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Inventory of Insect Pests of Eggplant Cultivation (*Solanum spp*) in Walungu, South Kivu, Dr Congo

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Abstract: Eggplant cultivation is subject to attacks from several enemies (biotic and abiotic) which affect its yield. In the objective to inventory the pests (enemies) of eggplant cultivation in Walungu this study was initiated; the method adopted consisted of a survey coupled with an observation in the fields of 90 producers and a capture of the pests encountered on the aerial parts of the plants. The results obtained revealed that the identified pests belong to 6 entomological orders which are, Orthoptera, Heteroptera, Lepidoptera, Coleoptera, Diptera and Hemiptera; and to 14 entomological families with 18 species. These pests were identified at the agricultural entomology laboratory of CRSN Lwiro coupled with an identification key.

Keywords*: Eggplant, Insect Pests, Walungu , DRC.*

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I. INTRODUCTION

South Kivu is one of the provinces of the Democratic Republic of Congo with a strong agricultural vocation in the economic activities of farmers. Agriculture employs 68.7% of the active population (UNDP, 2009). This has long earned this province the title of the country's breadbasket because it served to supply other provinces with food products (Mastaki , 2006). With its relief dotted with mountains and plains, the province of South Kivu offers favorable pedoclimatic conditions for different types of crops, such as market gardening, which is one of the fastest growing sectors of agriculture. In this province, urban population growth leads to a strong demand for market garden products; market gardening is a growing sector that employs more and more people. In addition, it is a means of generating income that allows people to meet their daily household needs and ensure their livelihood from small-scale agricultural production (Rushigira , 2017, Kanda et al., 2009).

Moustier and David, 1996 state that most market gardening systems require little initial capital; even if their installation requires a significant workforce or labor force. Among the market gardening crops found in South Kivu and particularly in the Walungu territory , there is the cultivation of eggplant *(Solanum aethipicum and solanum macrocaropn*) (Rushigira , 2017).

Walungu Territorial Agriculture Inspectorate , eggplant cultivation in Walungu employs a significant portion of the population, with production estimated at 13,492 tonnes for 2018 and 69,789 tonnes for 2019 (ITA Walungu , 2019). These figures reflect the expansion of cultivation in Walungu territory . This increase is a direct consequence of the increase in the sown area, which rose from 8,995 ha in 2018 to 46,526 ha in 2019, with a yield per hectare of 1,500 kg over the last three years (ITA Walungu , 2019). However, eggplant cultivation is subject to numerous biotic (parasitic) and abiotic constraints contributing to the decline in yields in different types of soils (Muzingu , 2010), including diseases and phytophagous insects (Fondio et al.,

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2009). Indeed, crop enemies reduce, through their ravages, the capacity of the plant to produce or properly express its production potential. Among these pests, we find whiteflies (whitefly), trips, aphids, red spiders, tarsonemes, fruit flies, pyralids, beetles, bugs, caterpillars, etc. (Anonymous, 2009), which can affect the plant at different phenological stages : vegetative growth, flowering, fruiting and maturation (ears, pods, etc.), stored foodstuffs, etc. (Dupriez , 2007). The diversity of pests is poorly documented in this region, and it is necessary to better understand which species cause damage to eggplant cultivation in Walungu . The success of any crop requires knowledge of the different pests that attack it and associating it with knowledge of the auxiliary fauna that participates in the regulation of these pests (*E. TENDENG et al, 2017*), it is in this perspective that our study is part of. The inventory of species of enemies of eggplant cultivation in Walungu remains unknown.

The objective of this study is to contribute to the knowledge of the entomological fauna of market garden crops by collecting and identifying the different pests present in eggplant cultivation in Walungu .

II. MATERIALS AND METHODS

A. Presentation of the Study Environment

The study was carried out in the territory of Walungu , South Kivu province, Democratic Republic of Congo. It is located southeast of the provincial capital, Bukavu, south of the territory of Kabare , between $28^{0}10^{'}$ and $28^{0}10^{'}$ East longitude, and $2^{0}32^{'}$ and $2^{0}50^{'}$ South latitude, with an area of 1800 km². The territory of Walungu in general enjoys a tropical and humid climate of altitude with alternating two seasons: the rainy season which runs from September to mid-June, and the dry season which runs from mid-June to August. Average rainfall varies from 1500 and 1800 mm per year and average temperatures vary from 16° to 20.6°C. The soils found in the Walungu territory are of variable type depending on the nature of the parent rock, we find soils stripped by erosion with a compact profile, strongly acidic and with low agricultural value (Anonymous, 2005).

B. Methods

➢ *Sampling and Preservation of Collected Insects*

The sampling of arthropod pests of eggplant cultivation was carried out in the fields of producers selected in three groups in the Walungu territory , which constitute the most important production sites of this crop. Only insects found on the organs (stems, leaves, flowers and fruits) of the plants are captured. The collected individuals are placed in plastic tubes containing 70% alcohol for their transport and conservation. The work took place from June 2024 to December 2024 because of the abundance of this crop during this period. For each phenological stage of the crop (vegetative, flowering, fruiting and maturation) regular visits were carried out in the different selected fields.

➢ *Specimen Identification*

The illustrated catalog of the main insect pests and auxiliaries of crops in Guyana (Charlotte Gourmel , 2014) and diseases and pests of crops in the Great Lakes region of Central Africa (A. Autrique et al, 1989) were used for insect identification, combined with a visual capture of the insects. The collected specimens were submitted to the Agricultural Entomology Laboratory of the Natural Sciences Research Center (CRSN Lwiro) for identification using the entomological magnifying glass coupled with the insect identification key.

III. RESULTS

The preliminary inventory of the entomofauna made it possible to make a census of pests of the eggplant crop in Walungu . In total, 18 insects were identified, belonging to 6 orders and 14 entomological families, including Coleoptera (4), Lepidoptera (3), Orthoptera (3), Heteroptera (2), Diptera (1), and Hemiptera (2).

Table 1: Identification of Arthropod Pests of Eggplant Cultivation in Walungu , South Kivu

No.	Scientific Name	Common Noun	Order	Family
1	*Brachytrapes membraneceus (Drury)*	Stem-cutting cricket	Orthoptera	Gryllidae
2	*Nezara viridula*	Stink bug	Heteroptera	Pentatomidae
3	*Lygus pratensis*	Thumbtack	Heteroptera	Miridae
4	*Phthia picta*		Hemiptera	Coreidae
5	*Sesamia nonagrioides*	Corn sesame	Lepidoptera	Noctuidae
6	*Helicoverpa armigera*	Tomato moth	Lepidoptera	Noctuidae
7	*phyllotreta spp*	Flea beetle	Coleoptera	Chrysomellidae
8	*Anthonomus eugenii*	Weevil	Coleoptera	Curculionidae
9	*Eublemma olivacea*	Eggplant Twister	Lepidoptera	Eribidae
10	*Calliptamus italicus*	Italian cricket	Orthoptera	Tetrigidae
11	*Chrysolina bankii (= Chrysolina Banskii)*	Maribe leaf beetle	Coleoptera	Chrysomellidae
12	*Agrotis sagetum*	Gray worms	Lepidoptera	Noctuidae
13	*Tettigonia ssp*	Grasshopper	Orthoptera	Tetigonidae
14	*Liriomyza spp*	Leafminer fly	Diptera	Agromyzidae
15	*Aphis gossypii*	Black aphid	Hemiptera	Aphididae

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16	*Epitrix hirtipennis*	Flea beetle	Coleoptera	Chrysomellidae
17	*Cetonia aurata*	Cetonia	Coleoptera	Cetonidae

Inspection of the above-ground organs of eggplant plants allowed the collection of samples which led to the identification of 18 insects were identified, belonging to 6 orders and 14 entomological families, including Coleoptera (4), Lepidoptera (3), Orthoptera (3), Heteroptera (2), Diptera (1), and Hemiptera (2) as indicated in the table above. Only the species *Agrotis sagetum* was found in the soil near the plant collar in which it had cut the stem.

Table 2: Insects and their Presence According to the Phenological Stages of the Eggplant

No.	*ORDERS*	*Vegetative growth*	*Bloom*	*Fruiting and maturation*
1	**Diptera** :			
	Liriomyza spp	+	+	+
2	**Beetles** :			
	Cetonia aurata	-	+	+
	Chrysolina Banskii	-	+	+
	Epitrix hirtipennis	+	+	-
	Anthonomus eugenii	-	+	+
	Phylotreta ssp	-	+	-
3	**Hemiptera** :			
	Aphis gossypi		+	+
	Phtia picta	-	+	+
4	**Heteroptera:**			
	Nezara viridula	-	+	+
	Lygus pratensis	-	+	+
5	**Lepidoptera** :			
	Agrotis sagetum	+	-	-
	Eublema olerecea	-	+	
6	**Orthoptera:**			
	Callipamus italicus	-	+	+
	Brachytrapes mambraneceus	-	+	+
	tettigonia ssp		+	+

Presence +
Absence -

Of From this table, it is clear that insect pests were more abundant in eggplant cultivation during the flowering stage followed by fruiting and ripening and finally vegetative growth. Only *agrotis sagetum* , *Epitrix hirtipennis and Liriomyza spp* were remarkable during the vegetative growth stage and that *agrotis sagetum* was only found during this specific phenological phase , only. The species were found in two phenological phases of eggplant plants (flowering and fruiting and maturation) which affects the development and flowering of the plant.

Table 3: Severity of Insect Attacks According to Phenological Stages

Plants inspected		**Severity of Insect Attacks in %**		
		Vegetative growth	Bloom	Fruiting and maturation
900	Attacked plants	114	129	117
		12.6%	**14.3%**	**13%**

From this table, it is clear that the attacks are most serious during flowering (14.3%), followed by fruiting and ripening (13%) and finally vegetative growth (12.6%), figures which, moreover, seem very close. This can be explained by the fact that during the vegetative growth stage, the presence of pests is the lowest possible, according to information received from producers and the crop vigor is the best possible.

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Table 4. Means of Recognizing Insect Damage on Eggplant Crops

Means of recognition	Frequency	Percentage
Cutting of stems by the insect	20	22%
Leaf stunting	9	10%
Fruit perforation	26	29%
Fall of flowers and buds	19	21%
Grazed leaves	16	18%
Total	90	100%

Table 4 shows the different ways producers identify traces of insect pests on crops. These are mainly stem cutting (22%), leaf stunting (10%), fruit holes (29%), leaf drop (21%) and browsed leaves (18%). It should be noted that these methods of identification may depend on the stage of crop development and negatively impact the production of affected plants. Market gardeners are unable to determine which insect pests to attribute to which pests.

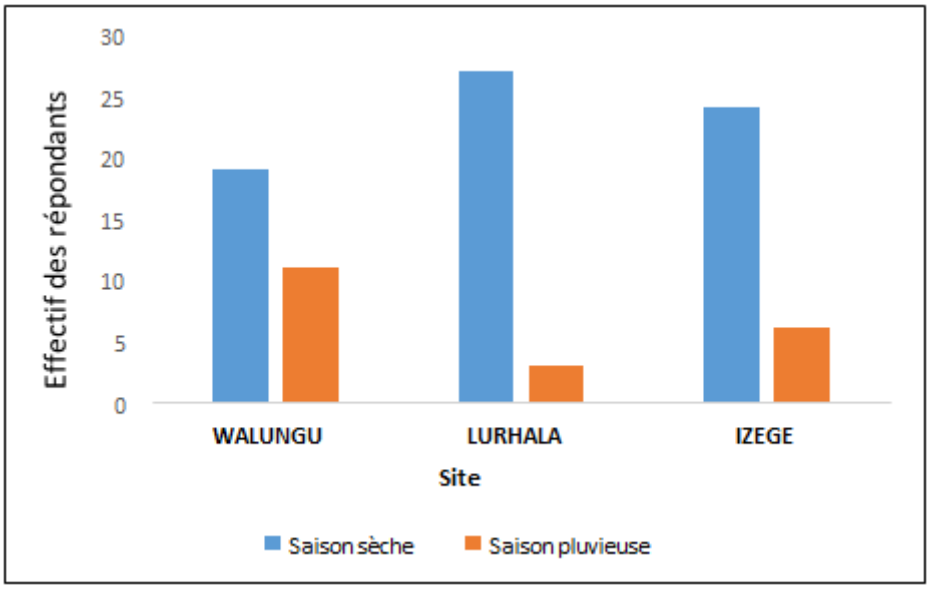

Fig. 1. Producers' Perception of Pest Prevalence by Season

In the three sites that were the subject of our study, according to the perception of the producers, it emerges from this figure that insects are more abundant in the dry season than in the rainy season. Nevertheless, there is an increase in insects in the rainy season in the Walungu site , this is linked to the intensification and monoculture applied by most of the producers of this site.

IV. DISCUSSION OF RESULTS

The results obtained from this study made it possible to make a first update of the entomofauna of eggplant cultivation in Walungu . After identification, 14 entomological families and 18 species of insects were listed (Table 1). These results do not contradict those obtained by E. TENDENG et al in 2017 , in his study carried out in Casamance, Senegal, which indicates that most of the pests of market garden crops belong to the orders of Diptera, Coleoptera, Hemiptera, Lepidoptera. However, in this study, *Nezara viridula , Aphis gossypii , Liriomysa* sp are not found on eggplant but rather on cucumber, squash, okra and tomato. The conclusions of work by *Johnson FELICIA et al 2019* , on eggplant in Ivory Coast indicates that *Tettigonia viridissima* and *tettigonia caudata* , *Callipamus italicus* meet on eggplant which corroborates the result of the present study. However, in our study the other species included in its results were not found.

The presence of pests during cultivation according to phenological stage , indicates that more species were present during flowering (14 species) followed by fruiting and maturation (11 species) and finally growth (3 species, such as *agrotis sagetum , epitrix hirtipennis and liriomyza spp* .). Only *agrotis sagetum* appears only at the vegetative growth stage, and *Eublema olererea* appears only during flowering, while the other species appear at almost all stages (*liriomyza spp)* or two-stage (Table 2).

The work of. *PATOUMA et al* , 2020 on the characterization of the entomofauna of the tomato in the locality of Meskine in Cameroon made it possible to make an inventory of the entomofauna in tomato cultivation, and the results do not deviate too much from the conclusion of our study. The work of *ISSOUFOU et al 2017* , *Fortuné BIAO* et al, in 2019 obtained results which are in harmony with the results of this study. For *ISSOUFOU et al 2017, the* phenological stages during which insects were present on the cowpea crop in Niger are vegetative growth, flowering and fruiting and maturation while *Fortuné BIAO et al, in 2019* , noted that the market gardener practicing chili

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cultivation encounters insects such as aphids, whiteflies as well as thrips, and that their damage is most serious during fruiting (59.9%), flowering (20.20%) and strong vegetative growth (16.16%) while ours indicates an attack severity of 14.3% at the flowering stage, 13% during fruiting and maturation and 12.6% during the intense growth stage (Table 3). This indicates a low attack of these insects in eggplant cultivation in our environment. Even if during flowering the attack severity remains the most important in both works.

The results of the work of Sivapragasam A et al, 2008, indicate that the recognition of insect pests in eggplant fields includes various symptoms, including visible damage, such as cutting of stems, damaged leaves and the presence of galleries in the fruits. The browsed leaves, leading to a disruption of photosynthesis and thus weakening the plant, which is corroborated by the results of the present study (Table 4). Also, it is important to note that the favorable season for the development of most insects, seems to be the dry season, and that is why it is during this period that producers face more attacks than in the rainy season (Figure 1). The trend in the Walungu site is towards an increase in attacks during the rainy season, something linked to the repetitive monoculture on the same plots offering favorable conditions for the development of insect pests of this crop.

V. CONCLUSION

In the DRC, eggplant cultivation is subject to attack by insect pests. In this study, we identified the insect pests associated with this crop in the territory of Walungu , in the province of South Kivu. It appears from this study that insects are more abundant during flowering, followed by fruiting and maturation and at the end of intense vegetative growth. Some of these pests are observed during all phenological stages of the crop, others on two stages and the others during a single stage (*agrotis sagetum)* . Attacks are most increased during flowering and fruiting maturation. Beetles are the most common pests encountered on eggplant. The means of recognition of pests by producers have been determined; these are essentially the cutting of stems, the stunting of leaves, galleries in the fruits, browsed leaves, etc. Producers are able to perceive insect damage without knowing which types of insects they are. The prevalence of insect pests is highest during the dry season (which is a favorable period for the development of the most insects), but some insects are also reported during rainy periods.

In this study, we did not dwell on the damage that these phytophages inflict on eggplant crops. However, we indicated the attack threshold according to the phenological stages of the crop.

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