Evaluation of Protein Content of Fall Armyworm (*Spodopterafrugiperda*) on Maize and Cotton Crops in Telangana, India

ABSTRACT

The present study was carried out to estimate the protein content of *Spodopterafrugiperda* (J.E. Smith) (Insecta: Lepidoptera: Noctuidae) collected from maize and cotton fields in Telangana State, India during 2021-2022 using Lowry method. The total protein content in *Spodopterafrugiperda* was significantly higher from maize fields (12.4 ± 0.7 mg/g) compared to cotton fields (9.6 ± 0.5 mg/g) where similar results were shown for soluble proteins as 7.4 ± 0.4 mg/g and 4.9 ± 0.3 mg/g, respectively. Conversely, cotton-fed larvae had slightly higher insoluble protein content (4.5 ± 0.4 mg/g) than maize-fed larvae (4.1 ± 0.3 mg/g). Larvae were exhibited higher protein levels than that of adults where maize-fed larvae showed the highest total protein content (12.9 ± 0.6 mg/g). Statistical analysis revealed significant differences in total and soluble protein content between the two staple crop types ($p<0.05$), and observed that maize supports enhanced protein accumulation in *S. frugiperda*. These results highlight the significant role of host plant quality in influencing protein content and development in *S. frugiperda*, offering insights for effective pest management strategies.

Keywords: Protein content, fall armyworm, maize, and cotton.

INTRODUCTION

The fall armyworm (FAW) *Spodopterafrugiperda* (J.E. Smith) (Insecta: Lepidoptera: Noctuidae) is one of the highly destructive, polyphagous pests which has cosmopolitan distribution including Asia, with significant impacts on staple crops such as maize (Chimweta*et al*., 2019) and cotton, native to subtropical and tropical regions of America (FAO, 2017) which causes severe yield losses in both maize and cotton fields in India. Based on reports, it was intruded inIndia on maize (*Zea mays*: Poaceae) crops in Karnataka (Sharansabasappa*et al*., 2018) and was also observed in maize/corn crop fields in Telangana during Rabi and Kharif seasons (Mallesh*et al*., 2023). The insect prefers to inhabit on maize than that of other crops (Prasanna *et al*., 2018). The earlier studies were recorded that the larval feed on the leaves, stems and other reproductive structures of the staple crops which affect the growth and yielding (Mallesh*et al*., 2021; Mallesh and Sravanthy, 2021). It is very important to understand the nutritional dynamics of *Spodopterafrugiperda* on different host plants, plays crucial role for developing sustainable and targeted pest management strategies (Feng *et al*., 2019; Nagle *et al*., 2022).

Proteins play a vital role in growth, development, and reproductive capacity of insects, including *S. frugiperda*. The content of total proteins, soluble proteins, and insoluble proteins can vary significantly depending on the host plant, influencing the pest's fitness and survival. Soluble proteins are primarily involved in metabolic functions, enzymatic processes, and energy production whereas insoluble proteins are essential for structural support, particularly in relation to the physical properties of the host plant (Matos *et al*., 2015; Vieira *et al*., 2017). *S. frugiperda* fed on nutrient-dense crops

such as maize tend to accumulate higher levels of total and soluble proteins compared to those feeding on more fibrous and nutrient-deficient plants like cotton (Cruz *et al*., 2009; Leach, 2009). Maize is a high-protein, energy-rich crop, which supports better metabolic and developmental performance in *S. frugiperda*. In contrast, cotton, while less nutrient-dense, presents a more fibrous structure, which could require higher levels of structural (insoluble) proteins for the insect to survive (Pandey *et al*., 2011). The variation in nutritional value between maize and cotton has the potential to significantly affect the growth and protein composition in larvae and adult stages of *S. frugiperda* populations (Leach, 2009; Pandey *et al*., 2011).

The present study aims to estimate and compare the total protein content, soluble proteins and insoluble proteins in *Spodopterafrugiperda* populations of two host plants maize and cotton fields and provides insights into how nutritional quality influences protein synthesis in *S. frugiperda*, contributing to understand the adaptive strategies on different crops. The present investigation paves the way to design for the effective pest management strategies which considers the nutritional ecology of *S. frugiperda* and its interaction with the different host plants.

STUDY AREA

The study was conducted in '900M Gold' maize variety and 'non-Bt' cotton fields of Nalgonda district, Telangana, India. The maize field was selected randomly, while the cotton field was selected separately during Rabi and Kharif seasons of 2021-2022.

MATERIALS AND METHODS

Spodopterafrugiperda (fall armyworm) was collected in both larval and adult stages from maize and cotton fields during the growing seasons. Specimens were immediately preserved in ice and transported to the laboratory for further analysis. The materials were thoroughly washed with distilled water to remove any external unwanted debris and were then homogenized separately in a buffer solution to extract proteins. After homogenization, the samples were centrifuged to separate soluble proteins from insoluble fractions. For the protein estimation, performed Lowry method (Lowry *et al*., 1951) which is involved a colorimetric reaction between proteins and a mixture of Folin-Ciocalteu phenol reagent and alkaline copper solution.

RESULTS

The estimated data were analyzed using ANOVA to determine significant differences in protein levels between the maize and cotton populations of *Spodopterafrugiperda*. Statistical significance was set at $p<0.05$ (for all comparisons).

Total Protein Content: The total protein content in *S. frugiperda* was significantly higher in maize fields (12.4 ± 0.7 mg/g) compared to cotton fields (9.6 ± 0.5 mg/g) which suggests that maize provides a more nutrient-dense environment, promoting higher protein synthesis in the pest. The results

highlight the potential of maize fields to support enhanced protein accumulation in *S. frugiperda* (Table 1).

Soluble Proteins: Soluble protein levels were also significantly higher in *S. frugiperda* populations from maize-fed insects (7.4 ± 0.4 mg/g) compared to cotton-fed populations (4.9 ± 0.3 mg/g). Soluble proteins are vital for metabolic and enzymatic processes, and these higher levels in maize-fed populations imply that the maize crop offers a more bioavailable source of nutrients, supporting increased protein synthesis (Table 1).

Insoluble Proteins: Insoluble proteins, associated with structural functions, were higher in cotton-fed populations (4.5 ± 0.4 mg/g) than in maize-fed populations (4.1 ± 0.3 mg/g). This difference could be an adaptive response to the more fibrous and nutritionally challenging cotton environment, as *S. frugiperda* may require more structural proteins to withstand the physical properties of cotton (Table 1).

Table 1. The total protein content, soluble proteins, and insoluble proteins in *Spodopterafrugiperda* of maize and cotton plants.

Parameter	**Maize Fields (Mean ± SD)**	**Cotton Fields (Mean ± SD)**
Total Protein Content	12.4 ± 0.7 mg/g	9.6 ± 0.5 mg/g
Soluble Proteins	7.4 ± 0.4 mg/g	4.9 ± 0.3 mg/g
Insoluble Proteins	4.1 ± 0.3 mg/g	4.5 ± 0.4 mg/g

Larval vs. Adult Protein Content: Larvae showed higher overall protein content compared to adults, with maize-fed larvae having the highest protein levels (12.9 ± 0.6 mg/g) compared to cotton-fed larvae (9.9 ± 0.4 mg/g). It is consistent with the higher nutritional demands of larvae during their growth phase, highlighting the importance of nutrient availability during different developmental stages (Table 2).

Table 2. The Protein Content in larva and adult of *Spodopterafrugiperda* of maize and cotton plants.

Parameter	**Maize Fields (Mean ± SD)**	**Cotton Fields (Mean ± SD)**
Larval Protein Content	12.9 ± 0.6 mg/g	9.9 ± 0.4 mg/g
Adult Protein Content	11.5 ± 0.6 mg/g	9.4 ± 0.4 mg/g

Statistical analysis using ANOVA revealed the significant differences in total and soluble protein content between *Spodopterafrugiperda* populations from maize and cotton fields ($p<0.05$). However,

the differences in insoluble protein content were not statistically significant ($p>0.05$). These results suggest that while the protein content in terms of total and soluble proteins varies significantly between the two crop types, the variation in insoluble proteins may not be large enough to warrant a statistical distinction (Table 1, 2).

DISCUSSION

The results showed that the larvae from maize fields had significantly higher total protein content (12.4 ± 0.7 mg/g) and soluble proteins (7.4 ± 0.4 mg/g) compared to those from cotton fields (9.6 ± 0.5 mg/g and 4.9 ± 0.3 mg/g, respectively). These findings align with those of Cruz *et al*. (2009) and Leach (2009) which showed that *S. frugiperda* larvae feeding on maize accumulate more protein, attributed to the nutrient-dense nature of maize. The higher soluble protein levels in maize-fed larvae suggest better metabolic and enzymatic activity, as maize provides more bioavailable nutrients (Matos *et al*., 2015). Insoluble proteins were slightly higher in cotton-fed larvae (4.5 ± 0.4 mg/g) than in maize-fed larvae (4.1 ± 0.3 mg/g), though the difference was not statistically significant. The increased insoluble proteins in cotton-fed larvae are likely an adaptation to the more fibrous and challenging nature of cotton, requiring more structural proteins for survival (Pandey et al., 2011). The protein content was lower compared to larvae, with maize-fed adults showing 11.5 ± 0.6 mg/g and cotton-fed adults 9.4 ± 0.4 mg/g. This difference is consistent with the nutritional needs of adults, which are less demanding compared to the rapid growth requirements of larvae. The similar trend was also observed by Vieira *et al*. (2017) in noting the larvae require higher protein for growth and development, while adults primarily need protein for reproduction and maintenance.

CONCLUSION

The present study highlights the nutritional differences between *Spodopterafrugiperda* populations feeding on maize and cotton. Maize-fed larvae exhibited higher total protein and soluble protein content which suggest that maize offers a more nutrient-dense environment compared to cotton. The higher insoluble protein content was observed in cotton-fed larvae reflects an adaptation to the more fibrous cotton plants. Additionally, larvae exhibited higher protein levels than adults, reflecting their greater nutritional demands. These findings underscore the significant role of host plants in shaping the protein content and growth of *Spodopterafrugiperda* and provide valuable insights for the proper pest management strategies.

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