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# Insecticidal activity of the powder from *Capsicum frutescens* (Solanaceae), *Lavandula stoechas* (Lamiaceae) and *Syzygium aromaticum* (Myrtaceae) against *Callosobruchus maculatus* insect pest of chickpea seeds

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**Abstract**

During storage, the seeds of legumes suffer considerable losses from several pests, mainly *Callosobruchus maculatus*. In Morocco, synthetic pesticides remain the most used means for the protection of stored products. They cause harmful effects on humans and the environment, in addition to resistance phenomena in pests.

In perspective to develop a new approach to protect legumes against *Callosobruchus maculatus*, the powder of three plants (*Capsicum frutescens, Lavandula stoechas Syzygium aromaticum*) applied to the laboratory under controlled conditions (25 ° C, 70 ± 5% relative humidity and 10h light) were tested against *Callosobruchus maculatus* at the expense of chickpea seeds at 0.1; 0.5 and 1g. For each dose, 10 pairs of the weevil were released on 10g of treated seeds. In the same conditions, lots of untreated seeds were used as witnesses. Daily mortality of weevil, eggs, laid, hatched and unhatched emitted on seeds, emerged adults were identified. The analysis of plant toxicity tests reveals that the powders of (lavender, hot pepper and cloves) exert a variable insecticidal action on the various parameters of *Callosobruchus maculatus*, and that the powder of cloves has the highest lethal effect on adults weevil *Callosobruchus maculatus* at the same time as a maximal inhibitory effect on reproduction of the insect studied.

It emerges from the various tests carried out that the plants used constitute a means of biological control which could substitute for the use of synthetic pesticides in order to protect stored products against pests, while preserving the environment as well as the quality of the stored commodity.

## 1. Introduction

Stored food can be attacked by insects, fungi and rodents. The damage caused by insects is the most important. Although the problem is global, it is more important in developing countries particularly those in Africa, because of the favorable climatic conditions for their development [1].

In Morocco, crops legumes are located in areas with favorable rainfall. The area planted for the 2013-2014 crop year reached 373,000 ha.The bean remaining the most dominant crop with 56%, chickpea 22.10%, lentil 14.73%. At last, pea 11.78% of the area planted to food legumes [2].

*Callosobruchus maculatus* is one of the agents responsible for large losses in the stored food of seeds chickpea, which are usually protected by chemicals insecticides [3;4]. Currently, this method is less solicited because of these harmful effects on man and on environment: toxic residues, appearance of resistant strains, etc.

In the search for alternative methods of struggle, a lot of possibilities offer by the plants. Many studies are developing to isolate and identify secondary substances plant extracts which have insecticidal activity, [5]. This study has for object to evaluate the biological activity of 2 plants cultivated in Morocco , including *Capsicum frutescens* (solanaceae) and *Lavandula stoechas* (Lamiaceae), and a tropical plant, *Syzygium aromaticum* (Myrtaceae) on C. *maculatus*. The interest of this kind of work lies in the search for plants that can be used as bio-pesticides for the protection of stored-product.

## 2. Material and Methods

### *2.1.Breeding of the weevils*

The species studied is *C. maculatus*, obtained from a stock in the city of Fez. She is maintained by mass rearing at the laboratory of biotechnology and preservation of natural resources of the Faculty of Sciences Dhar Mahraz USMBA Fez.

Mass rearing of *C. maculatus* stumps was performed in glass jars on *Cicer arietinum* chickpea seeds. The pots are kept at a temperature of 25 ± 1 ° C, a relative humidity and a photoperiod of 14h (light) / 10h (darkness) during successive generations.

Fig 1: Breeding conditions and biological treatments of *C. maculatus* weevils in the presence of chickpea seeds.

### *2.2.Plant materials*

The plants used for the biological treatment were harvested from different regions:

- The hot pepper fruit (*Capsicum frutescens*): Fez region
- Cloves (*Syzygium aromaticum*): central market of Fez
- Lavender leaves (*Lavandula stoechas*): Taounate region

The plants are cleaned, dried at 21 to 24 ° C for ten days, and then ground into powder by an electric grinder to test the effect of leaf powders on the insect. The crushed is then passed on a sieve of 0.5 mm to get a homogeneous powder. The identification plant species is performed at the laboratory.

### *2.3.Doses and treatments*

The biological tests were carried out at the laboratory in Petri boxes diameter 9 cm. Five couples of *C. maculates* were introduced into Petri boxes, each containing 10 g of healthy chickpea mixed with the powders of the various plants studied (lavender leaves, cloves and the fruit of hot pepper) in different doses (0.1g, 0.5g and 1g) a daily monitoring of their activity has been carried out.

The parameters for determining the effect and action of the 3 powders on *C. maculatus* are: mortality of adults as a result of contact with the powder, the fertility of females, egg fertility and emergence rate.

### *2.4.Statistical analysis*

Data analysis was performed with statistical tests (Analysis of variances) using the software, IBM SPSS Statistics 19. Statistical analyzes were performed on raw data for quantitative variables (Longevity, Fertility and Descendants).

## 3. Results and discussion

### *3.1.Longevity of adults*

Fig 2 shows the biocidal effect of three plants *Capsicum frutescens, Syzygium aromaticum, Lavandula stoechas* on the longevity of *C. maculatus* adults.

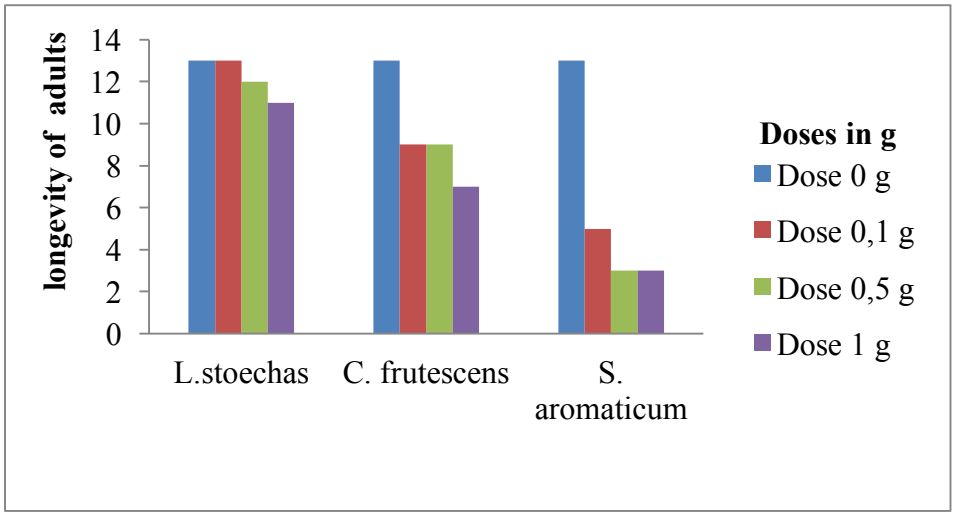


Fig 2: The average longevity of *C. maculatus* adults under the effect of the different doses of the vegetable powders tested.

The results of this test show that adults of *C. maculatus* decrease as the dose increases. Starting from an average longevity of 13 days for all the control lots (untreated batches), it is found that the latter is the lowest for the dose of 1g. Nevertheless, the clove powder induces the shortest average longevity which is 3 days. While for lavender powder, this longevity is weakly influenced since it is 9 days (Fig 2).

Many works have shown the efficacy of the insecticidal activity of plants against stored seed pests including insects. This efficiency depends on the quantity of seeds to be stored and the toxic power of the plant. [6].

Our results are in agreement with those of the authors who have studied the impact of plant powders on the C. maculatus chickpea pest or on neighboring species.

The work of [7] showed that Pachyrhizus erosus powder negatively affected the population growth of the weevil with high mortality rates leading to a significant reduction in the population of been weevil. In the same sense [8] observe that the powders and essential oils from the dry leaves of Chenopodium ambrosioides and Eucalyptus saligna are effective in the protection of cowpea grains against Callosobruchus maculatus. The toxic and repellent effects of these plant materials depend on several factors, including their chemical composition and the level of insect sensitivity. Thereby, [9] found that the adult longevity of bean weevil varies according to the sensitivity of the insect and the dose of powder used, in fact, the 0.4% powder dose of *Chenopodium ambrosioides* leaves results in 60% mortality of adults of *Acanthoscelides obtectus* after two days of exposure, while 6.4% of the same plant causes a total mortality of adults of *Sitophilus zeamais* corn weevil, after same treatment time.

### *3.2. Fecundity of females*

Fig 3 shows changes in average fertility of females of the insect *C. maculatus* in the presence of plant powders studied.

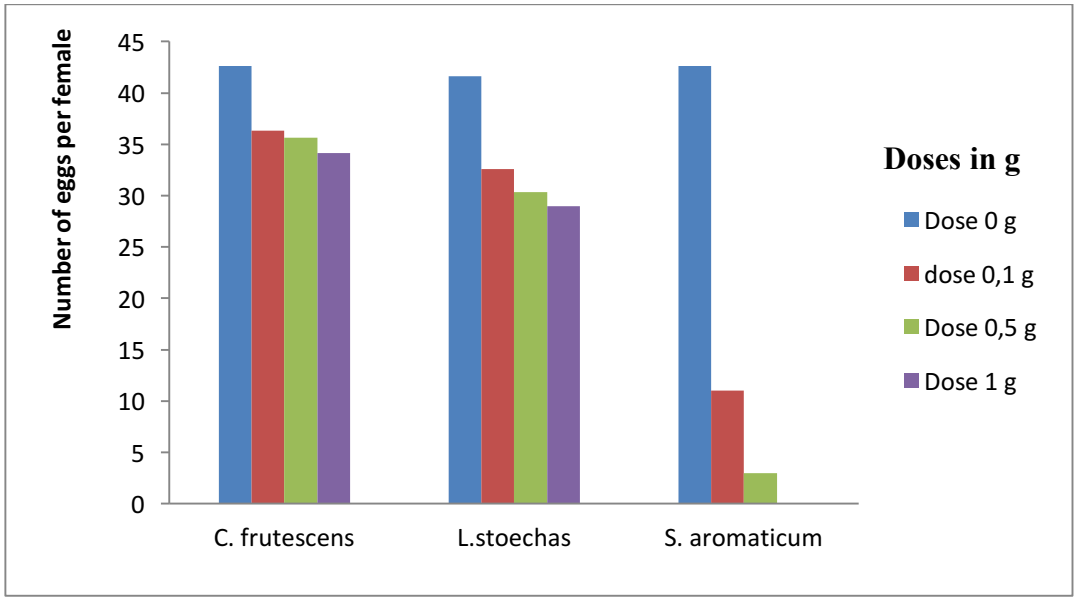


Fig 3: Average female fecundity of *C. maculatus* as a function of the doses of the different plant powders during contact treatment

Egg-laying recorded in control batches averages 42.6 eggs per female. The reduction in average spawning observed under the effect of lavender and hot pepper remains low although it is significant in the three doses (0.1g, 0.5g and 1g). On the other hand we noticed in doses 0.1 and 0.5 of clove tree that the fecundity is lower and vanishes for the 1g dose (Fig. 3).

It is found that the powder of the clove blossom induces a much greater decrease in the fecundity of the female C. *maculatus* compared to the control. Consequently, it can be concluded that the physiology of male and female genitalia of C. *maculatus* is significantly disturbed by the presence of clove powder.

These results are in harmony with those of [10] who have shown that the plants of the Labié family (Lamiaceae) such as *Mentha piperata*, *Origanum serpyllum*, *Saiureia hortensis*, *Rosmarinus officinalis*, *Thymus vulgaris* and *Thymus serpyllum* cause a significant decrease in oviposition of females of *Acanthoscelides obtectus* main pests of bean seeds. Also Hamdani (2012) show that the powders of the lemon and the orange reduce adult emergence at the lowest dose (2%). But the most important effect is recorded by the powder of bitter orange that has the lowest rate of emergence even at low dose (2%).

### *3.3. Fertility of eggs*

Fig 4 illustrates the observed fluctuations in egg fertility in the presence of the powders of plants used as biological treatment.

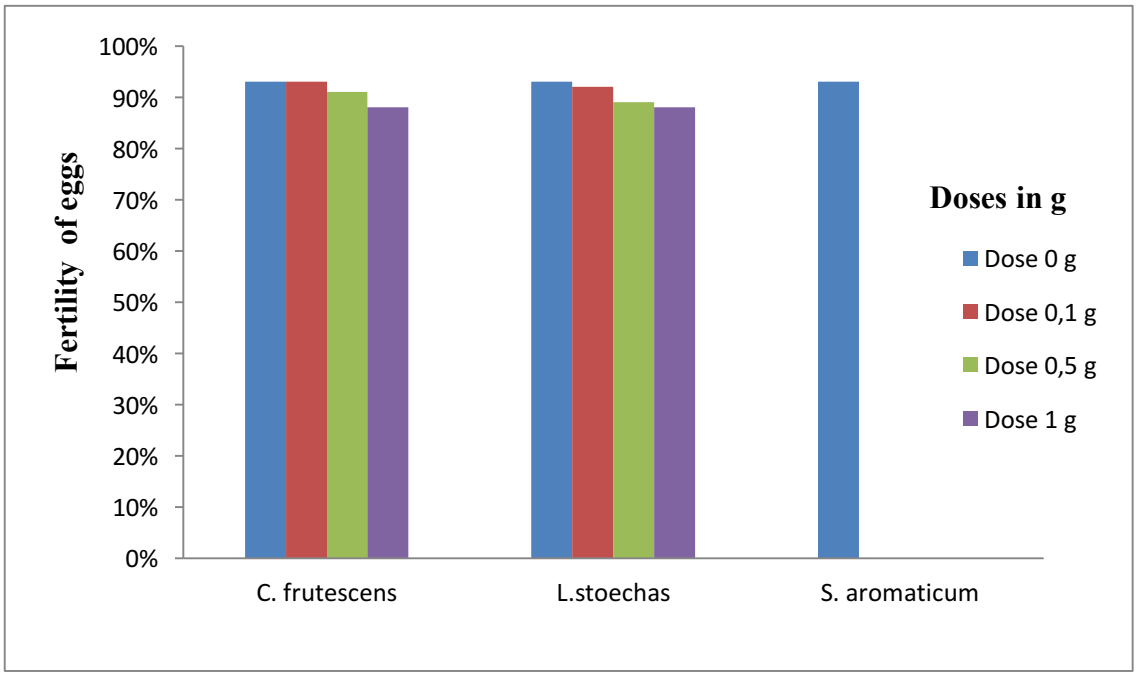


Fig 4: Influence of contact treatments of different plant powders on the average fertility of *C. maculatus* eggs.

Treatments made by lavender, hot pepper showed no significant effect on egg fertility. On the other hand, the action of the powder of the clove blossom causes total annihilation of the fertility for the three doses (0.1g, 0.5g and 1g). The clove tree therefore has a very important inhibitory effect on the fertility of *C. maculatus* eggs compared to the other plants used (Fig 4).

### *3.4. Emergence rate*

Fig 5 shows the emergence rate of new *C. maculatus* individuals treated with the powders of the plants tested**.**

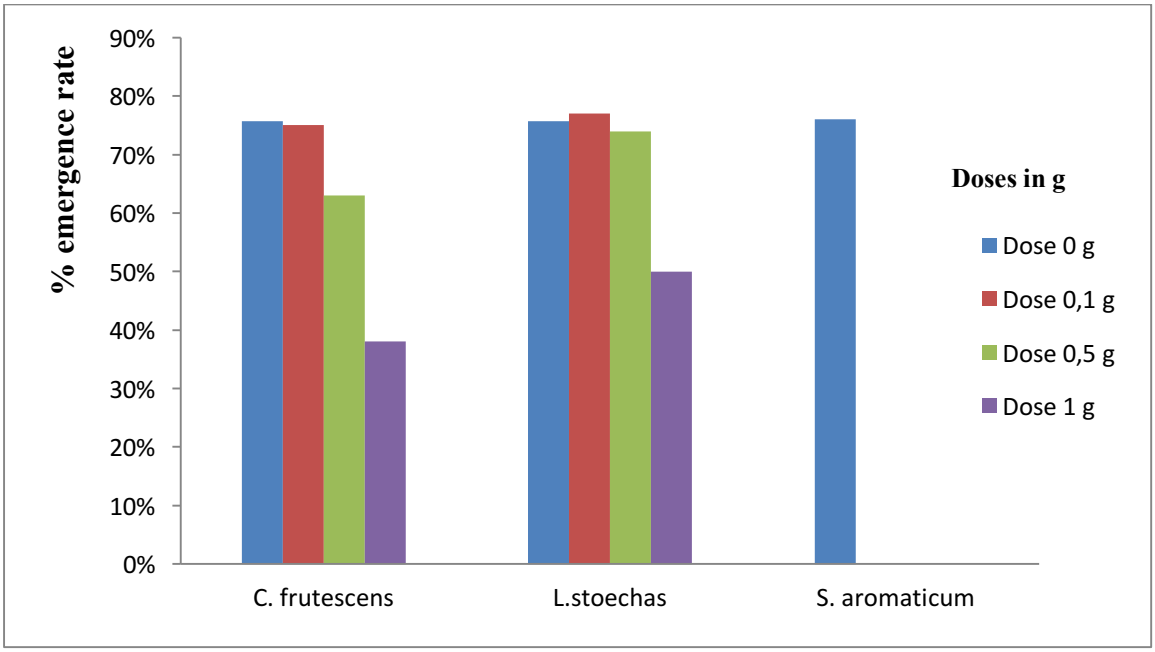


Fig 5: Average emergence rate of individuals of *C. maculatus* under the effect of contact treatment of the different plant powders tested.

The analysis of emergence variation according to the powder used reveals that the analysis of emergence variation according to the powder used reveals that lavender powder did not show any influence on C. *maculatus* whatever the dose used. This emergence, under the effect of the hot pepper powder, undergoes a noticeable decrease with the increase of the dose used. In the case of clove powder, a total absence of emergence was recorded (Fig 5).

As a first approach, clove powders have a marked effect on C. *maculatus* reducing the viability of eggs. However lavender powder shows no effect on the emergence of adults. So we can conclude that clove substances cause an influence on the development of larval stages of C. *maculates.* [11]. Has recorded a reduction in the number of descendants in *C. maculatus* treated with vegetable powders, which are classified by increasing order of their effectiveness as follows: *Ficus carica*, *Citrus limon*, *Eucalyptus globulus* and *Olea europea*. Eucalyptus and olive trees reduce by 50% the number of adults who emerge at doses of 4 and 5%. In treatments with fig leaf powder, the reduction in progeny is greater than 90% at the 5% dose. Concerning the longevity of adults our results are in agreement with those obtained by other researchers who have highlighted the insecticidal effect of powders against insect pests of stored commodities.

## Conclusion

This study allowed us to show that some plants can be considered as an alternative solution to control the pests of stored seeds. This will help reduce the amount of insecticides applied and reduce the negative impact of synthetic products, such as the problem of environmental pollution, the resistance of pests and the preservation of the health of consumers.

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