First Record of *Mythimna sequax* (lepidoptera: noctuidae) damaging canary grass (*Phalaris canariensis*) in Ijuí, RS, Brazil

Primeiro registro de *Mythimna sequax* (lepidoptera: noctuidae) causando danos ao alpiste (*Phalaris canariensis*) em Ijuí, RS, Brasil

Primer registro de *Mythimna sequax* (lepidoptera: noctuidae) causando daño al pasto canario (*Phalaris canariensis*) en Ijuí, RS, Brasil

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ABSTRACT
Canary grass (*Phalaris canariensis* L.) is a plant belonging to the Poaceae family, exhibiting a production cycle like the main winter cereals cultivated in Rio Grande do Sul. In pursuit of this market, the Regional University of Northwestern State of Rio Grande do Sul, through the Genetic Improvement Program – Grain and Cover Plants line, has successfully undertaken initiatives to enhance canary grass cultivation. This involves improving cultivars and adopting technologies to maximize productivity, with the aim of providing cultivars better adapted to the northwestern region of the state to meet the needs of local producers. In this sense, this research stands as the inaugural report of the pest in Ijuí, RS, Brazil, specifically targeting canary grass, offering valuable insights into its life stages, and providing a foundation for future studies on *Mythimna sequax*.

Keywords: caterpillar, record, new host, winter, canary grass.

RESUMO
O alpiste (*Phalaris canariensis* L.) é uma planta pertencente à família Poaceae, apresentando um ciclo de produção semelhante aos principais cereais de inverno cultivados no Rio Grande do Sul. Em busca desse mercado, a Universidade Regional do Noroeste do Estado do Rio Grande do Sul, por meio do Programa de Melhoramento Genético – Linha de Plantas de Grãos e Cobertura, empreendeu com sucesso iniciativas para aprimorar o cultivo de alpiste. Isso envolve a melhoria de cultivares e a adoção de tecnologias para maximizar a produtividade, com o objetivo de fornecer cultivares melhor adaptados à região noroeste do estado para atender às necessidades dos produtores locais. Nesse sentido, esta pesquisa se destaca como o relato inaugural da praga em Ijuí, RS, Brasil, direcionando-se especificamente ao alpiste, oferecendo insights valiosos sobre seus estágios de vida e estabelecendo uma base para estudos futuros sobre *Mythimna sequax*.

Palavras-chave: lagarta, registro, novo hospedeiro, inverno, alpiste.

RESUMEN

Phalaris canariensis L. es una planta perteneciente a la familia Poaceae, con un ciclo de producción similar a los principales cereales de invierno cultivados en Río Grande do Sul. En busca de este mercado, la Universidad Regional del Noroeste del Estado de Río Grande del Sur, a través del Programa de Mejoramiento Genético – Línea de Plantas de Grano y Cobertura, ha emprendido con éxito iniciativas para mejorar el cultivo de pasto canario. Esto implica mejorar los cultivares y adoptar tecnologías para maximizar la productividad, con el objetivo de brindar cultivares mejor adaptados a la región noroccidental del estado para satisfacer las necesidades de los productores locales. En este sentido, esta investigación se destaca como el informe inaugural de la plaga en Ijuí, RS, Brasil, abordando específicamente el tamizaje, ofreciendo valiosos conocimientos sobre sus etapas de vida y estableciendo una base para futuros estudios sobre Mythmina sequax.

Palabras clave: oruga, registro, nuevo anfitrión, invierno, oruga.

1 INTRODUCTION

Alpiste, alpista or canary grass (*Phalaris canariensis* L.) is a plant belonging to the Poaceae family, exhibiting a production cycle like the main winter cereals cultivated in Rio Grande do Sul (COGLIATTI, 2012). Canada stands as the world's largest producer, contributing to approximately 70% of global production, followed by Thailand, Argentina, Turkey, Australia, Uruguay, Morocco, and Mexico (TRIDGE, 2023). The most plausible theory regarding the introduction of alpiste in Brazil suggests that cultivation began in Rio Grande do Sul, with seeds imported from Uruguay and Argentina. In the 1940s and 1950s, Rio Grande do Sul emerged as a major producer, particularly in specific municipalities (Canguçu, Encruzilhada do Sul, Caçapava do Sul, São Lourenço, and Bagé). During this period, the state surpassed Uruguayan production, reaching a cultivated area of 13,000 hectares. The cultivation of this grain gained significant importance in the region, leading to the establishment of a research program at the Estação Fitotécnica de Bagé. Notably, in some municipalities such as Caçapava do Sul, yields exceeded 2,000 kg/ha (BAIER; FLOSS; AUDE, 1988).

Recently, due to the cultivation possibilities and attractive market values, there has been a significant interest in increasing the production and productivity of canary grass cultivation. In pursuit of this market, the Regional University of Northwestern State of Rio Grande do Sul, through the Genetic Improvement Program – Grain and Cover Plants line, has successfully undertaken initiatives to enhance canary grass cultivation. This involves improving cultivars and adopting technologies to maximize productivity, with the aim of providing cultivars better adapted to the northwestern region of the state to meet the needs of local producers.

Due to its protein content comparable to common grains, this grass can be designated for human consumption in the form of flours, as well as for animal feed, particularly for birds, either used alone or in blends with other species such as sunflower, corn, and flax (GRAJEDA et al., 2012). The structure of canary grass features starch and protein granules akin to those found in oats. The significant distinction of this seed from other cereals lies in its higher levels of protein and fat, coupled with a lower fiber content (ABDEL-AAL et al., 2011).

Moreover, the cereal can serve as an alternative for winter cultivation to meet animal feed demands, given its shallow roots that are more sensitive to heat and drought. Therefore, it thrives better in soils that retain moisture during the growth phase (CDCS, 2018). According to data from the Food and Agriculture Organization of the United Nations (FAO, 2021), in 2020, Canada achieved a canary grass production of 178,200 tons, with an estimated yield of 16,171 kg/ha. Argentina, on the other hand, exhibited an average of 13,924 kg/ha, totaling a cereal production of 20,540 tons.

Undoubtedly, the impact of pest insects poses a significant challenge to agriculture worldwide (FAO, 2021). These insects have the potential to cause substantial damage to crops, jeopardizing both productivity and crop quality. Pests represent a considerable threat to agriculture by causing productivity losses through their feeding on essential plant parts such as leaves, roots, fruits, and seeds (GALLO et al., 2002). These attacks result not only in quantitative reductions in production but also affect crop quality, inducing deformities, discoloration, and infections (FRANCO et al., 2021).

According to OUABA et al., 2022, the order Lepidoptera represents one of the most abundant and diverse insect groups globally, with more than 178,159 species described in more than 4000 genera. The frequent reliance on agrochemicals, including pesticides and insecticides, for pest control establishes a cycle of intensive usage that has adverse environmental impacts. These impacts encompass issues such as resistance problems within insect populations and environmental contamination (KAUR and GARG, 2014). Beyond environmental challenges, the additional costs associated with pest control, including preventive measures, continuous monitoring, and chemical applications, can undermine the economic viability of agricultural operations, particularly for small-scale farmers (KANSIIME; RWOMUSHANA; MUGAMBI, 2023). These challenges underscore the urgent need for sustainable and integrated approaches in pest management to ensure long-term agricultural productivity, crop quality, and overall sustainability (DEGUINE et al., 2023).

One fundamental element in implementing an Integrated Pest Management (IPM) program, as proposed by CROCOMO (1990), involves the accurate taxonomic identification of insects. This should be followed by plans for monitoring, sampling, and along with population quantification and the observation of natural enemies' behavior in the area. These observational elements serve as the foundation for adopting insect control strategies, with chemical control being considered the last resort (PEDIGO and RICE, 2006), The aim is always to use products as selectively as possible, promoting more sustainable approaches and minimizing environmental impacts. Regarding pest insects, canary grass cultivation lacks established control and damage thresholds for insects. However, the potential for aphid attacks and a complex of caterpillars necessitates investigation based on their incidence in crops (CARVALHO et al., 2023).

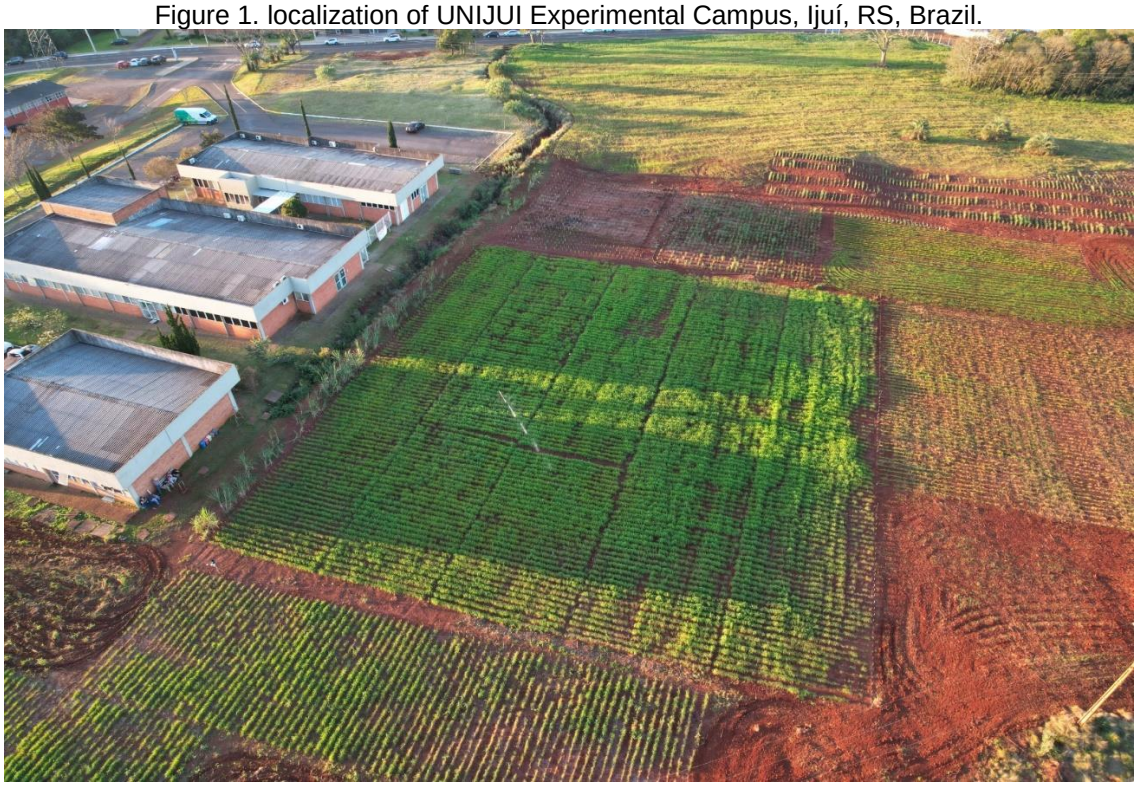
Mythimna sequax Franclemont, 1951 (Lepidoptera: Noctuidae) emerges as a significant threat among armyworms in the American tropics and subtropics, particularly when infesting canary grass (*Phalaris canariensis)*. This study provides a comprehensive examination of the consumption focusing on larvae

reared on canary grass, constituting the first photographic record of damages caused by the species in canary grass, documented in Ijuí, RS, Brazil.

2 MATERIAL AND METHODS

The research was conducted at the UNIJUI Experimental Campus, in the municipality of Ijuí, RS, located at coordinates 28°23'15"S, 53°56'39"W, during the period from August to November 2023, according to figure 1. Each experimental unit occupied a plot of 9.00 x 2.40 meters, totaling 12 plots of 21.6 square meters each, containing canary grass where the specimen was found. The pictures are taken with a digital camera Sony Alpha a6400, excellent image quality, fast autofocus, and advanced capabilities. It features a 24.2MP APS-C sensor, Real-time Eye AF, that granted, pictures with good quality, during the development to different phases of insect in the Entomology lab of Unijuí.

Figure 1. localization of UNIJUI Experimental Campus, Ijuí, RS, Brazil.



Source: The Authors, 2023.

3 RESULTS AND DISCUSSION

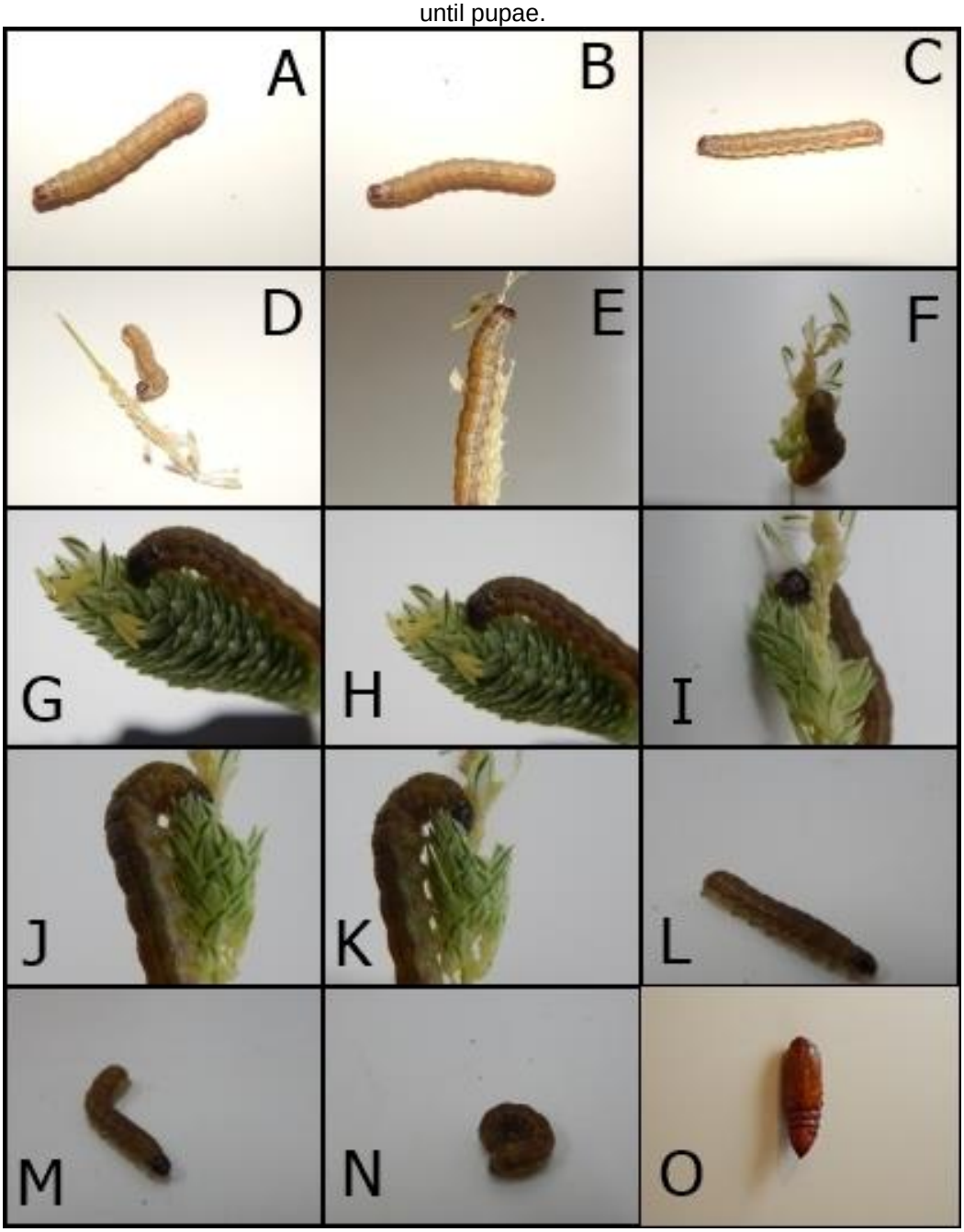
The subgenus *Mythimna*, as identified by Franclemont in 1951, comprises 17 species distributed across the Neotropical and Oriental regions, as well as the Hawaii islands. Distinguishing features include a well-defined and sclerotized valva with a reduced-size ampulla and clasper (HACKER et al., 2002). Notably, the majority of the 17 species within this subgenus hold economic significance (HACKER et al., 2002), often attaining substantial population levels that lead to notable economic repercussions (SALVADORI and PARRA, 1990a, 1990b, 1990c; RIZZO and LA ROSSA, 1991; Capinera, 2006). In their analysis, Terra and Zerbino (1986) inferred that the biological characteristics of *Mythimna adultera* are likely comparable to those of other species within the genus. Consequently, they asserted that morphology remains the primary means of distinguishing larvae across these species.

Madruga et al., (2022) reporting that *Mythimna sequax* is commonly found in the American tropics and subtropics, ranging from the Southern United States to Northern Argentina (Franclemont, 1951) and Uruguay (Biezanko and Ruffinelli, 1971). In Brazil, this species has been documented in numerous states, including Roraima (Alto Alegre), Acre (Rio Branco), Mato Grosso (Sinop), Mato Grosso do Sul (Chapadão do Sul and Miranda), Tocantins (Porto Nacional), Distrito Federal (Planaltina), Pernambuco (Petrolina), Bahia (Correntina and São Desidério), Minas Gerais (Santana do Riacho and Uberaba), Espírito Santo (Alegre and Domingos Martins), Rio de Janeiro (Cachoeiras de Macacu, Itatiaia, Petrópolis, and Rio de Janeiro), São Paulo (Cajati, Campos do Jordão, Jundiaí, and São Bernardo do Campo), Paraná (Cornélio Procópio, Curitiba, Londrina, Morretes, Ponta Grossa, and Quatro Barras), and Rio Grande do Sul (Bagé, Passo Fundo, Salvador do Sul, and Vacaria).

In this case this is the first report of this specie occurring in Ijuí-RS and establish a new host, the plant of *Phalaris canariensis.* We collected the larvae in the second instar. In Rio Grande do Sul, Brazil, two species of wheat caterpillars are common: *M. adultera* and *M. sequax*. Both have similar early developmental stages, but differentiation occurs from the fourth instar, with *M. adultera* larvae becoming dark and *M. sequax* larvae turning pink. In the adult stage, identification

is facilitated by the grayish-brown color, with *M. adultera* moths having dark spots on each forewing. Females lay up to 1000 eggs on leaves and stems, with the caterpillar hatching after 8 days. In the figure 2, we can check the behavior of this insect damaging panicles of canary grass.

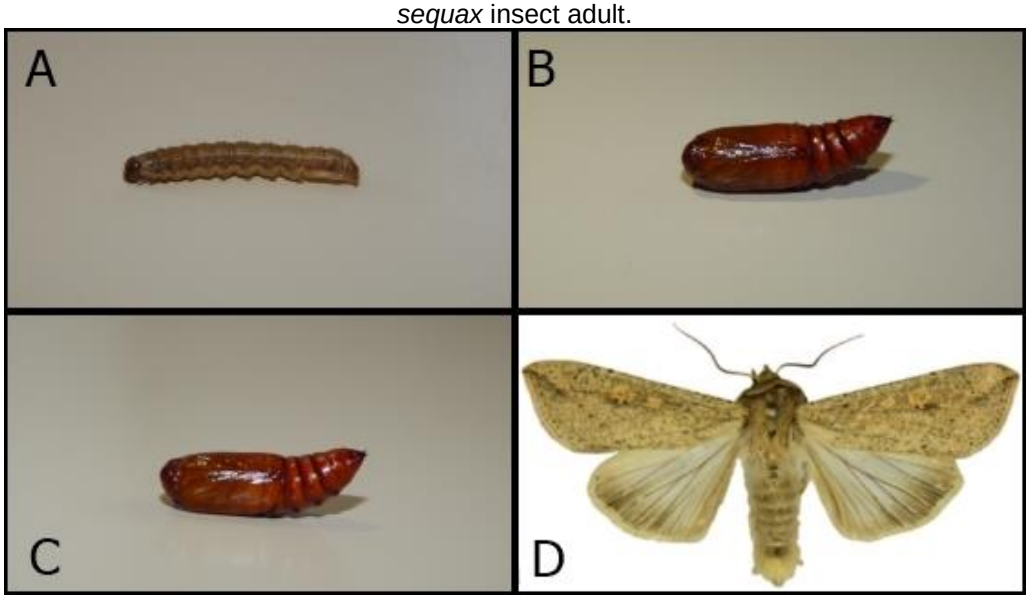
Figure 2. Development of larvae feeding by canary grass during it life cycle by different instars until pupae.



Font: The authors, 2023.

The average life cycle is 28 days, followed by the pupal stage, which occurs in the soil and lasts about 14 days. Adult insects emerge subsequently. The caterpillars initially feed on leaves and later attack the panicles. *M. sequax*, common among grasses, can cause significant damage to flag leaves and ears. Although once a major pest, the population of *M. sequax* has decreased over the years, becoming a secondary pest due to competition with the corn earworm. Each female lays an average of 200 to 1000 eggs, with a 4-day incubation period. After hatching, the larvae develop for 14 to 24 days, pupating in the soil for 5 to 30 days depending on the ambient temperature (MADRUGA et al.; 2019) like showed in the figure 3. We can observe that to complete its life cycle, the caterpillar consumed eight panicles of canary seed, consuming each panicle entirely.

Figure 3. (A) Larvae in the sixty larvae instar (B, C) pupae and its development and (D) *M. sequax* insect adult.



Source: The authors, 2023.

Discovering a new pest in a less-studied crop, as is the case with canary seed in Brazil, assumes crucial importance for safeguarding agriculture. By identifying new threats, farmers gain the ability not only to recognize them but also to understand their characteristics and potential harm to crops. This knowledge forms the basis for implementing specific and effective control measures, aiming to protect harvests appropriately. Beyond the practical aspect of agricultural

protection, the discovery of a new pest triggers a series of scientific investigations that range from the biology and ecology of the species to its life cycle, behavior, and interactions in the environment. These research endeavors are fundamental for the development of integrated management strategies, providing a more comprehensive understanding of the challenges faced by agriculture in a particular region. Additionally, the early identification of a new pest enables the implementation of monitoring programs, reducing the risk of its spread to other areas or crops. The swift response not only minimizes economic damages, especially in high-value commercial crops, but also contributes to long-term agricultural sustainability. In summary, the discovery and study of new pests in less-explored crops not only strengthen management practices but also enrich scientific knowledge, essential for addressing the constant challenges in modern agriculture.

4 CONCLUSION

This research stands out as the inaugural report of the pest in Ijuí, RS, Brazil, focusing specifically on canary grass, providing valuable insights into its life stages and establishing a foundation for future studies on *Mythimna sequax*.

The next steps in the research related to *Mythimna sequax* in canary grass involve further investigations to deepen our understanding of its ecological interactions, life cycle dynamics, and the development of effective management strategies. Subsequent phases of the study will likely include assessing the impact of environmental factors on the pest's population, exploring potential biological control methods, and evaluating the efficacy of various insecticides in mitigating infestations. Additionally, monitoring the spread and distribution of *Mythimna sequax* in other regions and crops, as well as studying its response to different agricultural practices, will contribute valuable insights for developing sustainable pest management practices.

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REFERENCES

ABDEL-AAL E-SM, HUCL PJ, PATTERSON CA, GRAY D. Phytochemicals, and heavy metals content of hairless canary seed: A variety developed for food use. **Food Science and Technology – LWT**. 2011;44(4):904-10.

BAIER, A. C., FLOSS, L. E., & AUDE, M. I. S. **As Lavouras de Inverno**. Rio de Janeiro: Globo. Coleção do Agricultor, 1988, 172p.

CDCS – CANARYSEED DEVELOPMENT COMMISSION OF SASKATCHEWAN. **Nutrition & Sensory Profile**. 2018. Disponível em: <https://www.canaryseed.ca/nutritionalfactsheets.html>. Acesso em: 10 de junho de 2022.

COGLIATTI, M. Canaryseed Crop. **Scientia Agropecuaria**, v.1, p.75 – 88, 2012.

CROCOMO, W.B (Org.). **Manejo Integrado de Pragas**. São Paulo: UNESP, 1990. 358p.

DEGUINE, J. P.; AUBERTOT, J. N.; FLOR, R. J. et al. Integrated pest management: good intentions, hard realities. A review. **Agronomy for Sustainable Development**, v. 41, p. 38, 2021. DOI: 10.1007/s13593-021-00689-w.

FAO (Food and Agriculture Organization of the United Nations), 2021. Disponível em: https://www.fao.org/faostat/en/#data/QCL Acesso em: 14 de janeiro de 202.

FRANCO, F.P., TÚLER, A.C., GALLAN, D.Z. et al. Fungal phytopathogen modulates plant and insect responses to promote its dissemination. **ISME J** 15, 3522–3533 (2021). https://doi.org/10.1038/s41396-021-01010-z.

GALLO D, NAKANO O, SILVEIRA NETO S, CARVALHO RPL, BAPTISTA GC DE, BERTI FILHO E, PARRA JRP, ZUCCHI RA, ALVES SB, VENDRAMIM JD, MARCHINI LC, LOPES JRS, OMOTO C. **Entomologia agricola**. 2002 [citado 2024 jan. 10]

GRAJEDA, C.I.; CARVAJAL-MILLÁN, E.; SANTANA, V.M.R.; LICON, A.T.; MARQUEZ-MELENDEZ, R. **Avaliação do Efeito do Tratamento a alcalinos em propriedades físico-químicas e alpista funcional farinha (*Phalaris canariensis* L.)**. Faculdade de Química. Universidade Autônoma de Chihuahua. Campus Universitário Circuito II. Chihuahua, Chihuahua, México. Proceedings Book ECITE, 2012.

HACKER, H., RONKAY, K., HERBLAY, M. **Noctuidae Europaeae**. Vol. 4. Entomological Press, Soro.2002.

KANSIIME, M. K.; RWOMUSHANA, I.; MUGAMBI, I. Fall armyworm invasion in Sub-Saharan Africa and impacts on community sustainability in the wake of Coronavirus Disease 2019: reviewing the evidence. **Current Opinion in**

Environmental Sustainability, v. 62, 2023, p. 101279. Disponível em: https://doi.org/10.1016/j.cosust.2023.101279. Acesso em: 22/01/2024.

KAUR H, GARG H. Pesticides: Environmental Impacts and Management Strategies **[Internet]. Pesticides – Toxic Aspects**. In: Marcelo L. Larramendy and Sonia Soloneski Ed. **InTech**; 2014. Available from: http://dx.doi.org/10.5772/57399,

MADRUGA, J., SPECHT, A., SAN BLAS, G., MIELKE, O. H. H., & CASAGRANDE, M. M. Revision of the species of Mythimna Ochsenheimer, 1816 (Pseudaletia Franclemont, 1951) (Lepidoptera: Noctuidae: Noctuinae: Leucaniini) occurring in Brazil. **Revista Brasileira de Entomologia**, v. 66, n. 3, e20220026, 2022.

MADRUGA, J., SPECHT, A., SALIK, L. M. G., & CASAGRANDE, M. M. The External Morphology of Mythimna (Pseudaletia) sequax (Lepidoptera: Noctuidae). **Neotropical Entomology**, v.48, n.4, p. 834–852, 2019. https://doi.org/10.1007/s13744-019-00703-7.

OUABA, J.; TCHUINKAM, T.; WAÏMANE, A.; HENLAY JUMA OTIENO MAGARA, SALIOU NIASSY, FÉLIX MEUTCHIEYE, Lepidopterans of economic importance in Cameroon: A systematic review, **Journal of Agriculture and Food Research**, v. 8, 2022, p. 100286. https://doi.org/10.1016/j.jafr.2022.100286.

PEDIGO, L.P.; RICE, M.E. **Entomology and Pest Management**. Pearson Prentice Hall. Upper Saddle River, 2006, 749p.

RIZZO, H. F.; LA ROSSA, F. R. Aspectos morfológicos y biológicos de la "oruga militar verdadeira" (*Pseudaletia adultera* (Schaus)) (Lep. Noctuidae). **Revista Faculdade de Agronomia**, v. 12, n. 1, p. 39-46, 1991.

SALVADORI, J. R.; PARRA, J. R. P. Efeito da temperatura na biologia e exigências térmicas de *Pseudaletia sequax* (Lep.: Noctuidae), em dieta artificial. **Pesquisa Agropecuária Brasileira**, v. 25, n. 12, p. 1693-1700, 1990a.

SALVADORI, J. R.; PARRA, J. R. P. Desempenho de *Pseudaletia sequax* (Lep.: Noctuidae) em dietas natural e artificiais. **Pesquisa Agropecuária Brasileira**, v. 25, n. 12, p. 1679-1686, 1990b.

SALVADORI, J. R.; PARRA, J. R. P. Seleção de dietas artificiais para Pseudaletia sequax (Lep.: Noctuidae). **Pesquisa Agropecuária Brasileira**, v. 25, n. 12, p. 1701-1713, 1990c.

TERRA, A. L.; ZERBINO, M. S. Características biológicas de Mythimna (=Pseudaletia) adultera Schaus (Lep.: Noctuidae: Hadeninae) frente a dois tipos de alimento. **Investigaciones Agronómicas**, v. 6, p. 49-53, 1986.

TRIDGE – **Trading and Bridge Alpiste no mundo**. Disponível em: https://www.tridge.com/pt/intelligences/canary-seed/import acessado em: 27 mar 2023.