| Studii şi Cercetări | Mai 2014 | Biologie | 23/2 | 79-84 | Universitatea"Vasile Alecsandri" din Bacău |
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# PRELYMINARY STUDY REGARDING THE PEST INSECTS MANAGEMENT AT *VIGNA* GENUS

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***Key words:*** *genotype, pathogen attack, risk, yield*

## INTRODUCTION

The genus *Vigna* contains several species that are important in world agriculture. Cowpeas (*V. unguiculata*), mung beans (*V. radiata*), and urd beans (*V. mungo*) are grown on more than 10 million ha annually, and provide a significant portion of the dietary protein in many societies. Several other species, i.e., adzuki beans (*V. angularis*), moth beans (*V. aconitifolia*), rice beans (*V. umbellata*), and bambarra groundnut (*V. subterranea*) are important in the diets of other societies.

Mungbean (*Vigna radiata* (L.) Wilczek) is one of the most important legumes of the arid and semiarid tropics (Chen et al., 1987). Blackgram (*Vigna mungo* (L.) Hepper) is a closely relative species of mungbean. Cowpea, *Vigna unguiculata* (L.) Walp (Family: Leguminosae) is grown and consumed for its high protein content (23-25%). The crop grows well in the Guinea and Sudan Savannahs of Nigeria. Pests and diseases are the most important impediment to cowpea production. In storage, cowpea is also affected by pests and diseases leading to their deterioration, and loss of nutritive value.

The importance of genus is highlighted by some aspects as follows: the species are excellent source of easily digestible protein and ascorbic acid (Vitamin-C) - synthesized in sprouted seeds of mung bean. Being leguminous crops have the capacity to fix-atmospheric nitrogen through symbiotic nitrogen fixation. The plants are also used as green manure crop. In the last period the genus *Vigna* become popular in Romanian farms thanks to all above mentioned aspects and also to its strong drought resistance.

Several factors are responsible for low production of mungbean and blackgram. Among them, insects attack plays an important role (Nine, 1980; Pal, 1996). Losses due to insect infestation are important problem in mungbean cultivation. According to farmers, insects caused more losses in modern varieties (about 14% yield losses) than in traditional varieties (about 9% yield losses).

The most important insects observed in the field, in order of their intensity, were caterpillar *(Spodoptera litura),* white fly *(Bemisia tabaci),* and pod borer *(Helicoverpa armigera)*. The farmers' perception of losses due to insect infestation matched with higher pesticide use on modern varieties. The perceived losses due to disease were found to be minimal at about 4-6%, depending upon variety.

## MATERIAL AND METHODS

The biological material was represented by *Vigna radiate* species. The paper presents a literature review regarding the pathogen insect attack. The investigated items presented are following:

- main insects helicoverpa *(Helicoverpa armigera, Helicoverpa punctigera)*; mirds (green mirid - *Creontiades dilutus* and brown mird - *Creontiades pacificus*); green vegetable bug (GVB) *(Nezara viridula);* redbanded shield bug (RBSB) *(Piezodorus oceanicus);* large brown bean bug (*Riptortus serripes)*; small brown bean bug (*Melanacanthus scutellaris)*; bean podborer *(Maruca vitrata)* (previously *Maruca testulalis*); thrips, silverleaf whitefly (SLW), *Bruchidius atrolineatus;*
- monitoring of insect attack,
- risk period and damage,
- thresholds of attack,
- control of pathogens.

## RESULTS AND DISCUSSIONS

Insects can significantly affect the overall profitability of a mungbean crop, reducing both yield and seed quality. Insect damage is one of the main reasons for decreasing the mungbean harvest.

**Helicoverpa *(H. punctigera)*** – figure 1

Helicoverpa can severely damage all crop stages and all plant parts of mungbeans.

Fig. 1. *Helicoverpa punctigera* – larvae

*Damage*

Helicoverpa defoliation is characterized by rounded chew marks and holes - loopers make angular holes. High populations in seedling or drought-stressed crops can cause considerable damage if vegetative terminals and stems are eaten. This type of damage results in pods being set closer to the ground. Such pods are more difficult to harvest. The vegetative terminals of drought-stressed crops are more likely to be severely damaged by helicoverpa as they remain on the last green tissue on the plant. Once crops reach flowering, larvae focus on buds, flowers and pods. Young larvae are more likely to feed on vegetative terminals, young leaves and flowers before attacking pods. Small pods may be totally consumed by helicoverpa, but larvae target the seeds in large pods. Crops are better able to compensate for early than late pod damage, however in dry land crops, where water is limiting, significant early damage may delay or stagger podding with subsequent yield and quality losses. Damage to well-developed pods also results in weather staining of uneaten seeds due to water entering the pods.

*Monitoring*

Beat sheet sampling is the preferred sampling method for medium to large helicoverpa larvae. Small larvae should be scouted for by inspecting (opening) vegetative terminals and flowers. Damage to vegetative terminals is often the first visual clue that helicoverpa larvae are present. Ideally, mungbeans should also be scouted for eggs and moths, to pinpoint the start of infestations and increase the chance of successful control.

- Inspect crops weekly during the vegetative stage.
- Inspect twice weekly from early budding until late podding.
- Sample 6 widely spaced locations/field.
- Take 5 one-meter long samples at each site with
- a ´standard´ beat sheet.

Convert larval counts/meter to larvae/$m^2$ by dividing counts by the row spacing in meters.

Beat sheet sampling may only detect 50% of small larvae in vegetative and podding mungbeans, and 70% during flowering, as they feed in sheltered sites such as leaf terminals. However, many small larvae may be lost to natural mortality factors before they reach a damaging size and this cancels out sampling inefficiencies in most crops.

*Thresholds*

In general, mungbeans are more tolerant of early than late damage. Vegetative mungbeans can tolerate up to 33% defoliation without yield loss. While up to 6 larvae/m² have no impact on yield in well-watered flowering mungbeans, 35 kg/ha is lost per larva per square meter by late podding. To simplify recommendations, the new reproductive threshold (late flowering/early podding to late podfill) is conservatively based on the rate of damage at late pod-fill, and varies from 1-3/m², depending on the cost of control and the price of mungbeans. This threshold allows for possible yield loss in drought-stressed crops damaged by helicoverpa at flowering.

**Mirids** - green mirid (*Creontiades dilutus*) – see fig. 2 and brown mired (*Creontiades pacificus*)

Mirids target buds and flowers causing them to abort and are considered one of the key pests of mungbeans. Mirid populations gradually build up in the vegetative crop and can be above the damage threshold before budding. It is critical to scout weekly prior to budding, and not to miss the start of budding.

Fig. 2. *Creontiades dilutes* – adult

*Risk period and damage*

- Budding, flowering and early-podding crops are at greatest risk
- Low populations (1/m) of green mirids are often present in vegetative crops but there is no evidence they cause ´tipping´ of vegetative terminals or yield loss.
- Further influxes of mirid adults often follow north-west winds in spring.
- Mirids attack buds, flowers and small pods.

*Monitoring*

- Mirids are very mobile and in-crop populations can increase rapidly.
- Crops should be inspected twice weekly from budding onwards until post-flowering.
- In row crops, the preferred method is beat sheeting, as this method is the most effective for helicoverpa and pod-sucking bugs.

- Sample 5 one-meter lengths of row (not consecutive) within a 20 m radius, from at least 6 sites throughout a crop.
- Avoid sampling during very windy weather as mirids are easily blown off the sheet.
- Thresholds for mirids in mungbeans vary from 0.3-0.6/m², depending on application costs and mungbean prices.

*Control*

- Shortening a crop´s flowering period reduces the risk of mirid damage.
- Flowering periods can be shortened by planting on a full moisture profile and by watering crops just before budding.
- Consider planting crops in at least 50 cm rows (as opposed to broadcast planting) to facilitate easier pest sampling.
- QPIF trials have shown that the addition of salt (0.5% NaCl) as an adjuvant can improve chemical control of moderate populations of mirids at lower chemical rates. Reducing pesticide rates (typically by 50-60%) greatly reduces their impact on beneficial insects and reduces the risk of flaring helicoverpa.

**Green vegetable bug (GVB)** ***(Nezara viridula)*** – see fig. 3. This species is the most damaging pod-sucking bug
in mungbeans due to its abundance, widespread distribution, rate of damage and rate of reproduction.

*Risk period*

Adult bugs typically invade summer legumes at flowering, but GVB is primarily a pod feeder with a preference for pods with well-developed seeds. Mungbeans remain at risk until pods are too hard to damage (i.e. very close to harvest). Damaging populations are typically highest in late summer crops during late pod-fill (when nymphs have reached or are near adulthood).

*Damage*

Pods most at risk are those containing well developed seeds. GVB also damages buds and flowers but mungbeans can compensate for this early damage. Damage to young pods causes deformed and shrivelled seeds and reduce yield. Seeds damaged in older pods are blemished, difficult to grade out and reduce quality. Bug-damaged seeds are frequently discolored, either directly as a result of tissue breakdown or water which may gain entry where pods are pierced by bugs.

*Sampling and monitoring*

Crops should be inspected for GVB twice weekly from budding until close to harvest.

Sample for GVB in early to mid morning.

- Beat sheet sampling is the most efficient monitoring method.
- Standard sampling units consists of 5 one-meter non-consecutive lengths of row within a 20 m radius.
- Convert all bug counts/row meter to bugs/m² by dividing counts/row meter by the row spacing in meters.
- At least 6 sites should be sampled throughout a crop to accurately determine adult GVB populations.
- GVB nymphs are more difficult to sample accurately as their distribution is extremely clumped, particularly during the early nymphal stages (instars 1-3).
- Ideally, at least 10 sites (with 5 non-consecutive row meters sampled/site) should be sampled to adequately assess nymphal populations.

*Thresholds*

Pod-sucking bug thresholds in mungbeans are determined by seed quality, the maximum bug damage permitted being only 2%. GVB thresholds typically range from 0.3-0.6/m² depending on the crop size (seeds/m²). In practice in infested crops, GVB and other pod sucking bugs are usually present from 28-35 days prior to harvest, and populations increase rapidly as a result of in-crop breeding.

Fig. 3. *Nezara viridula* – adult

**Redbanded shield bug (RBSB)** ***(Piezodorus oceanicus)*** - fig. 4 previously classified as *Piezodorus hybneri* and more recently as *P. grossi*.

*Pest status*

Major, widespread, regular. RBSB is 75% as damaging as GVB in summer pulses, but is usually not as abundant. However, it is more difficult to control with current pesticides. Adults are similar in shape to GVB but are smaller and paler, and with pink, white or yellow bands.

Fig. 4. *Piezodorus oceanicus* – adult

*Damage*
Damage is similar to that caused by GVB, with early damage reducing yield, and later damage reducing grain quality.
*Thresholds*
Convert to GVB equivalents to determine damage potential.
*Monitoring*
As for GVB. Beat sheeting is the preferred sampling method. Look for the distinctive twin-row egg rafts which indicate the presence of RBSB.
**Large Brown Bean Bug** (*Riptortus serripes)* and **Small Brown Bean Bug** (*Melanacanthus scutellaris)*
*Pest status* - as damaging as GVB.
*Host range and risk period* - as for GVB.
*Damage*
Both large and small brown bean bugs are as damaging as GVB. Damage is similar to that caused by GVB, with early damage reducing yield, while later damage reduces the quality of harvested seed.
**Bean podborer *(Maruca vitrata)* (**previously named ***Maruca testulalis*****) –** fig. 4.

Fig. 4 - *Maruca vitrata* **–** larvae

*Pest status and damage*
- Crops may be infested from early budding onwards.
- Eggs are laid on or in the flowers (inserted between the petals). Young larvae feed inside the flowers before moving to developing pods when mid-sized.
- Seeds in damaged pods are eaten out by larvae.
- Entry holes also let in water, which stains the remaining seeds.
- Early sign of infestation is the webbing of flowers.
- Infested pods have a well-defined entry hole (usually one/larva).

*Monitoring and control*
- Open all flowers from as many racemes as possible to look for larvae (at least 30 racemes randomly sampled across a crop).
- Divide the total number of bean pod borers detected by the number of racemes sampled, and multiply by the estimated number of racemes/ m².
- Current threshold are 3 larvae/m² but accurate assessments are difficult where larvae are inside flowers or pods.
- Pesticides are most effective if applied before larvae enter pods.

**Thrips –** fig. 5
*Pest status*
- Pest status is moderate, widespread and regular.
- Pest status is likely to increase given that they are vectors of the Tobacco Streak Virus (TSV) which also affects mungbeans.

*Risk period and damage*
Crops are at greatest risk during flowering and podset. Early infestations increase the risk of TSV.
Nymphs and adults feed in growing points and inside flowers which can result in flower abortion and pod distortion.
Deformed pods may be difficult to thresh, resulting in further yield losses.

Fig. 5. *Thrips* – adult

*Monitoring, thresholds and control*
- Open and examine flowers for thrips.
- If flowers cannot be assessed immediately, store in 70% alcohol to dislodge thrips and prevent thrips escaping.
- Control thrips if on average more than 4-6 thrips/flower.
- Vigorously growing crops can better compensate for flower abortion.
- Remove weeds such as *Parthenium* which host TSV. These weeds are also a potential source of

infested pollen which can be blown into mungbean crops.

**Silverleaf Whitefly (SLW)**

Mungbeans are not preferred hosts of silverleaf whitefly. While adults are often seen on mungbeans, SLW nymphs only develop poorly in this crop. Insect pathogen attack harm production, for which during the growing season, in addition to the management practices and chemical treatments are recommended when exceeding the economic damage threshold.

***Bruchidius atrolineatus*** - This beetle commonly infests and damage seeds of cowpea (*V. unguiculata*) and is sympatric in the distribution with C. maculatus in the West African Sahel (Ofuya and Credland, 1995b). B. atrolineatus is primarily a field pest (Booker, 1967). In the West African Sahel, adults are seen in cowpea fields at the flowering and podding phases and the females lay eggs on mature and ripening pods, and at harvest about 80-90% of the pods are infested (Alabeek, 1996). Average egg loads in the field are about ten eggs per pod, but may be higher (Huignard et al., 1985). Cowpea pods taken into storage are infested with *B. atrolineatus* eggs and the larvae at different stages of development.

Taking into account the negative impact of pathogens attack especially on yield, there were developed different methods for control. These methods differ and can be classified according to their nature in traditional methods – use of insecticides and biological control – use of natural enemies in order to avoid suppression of some species. Pesticides have been widely studied and have been shown to have a negative effect on natural enemy populations in many different studies (Tietjen and Cady, 2007). The table 1 presents the most used active ingredients at farm level, in order to control the insect attack on *Vigna* species, and takes into account also the impact of active ingredient on other non – target species.

Table 1. Insect control at *Vigna* species - traditional method –use of insecticides

| Pest | Active ingredient | Rate/ha | Impact on non-target species | WHP (days) | Comments |
|---|---|---|---|---|---|
| Helicoverpa | indoxacarb | 0.4 L | Moderate | 28 | Only 1 spray per crop* |
| | thiodicarb | 0.5-0.75 L | Disruptive to beneficials | 21 | Target larvae < 7 mm for best results |
| | methomyl | 0.5-2 L* | Disruptive to beneficials | 7 | Target larvae < 7 mm for best results |
| | deltamethrin | 0.5 L | Extreme | 7 | Target larvae < 5 mm for best results |
| | alphacypermethrin | 0.3-0.4 L | Extreme | 7 | Target larvae < 5 mm for best results |
| | helicoverpa NPV | 0.15 L | Little or no impact | NA | Target larvae < 7-10 mm. Preferred vegetative option |
| | Bt | 1-4 L | Little or no impact | NA | Target hatchlings for best results |
| Bean podborer | methomyl | 1.5-2 L | Disruptive to beneficials | 7 | Spray while larvae in flowers |
| GVB | deltamethrin | 0.5 L | Extreme | 7 | Most effective option |
| | methomyl | 1.5 L | Disruptive to beneficials | 7 | Poor control where dense canopy |
| Mirids | dimethoate | 0.5 L | Disruptive to beneficials | 7 | Most effective option |
| | indoxacarb | 0.4 L | Moderate | 28 | Don´t use if >2/m$^2$ |
| Thrips | dimethoate | 0.8 L | Disruptive to beneficials | 7 | Check in flowers |

WHP = withholding period (days).
*Maximum allowed for on label.
**Currently under permit, check www.apvma.gov.au prior to use.
Refer to all current product labels for full directions prior to use.

## CONCLUSIONS

Crops should be inspected regularly (weekly) from the vegetative stage through to budding, and twice weekly from the start of budding-flowering through to the completion of pod fill. Crops which are producing buds, but not flowers, may contain damaging levels of sucking insects, causing the buds to abort before the flowers open. Mungbeans can compensate for early damage by setting new buds and pods but this may result in uneven maturity. Excessive early damage can delay harvest.

Grain legumes like other food crops contain moisture at harvest. The amount of moisture they contain is of great consequence of the crop is to be stored for any length of time from one or two days upwards. To reduce crop respiration and spoilage and to extend its shelf life, it is essential that following harvest its moisture level be systematically reduced to

below certain well-defined limits. Excessive moisture content levels lead to deterioration of seeds and make them more susceptible to infestation by insect pests and infection by fungi. At harvest, *Vigna* seeds should be left to dry for some time to reduce the moisture content to safe levels. The safe moisture content level for *Vigna* species is 13% or lower.


## ABSTRACT

Insects can significantly affect the overall profitability of a mungbean crop, reducing both yield and seed quality. Accordingly, insect damage is one of the main reasons for downgrading *Vigna* crops. The investigated items presented in this paper are following: main insects helicoverpa *(Helicoverpa punctigera)*, mirds (green mirid - *Creontiades dilutus* and brown mird - *Creontiades pacificus*), green vegetable bug (GVB) *(Nezara viridula),* redbanded shield bug (RBSB) *(Piezodorus oceanicus),* large brown bean bug (*Riptortus serripes)*, small brown bean bug (*Melanacanthus scutellaris)*, bean podborer *(Maruca vitrata)* (previously *Maruca testulalis*), thrips, silverleaf whitefly (SLW); monitoring of insect attack; risk period and damage; thresholds of attack; control of pathogens. For a proper management of insect attack, crops should be inspected regularly (weekly) from the vegetative stage through to budding, and twice weekly from the start of budding-flowering through to the completion of pod fill. Crops which are producing buds, but not flowers, may contain damaging levels of sucking insects, causing the buds to abort before the flowers open. Mungbeans can compensate for early damage by setting new buds and pods but this may result in uneven maturity. Excessive early damage can delay harvest.



## ACKNOWLEDGEMENTS

This work was cofinanced from the European Social Fund through Sectorial Operational Programme Human Resources Development 2007-20013 project number POSDRU/I.89/1.5/S62371 "Postdoctoral School in agriculture and Veterinary Medicine area", "Partnerships in Priority Areas Programme" – PN II developed with support of *ANCS, CNDI – UEFISCDI, project number* PN-II-PT-PCCA-2011-3.2-1351, contract registration 68/2012, PN II Innovation and also ADER 2020 Programme.


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