Basis of host plant recognition and acceptance by *Busseola fusca* (Fuller) (Lepidoptera: Noctuidae) larvae

Gerald Juma

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ABSTRACT

Busseola fusca (Fuller) (Lepidoptera: Noctuidae) is an important pest of maize and sorghum in sub-Saharan Africa whose larvae exhibits oligophagic than polyphagic feeding habits. The host plants for this species are primarily maize and sorghum though some populations appear to be restricted on wild sorghum. The purpose of this study was to determine the extent of oligophagy of larvae of this species based on (i) the sensory abilities to discriminate among different host plants (ii) feeding behaviour and growth on different Poaceae plant species present in its natural habitat (iii) plant stimuli that influence larval growth and feeding and (iv) the physiological adaptations to various host plant diets. The potential existence of genetically determined host-plant associated populations was also investigated. The results obtained from scanning microscopic preparations, selective silver nitrate staining and dose response electrophysiological experiments indicate that larval sensory structures present on the maxillae and the antennae are typical of other lepidopteran species and consist mainly of multiporous olfactory and uniporous gustatory sensilla. These sensorial equipments are thought to be involved in discriminating amongst chemical cues important for larval host recognition and selection. The gustatory role of both sensorial equipments was confirmed from the significant and positive dose-response electrophysiological tip recording tests, for the antennal sensillum ($F_{1,56}$ = 41.637, P<0.0001) and for the maxillary palp ($F_{1,58}$ = 32.124, P<0.0001) using increasing concentrations of sucrose. Moreover, this study demonstrated for the first time the presence of antennal taste receptors on a lepidopteran larva key to host choice, explaining the ability of larvae to quickly evaluate the phago-suitability of the host plant following landing on its surface.

Among the selected Poacaeae plant species used and which form the natural feeding repertoire of *B. fusca*, only *Zea mays* and *Sorghum arundinaceum* supported the highest larval performance. Endogenous silica which is thought to negatively influence feeding behaviour of many herbivorous insects, varied significantly among the plant species studied. The amount of silica found among the plant extracts studied ranged between 20µg/mg-55µg/mg of dry leaf weight following spectrophotometric determination of each of the plant leaf samples digested with dilute hydrofluoric acid. The silica levels in the plants's digests correlated negatively with both larval feeding and growth rates, hence confirming the importance of silica as a significant barrier to dietary adaptation by *B. fusca* larvae. All the polar and methanol-soluble plant extracts tested elicited feeding of third instar larva as compared to the non-polar hexane extracts both in choice and in non-choice bioassays. Methanol extracts of *Z. mays, S. arundinaceum* and *Arundo donax* were however the most phagostimulatory. Plant sugar content as identified by HPLC also varied among plants tested with sucrose contributing the highest (22µg/mg to 65µg/mg of dry leaf weight), which was an equivalent of between 25%-38% of the total sugar content of each plant leaf extract analysed. Larval feeding positively correlated with sucrose content but negatively with turanose, the most variable sugar fraction (5-36µg/mg dry leaf weight) of the plant extracts analysed. However, additional bioassays indicated that whereas turanose and sucrose play a phagodeterrent and phagostimulant roles respectively, a balance between the two (probably in the ratio of 3:1 respectively) appeared to be an important factor in host acceptance for larval feeding. Therefore, the level of silica and the balance between the two sugars in the plant leaves seem to be key

determinants of host plant choice and acceptance for feeding and growth by *B. fusca* larvae.

Larvae fed on *Z. mays* and *S. arundinaceum;* plants that supported the highest larval survival and growth rates had pronounced levels of sugar than amino acid degrading enzymes, indicating the general over reliance of larvae on carbohydrates over proteins for survival. However, esterase enzymes were also highly induced in homogenates of larvae that consumed leaves of their least preferred host plants that included *P. maximum P. desteum* and *S. megaphylla*. These three plant species had also the highest total phenolic content in their leaf tissues following spectrophotometric determination of the same in their leave tissues. Therefore, the induction of esterase in larvae fed on the three high phenolic containing plants could possibly indicate the accompanying physiological responses of larvae to a specific or a number of deterrent phenolic glycosides in the particular plant leaf tissue. Finally, no conclusive evidence was deduced for host associated genetic differentiation among individuals of *B. fusca* larva found on wild plants (*A. donax*) or cultivated crops (*Z. mays*) as was inferred from genetic analysis of two fragments of the gene coding for cytochrome *b.*