

Evaluation of the action of secondary metabolites of *Metarhizium anisopliae* and of some Algerian medicinal plants for their insecticidal activities against *Ceratitis capitata* and *Schistocerca gregaria*

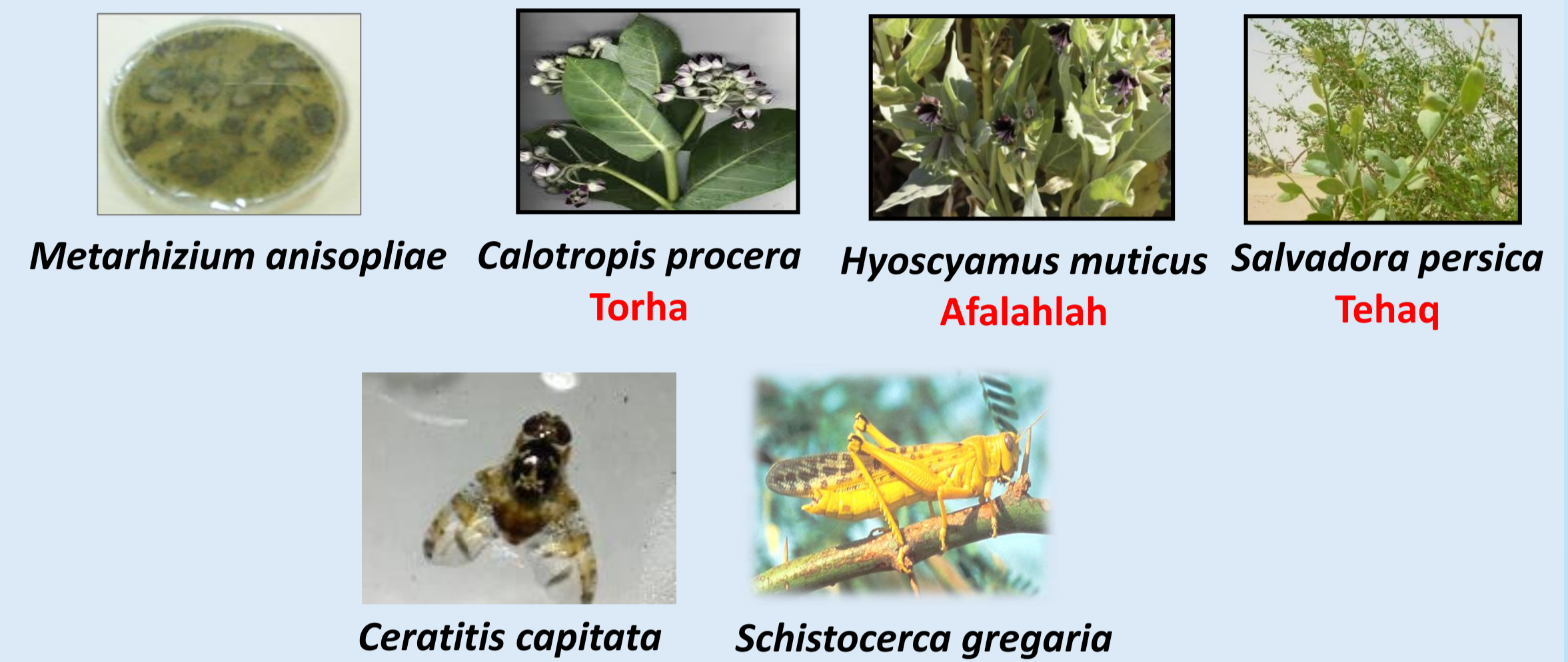
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Summary: Our research focuses on evaluating the action of *Metarhizium anisopliae* and *Hyoscyamus muticus*, *Calotropis procera* and *Salvadora persica*, for their insecticidal activity against *Schistocerca gregaria* and *Ceratitis capitata*. After mass rearing the pests in the laboratory, we applied treatments based on entomopathogenic solutions and aqueous extracts of the plants tested against the adults. The results highlighted the neurotoxic, lethal and hemolytic action of the biological agents tested. The integration of entomopathogenic plants and fungi in integrated pest management could contribute to a more sustainable and effective approach, while helping to achieve food security worldwide.

Introduction: The use of biological control in crop management is essential to guarantee food safety while respecting the environment, by promoting the use of entomopathogenic fungi and insecticidal plants, thus reducing dependence on chemical pesticides, which can harm biodiversity and ecosystem health. Our aim is to propose more effective and less polluting means of control, through the use of natural substances of plant origin and entomopathogenic fungi as insecticides.

Methods/Approach: The experimental protocol is based on mass rearing of the two pests in question, extraction of the secondary metabolites of the biological agents tested and, finally, treatment of the adults, firstly with the entomopathogenic solution and secondly with the aqueous plant extracts. Our study concerns the evaluation of the biological activity of the entomopathogenic fungus *M. anisopliae* and the plants *Hyoscyamus muticus*, *Calotropis procera* and *Salvadora persica*, on the mortality and hemolymph of adults of *Ceratitis capitata* and *Schistocerca gregaria*.



Results and Impacts:

-The extraction of secondary metabolites reveals the presence of destruxins on *M. anisopliae* and alkaloids, tannins, flavonoids, saponins, terpene compounds, sterols and triterpenes, Cardiotonic heterosides and Cyanogenic compounds on plants studied. Our results confirm the work of Bammou and *al.* (2015).

- Individuals (*C. capitata*, *S. gregaria*) treated either with *M. anisopliae* or with the three plants tested showed excitation movements (neurotoxic action of alkaloids) and weakened, followed by the death of all the individuals in the treated batch. The alkaloids contained in the plant develop neurotoxic activity by slowing the closure of Na⁺-dependent channels (like pyrethrum) and disrupting membrane depolarization, thus causing paralysis before death (figure 1).

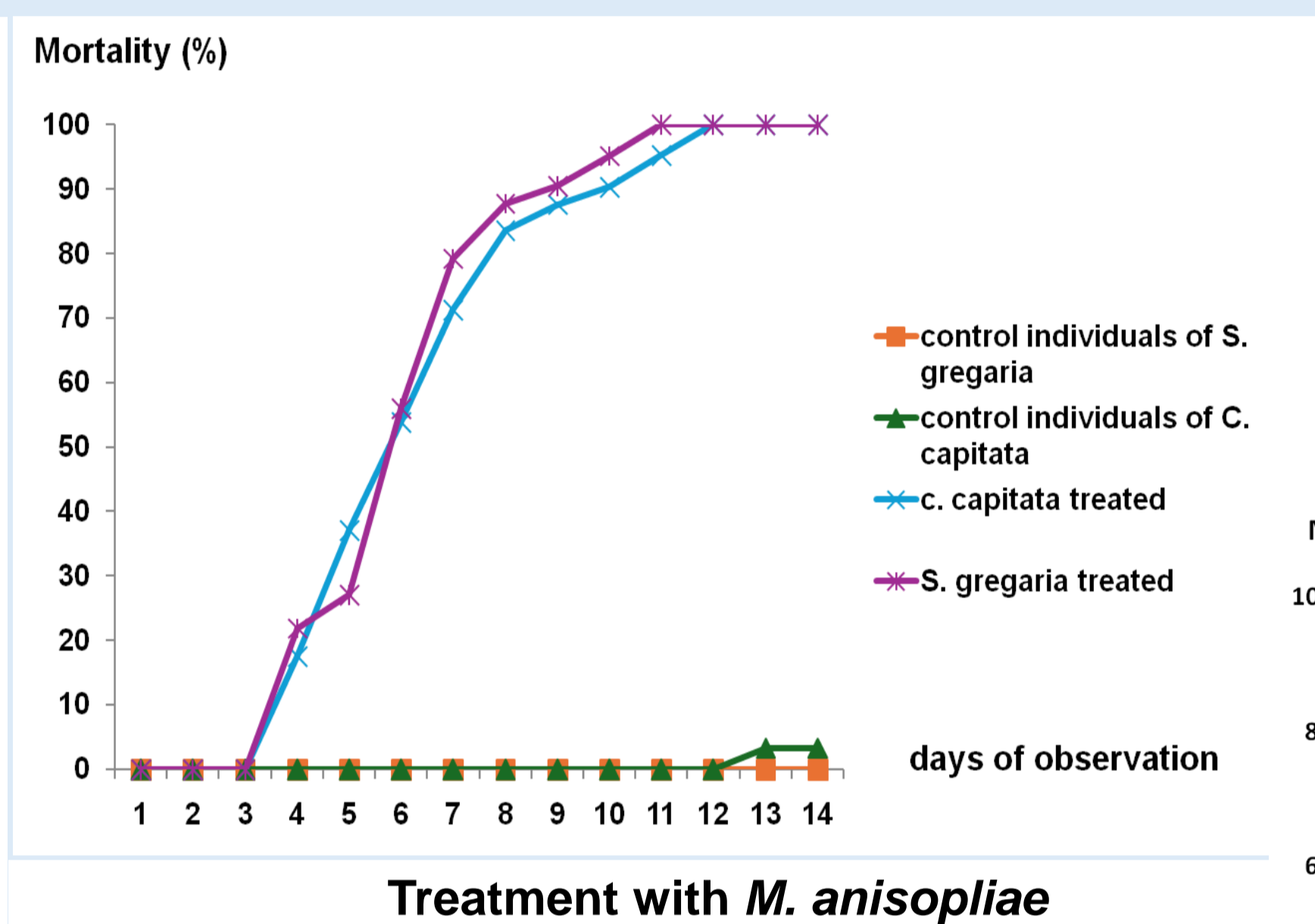
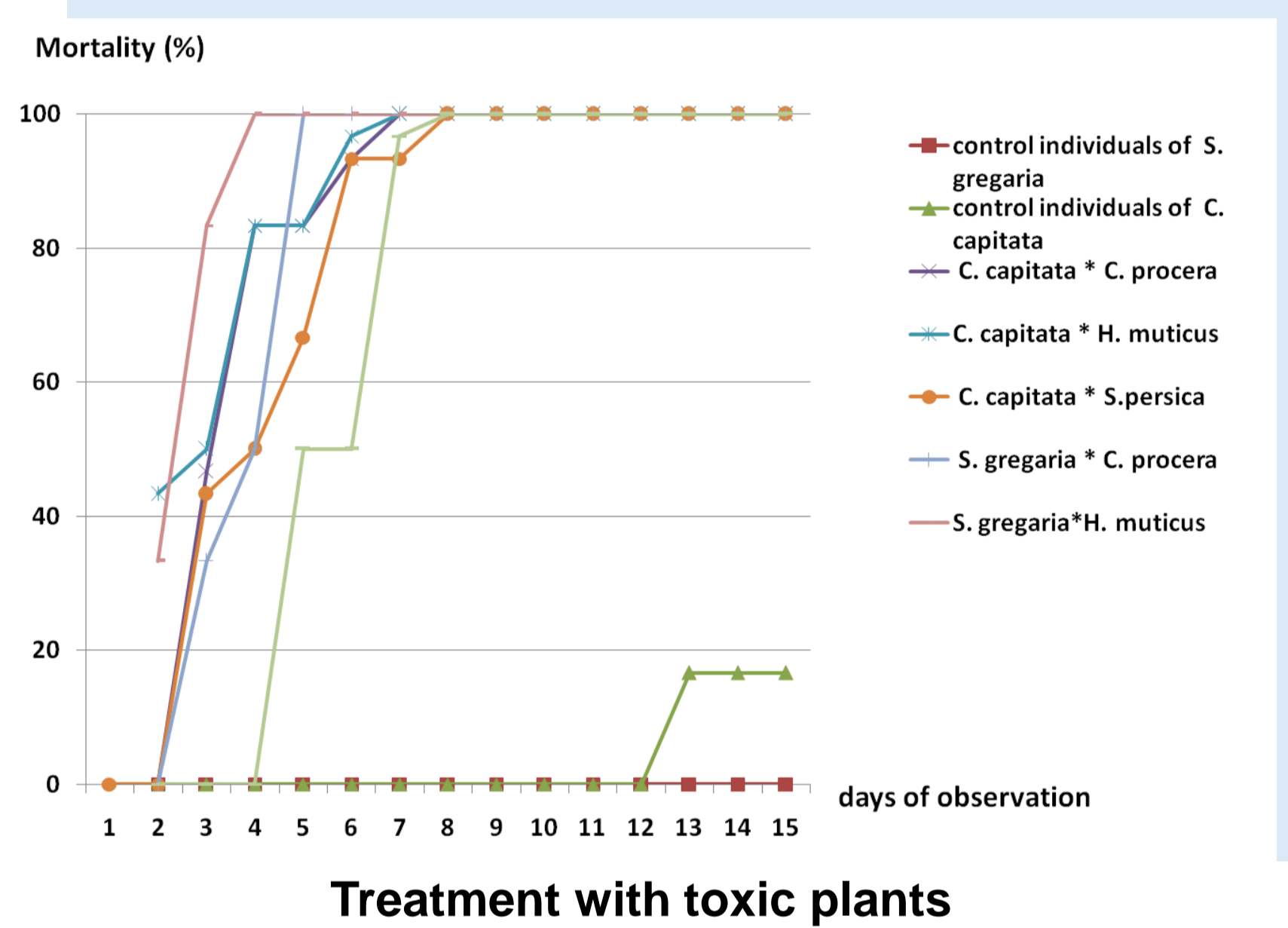


Figure 1: mortality of *S. gregaria* and *C. capitata* individuals, control and treated with the biological agents tested



- The two treatments revealed an immune response in treated individuals, reflected in structural alterations but also a disturbance of the blood count: remarkable drop in prohemocytes and granulocytes + slight increase in plasmatocytes and coagulocytes.

-The rapid degeneration of granular hemocytes, initiated by vacuolization and the loss of firmness of organelles, leading to degranulation and degenerative transformation within a 48-hour period.

-Formation of cell clusters + Release of secretory granules

-Retraction of some cells + release of the contents of other cells into the extracellular space + Extension of pseudopods (figure 2).

-Hemocyte-induced phagocytosis, nodulation and encapsulation were initiated by exposure to different invaders. This type of results will contribute to our understanding of cellular immune responses and further study of hemocyte recognition receptors in YPM (Shaohua and *al.*,2022) .

Abnormalities in the blood count (potential immunosuppressive effect of blood cells), or cell depletion resulting from the immune system's attempt to phagocytose toxins that have evaded the phagocytic barrier in treated individuals, leading to nearly complete cell lysis 24 hours after treatment.

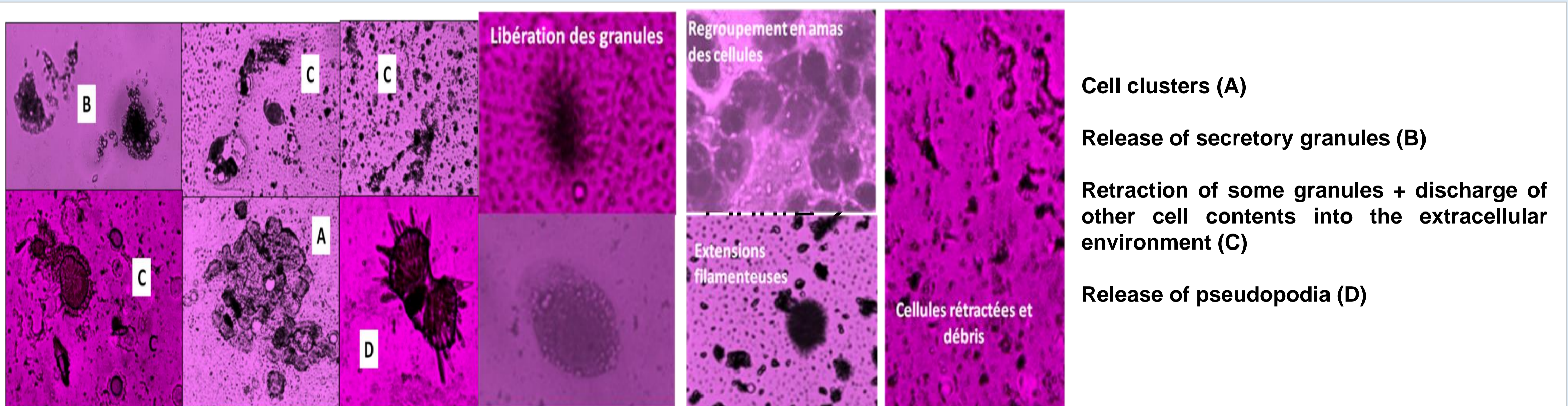


Figure 2: Hemolytic and cytotoxic action of biological agents used against *C. capitata* and *S. gregaria* (Gr X 40; original photos)

Way forward: The introduction natural substances of plant origin is proving to be a promising alternative for a more tempting solution against insect pests. The use of *M. anisopliae* is proving to be a promising method of biological pest control. Further adjustments and studies are recommended to standardize its application and improve its effectiveness in the field.

References:

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 Shaohua Li, Fanghua Liu, Zhiwei Kang ,Xiangdong Li, Yang Lu, Qiyun Li, Yunshun Pang ,Fangqiang Zheng and Xiangchu Yin, 2022 - Cellular immune responses of the yellow peach moth, *Conogethes punctiferalis* (Lepidoptera: Crambidae), to the entomopathogenic fungus, *Beauveria bassiana* (Hypocreales: Cordycipitaceae). *Journal of Invertebrate Pathology*. Vol. 194 , pp : 107826.