Boundjou G., Wala K., Gnandi K., Batawila K., Sanni A., &Akpagana K., (2013). Application des pesticides en agriculture maraichère au Togo. [VertigO] *La revue électronique en sciences de l’environnement*, 13(1), 17p.
17. Koné K., (2015). Entomofaune et pratiques phytosanitaires en culture de choux pommés (*Brassicaoleracea*L. 1759) dans la commune de Korhogo (Côte d’Ivoire). *Mémoire de Master II, Entomologie Agricole, Université Félix-HouphouëtBoigny d’Abidjan*, 64p.
18. Ross, I. A., (2003): *Hibiscus sabdariffa*. In *Medicinal Plants of the World*, Vol 1, 2nd edn. Humana Press: New Jersey, 267-275.

19. Sanou J., Ouedraogo L., Sanfo D., Ney B., Somda L., & Paré P., (2005). Rapport d'activités de recherche sur le développement des fibres végétales au Burkina Faso. Campagne 2004, Farako-Bâ, CRREA-ouest, station de Farako-Bâ. Bobo-Dioulasso, Burkina Faso, 45p.
20. Sarojini G., Rao K.C., Tulpule P.G., & Lakshminarayana G., (1985). Effects of processing on physicochemical properties and fatty acid composition of Hibiscus sabdariffa seed oil. Journal of the American Oil Chemists' Society 62: 728–730.
21. Salah, A. M., J. Gathumbi, W. Vierling, (2002): Inhibition of intestinal motility by methanolic extracts of Hibiscus sabdariffa L. (Malvaceae) in rats. Phytother. Res. 16: 283-285.
22. Sie R. S., Akaffou D. S., Kone D., Dogbo O. D., Assouhoun V., Charles G. et Branchard M. (2008) influence des conditions de culture et du substrat sur le développement des boutures de l'oseille de guinée : hibiscus sabdariffa L. (malvaceae). Agronomie Africaine 20 (2) : 141 - 149
23. Sougnabe SP, Yandia A, Acheleke J., Brevault T., Vaissayre M., Ngartoubam LT. (2009). Pratiques phytosanitaires paysannes dans les savanes d'Afrique centrale. Actes du colloque « Savanes africaines en développement : innover pour durer » 13p.
24. Ternoy, J., C. Poulanc, S. Gomis, P. Nugawela, M. Diouf, (2006) : Analyse de la chaîne de valeurs de la filière bissap au Sénégal. Programme USAID/Croissance économique (BDS Component). (SAGIC IQC No. 685-I-01-06-0005-00)
25. Tuo Y., Dago N. D., Yapo M. L. et Koua K. H. (2017). Screening of phytosanitary practices in vegetable growth activities northern of Côte d'Ivoire. International Journal of Recent Scientific Research Vol. 8, Issue, 6, pp. 17396-17402.