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# Study of Some Biological Parameters of *Callosobruchus Maculatus* F. Under the Impact of the Persistence of Three Plants (*Azadirachta Indica* Juss., *Senna Occidentalis* L. and *Crataeva Religiosa* Forts.) Native of Senegal

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**Abstract :** *The persistence of several plants (Azadirachta indica, Crateava religiosa and Senna occidentalis) was assessed on some biological parameters (sex ratio, oviposition deterrence, emergence rate and number of eggs laid per female) Callosobrucchus maculatus, the main pest of cowpea stocks at the laboratory. Applied for all plants, the sex ratio in favor of females of this insect. Only A. indica gave a sex ratio (70%) than controls (60%). The comparative study of the deterrent effect of oviposition of C. maculatus three plants showed greater efficacy of S. occidentalis with application of $C_1$ concentrations (83.17%) and $C_3$ (98.55%). By cons for $C_2$ is that A. indicawhich was more determinant (74.80%) in this setting. This plant is also more effective than others in reducing the emergence of adults of this insect, from the eggs laid by the survivors of an ovicidal treatment. Compared with controls, the eggs from female survivors have laid few eggs. And there is a reductive effect of the laying females under the impact of the plants tested. We have in fact observed greater efficiency of S. occidentalis reduced egg of C. maculatus with the application of the two highest concentrations. However C. religiosa was more effective than other plants with the impact of $C_3$.*

**Keywords:** *afterglow, Azadirachta indica, Senna occidentalis, Crateava religiosa, Callosobruchus maculatus, biological parameters*

## 1. Introduction

Cowpea (*Vigna unguiculata* Walp.) Is one of the most important food legume in the world. It is cultivated in tropical and subtropical regions. Its worldwide production exceeds 3 million tonnes (FAOSTAT, 2004), of which more than half is obtained from West Africa. In addition, the West African production is dominated by Nigeria. Cowpea, coveted by indigenous peoples in tropical and subtropical regions of the world is very rich in protein. Its lust is also based on its amino acid composition. Indeed cowpea contains all the amino acids necessary for human consumption with the exception of sulfur amino acids (Smart, 1964). It may therefore contribute to the effort of African governments in search of food self-sufficiency. However, it is a victim of a disastrous infestation. It begins in the field on pods of *V. unguiculata* and continues in stocks on the seeds and dry beans. This infestation is often the work of two sympatric Bruchinae *Bruchidius atrolinéatus* and *Callosobruchus maculatus*. The latter is the more great because that can be maintained in inventory during the whole time of storage. Therefore *C. maculatus* can cause loss of seeds from 80 to100% after 5-6 months of storage. To compensate for these losses, farmers often use summaries of insecticides. These have long contributed to an effective fight against insect pests, but currently their effectiveness is controversial. Indeed, their continued use is involved in the selection of resistant strains and the elimination of natural enemies of pests. These syntheses insecticides cause environmental pollution and concentrate in food chains. To counter the effect of these insecticides syntheses, many researchers consider looking for alternatives to these (Doumma *et al*, 2011; and Abdullahi Majeed, 2010; Singh, 2011; Toufique *et al*, 2014; Faye *et al*, 2014).

It is in this order that we proposed to evaluate the effect of the persistence of three native plants of Senegal (*C. religiosa, A. indica* and *S. occidentalis*) on some biological parameters of *Callosobruchus maculatus*. Indeed, we sought the impact of these plants on the nature of the sex of emerging adults of this insect, their deterrent effect of its oviposition, adult emergence rate and the average number of eggs laid per female survivor.

## 2. Methodology: Biological Parameters

The determination of these biological parameters is performed by running a series of experiments. After ovicides tests with aqueous extracts of the powder of different plants used (*Crateva religiosa, Sennaoccidentalis* and *Azadirachta indica*), adult survivors emerging from treated eggs are placed in pairs in numbered Petri dishes containing healthy seeds cowpea ( and the coupling between male and female is performed). Initially, it was about to put 10 pairs of *C. maculatus* survivors in Petri dishes containing 10 seeds each cowpea, order a pair per box. The seeds are renewed daily and replaced (infested) are placed in Petri dishes with the laying date. Note, however, that conditions (lack of water and food) are applied to these emerging young adults. The experiment continued until the death of those rescued couple. This allows to assess the fertility of females. To test the impact of treatment with plant extracts, we conducted the same series of experiments with adults from untreated eggs (controls).

Immediately after the replacement, we conducted a count of eggs laid on the replaced seeds, for females of each couple. At the end of the experiment, the following parameters were assessed:

- The sex ratio (R) gives the percentage of females compared to all descendants. Sexing is done by observing the last abdominal tergite which is curved in the male and the lying female. If the sex ratio is higher than 50% so the sex ratio in favor of females, otherwise it is in favor of males. It is determined by the following formula: R = (Number of emerged females / total number of emerged individuals) × 100.
- The oviposition deterrence (OD) is determined by the formula applied by Ravinder Singh (2011); OD = (number of eggs laid by adult survivors - the number of eggs laid by adult witnesses) / (number of eggs laid by adult survivors) × 100.
- The emergence rate (RE): It is determined by the ratio between the total number of emerged adults and the total number of eggs; TE = (Number of emerged adults / total number of eggs) × 100.
- The number of eggs laid by females (N) which is the total number of eggs laid per female throughout her life.

## 3. Results

### 3.1. The Sex Ratio

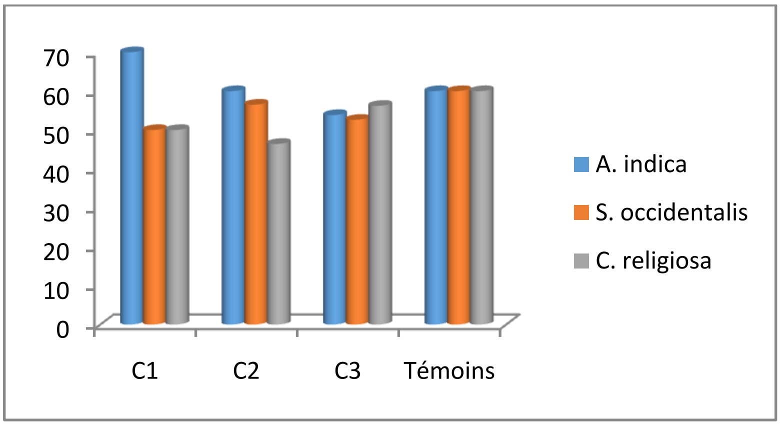


**Fig1.** *Sex ratio of adults from eggs treated with the aqueous extract of different plants*

The analysis of the following figure shows the effect of different plants on the nature of the sex of adult survivors from ovicidetest with the application of all concentrations. It turns out that the sex ratio in favor of females of C. maculatus with the application of neem for all concentrations. We note that this favor is attenuated with decreasing concentration. Thus, the highest concentration gives a percentage of sex ratio of 70% when other concentrations give 60%, respectively ($C_2$) and 53.85%

($C_3$) sex ratio. *C. religiosa* and *S. occidentalis* were all induced separatedsex ratio (50%) between males and females with the application of the $C_1$ concentration. The sex ratio in favor of males of the cowpea weevil with the impact of C. religiosa by applying the $C_2$ concentration. It's only with $C_3$ as *C. religiosa* gave a higher sex ratio than that given by other plants in favor of females of the insect. Only with the application of *A. indica* with $C_1$ (70%) we see a higher sex ratio as that given by witnesses (60%) in favor of females.

### 3.2. Deterring Oviposition Survivors of C. Maculatus

The results of deterring oviposition of *C. maculatus* survivors after treatment with *C. religiosa* are summarized in the following figure. It is clear from these results that the oviposition deterrence is generally greater with the impact of lower concentration ($C_3$), whereas it becomes weaker under the influence of the highest concentration. Nevertheless, we note the first day of oviposition $C_2$ caused the greatest deterrent to 43.31%. When the $C_1$ and $C_3$ concentrations give respectively 4.72% and 30.71% of oviposition deterrence *C. maculatus* on the seeds of cowpea. We also note that it is only the third day of oviposition the highest concentration ($C_1$) induced a greater deterrent to that caused by other concentrations, $C_2$ and $C_3$, which gives respectively 43.48% and 32 17%. It is also notable that only $C_1$ did not give 100% oviposition deterrence seventh day of oviposition.

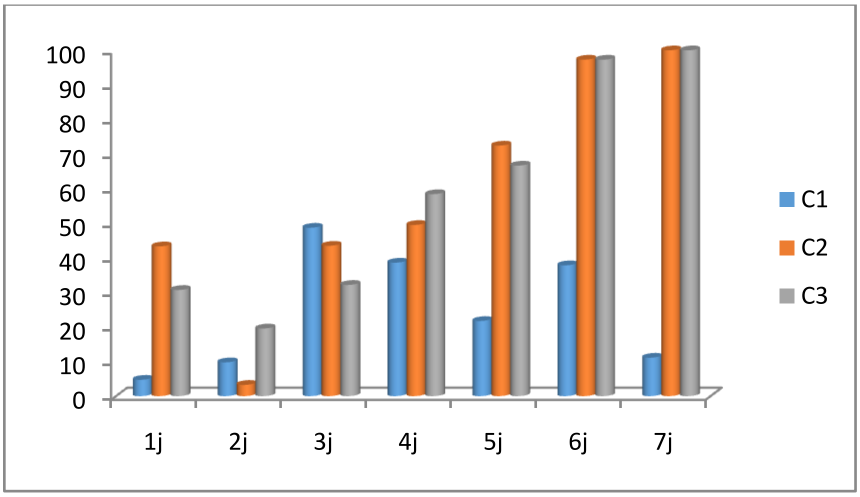


**Fig2.** *C. religiosa deterrent effect on oviposition survivors of C. maculatus*

The figure below shows that the deterrent effect of oviposition of *S. occidentalis* was felt until the third day of oviposition. The first two days show that the two lower concentrations ($C_2$ and $C_3$) showed any, negative effects on deterrence of oviposition of *C. maculatus* on the seeds of cowpea, while $C_1$ yielded a deterrent negative (-6.52%) at the second day of application. The most negative deterrent effect of oviposition was recorded on the first day of the experiment with the lowest concentration ($C_3$). On the fourth day of the application, we note deterrent effects of oviposition very interesting, with a greater impact with the application of $C_1$. The latter gives respectively 94.06% and 98.55% of oviposition deterrence in the fourth and fifth days of the experiment. On the fifth day of oviposition, $C_3$ concentration induced a maximum deterrent effect (100%) of *C. maculatus* oviposition, while $C_1$ and $C_2$ do not give as sixth and seventh days' l respectively application. It is generally found that $C_1$ is the most effective concentration of oviposition deterrence *C. maculatus* Seeds of cowpea (*Vigna unguiculata*) with the impact of *S. occidentalis*.

*Azadirachta indica* showed deterrent effects of oviposition of *C. maculatus* on the seeds of *V. unguiculata* on the first day of the experiment, with decreasing effects with the concentrations. Thus, the $C_1$, $C_2$ and $C_3$ have concentrations given oviposition deterrents of 78.74%, respectively, of 74.80% and 44.09%. The second and third days showed a greater impact of $C_2$, which gave 54.35% and 53.91% respectively deterrent effect. At this time the lower concentration showed negative effects. The importance of deterrence and experiencing a change in time with the application of various concentrations. Thus, after the first day of the experiment the concentration $C_1$ proved less effective than the other concentrations throughout the remainder of the experiment, except for the second and third days of the impact period $C_3$ induced adverse effects on oviposition deterrence. However $C_2$ is more efficient than $C_3$ after the fifth day of the application. It thus gives 100% oviposition deterrence on the sixth day of the experiment, during which, we note 94.60% of oviposition deterrence with the application of $C_3$. *A. indica* and shows a greater effectiveness of the concentration $C_2$, compared to all other concentrations ($C_1$ and $C_3$) on oviposition deterrent to *C. maculatus* on seeds of *V. unguiculata*.

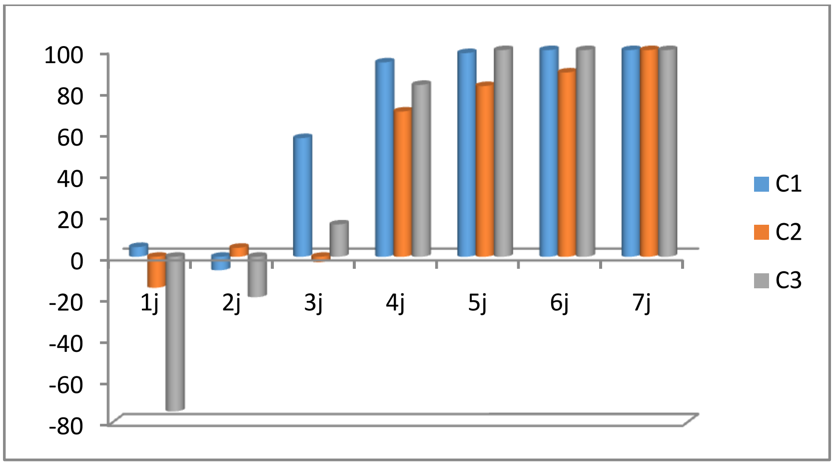


**Fig3.** *Deterrent effect of S. occidentalis on oviposition survivors of C. maculatus*

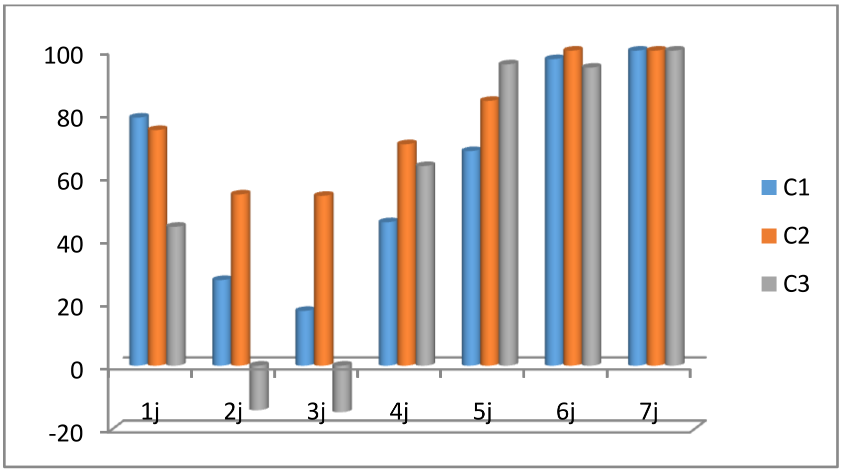


**Fig4.** *Deterrent effect of A. indica on oviposition survivors of C. maculatus*

### 3.3. The Rate of Emergence of C. Maculatus

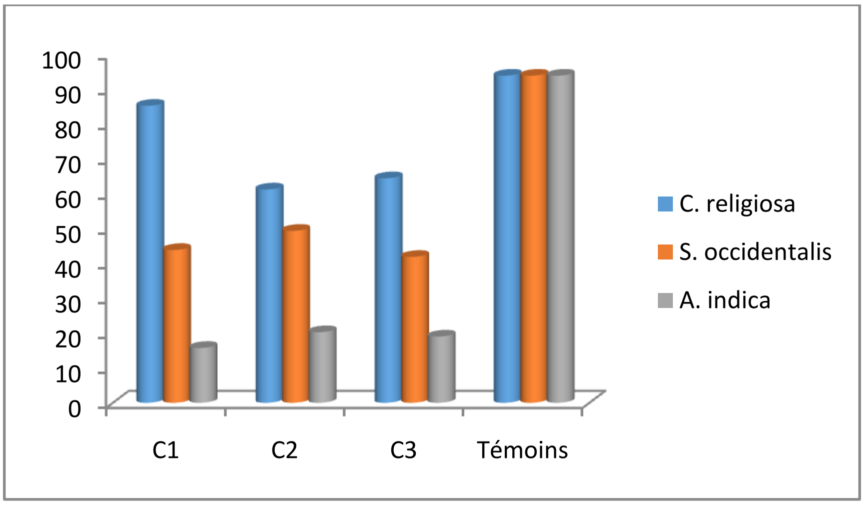


**Fig5.** *Adult emergence rate from the eggs laid by the survivors of C. maculatus*

For all concentrations used, *A. indica* shows have less impact on the emergence of adult *C. maculatus* all other plants. Thus we recorded with *C. religiosa* of 85.17% emergences of 61.17 and 64.38% with the respective application concentrations $C_1$, $C_2$ and $C_3$. Of all the plants *A. indica* is the one that causes the lower rate of adult emergence of cowpea weevil with all applied concentrations.

Concentrations $C_1$, $C_2$ and $C_3$ and respectively induce emergence rates of 15.72%, 20.4% and 18.98%. We also note that the reductive impact of the emergence of adult *C. maculatus* became lower for *S. occidentalis* and *A. indica* with $C_2$ application, then it is more important for *C. religiosa* with the application of the same concentration. $C_1$ concentration gave less impact on reducing adult emergence of the insect than other concentrations ($C_2$ and $C_3$) with the application of *C. religiosa*. For cons, the reverse effect is noted for other plants.

### 3.4. The Number of Eggs Laid Per Female

The figure below provides information on the number of eggs laid per female survivor of ovicides tests with different plants. We record with the two highest concentrations ($C_1$ and $C_2$), the females survivors tests ovicides with the application of *C. religiosa* have laid more eggs than those from the application with other plants (*A. indica* and *S. occidentalis*). Thus, with the application of *C. religiosa*, a female gives average by 83.6 and 86 eggs, respectively, with the impact of $C_1$ and $C_2$; while a female survivor of the application of *A. indica* has averaged 76.33 laid eggs with the impact of $C_1$ and $C_2$ with 56 eggs effect. By *S. occidentalis* against induced a lesser number of eggs laid per female survivor than other plants with the impact of $C_1$ and $C_2$, which respectively gave 56.6 and 58 eggs per female. With the application of $C_3$, *A. indica* gave more eggs per female than other plants, *S. occidentalis* and *C. religiosa* who give respectively 69.8 and 61.2 eggs. Overall, it appears, and the effect of *S. occidentalis* is greater than that induced by other plants on reducing the laying of the survivors. In comparison of the effect of all plants, adult witnesses have laid more eggs (109.6 per female) than adults survivors of the application of the aqueous different plants leaf powder extract. Therefore, we have noticed that all the applied plant cause a real impact on the reduction of spawning female *C. maculatus*.

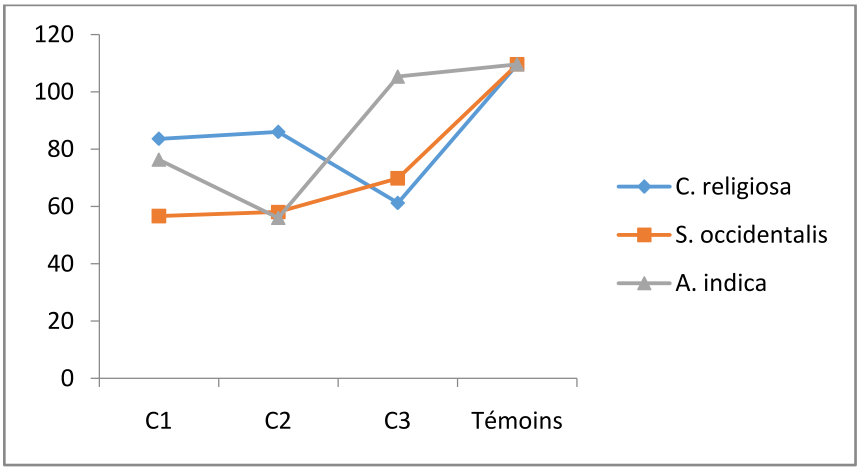


**Fig6.** *Number of eggs laid per female survivor C. maculatus in function of the concentration with the application of different plants*

## 4. Discussion

Our study reveals that the percentage of sex ratio is generally in favor of females and this regardless of the applied concentration. It also shows that this favor is accented than with *A. indica* with other plants. Only *C. religiosa* gave a sex ratio towards males of *C. maculatus*. Compared to the control batch which also gave a favor to females, *A. indica* is the only plant that induced sex ratio greater than that of the batch with the application of control $C_1$. Our results are in the same vein as those of N'goran-Ouali *et al* (2014). These authors obtained a sex ratio towards females of *C. maculatus*. It ranges around 85% with the use of different varieties of cowpea as spawning substrates (IT97K499-38: 85.20 ± 1.12%; IT96D610: 85.15 ± 1.24% and TVX1248: 85, 07 ± 1.6%). The numerical superiority of females could affect the reproductive behavior of the offspring, because if females get very many compared to males, recurrence egg without fertilization would be very important. This would have a significant impact on the fertility of eggs and consequently on the number of adults that emerge from that eggs. Also we noticed in monitoring these survivors per couple that the male always dying first, whatever the plant considered and applied concentration. In addition the control showed otherwise. Our results corroborate with those of Thiaw (2008) which showed the effect of S.

occidentalis and that of *Calotropis procera* on sexing *Caryedon serratus*adult emerging from eggs treated with these plants. He showed that *S. ocidentalis* had induced a higher sex ratio than that induced by *C. procera* whatever the extraction solvent used, which is always in favor of females.

The deterrent effect of oviposition survivors adult *C. maculatus* varies with time, concentration and the applied plant. It is clear from our study that *A. indica* is the most crucial plant in deterring oviposition of *C. maculatus* on the seeds of *V. unguiculata*. This dominance of oviposition deterrent is more remarkable with the implementation of the $C_2$ concentration. In our study, all tested plants cause fertility reduction female *C. maculatus* eggs survivors treated with aqueous extracts of these plants. Our results were confirmed by those of several authors working on oviposition of the insect. Indeed, Rotimi and Evbuomwan showed in 2012 the effectiveness of several species of citrus Adult emergence *C. maculatus* and their oviposition on the seeds of cowpea. Thus they identified that*Citrus sinensis* caused deter oviposition between 72 and 79% while *C. tangerina* resulted 62-68% oviposition deterrence female *C. macultaus*. Furthermore Ravinder Singh (2011) detected a deterrent oviposition female *C. maculatus* 58.86% with the application of 1.0ml / 100gm of aqueous extract of neem, while the lowest dose (0,5ml / 100gm) induced 36.98% of oviposition deterrence. The notable difference in oviposition deterrence recorded in our study versus concentrations and tested plants reside in their content of toxic substances to insects. This idea was supported by Ravinder Singh in his assessment of deterring oviposition of *C. maculatus* females. The notable difference of the deterrent effect of oviposition identified by this author with our with the application of neem extract, is linked to the fact that processing takes place on seeds constitute spawning substrates insects while our processing was done on seeds carrying eggs that gave rise to adults to which carry oviposition study. This difference may also reside in the difference of solvents used. Furthermore Thiaw (2008) showed average oviposition survivors of female *C. serratus* about 56.872% and 58.167% of peanut seeds, respectively, with treatment of *S. occidentalis* and *C. procera*. Many other studies show that the plant extracts are very effective in reducing the fertility of stored product pests. It is in this light that Kellouche and Soltani (2004) highlight a fertility reduction of female *C. maculatus* with the impact on chickpea seed powder leaves of four plants, lemon, fig, eucalyptus and olive trees, while the essential oils of clove inhibit spawning females of this insect. The number of eggs laid per female of *C. maculatus* was significantly reduced by the effect of essential oils from aromatic plants both from Ivory Coast, *Melaleuca quinquenervia* L. and *Ocimum basalicum* L. (Seri-Kouassi *et al* , 2004). Dan Mairo, working on different strains of *C. maculatus* showed that the persistence of crushed leaves of *Boscia senegalensis* induced differences in the number of eggs laid by females. There was thus obtained numbers ranging from 38.9 ± 15.53 to 57.4 ± 22.32 to different strains ((Maradi 57.4 ± 22.32), (Gaya 38,9 ± 15.53), (Ayerou 40.25 ±17.24) and (Tchintabaraden 42.2 ±16.26)).

The fertility of the eggs laid by female survivors made evaluation office in our study. We have noticed a very large eggs fertility reduction laid by the survivors from the treatment with *A. indica* whereas the survivors of treatment with *C. religiosa* give very fertile eggs. Our results may be understood, when we questione those of Ikeura H. *et al* (2010). They show the attraction and the stimulation of oviposition of Pieris rapae by cabbage and *C. religiosa*. The spawning of *C. religiosa* stimulation *Pieris rapae* to be related to the méthylthiocyanate, very close molecule Allylisothiocyanate. The latter was identified responsible for the attraction and spawning of *P. rapae* on cabbage. One may therefore conclude that this molecule is responsible for of the largest fertility of eggs survivors treated with *C. religiosa*. The greatest reduction of fertility that we identified on the eggs survivors treated with *A. indica* is related to bioactive molecules contained in the plant, of which the most studied is azadirachtin. ; but it is noted that it is the support of several bioactive molecules that is at the origin of the insecticidal activity of this plant (Gauvin *et al*., 2003). The work of some authors confirmed ours on the emergence of adults from control eggs. Thus N'goran-Ouali *et al* (2014) showed a rise of 80.86% of adults on the IT97K499-38 variety, while we had recorded 93.80% of emergence with witnesses. Thus we see a real impact extract leaf powder of these plants on the fertility of the eggs laid by adult survivors ovicidal tests. Dan Mairo (2011) meanwhile, got eggs fertility rates of *C. maculatus* from 94.92 to 98.28% as a result of *B. senegalensis*. So the plants that we used seem more effective than *B. senegalensis* on reducing fertility of eggs laid by *C. maculatus*. This difference in efficiency would be the work of a different nature of bioactive molecules contained in these plants or their concentration. We could also look for it in the difference in the effectiveness of the persistence of the products of these different plants. The work of Dan Mairo (2011), *B. senegalensis* showed also a greater persistence than that of plants that we used on the reduction of the adult emergence rate of *C. maculatus*. Other control methods against pests have also been undertaken by many researchers. These methods rely on the resistance of certain varieties of plants against insects. It is in this movement that Doumma *et al* (2011) have obtained interesting results on restricting the proliferation of *C. maculatus*, through the application of several local varieties of cowpeas from Niger. They obtained larval mortality rate of *C. maculatus* than 20% with the exception of 041-84 and 057-84 varieties, which respectively induces larval mortalities 12.810 ± 3.15% and ± 2 17.423 35%. The results obtained by these authors identified among the varieties tested, two local ecotypes, 063-84 and 044-84, which appear to significantly reduce the development of *C. maculatus*. The impact of these two varieties results in the inhibition of post-embryonic development of this species, respectively, resulting 49% and 42% larval mortality compared to strength indicator which recorded 80%. This has led to significantly reduce the emergence of adults of this species in these varieties compared to other varieties where emergence rates of over 60% are observed (Doumma *et al*, 2011).

## 5. Conclusion and Perspectives

The persistence of several plants has been evaluated in several biological parameters of *C. maculatus* in our study. The sex ratio induced by the persistence of all plants proved broadly in favor of females. Furthermore *A. indica* has been more favorable than all other plants emerging females than males. The impact of the persistence of the plants used on the oviposition deterrence of this insect is real. Thus *S. occidentalis* was more reducing on the amount of eggs laid with the impact of all plants. *C. religiosa* is also the least efficient plant on the decrease in the number of eggs laid per female, as well as reducing the rate of emergence from eggs laid by adult survivors of *C. maculatus*. In contrast, we recorded a higher efficiency of *A. indica* on the evaluation of the latter two biological parameters. We intend in the future to assess the impact of these plants and other plants on other biological parameters of the insect and other insects in the real storage systems.

## References

[1] **Abdullahi N. and Majeed Q., 2010.** Evaluations of the Efficacy of *Vittellaria paradoxa* seed powder on the Oviposition eggs viability and mortality of *Callosobruchusmaculatus* (F.) (Coleoptera: Bruchidae) on treated cowpea seed. *African Journal of General Agriculture* 6(4):289-293

[2] **Dan Mairo A. M., 2011.** Cartographie des paramètres biologiques de *Callosobruchus maculatus* suivant les zones agroécologiques du Niger

[3] **Doumma A., Salissou O., Sembène M., Sidikou R.S.D., Sanon A., Ketoh G.K., Glitho I.A., 2011.** Etude de l’activité reproductrice de *Callosobruchus maculatus* (F.)(Coleoptera : Bruchidae) sur dix variétés de niébé, *Vigna unguiculata* (L.) Walp. en présence ou non de son parasitoïde, *Dinarmus basalis* R. (Hymenoptera : Pteromalidae). *Journal of Animal & Plant Sciences* 11(2): 1398-1408

[4] **Gauvin M. J., Bélanger A., Nébié R., Boivin G., 2003.** « Azadirachta indica : l’azadirachtine est-elle le seul ingrédient actif ? ». *Phytoprotection,* 84 (2) : 115-119.

[5] **Ikeura H. Kobayashi F. and Hayata Y., 2010.** Attractant and oviposition stimulant of Crataeva religiosa Forst. to *Pieris rapae. Asian Journal of plante Science. 9 (8)492-497, 2010.*

[6] **Kellouche Abdellah, Soltani Nourudine., 2004.** Activité biologique des poudres de cinq plantes et de l’huile essentielle d’une d’entre elles sur *Callosobruchus maculatus* (F.). *International Journal of Tropical Insect Science* 24(1): 184-191.

[7] **Koubala B. B.,Miafo A. P. T., Bouba D., Kamda A. G. S. and K. G., 2013.** Evaluation of Insecticide Properties of Ethanolic Extract from *Balanites aegyptiaca, Melia azedarach* and *Ocimum gratissimum* leaves on *Callosobruchus maculatus* (Coleptera: Bruchidae). *Asian Journal of Agricultural Sciences* 5(5): 93-101

[8] **Moumouni D. A., Doumma A. Sembene M., 2013.** Influence des zones agroécologiques sur les paramètres biologiques de *Callosobruchus maculatus* (Coleoptera-Bruchidea), ravageurs des graines du niébé (*Vigna unguiculata* Walp.) au Niger. *International Journal Biological Chemical Sciences* 7(5): 1866-1876

[9] **Ouali-N'goran S-W. M., Boga J.P., Johnson F., Tano Y. and Fouabi K. (2014).** Influence of dietary factors of five varieties of beans sold in Côte d'Ivoire on some biological parameters of *Callosobruchus maculatus* (Fab.) Coleoptera, Bruchidae. *Journal of Animal &Plant Sciences,* 21(1): 3251-3262

[10] **Rotimi J. and Evbuomwan C.O., 2012**. Deterrent effects of citrus peel oils on oviposition and adult emergence of the cowpea weevil, *Callosobruchus maculatus* (F.) (Coleoptera: Bruchidae). *Pelagia Research Library Advances in Applied Science Research.* 3 (6):3545-3550.

[11] **Singh Ravinder., 2011.** Evaluation of some plant products for their oviposition deterrent properties against the *Callosobruchus maculatus* (F.) on Chik pea seeds. *Journal of Agricultural Technology* 7(5): 1363-1367

[12] **Thiaw Cheikh., 2008.** Bioactivite des extraits de *Calotropis procera* ait. et de *Senna occidentalis* l. sur *Caryedon serratus* (ol.), ravageur des stocks et semences d'arachide au Sénégal. *Thèse de doctorat de troisième cycle de Chimie et Biochimie des Produits Naturels.* pp : 196

[13] **Toufique B. M., Moumouni D. A., Kadidjatou H. H., and Doumma A., 2014.** Etude de quelques facteurs influençant l'efficacité de l'activité insecticide de *Boscia senegalensis* Lam (Ex. Poir) dans le contrôle de *Callosobruchus maculatus* F.(Coleoptera-Bruchinae), ravageur du niébé (*Vigna unguiculata* (L.) Walp. International *Journal of Innovation and Applied Studies* 8 (1): 320-327

[14] **Uddin II, R.O. and Adesiyun, A.A., 2012.** Laboratory Investigation on Oviposition and Development of *Callosobruchus maculatus* (F.) on Four Varieties of Cowpea. *Agrosearch* 12 (1): 31 – 36.