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**REVIEW ARTICLE**

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# Biology of *Maruca vitrata* (Lepidoptera: Crambidae), a serous pest of cowpea and other legume crops: A review

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**ABSTRACT**

*Legume flower and pod borer, Maruca vitrata fabricius is a key pest of cowpea and other legume crops, causing up to 80 percent yield loss. The insect is most commonly found in tropical and subtropical areas with wide host range and favorable climate. There are about 39 host plant species of legume crops and weeds and undergoes complete metamorphoses with five destructive larval stages, attacking the flowers, pods, leaves and other parts of the host plant. Many control methods are attributed to its control but most farmers rely largely on chemical pesticides due its physical and immediate action, despite its huge negative effect. However, other alternative such as biocontrol e.g. parasitoid (such as Apanteles taragamae), entomopathogenic viruses (e.g. M. vitrata Multi-Nucleopolyhedrovirus), and entomopathogenic fungi have recently gained interest and proven effective. Moreover, use of sex pheromones and traps plus cultural control practices such as intercropping, weeding, time and density of planting are also highly efficient and complementary. More data on biology, population ecology, pesticides resistance techniques and natural enemies of M. vitrata and their integration would help establishes a tough control method and increased legume crops productivity.*

**Keywords:** Biology, *Maruca vitrata*, pest, cowpea, legume crops

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## INTRODUCTION

*Maruca vitrata* Fabricius (Lepidoptera: Crambidae), a legume pod borer has been investigated as destructive pest of cowpea and other legume crops in Africa and Asia [1]. This insect pest is widely distributed throughout tropical and subtropical areas [2], especially where the populace depends largely on agriculture [3]. Previous studies have suggested *M. vitrata* to originate most likely from Indo-Malaysian region [4]. However, present-day studies revealed that the genus *Maruca* might have spread to Africa more recently [5-6] and has already established on 39 species of leguminosae [7]. The larval stage is the damaging stage, attacking flower buds, flowers and young pods [8]. Up to 80 percent cowpea yield losses are recorded [9], especially with little or no control efforts. In West *Africa, M. vitrata* has been identified to form one of a complex of damaging insect pests of cowpea, comprising of *Aphis craccivora* (aphis), *Ootheca mutabilis* (foliage beetles), *Megalurothrips sjostedti* (thrips) and *Clavigralla tomentosicollis* Stål [10]. But the majority of damage is credited to *Maruca vitrata* according to [11].

Considering the above, this paper reviews literature in relation to the biology and other important aspect of *Maruca vitrata* that might help in reducing its effects on legume crops and maximize cowpea production. As this would facilitate hunger alleviation in tropical and subtropical areas [12].

**Taxonomy**
*Maruca vitrata* Fabricius is the scientific name of this legume flower and pod borer, synonymously called *Maruca testulalis* Geyer and *croshipora testulalis* Geyer [13]. It belongs to the family Crambidae (order Lepidoptera) [14] formally placed under Pyralidae, which has only a single L seta on its ninth abdominal segment.

**Distribution**
Several literatures have identified *M. vitrata* to be widely distributed most especially sub-Saharan Africa with wide-ranging host plant (Legumes) and favorable climatic condition [15]. According to recent studies the geographical range of *M. vitrata* has extended to some parts of Europe probably by means of pod transportation [16]. About 39 host species of this pest were identified feeding on flowers, pods, leaves and shoots [17-18]. Despite having such a wide range of alternative hosts in West Africa, *M. vitrata* appears to be migratory along the coastal areas to the dry savanna parts (South-North gradient) [18].

**Biology**
Eggs are laid singly or in batches of 2-6 [8] on the under surface of leaves, terminal shoots and flower buds [19]. The freshly laid eggs are milky white in color, oval in shape, dorsoventrally flattened and stuck to its substrate [19]. Temperature effect the number and period of egg laying [20] and up to 400 eggs are laid in batches of 2-16 [21] while the incubation period varies from $2.54 \pm 0.04$ days [19].

There are five larval instars lasting between 8-10 days [19] or even up to 16 days [15] depending on climatic condition and the host plants. A shorter duration was observed [8] who reared the larvae with artificial diet. Larval feed component also affects the biology of the insect and it preferentially feed on the reproductive organs of the host plant [8] for about three week and then migrates to the pods before pupation. Larval body is semitransparent and spotted on each segment and the spotting intensity varies [22] and the spots fade before pupation [23].

The pupae are elongated, measuring about 13 mm in length and with shouldered appearance [24]. Early pupal stage is greenish but turns brown when fully developed [22] and concealed in a cocoon on dry leaves, flowers and other dead plant matters [23]. The pupal period is normally one or two weeks [22]. No sign of diapause during the dry season [25].

The Adult are medium sized [22] and both sexes are morphologically alike. The forewings are brown having white spot and black-edged while the hind wings are semi-hyaline [22]. The highest percentage of mating and oviposition is in 4 or 5 nights of pairing [21] and the suitable temperature range for this is between 20 $^{0}$C and 25 $^{0}$C with 80 % and above humidity [26]. Mating occurs around 20:00 h and 05:00 h and the males and female longevity of 7-10 days and 5-6 days respectively [22].

**Economic Importance**
Several findings have described *M. vitrata* as the most devastating insect pest causing poor yield and considerable losses of cowpea worldwide [1]. The larval stage is the damaging stage [8] and it does so by entering the buds and seed pods. The damaged pods are completely or partially eaten out and entrance also allows water into the pod and stains the left behind seeds. The buds, flowers and leaves are also damage [27] which may be consumed and or bound together by the larvae. The young larvae usually feed on and damage the flower while the older ones feed most often on the pod [28].

**Control**
**Chemical Control**
To manage *M. vitrata* and other insect pests, farmers resort to many methods based on their knowledge and financial status [29]. Despite the financial burden and other problems associated with chemical insecticides, copious data have revealed that they are the most widely used [30]. Recent studies conducted in Thailand revealed that more than 90% of the surveyed growers relied on chemical pesticides and two-thirds of them applied it once a week [31]. Likewise, application of insecticidal chemicals once at both flowering and podding stages greatly increase grain yield [32].
Pesticides such as methomyl, cypermethrin, endosulfan, dimethoate, carbaryl, lambda-cyhalothrin 5 EC, beta-cyfluthrin and monocrotophos have all proven effective against *M. vitrata* [33-35] if sprays regularly. Dimethoate combined with cypermethrin gives efficient control in cowpea field [36]. A combination of deltamethrin and

lambda-cyhalothrin mix with dimethoate has also shown activity against this insect pest [32] especially when applied prior to pods infestation.

Chemical pesticides in the short-term exhibit significant control, increased yields, immediate effect and plant health improvement that easily attract less-literate farmers [37], but in the long run, causes serious long-term effects such as insecticide resistance and low level of tolerance in *M, vitrata*, which has already been identified [33]. For instance, resistance to cypermethrin, endosulfan and dimethoate were detected and non-chemical control or it use only when necessary was recommended [33[. Other effects includes; wiping out of natural enemies [38], pollution of the environment, toxicity to living organisms, farmers, consumers and are costly as well [39].

**Biological Control**

In recent years, biological control practices, an alternative method to chemical pesticides [40], has gained interest in the fight against insect pest [5] which has to some extent, been proved to be a better control method. This practice includes; the use of natural enemies (parasitoid e.g. *Phanerotoma leucobasis, Pristomerus* sp., *Testudobracon* sp. *Apanteles taragamae*) of eggs and larvae of *M. vitrata* [18, 6], entomopathogenic viruses e.g. *M. vitrata* Multi-Nucleopolyhedrovirus [41-42] and entomopathogenic fungi. *M. anisopliae* and *B. bassiana* Isolates [43]. *Bacillus thuringiensis* subsp. aizawai has also been observed to be highly effective [44]. Earlier studies have also revealed *M. vitrata* susceptibility to *Bacillus thuringiensis δ-endotoxins* in tropical and subtropical areas [45]. Most of these methods have shown encouraging results but some have not yet accepted and more studies at population-level are vital for fruitful biocontrol implementation [46].

**Botanical control**

Many potentialities of botanicals against *M. vitrata* have recently been documented. About 90 percent larval mortality to neem concentration of 50,000 ppm has been reported [44]. Similarly, a laboratory experiments by [47] revealed *Allium sativum* bulb, *Piper guineense* and *Azadirachta indica* seed extracts as effective in egg hatch reduction with black pepper and garlic bulb having the highest reduction at all concentrations. In another study, [48] examined Neem, papaya and Hyptis species to be effective on both *Maruca* and other pest like *Thrips* with neem having better result. Other findings on neem oil also revealed it's effectivity against *M. vitrata* in India and Africa [49]. Equally, [50] found that, neem seed kernel extract (5 percent) with Dichlorvos (0.5 ml per liter of water) produced an excellent result.

**Cultural Control**

Cultural practices such as intercropping, weeding, time and density of planting lessen the damage in cowpea [28]. A plant spacing range of 1.0–1.5m can reduce *M. vitrata* infestation and most other yield-limiting insect infestation [51] and planting at 30x20 $cm^2$ or 60x20 $cm^2$, at the onset of the rain also gives a better result [52]. Furthermore, [53] reported an increased bird perching resulting from Intercropping with sorghum seeds and summer ploughing reduces pod borer by 85 % and increase legume crops productivity. Daily inspections and hand picking of the eggs and larvae of *M. vitrata* are by far better than the use of synthetic chemicals when the plants are few.

**Sex Pheromones and Traps**

The use of sex pheromones and traps have established a high degree of efficiency and proved complementary in the control of *M. vitrata* population in recent times. Most studies on sex pheromone of insect pests of legumes were conducted on *M. vitrata* [54]. Existing research have identified (E,E)-10,12-hexadecadienol, and (E)-10-hexadecenal as minor components [54] and (E,E)-10,12-hexadecadienal as major component [55] of sex pheromones which are both effective. Additionally, two more components, (*E*)-10-hexadecenol and (*Z,Z,Z,Z,Z*)-3,6,9,12,15-tricosapentaene were identified with increased catch [56].

Lots of these moths (up to1500 moths in just a night) were caught during cowpea growing season in Kano, Nigeria, with a light traps [57] which indicates that it can complement other methods to reduce *M. vitrata* damage to cowpea field.

## CONCLUSION

Going by its recent distribution and development of resistance to some chemical pesticides, *M. vitrata* is becoming a potential threat to dwindling global cowpea and other legume production. Thus, *M. vitrata* requires a great deal of attention. More comprehensive, diverse and up-to-date information on its ecology, diversity, patterns of migration, pesticides resistance techniques and off-season occurrence are needed to understand it better and screen for the most appropriate management strategies. Identification of more natural enemies of this pest and its integration with cultural practices and other biocontrol strategies would be an effective and safer control approach. Sex pheromones and traps are also effective in reducing the population pressure this pest. Intensive research into the components of the sex pheromone of this insect pest in different geographical regions is still required to fine-tune the pheromone based control of *M. vitrata* populations. Crop improvement programs should focus on producing resistant and genetically transformed yet easily accessible cowpea and other legumes seeds to local farmers.

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