



Assessment of Fitness of Different Diets on Rearing and Oviposition of Pink Bollworm (*Pectinophora gossypiella*)

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ABSTRACT

The current research has been performed to check the assessment of the fitness of different diets on rearing and oviposition of pink bollworms. Nine different diets (natural and artificial) were used in this research. There were three replications in each treatment. The longevity of larvae of *P. gossypiella* was maximum (19.46 days) on diet 4 (cotton seed, okra seed, and permanent ingredients). The longevity of pupae of *P. gossypiella* was maximum (8.71 days) on cotton seed, okra seed, and permanent ingredients). The longevity of female *P. gossypiella* was maximum (16.39 days) on diet 5 (cotton seeds, grams seed, and permanent ingredients). The mortality of larvae of *P. gossypiella* was maximum (46.89%) on diet 7 (cotton seed, okra seed, grams seed, and permanent ingredients). The mortality of pupae of *P. gossypiella* was maximum (15.33%) on diet 1 (cotton seed and permanent ingredients). The mortality of females of *P. gossypiella* adults was maximum (19.16%) on a natural diet (cotton seed and flowers). The weight of larvae and *P. gossypiella* was maximum (30.47 mg) on a natural diet (cotton seed and flowers). The weight of pupae of *P. gossypiella* was maximum (21.01 mg) on a natural diet (cotton seeds and flowers). The ovipositional period of females of *P. gossypiella* was a maximum (10.39 days) on diet 5 (cotton seeds, grams seed, and permanent ingredients). Female adults of *P. gossypiella* with normal wings were maximum (5.52) insects on diet 7 (cotton seeds, okra seeds, grams seed, and permanent ingredients). Female adults of *P. gossypiella* with abnormal wings were the maximum (4.76) insects on diet 4 (cotton seeds, okra seeds, and permanent ingredients). The fecundity of females of *P. gossypiella* adults was maximum (24.24 eggs) on diet 1 (cotton seeds and permanent ingredients). The minimum mortality (maximum survival) of larvae and pupae was recorded on diet 8, whereas the minimum mortality (maximum survival) of adults was recorded on diet 5. Since different diets were used for the rearing of pink bollworms to check their effectiveness in rearing and oviposition. So, it is concluded that diet 8 and diet 5 are more effective in terms of rearing and oviposition, respectively.

Keywords: Pink bollworm, Diet assessment, Rearing efficiency, Oviposition performance, Larvae mortality.

Article History

Article # 23-517

Received: 01-Sep-2023

Revised: 29-Oct-2023

Accepted: 10-Nov-2023

INTRODUCTION

The pink bollworm develops 4-6 generations and completes its life cycle in 32–35 days during a single cotton growing season. However, depending on the environment, the length of the life cycle may change, with summer being the shortest and winter being the longest (Sarwar, 2017). The cotton crop is harmed by pink bollworm larvae, which feed on cotton blossoms, sensitive squares, and green cotton bolls. When cotton blossoms are consumed, the petals form a rosette structure, whereas when cotton bolls are consumed, the quality of the lint and fiber is compromised as well as also results in premature opening of the boll (Zafar et al. 2022). Following the harvest of the cotton crop, the larvae are found in the unopened bolls of the harvested cotton stalks, the broken cotton seeds, and the standing cotton sticks in the field. Up until the advent of transgenic cotton, pink bollworm was a significant pest of

cotton in a number of the world's major cotton-producing countries (Razzaq et al., 2021). The widespread cultivation of transgenic cotton, however, allowed this insect to adapt its metabolism and build a tolerance to the diverse Bt genotypes, making it challenging to control (Zafar et al., 2022). *Pectinophora gossypiella*'s devastating larvae are frequently concealed inside cotton's fruiting bodies, where they are protected from pesticide sprays. Larvae consume flowers, squares, and bolls. They also consume the seeds found inside bolls. The loss of blooms and squares could be substantial if the virus occurs early in the cotton crop's growing season. Pink bollworm larvae destroy the petals of cotton flowers, creating an odd-looking rosette (Zafar et al., 2020).

Mass rearing plays a vital role in integrated pest management and has a profound influence on insect performance through first-hand rearing. Commercial businesses use insect colonies that have been mass-

Cite this Article as: Shahid M, Kanwal N, Ali A, Akhtar N and Uzair SA, 2023. Assessment of different diets on rearing and oviposition of pink bollworm. International Journal of Agriculture and Biosciences 12(4): 284-291. <https://doi.org/10.47278/journal.ijab/2023.079>



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produced to assess the impacts of pesticides, host plant tolerance, and the manufacture of substitute insect control goods like viruses and pheromones (Razzaq et al., 2023). Growing industries need to raise beneficial insects to boost output and improve pest management. Many businesses use raised insects as intermediaries in agricultural and therapeutic products (Hughes and Wood, 1998). Producing a large quantity of strong, high-quality laboratory insects using insect-rearing technologies is beneficial to entomology for a variety of reasons (Cohen, 2001). Pink bollworm is reared on different diets but here we used both natural and artificial diets which include cotton seed, okra seed, grams, sucrose, yeast, casein, and ascorbic acid. Pink bollworms (*Pectinophora Gossypiella*) were reared successfully in the laboratory by using these diets. The present study was initiated to accomplish the following objectives:

- Rearing of pink bollworms on different diets.
- Impact of different diets on the fecundity of pink bollworm.

MATERIALS & METHODS

The current study was conducted in the pink bollworm rearing laboratory, department of Entomology, University Agriculture Faisalabad during the year 2022-23. This study was focused on the following aspects.

- Collection of pink bollworms
- Preparation of diets
- Impact of different diets on assessment of the fitness of different diets for mass rearing of pink bollworm
- Impact of different diets on the fecundity of pink bollworm

Pink Bollworm Collection from Fields

First, the infested bolls and flowers were collected from the cotton field of the University of Agriculture Faisalabad. The collected infested bolls and flowers were placed inside the plastic cages till the emergence of *P. gossypiella* adults.

Preparation of Diets

Two types of diets i.e., natural and artificial diets were used in this research. The natural diet consisted of cotton bolls and flowers while artificial were prepared according to the ingredients shown in the table. Cotton, okra, and grams of seeds were used in the form of powder which were mixed with permanent artificial components. After mixing, the diet was left to solidify and then insects were fed on it (Table 1 and 2). Different life parameters of *P. gossypiella* including longevity, mortality, length, weight of larvae, pupae, and adult fecundity of females were recorded on different diets.

Pink Bollworm Culture Maintenance

First instar larvae of the same age were collected from the culture and fed on nine different diets and one natural diet (Table 2). Larvae rearing was carried out inside small larval-rearing plastic cups with lids till the pupation. The pupae developed were transferred into adult cages till the emergence of adults. The adult was transferred into egg-laying chambers till death. The number of eggs deposited was counted daily to determine the fecundity of female *p. gossypiella*. The experiment was conducted under standard conditions of temperature ($29\pm 1^\circ\text{C}$), relative humidity ($65\pm 5\%$), and photoperiod (12:12 L: D photoperiod). The experiment was laid out in a completely randomized design with three replications.

Larvae, Pupae and Ault fed on Diet 1

Cotton seed (CS diet) and permanent ingredients (sucrose, casein, ascorbic acid, and yeast) were used as

the first diet. 34.5 g/kg of all ingredients was dissolved in 100 ml of water and boiled in an oven. Then prepared diet was poured into larval-rearing plastic cups with a lid till pupation. The pupae developed were transferred into adult cages till the emergence of adults. Adults were transferred into egg-laying chambers till death. Different life parameters of *P. gossypiella* including longevity, mortality, and length, the weight of larvae, pupae, and adult fecundity of females were recorded.

Larvae, Pupae, and Ault fed on Diet 2

Okra seed (OS diet) and permanent ingredients (sucrose, casein, ascorbic acid, and yeast) were used as the first diet. 34.5 g/kg of all ingredients was dissolved in 100 ml of water and boiled in an oven. Then prepared diet was poured into larval-rearing plastic cups with a lid till pupation. The pupae developed were transferred into adult cages till the emergence of adults. Adults were transferred into egg-laying chambers till death. Different life parameters of *P. gossypiella* including longevity, mortality, and length, the weight of larvae, pupae, and adult fecundity of females were recorded.

Larvae, Pupae, and Ault fed on Diet 3

Grams seed (CS diet) and permanent ingredients (sucrose, casein, ascorbic acid, and yeast) were used as the first diet. 34.5 g/kg of all ingredients was dissolved in 100 ml of water and boiled in an oven. Then prepared diet was poured into larval-rearing plastic cups with a lid till pupation. The pupae developed were transferred into adult cages till the emergence of adults. Adults were transferred into egg-laying chambers till death. Different life parameters of *P. gossypiella* including longevity, mortality, and length, the weight of larvae, pupae, and adult fecundity of females were recorded.

Larvae, Pupae and Ault fed on Diet 4

Cotton and okra seed (COS diet) and permanent ingredients (sucrose, casein, ascorbic acid, and yeast) were used as the first diet. 17.25 g/kg of all ingredients was dissolved in 100 ml of water and boiled in an oven. Then prepared diet was poured into larval-rearing plastic cups with a lid till pupation. The pupae developed were transferred into adult cages till the emergence of adults. Adults were transferred into egg-laying chambers till death. Different life parameters of *P. gossypiella* including longevity, mortality, and length, the weight of larvae, pupae, and adult fecundity of females were recorded.

Larvae, Pupae and Ault fed on Diet 5

Cotton and grams seed (CGS diet) and permanent ingredients (sucrose, casein, ascorbic acid, and yeast) were used as the first diet. 17.25 g/kg of all ingredients was dissolved in 100 ml of water and boiled in an oven. Then prepared diet was poured into larval-rearing plastic cups with a lid till pupation. The pupae developed were transferred into adult cages till the emergence of adults. Adults were transferred into egg-laying chambers till death. Different life parameters of *P. gossypiella* including longevity, mortality, and length, the weight of larvae, pupae, and adult fecundity of females were recorded.

Larvae, Pupae and Ault fed on Diet 6

Okra and grams seed (OGS diet) and permanent ingredients (sucrose, casein, ascorbic acid, and yeast) were used as the first diet. 17.25 g/kg of all ingredients was dissolved in 100 ml of water and boiled in an oven. Then prepared diet was poured into larval-rearing plastic cups with a lid till pupation. The pupae developed were transferred into adult cages till the emergence of adults.

Table 1: Artificial food ingredients and their quantity

Components of artificial medium		Components of decavitamin	
Component	Quantity (g. kg ⁻¹ or ml.L ⁻¹)	Component	Quantity (g. kg ⁻¹ or ml.L ⁻¹)
Wheat germ meal	34.5	Calcium pantothenate	12.0
Casein	30.0	Niacin	6.0
Agar	20.0	Riboflavin	3.0
Sucrose	10.0	Folic acid	3.0
Brewer's yeast	5.0	Thiamine	1.5
α-cellulose	1.0	Pyridoxine hydrochloride	1.5
Potassium sorbate	1.5	Biotin	0.93
Nipalgin	0.5	Vitamin B ₁₂	0.012
Decavitamin	0.01		
Choline chloride	0.06		
Maize oil	3.3		
Honey	2.0		
Water	730		

Table 2: Suggested Diets and Composition

Treatments	Description	Diet variants	Permanent (as per standard diet)	Quantity (g. kg ⁻¹ or ml.L ⁻¹)
Diet 1(CS-diet)	Cotton seed + permanent ingredients	Cotton seeds	Sucrose, casein, ascorbic acid and yeast	34.5
Diet 2(OS-diet)	Okra seed + permanent ingredients	Okra seeds	Sucrose, casein, ascorbic acid and yeast	34.5
Diet 3(GS-diet)	Grams + permanent ingredients	Grams	Sucrose, casein, ascorbic acid and yeast	34.5
Diet 4(COS-diet)	Cotton +okra + permanent ingredients	Cotton and okra seeds	Sucrose, casein, ascorbic acid and yeast	17.25 + 17.25
Diet 5(CGS-diet)	Cotton + grams + permanent ingredients	Cotton and grams seeds	Sucrose, casein, ascorbic acid and yeast	17.25 + 17.25
Diet 6(OGS-diet)	Okra + grams + permanent ingredients	Okra and grams seeds	Sucrose, casein, ascorbic acid and yeast	17.25 + 17.25
Diet 7(OCGS-diet)	Okra + cotton + grams + permanent ingredients	Okra, cotton, and grams seeds	Sucrose, casein, ascorbic acid and yeast	11.5 + 11.5 + 11.5
Standard diet	Wheat germ meal			According to the table of standard diet
Natural diet	Cotton bolls and flowers			

Adults were transferred into egg-laying chambers till death. Different life parameters of *P. gossypiella* including longevity, mortality, and length, the weight of larvae, pupae, and adult fecundity of females were recorded.

Larvae, Pupae, and Ault fed on Diet 7

Okra, cotton, and grams seed (OCGS diet) and permanent ingredients (sucrose, casein, ascorbic acid, and yeast) were used as the first diet. 11.5 g/kg of all ingredients was dissolved in 100 ml of water and boiled in an oven. Then prepared diet was poured into larval-rearing plastic cups with a lid till pupation. The pupae developed were transferred into adult cages till the emergence of adults. Adults were transferred into egg-laying chambers till death. Different life parameters of *P. gossypiella* including longevity, mortality, and length, the weight of larvae, pupae, and adult fecundity of females were recorded.

Larvae, Pupae and Ault fed on a Standard diet

34.5 g/kg of wheat germ meal was dissolved in 100 ml of water and boiled in an oven. Then prepared diet was poured into larval-rearing plastic cups with a lid till pupation. The pupae developed were transferred into adult cages till the emergence of adults. Adults were transferred into egg-laying chambers till death. Different life parameters of *P. gossypiella* including longevity, mortality, and length, the weight of larvae, pupae, and adult fecundity of females were recorded.

Larvae, Pupae and Ault fed on a Natural Diet

Natural diets (cotton bolls and flowers) were collected from the cotton field, University of Agriculture, Faisalabad. Cotton bolls and flowers were kept in the larval-rearing

plastic cups with a lid till pupation. The pupae developed were transferred into adult cages till the emergence of adults. Adults were transferred into egg-laying chambers till death. Different life parameters of *P. gossypiella* including longevity, mortality, and length, the weight of larvae, pupae, and adult fecundity of females were recorded.

Harvesting of Eggs

The female of *P. gossypiella* typically lay eggs on the gouch paper one by one or in groups. To check for eggs, we take the gouch paper from the petri dish and place it under the microscope (Fig. 1). The eggs were then transferred from tissue paper into a hatching jar. Eggs initially appeared whitish during the early stages of hatching before turning orange. The plastic egg jars were kept at 29 °C and 60±10% humidity.

Larvae

The first instar larvae were collected after egg hatching and transferred to artificial diets within glass vials, while the second, third, and fourth instar larvae were put in Petri dishes with a wheat germ diet. Larvae were raised on an artificial feed at a temperature of 26±2°C and a relative humidity of 55±5% (Fig. 2).

Pupae

Pupae were collected from the soil, lab, cotton gin, and cultivation plates. They were then stored on diet-free petri dishes until moth emergence (Fig. 3).

Adult Longevity

The pre-oviposition era, oviposition lifetime and post-oviposition period were the three main components of adult life.



Fig. 1: Gouche paper under the microscope with laid eggs.



Fig. 2: Instars of pink bollworm larvae.



Fig. 3: Pupae collection.

Oviposition Rate

The number of eggs laid was measured to determine the fecundity of the species. In Petri dishes, newly laid eggs were housed in the same carefully monitored lab environment. Eggs were watched from oviposition until hatching after being laid.

Statistical Analysis

All the dependent parameters including longevity, mortality, length, and weight of larvae and pupae mortality

and longevity of adults and fecundity, pre-oviposition, oviposition, and post-oviposition periods of *P. gossypiella* females were analyzed through the ANOVA technique using statistical (8.1) software. The means of treatment were compared by Tukey's HSD test at the probability of 5%.

The effect of different diets on different life parameters of *P. gossypiella* including longevity, mortality, length, the weight of larvae, pupae, and adults' pre-oviposition, oviposition, post-oviposition, and fecundity with morphology (normal and abnormal wings) of female was recorded on different diets, and these parameters were studied after rearing of nine different diets. [(T1 Cotton seed + permanent ingredients 34.5 g. kg⁻¹), (T2 Okra seed + permanent ingredients 34.5 g. kg⁻¹), (T3 Grams seed + permanent ingredients 34.5 g. kg⁻¹), (T4 cotton seed+ Okra seed + permanent ingredients 17.25 g. kg⁻¹), (T5 Cotton seed + Grams seed+ permanent ingredients 17.25 g. kg⁻¹), (T6 Okra seed+ Grams seed + permanent ingredients 17.25 g. kg⁻¹), (T7 Okra seed + cotton seed + Grams seed + permanent ingredients 11.5 g. kg⁻¹), Standard diet (T8 wheat germ meal) and Natural diet (T9 Cotton bolls and flowers)]. The results of the study are discussed below.

RESULTS AND DISCUSSION

The current research has been performed to check the assessment of the fitness of different diets on rearing and oviposition of pink bollworms. Nine different diets were used in this research with permanent ingredients. The experiment was performed in the pink bollworm laboratory department of entomology to assess the effect of different diets on different life parameters of *P. Gossypiella* including longevity, mortality, length, the weight of larvae, pupae, and adults pre-oviposition, oviposition, post-oviposition and fecundity with morphology (normal and abnormal wings) of female was recorded on different diets, and these parameters were studied after rearing of nine different diets. [(T1 Cotton seed + permanent ingredients 34.5 g. kg⁻¹), (T2 Okra seed + permanent ingredients 34.5 g. kg⁻¹), (T3 Grams + permanent ingredients 34.5 g. kg⁻¹), (T4 cotton+ Okra seed + permanent ingredients 17.25 g. kg⁻¹), (T5 Cotton + Grams + permanent ingredients 17.25 g. kg⁻¹), (T6 Okra+ Grams + permanent ingredients 17.25 g. kg⁻¹), (T7 Okra + cotton + Grams + permanent ingredients 11.5 g. kg⁻¹), Standard diet (T8 wheat germ meal) and Natural diet (T9 Cotton bolls and flowers)]. The mean values are given below from (Fig. 1 to Fig 16).

Larval Longevity

The result of the present investigation for larval longevity (19.46±0.53) days contradicts those (25.01±0.994) and (26.10±3.76) days by Jothi et al. (2016) and Muralimohan et al. (2009) respectively. The possibility for the deviation for a shorter duration might be the varietal difference of the COS diet. However, the larval longevity of (19.46±0.53) days recorded (COS- larval diet) in our study resemble those reported by Akhtar et al. (2023) who could able to record the larval longevity of (19.68±0.09) days using the almost same diet. Comparatively, the larvae developed faster than other tested diets and were pupated in (5.46±0.48) days when reared on a natural diet. The results for minimum larval longevity (5.46±0.48) days of the present study are approximately similar (08.03±0.43 to 11.36±0.30 days) with those reared on the same diet (cotton bolls) reported by Rajput et al. (2019).

Larval Mortality

Mortality in the laboratory-reared strain larvae was recorded (46.89±0.87 %) when fed on an OCGS diet.

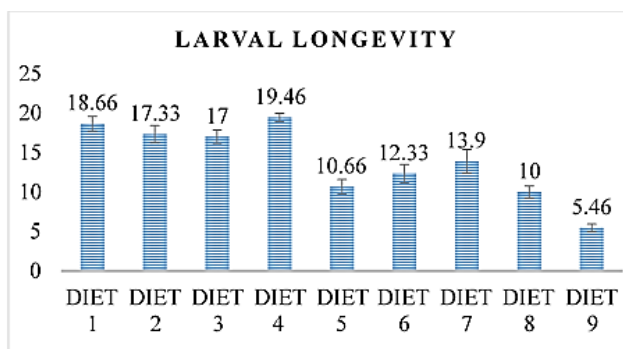


Fig. 1: Longevity of *P. gossypiella* larvae fed on different diets

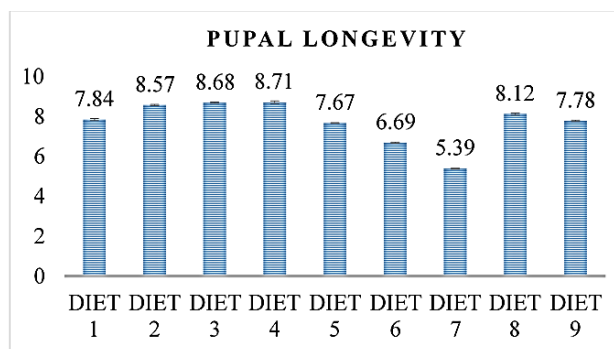


Fig. 5: Longevity of *P. gossypiella* pupae fed on different diets

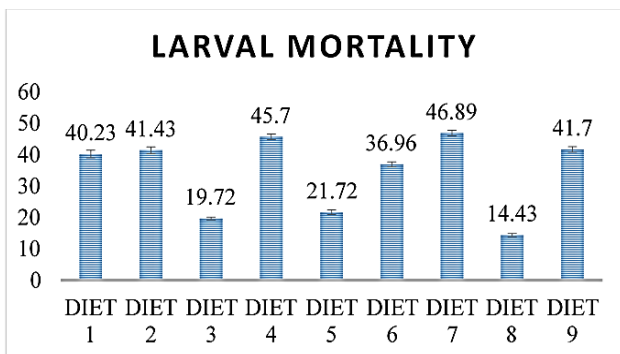


Fig. 2: Mortality of *P. gossypiella* larvae fed on different diets

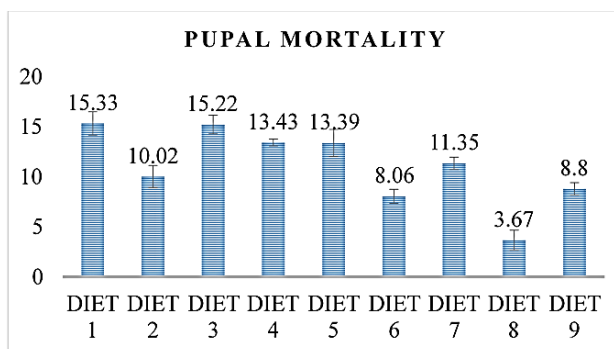


Fig. 6: Mortality of *P. gossypiella* pupae fed on different diets

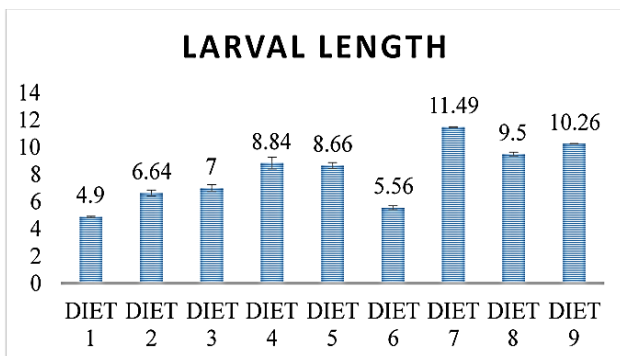


Fig. 3: Length of *P. gossypiella* larvae fed on different diets

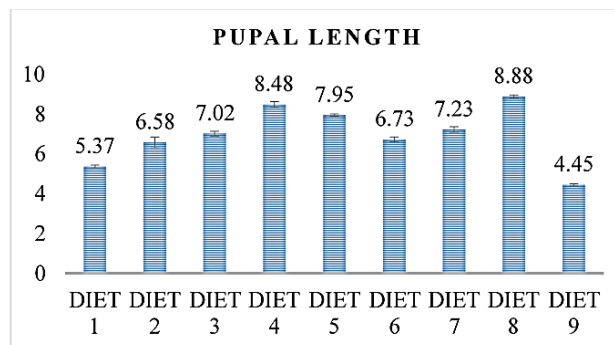


Fig. 7: Length of *P. gossypiella* pupae fed on different diets

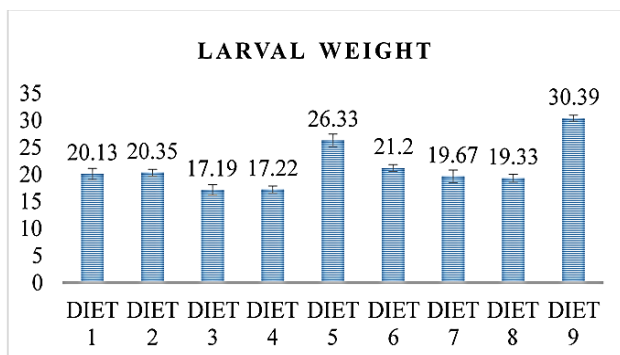


Fig. 4: Weight of *P. gossypiella* larvae fed on different diets

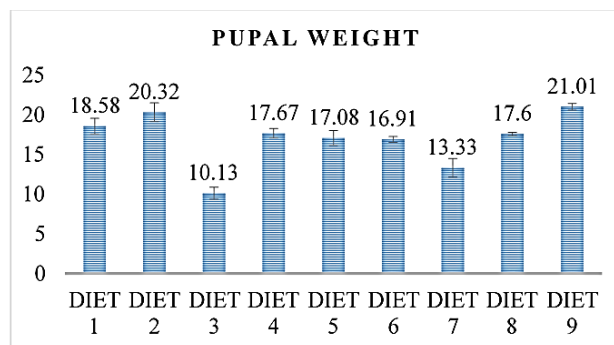


Fig. 8: Weight of *P. gossypiella* pupae fed on different diets

These results are similar to those reported (45.20 ± 0.49 %) by Akhtar et al. (2023) using the diet okra fruit (slice). These results are contrary to those reported by 24.95% by Rajput et al. (2019) using the same diet. The possibility of higher mortality (contradiction) could be the difference in food because they used cotton bolls of Bt cotton rather use non-Bt cotton bolls (Saeed et al., 2023).

Larval Weight

The highest weight of *P. gossypiella* larvae was recorded (30.39 ± 0.56 mg) on a diet composed of cotton seed and flowers. These results are contrary to those reported by (26.51 ± 1.07 mg) Akhtar et al. (2023). The reason for the contrary may be the diet used is different within environmental conditions (Ihsan et al., 2021).

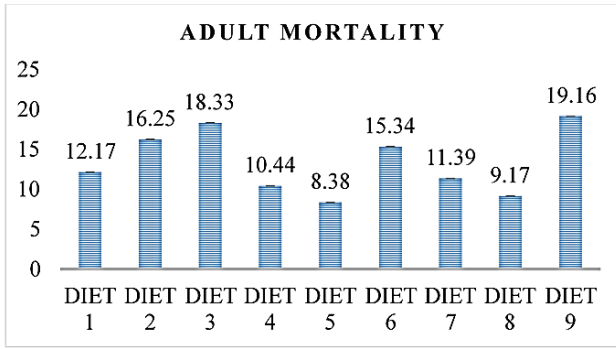


Fig. 9: Mortality of female *P. gossypiella* adults fed on different diets

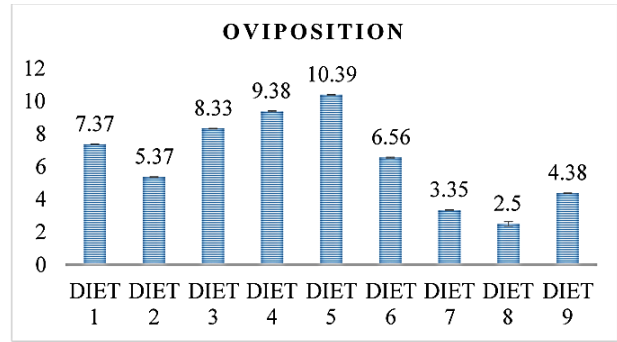


Fig. 13: Oviposition of female *P. gossypiella* adults fed on different diets

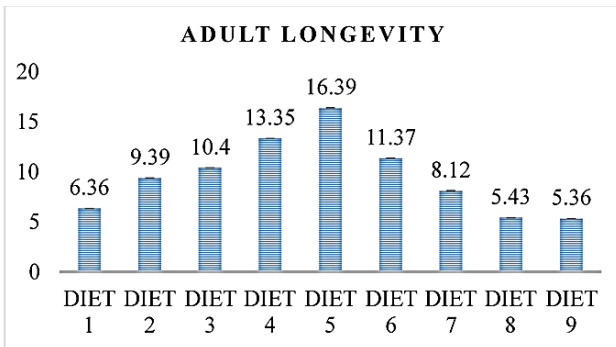


Fig. 10: Longevity of female *P. gossypiella* adults fed on different diets

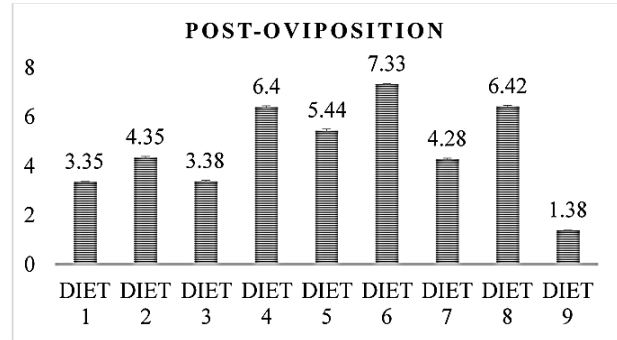


Fig. 14: Post-oviposition of female *P. gossypiella* adults fed on different diets

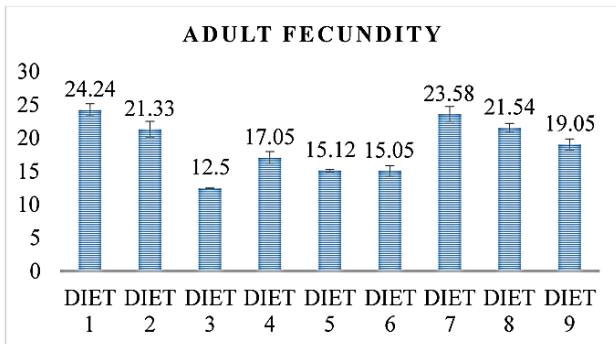


Fig. 11: Fecundity of female *P. gossypiella* adults fed on different diets

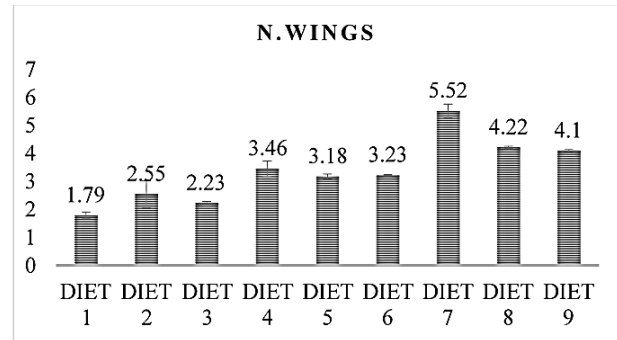


Fig. 15: Normal wings of female *P. gossypiella* adults fed on different diets

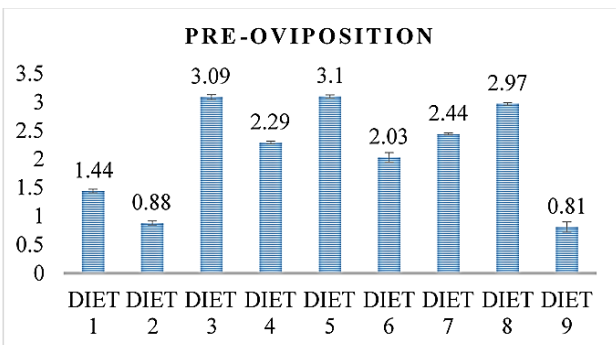


Fig. 12: Pre-oviposition of female *P. gossypiella* adults fed on different diets

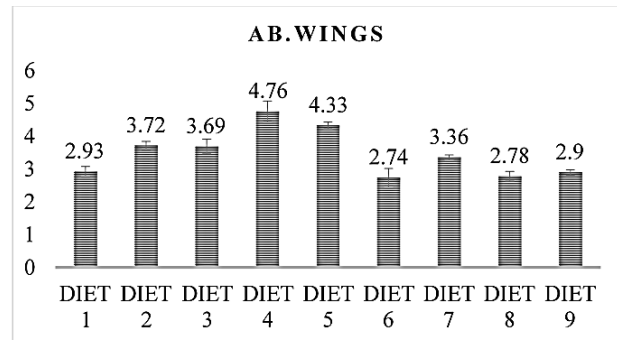


Fig. 16: Abnormal wings of female *P. gossypiella* adults fed on different diets

Larval Length

In the present study length of *P. gossypiella* larvae was recorded maximum (11.55 inches) on a diet composed of cotton seed+okra seed+grams seed+permanent ingredients.

The diet composed of Cotton seed and flowers (natural diet) demonstrated the length of *P. gossypiella* larvae of (10.26 inches). The lowest length of *P. gossypiella* larvae was recorded on cotton seed and permanent ingredients at (4.9 inches).

Pupal Longevity

The highest longevity of *P. gossypiella* pupae was recorded (8.71±0.03 days) on a diet composed of cotton seed + okra seed + permanent ingredients and a minimum of okra seed + cotton seed + grams seed and permanent ingredients at (5.39 days). These results are similar to those reported (8.64±0.03 days) by Akhtar et al. (2023) using the diet okra fruit (slice).

Pupal Mortality

The highest mortality of *P. gossypiella* pupae was recorded (15.33 %) on a diet composed of cotton seed + permanent ingredients. The diet composed of Grams seed + permanent ingredients demonstrated a mortality of *P. gossypiella* pupae of (15.22 %). The diet composed of cotton seeds and flowers demonstrated the mortality of *P. gossypiella* pupae (8.8 %). The diet composed of okra seed + grams seed + permanent ingredients demonstrated mortality of *P. gossypiella* larvae of (8.06 %). The lowest mortality of *P. gossypiella* pupae was recorded on wheat germ meal at (3.67 %).

Pupal Length

The highest length of *P. gossypiella* pupae was recorded (8.88 inches) on a diet composed of wheat germ meal (standard diet). The diet composed of cotton seed + okra seed+ permanent ingredients demonstrated the length of *P. gossypiella* pupae of (8.48 inches). The diet composed of cotton seed + permanent ingredients demonstrated a length of *P. gossypiella* pupae of (5.37 inches). The lowest length of *P. gossypiella* pupae was recorded on cotton seeds and flowers at (4.45 inches).

Pupal Weight

The highest weight of *P. gossypiella* pupae was recorded (21.01 mg) on a diet composed of cotton seeds and flowers and the minimum was recorded on grams seed + permanent ingredients at (10.13 mg). These results are contrary to those reported by (18 mg) Jothi et al. (2016). They used different diets with multivitamins.

Adult Mortality

The highest mortality of female *P. gossypiella* adults was recorded (19.16 %) on a diet composed of Cotton seeds + flowers. The diet composed of Grams seed + permanent ingredients demonstrated mortality of female *P. gossypiella* adults of (18.33 %). The diet composed of Okra seeds+ and permanent ingredients demonstrated mortality of female *P. gossypiella* adults of (16.25 %). The diet composed of Okra seeds + grams seeds + permanent ingredients demonstrated mortality of female *P. gossypiella* adults (15.34 %). The diet composed of okra seed + cotton seed + grams seed and permanent ingredients demonstrated a mortality of female *P. gossypiella* adults of (12.17 %). The diet composed of cotton seeds + grams seeds okra seed + permanent ingredients demonstrated mortality of female *P. gossypiella* adults of (11.39 %). The diet composed of cotton seeds + okra seed + permanent ingredients demonstrated the mortality of female *P. gossypiella* adults (10.44 %). The diet composed of wheat germ meal demonstrated a mortality of female *P. gossypiella* adults of (9.17 %). The lowest mortality of female *P. gossypiella* adults was recorded on cotton seed + grams seed and permanent ingredients at (8.38 %).

Adult Longevity

The longevity of female adults of *P. gossypiella* was maximum (16.39 days) on a diet composed of cotton seeds + grams seeds + permanent ingredients and minimum longevity on cotton seeds and flowers is (5.36 days). These

results are contradictory with Zinzuvadiya et al. (2017) who reported the highest longevity of female adults of pink bollworm (28 days) at 25 ± 1 °C and minimum longevity of female adults (3.45 days) at 35 ± 1 °C.

Adult Fecundity

In the present study fecundity of eggs /females was recorded maximum (24.24 eggs/day/female) on a diet composed of cotton seeds + permanent ingredients at lab temperature and minimum fecundity were recorded on grams seed and permanent ingredients at (12.5 eggs/day/female). These results are close to those reported by (22.26 eggs/day/female) Akhtar et al. (2023). The results recorded in this research were different from those reported by Rajput et al. (2019) who recorded (8.04 eggs/day/female) when studying the females on non-Bt cotton (during their larval development). Even the lowest fecundity rate (12.5 eggs/day/female) recorded in this research is 1.52 times higher than those under discussion (Ali et al., 2020).

Pre-oviposition

Pre- ovipositional period of *P. gossypiella* was recorded at a maximum (3.1 days) on a diet composed of cotton seeds + grams seed + permanent ingredients and the minimum pre-ovipositional period was recorded on Cotton bolls and flowers (natural diet) at (0.81 days). Thus, results were almost the same with Younes et al. (2011) who found that the maximum pre-oviposition period was (4.66 days) at 20 °c and the minimum pre-oviposition period (1.20 days) at 35°c.

Oviposition

In the present study, the ovipositional period of pink bollworm was observed maximum (10.39 days) on a diet composed of cotton seeds + grams seed + permanent ingredients, and a minimum ovipositional period was recorded on wheat germ meal (2.5 days). These results have similarities with Madhu et al. (2021) who evaluated that *Pectinophora gossypiella* laid more eggs on BT cotton mixed with okra and hibiscus. Overall pink bollworms have a stronger preference for non-Bt cotton for maximal egg release.

Post-oviposition

Post oviposition of *P. gossypiella* was recorded maximum (7.33 days) on a diet composed of Okra seeds + Grams seed + permanent ingredients and minimum post oviposition was recorded on Cotton seeds and flowers (1.38 days). These results are contradicted by Ali et al. (2020) who studied the average development of eggs per female from the different larval rations was studied: square-reared moths, 98.1 eggs; boll-reared, 204.3; 1% meal, 336.7; 5% meal, 302.1; and wheat germ, 312.2.

Normal Wings

The results of female adults with normal wings recorded a maximum (5.52) on a diet composed of Cotton seeds + Okra seeds + Grams seeds + permanent ingredients. The diet composed of wheat germ meal (standard diet) demonstrated normal wings of female *P. gossypiella* adults at (4.22). The diet composed of Grams seed + permanent ingredients demonstrated normal wings of female *P. gossypiella* adults of (2.23). The lowest normal wings of female *P. gossypiella* adults were recorded on Cotton seeds and permanent ingredients (1.79).

Abnormal Wings

The highest number of abnormal wings of female *P. gossypiella* adults were recorded (4.76) on a diet composed

of cotton seeds + okra seeds + permanent ingredients. The diet composed of wheat germ meal demonstrated abnormal wings of female *P. gossypiella* adults at (4.33). The diet composed of cotton seeds + grams seed + permanent ingredients demonstrated abnormal wings of female *P. gossypiella* adults (3.72). The lowest abnormal wings of female *P. gossypiella* adults were recorded on Okra seeds + grams seed + permanent ingredients (2.74).

Conclusions

The assessment of various diets on the rearing and oviposition of pink bollworms (*Pectinophora gossypiella*) has yielded valuable insights. The study employed nine different diets, both natural and artificial, with three replications for each treatment. Noteworthy findings include the optimal longevity of larvae on diet 4, pupae on diet 5, and female adults on diet 5 as well. Mortality rates varied across diets, with the highest recorded for larvae on diet 7 and females on a natural diet. The weight of larvae and pupae, ovipositional period, and fecundity of female adults demonstrated distinct patterns influenced by diet composition. Natural diets, specifically diet 1 and diet 5, proved superior in promoting higher weights and favorable reproductive characteristics. Crucially, the research highlights that diet 8 and diet 5 emerged as the most effective for rearing and oviposition, respectively. These findings provide valuable guidance for optimizing the diet composition in the rearing process of pink bollworms, offering potential applications in agricultural practices and pest management. The identification of specific diets conducive to enhanced survival and reproductive success underscores the practical significance of this research in the context of pest control strategies.

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