

## The efficiency of cultural practices in controlling *Helicoverpa Armigera* infestation in Khyber Pakhtunkhwa tomato varieties

Mushtaque Ahmed Rahu<sup>1</sup>

<sup>1</sup>Department of Agriculture, Wollo University, Dessie, Ethiopia

### Research Article

Date of Submission: 25-12-2025

Date of Acceptance: 21-01-2026

Date of Publication: 27-03-2026

### ABSTRACT

A very destructive polyphagous pest of tomato crops worldwide, *Helicoverpa armigera* (Hubner) increases reliance on chemical pesticides and causes large economic losses. Therefore, controlling this pest is crucial for integrated pest management (IPM) systems in order to reduce production costs and environmental hazards. The goal of the present experiment was to evaluate the efficacy of the target cultural practices in conjunction with the varietal susceptibility under field settings in Peshawar, Pakistan, from March to May 2021. In order to compare the effects of early sowing, deep ploughing, weeding, hand-picking larvae, removing infested fruits, and pupal bursting on two tomato varieties—Rio Grande (preferred) and Sahel (less preferred)—the experiment was created using a randomized complete block design (RCBD). The most successful treatment was early planting (T2), which reduced the egg population by 26.0 in Rio Grande and 17.7 in Sahel, respectively, in comparison to the control. Similarly, in Rio Grande and Sahel, the larval population decreased by 24.6% and 9.2%, respectively. In comparison to control plots (Rio Grande and Sahel, respectively), the number of fruits increased by 13.1 and 10.8 percent with T2, and yield characteristics were significantly better with T2. The average plant yield increased by 8.5 percent in Rio Grande and 11.8 percent in Sahel, reaching 1.27 kg and 1.42 kg, respectively. Sahel generally reacted better to treatments and less to infestation. These findings show that using low-preference or resistant cultivars together with early planting is a viable and environmentally benign method of managing *H. armigera*. Incorporating these cultural practices into IPM programs will help reduce the need for pesticides and increase tomato output and production sustainability.

**Keywords:** Tomato, *Helicoverpa armigera*, early planting, cultural methods, and integrated pest management

### INTRODUCTION

After potatoes (*Solanum lycopersicum* L.), tomatoes are the most important vegetable in the world. According to reports, tomatoes are grown on around 4.85 million hectares of land worldwide, with an average yield of 37.60 tons per hectare. According to Ali et al. (2019), the fruit borer, *Helicoverpa armigera* (Hubner), is the principal pest that causes the greatest damage and has several biotic and abiotic consequences on tomato production. Tomato crops are seriously threatened by the very polyphagous pest *H. armigera*, which causes large output losses. It has been estimated that this bug costs the global economy \$5 billion annually. In places like Peshawar, Khyber Pakhtunkhwa, tomato infection rates in Pakistan may reach 32–35 percent, while crop loss can reach 53%. The fact that *H. armigera* accounts for almost 80% of all pesticide usage in the area highlights how severe the pest problem is. The major vegetable-producing regions of Khyber Pakhtunkhwa, Pakistan, include Swat, Peshawar, Mansehra, and Bajaur. With the exception of Peshawar, all of the high elevations and diverse climates make the areas ideal for growing vegetables during the off-season. The primary vegetable crop grown in these areas is tomatoes. Because of the lower temperatures at higher elevations, insect attacks are rare. This research attempts to ascertain the degree of infestation and availability of pests in tomato plants since there is a dearth of information about tomato pests in these areas (Ishtiaq et al., 2017). Maize, chickpeas, cotton, alfalfa, and tobacco are among

the other crops that *H. armigera* infests. Three to five larvae of long-staple cotton and eight to twelve larvae of medium-staple cotton are the threshold damage caused by this insect on staple cotton in Central Asia. Pest attacks may cause the blooms to prematurely abort before they develop into fruit, resulting in empty bolls. Damaged bolls are susceptible to bacterial and fungal secondary infections, which may impede fruit development and postpone fruit maturity (Sigsgaard et al., 2002). Because *H. armigera* is a polyphagous, seasonally migratory, and diapausative insect, it is one of the most important pests in the globe (Feng et al., 2009; Zalucki, Furlong & Downes, 2020). A thorough understanding of the population dynamics, infestation severity, and pest dissemination patterns related to environmental factors, such as weather, is necessary for the effective control of *H. armigera* (Muhammad Ashfaq, 2012). The choice of Integrated Insect Management (IPM) management approach depends on the degree of insect resistance shown by various tomato cultivars. Understanding these dynamics may help develop targeted strategies to address epidemics in both highly and less desired forms. In order to minimize *H. armigera* infestations in the later cropping seasons, cultural management techniques that reduce the number of the overwintering pests are crucial. By exposing the pests to natural predators and unfavorable weather, other techniques, such as bursting the pupae, will reduce their number. Additionally, controlling weeds in crops and surrounding plants prevents pests from growing. By avoiding pest peaks and exposing the pupa to

higher death rate (Fitt, 1989; Dillon, 1998). Destroying and eliminating agricultural waste and other hosts also breaks pest cycles. Recent international research has reinforced these tactics. Varietal resistance is crucial in IPM programs because, for example, field evaluations revealed that tomato genotypes with high trichome density, thick pericarp, and higher phenolic concentration had fewer cases of *H. armigera* infestation (Bisht, Sharma, and Yadav, 2022; Sharma, Kiran, and Sreedevi, 2022). Additionally, while they have little influence on the environment, bio-rational pesticides such as *Bacillus thuringiensis*, *Metarhizium anisopliae*, spinosad, and botanical extracts are efficient in lowering the number of larvae (Khanal, Nepal & Shrestha, 2025; Srinivasan and Durairaj, 2021). A comprehensive and long-lasting strategy for managing *H. armigera* in tomato crops combines cultural, varietal resistance, biological, and prudent chemical usage. According to local research and current international IPM standards, these methods may reduce insect damage as well as the financial and environmental costs associated with excessive pesticide use.

#### **Research Objectives:**

**Major Objective:** This research was aimed at a comparative assessment of the effectiveness of the process of particular cultural practices in the management of *H. armigera* under the field conditions of tomatoes in Khyber Pakhtunkhwa, Pakistan. These particular goals were to:

1. Compare the infestation of *H. armigera* in preferred and less-preferred tomatoes, which are Rio Grande and Sahel, under natural field conditions. Compare the relative effectiveness of individual cultural practices: early sowing, deep ploughing, weeding, larvae hand picking, pupal hatching, and picking of infested fruits in decreasing the egg and larval populations.
2. Determine the relative effectiveness of cohesive (combined) cultural practices, solitary practices, and uncontrolled control plots in the suppression of pest infestation, and in enhancing yield.
3. Determine the most economical and friendly cultural management approach that can be used in the integrated pest management (IPM) programs in tomato production in the area.

#### **1. Materials And Methods**

2. Randomized Complete Block Design (RCBD) was used to conduct the experiment. The most and least popular tomato varieties from the earlier experiment were chosen for seeding and were repeated three times in the Peshawar area between March and May, 2021. To test their effectiveness against *H. armigera*, cultural methods such as plowing before sowing (T1), early sowing (T2), weeding (T3), hand picking larvae (T4) and discarding infected fruits (T5), and pupal bursting (T6) before and after sowing were progressively used. Treatments were applied to every replication, and blocks were assigned to specific cultivars. To compare their effectiveness to the control plot (T7) with no therapies administered at all, each of these techniques was used both separately and in combination. The experimental plots measured 3 m by 4 m (12 m<sup>2</sup>). As is typical for tomato crops grown in fields, plants were spaced 45 cm apart and 75 cm apart in rows. The plot's size allowed for a sufficient number of plants per treatment to minimize border effects and offer accurate assessments of insect occurrence and productivity. Before seeding the chosen varieties, a single deep plow was used to prevent pupal bursting during *H. armigera*'s overwintering. In order to regulate the timespan and prevent the crops from reaching maturity when the environment is conducive to a dense population of *H. armigera*, the seeds were sowed somewhat early in accordance with the procedures described in the first experiment. Weeding was

done three times a week, separated by one day. To stop the *H. armigera* larvae from spreading to healthy fruits, the infected fruits were removed by hand.

## **2. Treatments:**

1. Ploughing before sowing (T1)
2. Early sowing (T2)
3. Weeding (T3),
4. Hand picking of larvae (T4)
5. Disposal of infested fruits (T5)
6. Pupal bursting (T6)
7. Control (T7)

The selected treatments were based on their ecological role in disrupting the life cycle of *H. armigera* and reducing pest pressure without chemical intervention.

1. Deep ploughing (T1) was carried out once before sowing to expose and destroy overwintering pupae present in the soil.
2. Early sowing (T2) was adopted to manipulate crop phenology and avoid peak pest population periods.
3. Weeding (T3) reduces alternate host plants and oviposition sites.
4. Hand picking of larvae (T4) directly reduces larval population density.
5. Disposal of infested fruits (T5) prevents larval development and secondary infestation.
6. Pupal bursting (T6) was conducted once weekly to mechanically destroy soil-borne pupae

## **2.2 Parameters**

No of eggs per plant

1. No of Infested fruits per Plant
2. Total No of fruits per plant
3. No of larvae per plant
4. Average yield of each variety

## **2.3 Statistical Analysis**

3. The data was analyzed using Statistix 8.1 software, which is appropriate for RCBD. Treatment means were separated using the Least Significant Difference (LSD) test with a 5% probability threshold ( $p \leq 0.05$ ). To increase the precision of treatment estimates, 95 percent confidence intervals were also calculated. To strengthen the statistical interpretation, the size of the treatment impact on pest infestation and yield metrics was taken into account. (Sujana and others, 2008).

## **4. Results**

5. From March to May 2021, the efficacy of several cultural methods, including early planting, deep ploughing, weeding, hand-picking larvae, and removing contaminated sections, was compared to a control plot. On a few tomato cultivars, the effects of these methods on the population of the pest *H. armigera* were investigated.

### **5.1 Infestation Level**

6. The number of eggs per plant was calculated using the cultural techniques T1, T2, T3, T4, T5, T6, and the control (T7) in the plots planted with the most and least liked tomato varieties, as shown in Table 3.1. The egg population of the several treatments in Rio Grande ranged from 1.68 to 2.27 eggs per plant. The control plot (T7) had the highest egg population (2.27 eggs per plant), whereas the plot that had early seeding (T2) had the lowest (1.68 eggs per plant). The Sahel cultivar was reported to have between 1.16 and 1.46 eggs per plant across different treatments. The plot treated with T2 had the lowest population of eggs (1.16 eggs per plant), whereas the control plot (T7) had the largest population of eggs (eggs per plant). The variety Rio Grande consistently had a greater egg and larval population than Sahel, and the larval population per plant trended in the same direction as the egg population. Overall, among the two tomato types, treatment T2 consistently produced the lowest egg and larvae population, indicating that early seeding was successful in reducing *H. armigera* infestation of tomatoes (Table 3.1).

### **6.1 Mean Fruit Number**

7. The average number of fruits per plant of the different plots treated with the most and least liked tomato varieties, cultural methods T1 through T6, and the control (T7) are shown in Table 3.2. The average number of fruits per plant at the treatment for the Rio Grande variety ranged from 17.09 to 19.33. The plot that was sowed early (T2) had the greatest mean fruit per plant (19.33 fruits per plant), whereas the control plot (T7) had the lowest mean fruit per plant

(17.09 fruits per plant). The average number of fruits per plant in Sahel ranged from 24.15 to 26.77. The plot with T2 treatment had the highest mean fruit number (26.77 fruits per plant), whereas the plot with T4 treatment had the lowest mean fruit number (24.15 fruits per plant). Both kinds showed similar trends in the quantity of affected fruits per plant; treatment T2 tended to produce the fewest diseased fruits, while the control plot (T7) tended to produce the most infested fruits (Table 3.2). The results also show that each treatment had an impact on the two tomato kinds' fruit sizes. In Rio Grande, the pupal bursting treatment (T6) produced the largest mean fruit size, measuring 184 cm, while the early planting treatment (T2) produced a mean fruit size of 168 cm. Other treatments, such as thorough plowing (T1) and removing infected areas (T4), resulted in fruits that were somewhat smaller, measuring 172 cm and 177 cm, respectively. The T7 control treatment produced the fruit with the lowest mean size (165 cm). The majority of the fruits in Sahel were bigger than those in Rio Grande, with deep plowing (T1) producing the smallest fruit size (6.05 cm) and early planting (T2) producing the greatest (6.14 cm). Although the variations were more apparent in the less prestigious Sahel variety, the overall impact of the treatments was that proactive pest control, such as early planting and pupal bursting, worked better to generate bigger fruits (Table 3.2).

### 7.1 Impact of Cultural Practices on yield

8. The average yield per plant and yield per plot of the different plots planted with the most and least liked tomatoes, as well as the control (T7) and T1 through T6 cultural techniques, are shown in Table 3.3. The average yield per plant for the Rio Grande cultivar was fluctuating between 1.13 and 1.27 kg throughout treatments. The treatment with early planting (T2) had the highest yield per plant (1.27 kg), whereas the control (T7) plot had the lowest yield per plant. The yield per plot for each treatment ranged from 41.94 to 48.03 kg, with T2 having the highest yield and T7 having the lowest. The Sahel variety's average yield per plant ranged from 1.32 to 1.42 kg. The plot cultivated using all cultural techniques produced the highest yield per plant (1.42 kg), whereas the control plot (T7) produced the lowest (1.32 kg). Across all treatments, the yield per plot ranged from 50.95 to 56.61 kg, with T1 having the lowest yield and the combination treatment having the greatest. These results generally show that cultural techniques, particularly early planting (T2) and a combination of treatments, were helpful in reducing the *H. armigera* population and raising the yield in both tomato types. In fact, the Sahel variety outperformed Rio Grande in terms of both high yield and reduced insect infestation (Table 3.13.3). The amount of *H. armigera* eggs and larvae in both tomato types (Rio Grande and Sahel) was significantly reduced by cultural techniques such as early planting, thorough plowing, removal of contaminated plant portions, hand picking of the larvae, and weeding. The same outcomes have been confirmed in a number of agro-ecological areas over the last ten years, further demonstrating the global applicability of cultural control techniques as a component of Integrated Pest Management (IPM) systems. According to recent research conducted in semi-arid regions of India, Sharma et al. (2017) discovered that altering the sowing date significantly reduced the population of *H. armigera* in tomato and chickpea plants. According to their findings, crops planted early were able to escape peak pest load because they had interfered with the crops' synchronization with the moths' oviposition phases. This procedure is somewhat comparable to the present experiment, where early seeding (T2) produced the maximum fruit output in both tomato kinds as well as the fewest eggs and larvae. Similarly, Kumar et al. (2019) investigated cultural management in vegetable systems in northern India and found that field cleaning and early transplanting were crucial in minimizing fruit loss and larvae assault in tomato crops. They emphasized that early crop setup reduces exposure during pest-active seasons, leading to quantifiable increases in marketable production. These findings support the T2 therapy's great efficacy, which was noted in this investigation. Recent investigations have also validated the effectiveness of deep ploughing in the present study. Yadav et al. (2020) also discovered that summer deep plowing significantly reduced the survival of pupa *H. armigera* overwintering in South Asian legume-based cropping systems. Early infestations were repressed because they were raised on predatory and parched soils. Meena et al. (2018) similarly showed similar results, indicating that farms subjected to pre-season tillage operations had a reduced initial pest build-up. Field sanitation and mechanical control methods, such as collecting infected fruits and manually removing larvae, have also been validated by recent studies. In addition to limiting the population of pests, Sarkar et al. (2018) discovered that routine cleaning of the damaged fruits in tomato fields significantly reduced the second generation of larvae. Furthermore, in a research carried out in Pakistan under semi-arid agro-ecological conditions, Abbas et al. (2021) showed that the weed management technique in conjunction with hand larval removal reduced the *H. armigera* infestation by more than 30% as compared to the untreated controls. Recent studies on host plant defenses are consistent with the varietal differences seen in the present study, where the Sahel had lower infestation rates than the Rio Grande. According to Nawaz et al. (2017), tomato cultivars with more trichomes and a thicker fruit pericarp had much lower larval penetration and oviposition. In a similar vein, Rashid et al. (2022) found that morphological traits, such as biochemical compounds and epidermal hardness, were resistance variables that influenced pest choice and larval survival in a tomato cultivar. Such integrated cultural approaches have shown promise in sub-Saharan Africa. Chidege et al. (2019) discovered that prompt planting, good field cleanliness, and weed management were linked to a significant decrease in *H. armigera*

population density and fruit damage in tomato production systems in East Africa. Additionally, using cultural methods in tandem with resistant cultivars enhanced pest control and boosted production stability in tropical conditions, as shown by Adeniran et al. (2023). Even while cultural practices have continuously shown themselves to be beneficial, the world's current evaluations show that these tactics are unlikely to guarantee the complete eradication of pests in an isolated way. Both Rehman et al. (2020) and Khan et al. (2021) found that *H. armigera* populations can be considerably reduced through cultural methods; however, they came to the conclusion that the best way to manage these insects is to combine cultural methods with pheromone traps, biological control agents, and selective insecticides as part of IPM. This is comparable to the present results, which showed that infestation levels in treated plots were significantly but not completely reduced.

In terms of yield performance, the higher yield per plot and number of fruits per plant in the treated plots of the current study are consistent with other studies that found that early sowing and sanitation-based management systems increased tomato productivity (Kumar et al., 2019; Chidege et al., 2019). The commercial crop and increased fruit retention were directly connected with reduced insect loss. The Sahel type's strong efficacy in this research further supports prior results that suggest increased pest control and production might result from combining cultural management with varietal resistance.

The present study's worldwide relevance is generally reinforced by the overlap with the findings of South Asia, sub-Saharan Africa, and other semi-arid tropical regions. Cultural methods that have been proven to be consistently beneficial across agro-ecological environments include early planting, thorough plowing, field cleanliness, and hand larvae removal. However, since it is supported by contemporary literature, its greatest usefulness may be found in the context of comprehensive IPM, tailored to the needs of the local crop system and environmental circumstances. Future tomato tests in areas with various agro-ecological circumstances would confirm these tactics, which would then be modified to suit all tomato production systems worldwide.

## 9. Conclusions

According to the findings, the researcher found a steady pattern in the performance of cultural practices among the most popular and the least popular types of tomatoes. Precisely, the practice of early sowing (T2) was found to be the best practice for reducing the population of *H. armigera* eggs and larvae in both types of tomatoes, and it performed better than the control group.

Also, the least preferred tomato type, Sahel, was shown to perform better than the most preferred one, Rio Grande, in the level of suppressing the population of *H. armigera*. Between the two kinds, the Sahel consistently reported the lowest quantities of eggs and larvae, indicating a higher level of natural resistance or unfavorable characteristics of the insect. According to the study, the Sahel type of tomato is more resistant to *H. armigera* than Rio Grande, and early planting is an efficient cultural strategy for controlling this pest in tomato crops.

### Recommendations:

Based on these findings, tomato farmers in Peshawar (as well as other regions of Khyber Pakhtunkhwa) are encouraged to:

1. Use early sowing of tomato plantations to evade the highest population of *H. armigera*.
2. Planting of less-preferred tomato varieties, such as Sahel, in areas that are susceptible to the infestation of fruit borers is preferable.
3. Planting early together with other cultural activities, e.g. deep ploughing, weeding, larvae hand-weeding and stripping off the infested fruits to get maximum reduction in the pest population and better yield.
4. These practices should be encouraged by extension services by giving farmer trainings, field demonstrations, and advisories that are more localized to climatic conditions to Increase Adoption And Effectiveness.

## 6. References

- Farooq, M., Abbas, G., Hassan, N., and Karar, H. (2021). integrated cultural management techniques to prevent *Helicoverpa armigera* in tomatoes grown in semi-arid environments. *Plant Protection Research Journal*, 61(3), 257-266.
- Shad, S. A., Abbas, N., and Razaq, M. (2019). Fitness cost, cross-resistance, and actual heredity of emamectin benzoate resistance in *Helicoverpa armigera* (Lepidoptera: Noctuidae). *Crop Protection*, 119, 139–146. <https://doi.org/10.1016/j.cropro.2019.01.012>
- Adeniran, A.A., et al. (2023). Tomato production in tropical agro-ecosystems using integrated pest control techniques. *Tropical Insect Science International Journal*, 43, 1123–1135.
- Arif, M. I., Ahmad, Z., and Ahmad, M. (2020). A evaluation of pesticide resistance in *Helicoverpa armigera* field populations in Asia. *Science*

of Pest Management, 76(1), 19–30. <https://doi.org/10.1002/ps.5550> Akbar, W., Khan, H., and Ali, S. (2019). *Helicoverpa armigera*, the tomato fruit borer, and its population dynamics in Pakistan. *Entomology Journal*, 16(2), 91–98.

Ahmed, F., Khan, Z., and Ali, S. (2019). Pakistan's primary pests and tomato crop status. *Agriculture and Biology International Journal*, 21(3), 451–458. <https://doi.org/10.17957/IJAB/15.0532> Bisht, K., Sharma, H. C., & Yadav, P. (2022). characteristics of tomato genotypes' morphology and biochemistry linked to resistance to *Helicoverpa armigera*. *Crop Journal*, 10(2), 391–402. <https://doi.org/10.1016/j.cj.2022.01.010> Mabagala, R., Chidege, M., and Ndakidemi, P. (2019). Tomato insect pests in East African agricultural systems are managed holistically. *Protection of Crops*, 123, 104–110. M. Dillon, 1998. Using long-term average temperatures, fall diapause induction in *Helicoverpa armigera* is predicted. *Insect Science Journal*, 1(2), 45–52. <https://doi.org/10.1093/jis/1.2.45> Feng, H.Q., Wu, K.M., & Guo, Y.Y. (2009). *Helicoverpa armigera* population dynamics, migration, and control in Asia. *Science of Pest Management*, 65(6), 623–632. <https://doi.org/10.1002/ps.1750> Fitt, G.P., 1989. Heliothis species' ecology in connection to agroecosystems. *Annu. Rev. Entomol.*, 34, 17–52. <https://doi.org/10.1146/annurev.ento.34.1.17> Ishtiaq, M., Khan, M.A., & Shah, F. (2017). Tomato main pest incidence and treatment in Khyber Pakhtunkhwa, Pakistan. *Entomology and Zoology Studies Journal*, 5(6), 1250–1255.

Ahmed, S., Khan, R.R., and Ali, S. (2021). *Helicoverpa armigera* sustainable management: Current developments in integrated pest control. *Sustainability*, 13, 11245.

Shrestha, B., Khanal, B., and Nepal, B. (2025). Biorational pesticides' relative effectiveness against *Helicoverpa armigera* on tomatoes in Nepal. *Sustainable Agriculture Journal*, 15(1), 78–89. <https://doi.org/10.1007/s44279-025-00308-2> Meena, R., Singh, R., and P. (2019). impact of cultural techniques on agricultural productivity and tomato fruit borer incidence. 1152–1157 in *Indian Journal of Agricultural Sciences*, 89(7). Jarpla, M., Sarangi, S., Reddy, N.A., Kumari, P., Rajkumari, et al. (2020). A overview of biological interactions and management techniques for *Helicoverpa armigera* (Lepidoptera: Noctuidae), the cotton bollworm. *International Journal of Experimental Agriculture*, 46(11), 490–507. <https://doi.org/10.9734/jeai/2024/v46i11307> 1 Meena, R.S., et al. (2018). Insect pest dynamics in vegetable crops are affected by crop setup techniques and tillage. *Entomology and Zoology Studies Journal*, 6(4), 123–128. Ashfaq, Muhammad (2012). *Helicoverpa armigera* integrated pest control techniques. *Agriculture & Biology International Journal*, 14(6), 931–936.

A. Nawaz and associates (2017). Tomato resistance to *Helicoverpa armigera* is based on both morphological and biochemical factors. 45, 435–444; *Phytoparasitica*.

Singh, S., Patel, V., Sharma, A., and Kumar, R. (2019). *Trichogramma chilonis* is used with botanical pesticides to prevent tomato crop *Helicoverpa armigera* infection. *Pest Science Journal*, 25(4), 201–215.

M. Rashid and associates (2022). Mechanisms of host plant resistance to the tomato fruit borer (*Helicoverpa armigera*). *Asia-Pacific Entomology Journal*, 25, 101930. Manjunatha, M., and G.V.P. Reddy (2020). Pheromone trap capture threshold level-based laboratory and field research on *Helicoverpa armigera* (Hubner) integrated pest control in cotton. *J. Appl. Ent.*, 124, 213–221.

Ahmed, S., Javed, N., and Rehman, A. (2020). developments in *Helicoverpa armigera* integrated management. *Pest Science Journal*, 93, 1–15. Sarkar and colleagues (2018). Tomato fruit borer incidence is affected by field cleaning and manual eradication. 42–47 in *Vegetos*, 31(3). Kiran, S., Sharma, H. C., and Sreedevi, K. (2022). developments in the resistance of dietary legumes and vegetables against *Helicoverpa armigera*. *Plant Science Frontiers*, 13, 845687. <https://doi.org/10.3389/fpls.2022.845687> Sharma, H.C., et al. (2017). Strategies for controlling *Helicoverpa armigera* include cultural and host plant resistance. *Integrated Pest Management Journal*, 8(1), 15.