

Cross-mating and oviposition behaviour between strains of *Cotesia sesamiae* cameron (hymenoptera: braconidae) from Kitale, Mombasa and Mount Kenya

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Abstract

Stemborers cause 50% yield losses in cereal crops. In Kenya *Cotesia sesamiae* is one of the parasitoids that has been studied in regard to the control of stemborer pests. In this study the reproductive compatibility of three populations of *C. sesamiae* was investigated using the noctuid *S. calamistis* and *Busseola fusca* as hosts. The output of this work has helped to determine the effect of cross mating and oviposition behaviour of *C. sesamia* strains and has helped to understand the possible consequences of the introduction and redistribution of *C. sesamiae* for the sustainable control of stem borers in Africa.

Key words: *Busseola fusca*, cereals, *Chilo partellus*, maize, parasitoids, stemborers

Résumé

Les foreurs de tige causent 50% des pertes de rendement dans les cultures céréalières. Au Kenya, *Cotesia sesamiae* est l'un des parasitoïdes qui a été étudié en ce qui concerne le contrôle des ravageurs foreurs de tige. Dans cette étude de la compatibilité en matière de reproduction de trois populations de *C. sesamiae* a été étudiée en utilisant le *calamistis* noctuelles et *S. Busseola fusca* comme hôtes. La sortie de ce travail a contribué à déterminer l'effet de l'accouplement de la Croix et le comportement de ponte des souches de *C. Sesamia* et a aidé à comprendre les conséquences éventuelles de l'introduction et la redistribution de *C. sesamiae* pour le contrôle durable des foreurs en Afrique.

Mots clés: *Busseola fusca*, céréales, *Chilo partellus*, le maïs, les parasitoïdes, les foreurs de tiges

Background

Maize, *Zea mays* L.(Poaceae) is a staple food for majority of sub-saharan African countries (Ransom *et al.*, 1997) and is mostly grown by resource-poor small- scale farmers. In Kenya, maize yields are low due to factors like unreliable rainfall, low soil fertility, insect pests and diseases. Among the pests, the most important are the stemborers. Various control strategies

including chemical, cultural and host plant resistance have been used against stem borers. Unfortunately, none has provided control of the pest (Bruce *et al.*, 2004). In the recent past, institutions such as the International Centre for Insect Physiology and Ecology (ICIPE) have put emphasis on biological control of pests including stem borers.

The economically important two stem borers in East and Southern Africa (ESA) are *Busseola fusca* and *Chilo partellus* in high and lowland areas, respectively. The gregarious larval parasitoid *Cotesia sesamiae* is reportedly able to achieve a 75% control of the pest. In Kenya, *C. sesamiae* exists as two biotypes that differ in their ability to parasitize *B. fusca*. The first biotype is from western Kenya and is able to complete development in *B. fusca* larvae. The second is the coastal biotype whose eggs are encapsulated by haemocytes in *B. fusca* larvae (Gitau *et al.*, 2006). The use of biological control has several advantages including environmental friendliness. Kenya has three strains of *C. sesamiae* from coastal Kenya, Mt Kenya and Kitale which by cross-mating could yield compatible strains for distribution in parts of Africa where they are scarce. The aim of the study is to obtain this cross bred.

Literature Summary

The global demand for cereals in the year 2020 is estimated at 2.1 billion metric tones (James, 2003). Therefore there must be substantial increase in maize production especially in developing countries. In sub-Saharan Africa this may not be easy due to stem borers. The stem borer menace mostly hits the small-scale farmers who are the majority in sub-Saharan Africa countries such as Kenya.

Classical biological control refers to an approach whereby natural enemies of a pest in its aboriginal home are introduced to the area invaded by pest. When successful, classical biological control provides an environmentally and ecologically suitable means of pest control (Mochiah, 2002). The use of indigenous natural enemies to control indigenous stem borer pests is gaining importance in African regions. Indeed, the use of native natural enemies as biological agent to control pests is preferable because their impact on native enemies and non-target insects is assumed to be less than that of exotic enemies (Huffaker *et al.*, 1977; Stiling, 1993).

Study Description

Two stem borer species, *S. calamistis* and *B. fusca* were used in this study. Larvae of the two species were obtained directly

from the Animal Rearing and Containment Unit (ARCU) of ICIPE in Nairobi, Kenya. Fourth instar larvae, the most suitable host stage for development and reproduction of *C. sesamiae* were used (Ngi-Song *et al.*, 1995). The stem borer larvae were removed from the artificial diet and introduced into glass jars (16 x 9 cm) containing pieces of maize stems. This was to make the larvae more attractive to the parasitoids owing to the frass from maize: infested host plants release a synomone that is attractive to parasitoids (Potting *et al.*, 1995). The set up was left for 24 hours to allow borers to feed and produce frass prior to exposure to a mated female *C. sesamiae*.

The various populations of *C. sesamiae* were allowed to emerge singly by separating individual dark cocoons from the cocoon masses. Immediately after emergence, the naïve male and female parasitoids were paired and allowed to mate in transparent glass vials measuring 5 x 2 cm. Soon after mating, the pairs were fed on 20% honey/water solution (Overholt *et al.*, 1994) dipped in cotton wool placed on a plastic cup. Only mated females of *C. sesamiae* were used for the oviposition experiment in vials measuring (7.5 by 2.5cm). Sex ratio, progeny, number not forming cocoons, number dead in cocoons and mating behaviour, were assessed for both cured and uncured couples. The searching, foraging and oviposition period of the parasitoid on the stem borer larvae were assessed during crossings throughout the experiments.

For the assessment of the reproductive potential of the different crosses and all observations in all experiments, only one set of time series was used. Differences in percentage females were analyzed using (ANOVA) PROC GLM (SAS Institute, 2003). Tukey's test was used as a post ANOVA procedure at significant level of 5% to separate the means.

Research Application

The longest mating period was observed between crosses of uncured Mombasa males with uncured Mombasa females followed by cured Mt Kenya males with cured Mt Kenya females which were significantly different from all the other crosses but not significantly different from each other. The longest courting period was in two crosses, cured Kitale male mated with uncured Mombasa female and cured Kitale male mated with cured Mt Kenya female which were significantly different from other crosses. The oviposition period was significantly different in only one crossing, cured Mombasa male mated with cured Kitale female with the shortest period while

all others were not significantly different from each other. The longest periods in searching and foraging were in the same cross, i.e., cured Mombasa male mated with cured Kitale female. The same cross gave the shortest period of oviposition.

The sex ratio was expressed as a proportion of females and it was male biased. The highest numbers of females were from cured Kitale male mated with cured Kitale female crossing. The lowest was from cured Mombasa male mated with cured Kitale female which was significantly different from all other crosses but gave one of the highest progeny sizes.

Recommendation

1. Cross-mating effect both prolonged and shortened searching, mating and oviposition time of the three *C. sesamiae* strains.
2. Majority of the crosses had low compatibility and six out of twenty one can be used for establishment of *Cotesia sesamiae*.
3. The curing improves on sex ratio, progeny size and the reproductive parameters.
4. Strains of Kitale should be used as females and not for mating with Mombasa males.

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References

- Bruce, Y. A., Gounou, S., Chabi-Olaye, A., Smith, H. and Schulthess, F. 2004. The effect of neem (*Azadirachta indica* A. Juss) oil on oviposition development and reproductive potentials of *Sesamia calamistis* Hampson (Lepidoptera: Noctuidae) and *Eldana saccharina* Walker (Lepidoptera: Pyralidae). *Agricultural and Forest Entomology* 6: 1-10.
- Gitau, C.W., Dupas, S., Ngi-Song, A.J. , Mbugi, J.P. and Schulthess, F. 2006. Calyx fluid proteins of the two *Cotesia sesamiae* (Cameron) (Hymenoptera : Braconidae) biotypes in Kenya : implications to biological control of the stemborer *Busseola fusca* (Fuller) (Lepidoptera : Noctuidae). *Annales de la Société Entomologique de France* 42:433-441.
- James, C. 2003. Global review of commercialized transgenic crops: 2002 Feature: Bt Maize. ISAAA Briefs. No. 29. ISAAA: Ithaca, NY. <http://www.isaaa.org>.
- Ngi-Song, A.J., Overholt, W.A. and Ayertey, J. N. 1995. Host suitability of African gramineous stemborers for the development of *Cotesia flavipes* and *Cotesia sesamiae*

(Hymenoptera: braconidae). *Environmental Entomology* 24: 978-984.

Overholt, W.A., Ogeda, K. and Lammers, P.M. 1994. Distribution and sampling of *Cotesia partellus* (Swinhoe) (Lepidoptera: Pyralidae) in maize and sorghum in Kenyan coast. *Bulletin of Entomological Research* 84:367-378.

Ransom, J.K., Palmer, A.F.E., Zambezi, B.T., Mduruma, Z. O., Waddington, S.R., Pixley, K.V. and Jewell, D. C. (Eds.). 1997. Maize Productivity gains through research and technology dissemination: Proceedings of the fifth eastern and southern Africa regional maize conference, held in Arusha, Tanzania, 3-7 June 1996. CIMMYT. Addis Ababa, Ethiopia.