Journal of Advanced Zoology
*ISSN: 0253-7214*
*Volume* ***45*** *Issue 6* ***Year 2024*** *Page* ***214:222***

# Surveillance Through Pheromone Traps Of Tomato Leaf Miner (*Tuta absoluta*) In Hyderabad Region Sindh, Pakistan

**Muhammad Imran Khan[1*], Naheed Baloch[1], Niaz Hussain Khuhro[2] , Nadir Ali Shah[1]**

[1*]*Department of Zoology, University of Sindh Jamshoro, Sindh, Pakistan*
[2]*Nuclear Institute of Agriculture (NIA), Tando jam*

***Corresponding Author:*** Muhammad Imran Khan
**Email: imrankhankz45@gmail.com*



***Abstract***

*Tuta absoluta* commonly known as South American Tomato moth is a destructive and rapidly spreading pest of Tomato worldwide. Since its first observation from Spain in 2006, it has invaded over 90 countries successfully up till now including Pakistan (Ishtiaq et al., 2020). This study presents significant insights into the rapid establishment of *Tuta absoluta* a notorious tomato pest, in the Hyderabad region. Adult male moths of *T. absoluta* were monitored using sex pheromone traps at three locations Tando Allahyar, Tando Jam, and Kotri. Notably, substantial variation in moth captures was observed among these locations, with Tando Allahyar reporting the highest population, followed by Tando Jam, while Kotri consistently had lower captures. overall highest number of *T. absoluta* was recorded from Tando Allahyar 137.5, followed by Tando jam 106 and Kotri 66.25 for two crop seasons. The study also revealed a direct correlation between *T. absoluta* population and crop maturation.

***Keywords: Surveillance, Tuta absoluta, Pheromone traps, Sindh.***

## INTRODUCTION

Tomato *Lycopersicon esculantum* (MILL) is recognized as one of the most commonly sown vegetable which is one of the most important cash and industrial crop (Babaloa et al., 2010). According to FAO "Next to Potato tomato is the second valuable vegetable" (FAO 2001). Tomatoes are being grown in all four provinces of Pakistan. It has been successfully cultivated throughout the country round the year. In Pakistan Cultivated Area under Tomato Crop in 2021-22 has been 124.22 thousand acres and the total production was 541.28 thousand tons. Pakistan ranks at 33rd for tomato production in the world. The global average yield is 35 tonnes/ha, whereas in Pakistan it is 9.90 tonnes/ha – thus a yield gap of 25.1 tonnes/ha exists. (GOP 2023). Although, Tomato is attacked by a wide range of insect pests that limits the growth and yield. Tomato leaf miners among all, are one of the most important pests that limit the yield and production (Retta et al.,2015). *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae), commonly known as South American tomato Pinworm reinstated recently as *Phthorimaea absoluta* Meyrick (Chang et al., 2021) is a destructive pest of tomato crops worldwide. *T. absoluta* was first seen in 2006 from Spain, South America, and from there it made its way to Europe, Mediterranean, Central and South Africa (Desneux et al., 2011). In 2010 it was reported from Turkey ( Kılıç, 2010) and entered India in 2014 (Sridhar et al., 2014) and in Nepal in 2016 (Bajracharya et al., 2016) by defeating all quarantine measures. It was also recorded from other neighbouring countries such

as Iran (Baniameri et al.,2012) and Bangladesh (Hossain et al 2016). Up till now it has successfully invaded over 90 countries (EPPO, 2021) hence posing a severe danger not only to tomato but to a lesser extent to other economically valuable solanaceous crops throughout the world such as Eggplant, Potato, Tobacco and Pepper (Razowski et al., 1995 and Verheggen et al., 2019). Presence confirmation in India and Middle East makes Pakistan, Afghanistan, China and Nepal as risk areas (Ishtiaq et al., 2020). It has been confirmed that tomato leaf miner *Tuta absoluta* (Meyrick1917) (Lepidoptera: Gelechiidae) has invaded tomato (*Solanum Lycopersicon* L.) crop in Pakistan in some regions of KPK and Punjab provinces i.e. in Charsadda (Sadique et al., 2022) and in Multan(Ishtiaq et al., 2020) respectively, (Gabol et al., 2023) has confirmed *T. absoluta* presence in different regions of Sindh province also.if it establishes itself into Pakistan than it will pose a big threat to country's tomato production.

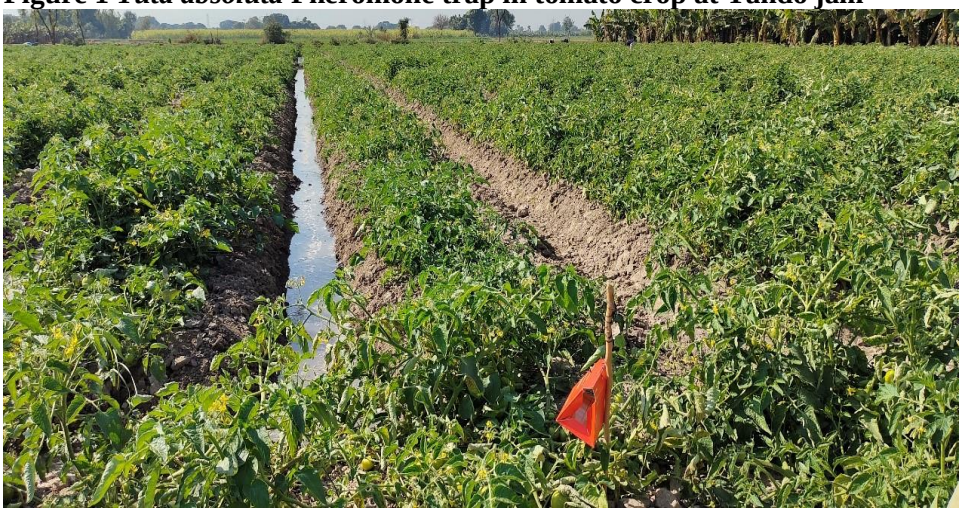
The Larvae of *T. absoluta* starts damage from penetration into the leaves and feeding on mesophyll parts which results in irregular mines on the leaf surface, negatively affecting the photosynthetic activity of the plant. Subsequently, damaged leaves shrivel and potentially minimizing the plant's ability to fight against other harmful organisms. The galleries and mines in the leaves alter the general development of the plant and could cause necrosis (Biondi et al., 2018). Under extreme attacks, the leaves give a burnt appearance. Other usual signs and symptoms of leaf minor's damage shows: puncture marks, abnormal shape, exit holes and rot due to secondary infective agents, and Frass (fine powdery material that plant-eating insects pass as waste after they digest plant parts). Mature larvae (third to four instar) could feed upon plant parts that results in economic losses The severe infestation of this insect pest causes heavy losses to the extent of 80% to 100 % in Tomato both in protected and in open field cultivation (Desneux et al., 2010).

## MATERIALS & METHODS

### Pheromone traps

The employment of pheromone-based strategies is widely acknowledged as a valuable approach for monitoring and controlling *T. absoluta* (Cocco et al., 2013 and Caparros et al 2013). Therefore, three tomato growing areas of Hyderabad region namely Tando allahyar, Tando jam and Kotri were monitored for identification and to confirm the presence of tomato leaf miner *T. absoluta* in the area. Pheromone traps were installed into the tomato fields in order to lure and capture adult male moths. From China, Lure comprised of chemical (3E, 8Z, 11Z) -3,8,11- tetradecatrien-1-yl acetate or TDTA (90%) and (3E, 8Z) -3,8- tetradecadien-lyl acetate or TDDA (10%) attractive to male synthesized by Beijing Zhongjie Sifang Biotechnology Co., Ltd. China, fixed inside the middle of delta traps. One Trap/plot was installed at a height of 1.5 m to lure *T. absoluta* males at four different sites at Tando allahyar, Tando jam & Kotri respectively for two cropping cycles from September 2021 to April 2022 (Fig.1).

**Figure 1 *Tuta absoluta* Pheromone trap in tomato crop at Tando jam**



### Data Collection

Only male adult insects are captured by the pheromone traps (Braham,2014) therefore, data was recorded from the beginning of the vegetative Phase up to harvesting stage of the crop by collecting the number of males adults trapped at 15 days intervals and removed after counting from the traps. The Sticky paper of the trap was changed twice a month and pheromone lure once a month (Fig.2).

**Figure 2 *Tuta absoluta* male trapped in tomato at Tando jam**

**Identification**

The warm Histoclear-II (a mix of refined paraffin oil with orange oil) was used for cleaning the sticky traps to dissolve or remove any adhesive. The removal of the abdomen was done with 10% potassium hydroxide (KOH) and scales were detached from the valvae (part of the male genitalia) by brushing them gently for a clearer view of the underlying structures. The adult moths caught through pheromone traps were inspected with a computer connected stereomicroscope at zoological lab university of Sindh Jamshoro and matched completely to the characters mentioned in taxonomic literature. Images of inspected samples were taken.

## RESULTS

**Geographical Distribution**

The specimen captured through the pheromone traps provided a current distribution overview and confirmed the presence of *T. absoluta* in all experimental regions of Hyderabad throughout the study period.

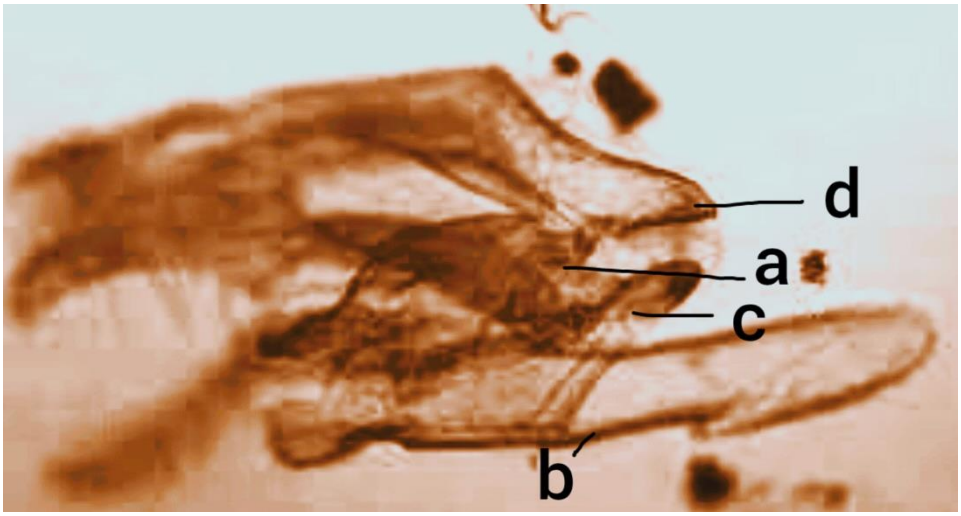
**Insect Identification**

The specimen captured throughout the trapping period were silver, grey 6 to 7 mm long lepidopteran moth *T. absoluta* with darkly spotted forewings and filiform pair of antennae (Akbar et al., 2023) along with Lanceolate and dark grey hind wings with long cilia, prominent Labial palpi, curved upward and projected onward with long and acute apical segment, obvious dark brown and grey band on legs, antennae and labial palpi. Vertex of head was shielded with flattened scales (Fig.3)

**Figure 3 *Tuta absoluta* Adult**

Genitalia was with broad and hood- shaped uncus widened at apex (a), valvae was digitate, setose apically, medially convexed inner margin (b) (Brambila et al 2010), Basally extended tegumen (c), Wide gnathos (d), with circular tip Widened vinculum, well established (e), along with, extended saccus and Phallus with distinct caecum (f) (Fig.4).

**Figure 4 Male Genitalia**




**Climate**

The mean temperature throughout the first (from September 2021 to December 2021) and second (from January 2022 to April 2022) cropping season at Hyderabad ranged from 32 ℃ to 19 ℃, and 18 ℃ to 33 ℃ respectively whereas relative humidity recorded from 66% to 53% during first (from September 2021 to December 2021) and from 61% to 46 % during second (from January 2022 to April 2022) cropping season respectively.

**Abundance of males**

The average numbers of captured *T. absoluta* moth varied area wise during both crop seasons (Table 01). A two-way ANOVA showed significant difference (F= 2.87, df= 14, P=0.0019) between number of captured moths during season 1. Among the sampling locations maximum average number of *T. absoluta* moth captured at different intervals were (14) from Tando allahyar (Fig 5) followed by (12) from Tando jam (Fig 6), while the minimum was (0) at kotri (Fig 7) during season 1. Similarly, during season 2 a significant difference (F= 2.75, df= 14, P=0.0028) between average numbers of *T. absoluta* moths captured through pheromone traps was noticed at all locations. Accordingly, at Tando allahyar maximum average number (19) of *T. absoluta* moth was recorded followed by Tando jam with (16.75), while Kotri manifested the lowest average number (0.75) of moth catches.

Table 01. Average number of *T. absoluta* moths captured through pheromone traps at different time intervals in Hyderabad region

| Location | Time interval | Season 1 | Season 2 |
|---|---|---|---|
| Tando allahyar | 1 | 1 ± 0.40 JK | 2.75 ± 0.47 JKL |
| | 2 | 1.5 ± 0.28 IJK | 3 ± 0.5 JK |
| | 3 | 3 ± 0.57 HI | 5.50 ± 0.2 HI |
| | 4 | 7 ± 0.40 EF | 9 ± 0.4 EF |
| | 5 | 8.50 ± 1.04 CDE | 11.0 ± 0.81 DE |
| | 6 | 10 ± 0.70 C | 14 ± 1.41 C |
| | 7 | 12 ± 1.08 B | 16.25 ± 1.31 B |
| | 8 | 14 ± 1.22 A | 19 ± 0.91 A |
| Tando jam | 1 | 0.5 ± 0.28 JK | 2 ± 0 JKL |
| | 2 | 0.75 ± 0.47 JK | 2 ± 0.40 JKL |
| | 3 | 2 ± 0 IJ | 4 ± 0.70 IJ |
| | 4 | 5 ± 0.40 G | 6.5 ± 0.64 GH |
| | 5 | 6 ± 0.70 FG | 8 ± 0.40 FG |
| | 6 | 7 ± 1.08 EF | 11 ± 1.08 DE |
| | 7 | 9.25 ± 1.10 CD | 13.75 ± 1.37 C |
| | 8 | 12 ± 0.40 B | 16.75 ± 0.75 B |
| Kotri | 1 | 0 ± 0 K | 0.75 ± 0.25 L |
| | 2 | 0.5 ± 0.28 JK | 1.25 ± 0.25 KL |
| | 3 | 1 ± 0 JK | 2 ± 0.40 JKL |
| | 4 | 2 ± 0.40 IJ | 4 ± 0.40 IJ |
| | 5 | 3 ± 0.40 HI | 5.25 ± 0.62 HI |
| | 6 | 4.75 ± 0.62 GH | 7 ± 0.57 FGH |
| | 7 | 6 ± 1.08 FG | 9 ± 0.81 EF |
| | 8 | 8 ± 0.40 DE | 11.5 ± 0.64 D |

Means in the same column followed by the same letter are not significantly different LSD test at P= 0.05

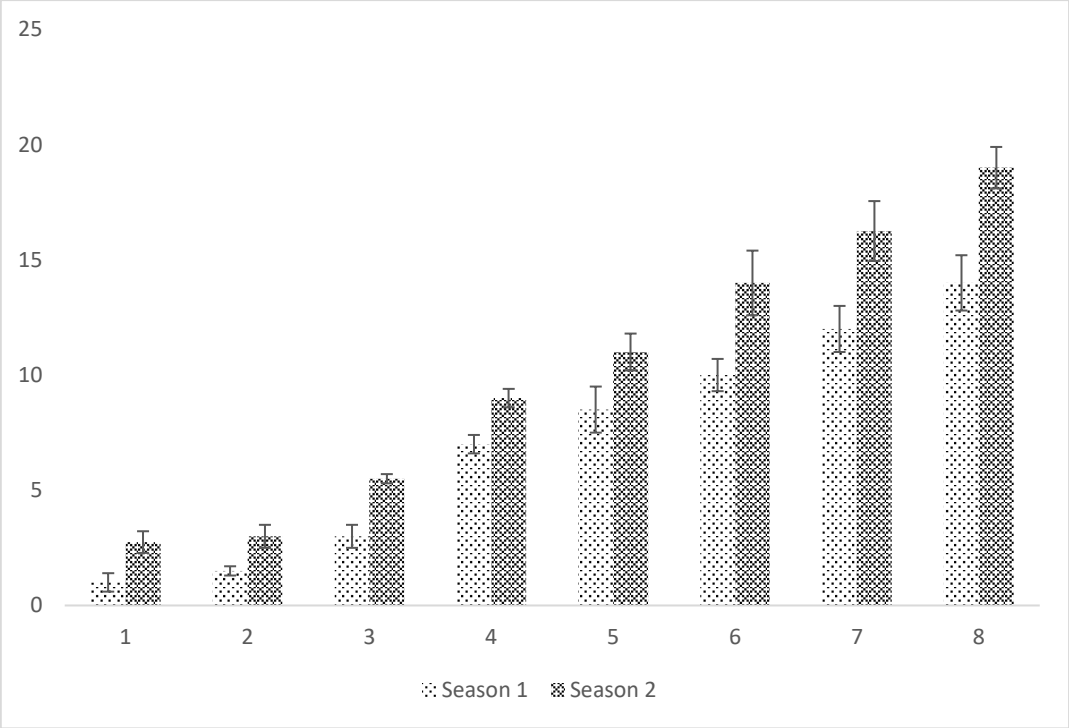



**Figure 5 Average number of *T. absoluta* moths captured through pheromone traps at different intervals in Tando allahyar**

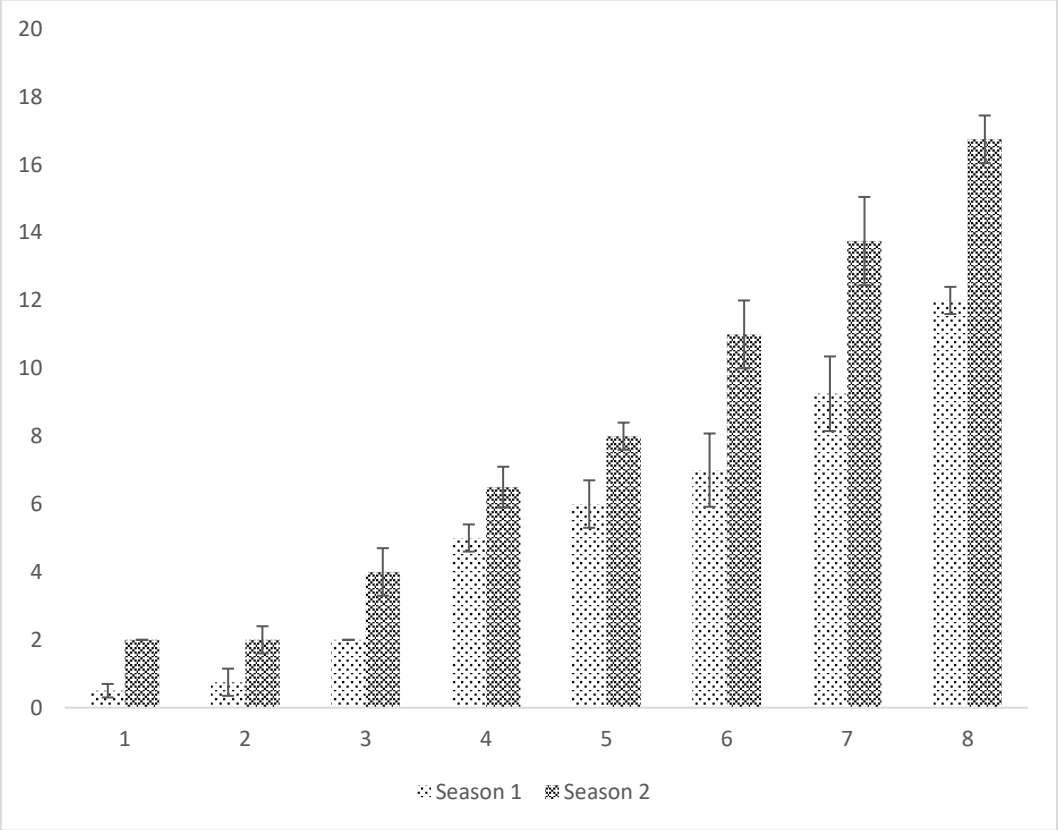



**Figure 6 Average number of *T. absoluta* moths captured through pheromone traps at different intervals in Tando jam**

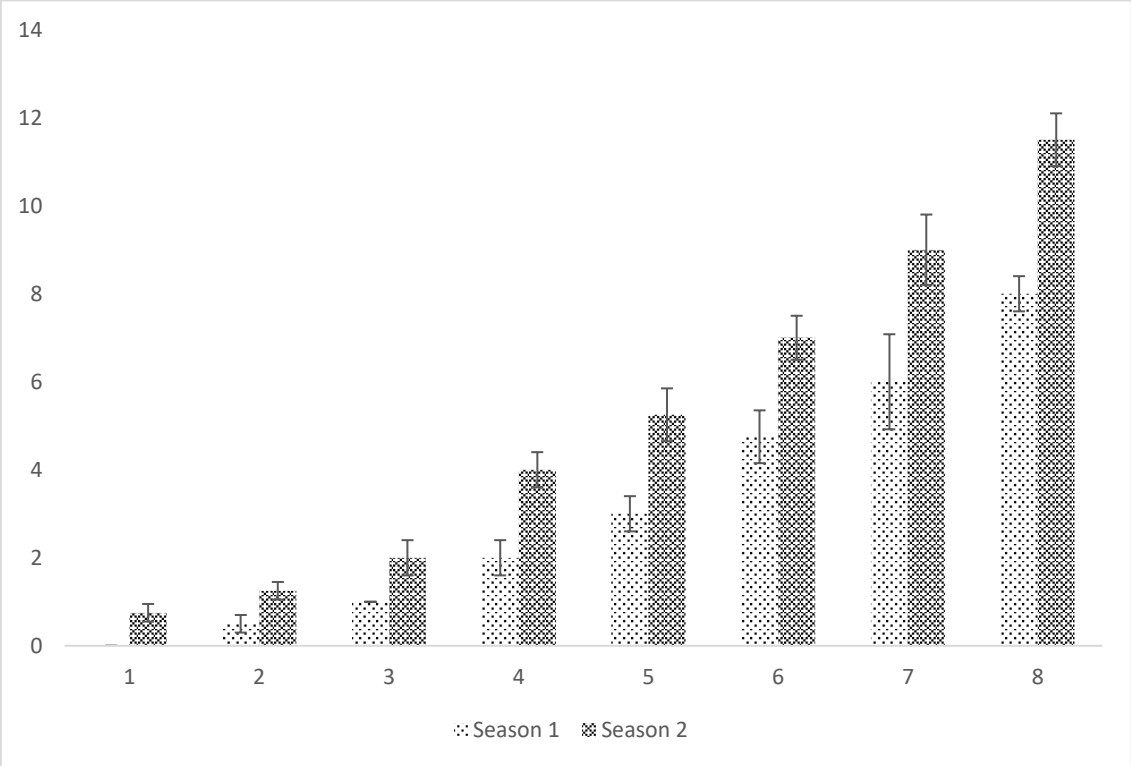



**Figure 7 Average number of *T. absoluta* moths captured through pheromone traps at different intervals in Kotri**

During season 1 overall cumulative highest mean sum (57) of *T. absoluta* male moth trapped in Tando allahyar followed by Tando jam with (42.5) while the lowest (25.5) was recorded in Kotri. Likewise, during season 2 highest collective mean sum (80.5) was obtained in Tando allahyar followed by Tando jam (64), while the lowest (40.75) was documented in Kotri (Fig 8).

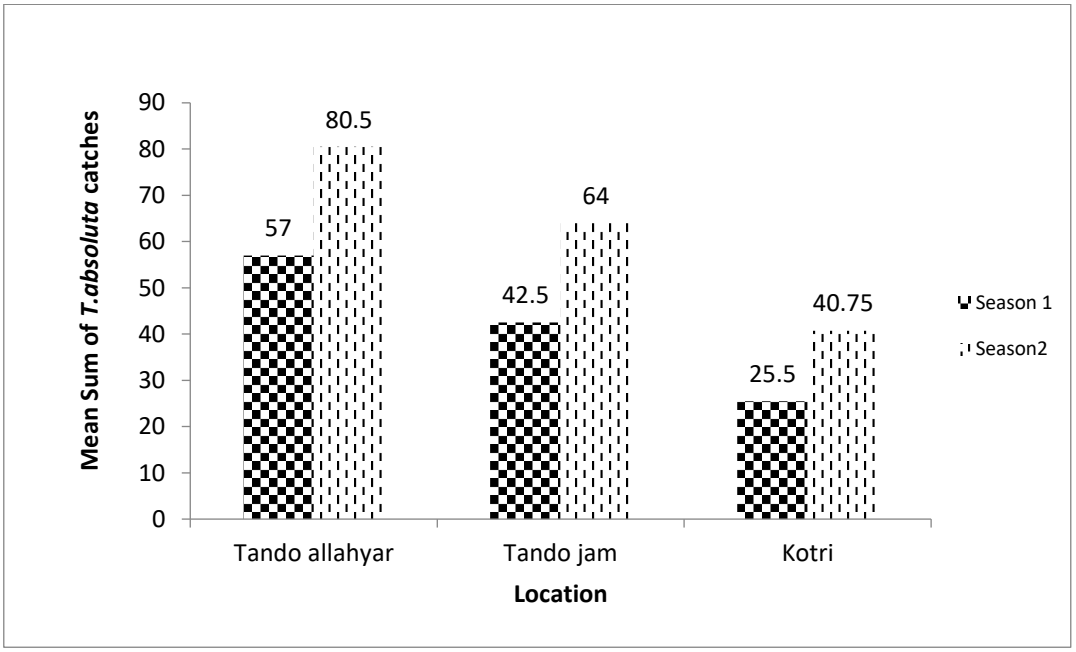



**Figure 8. Comulative mean sum of *T. absoluta* moth catches through pheromone traps at different locations**

It was also observed from the data obtained at different intervals of study that there was a Positive linear progression in *T. absoluta* population with respect to time and maturation of tomato crop at all monitoring locations (Fig.9)

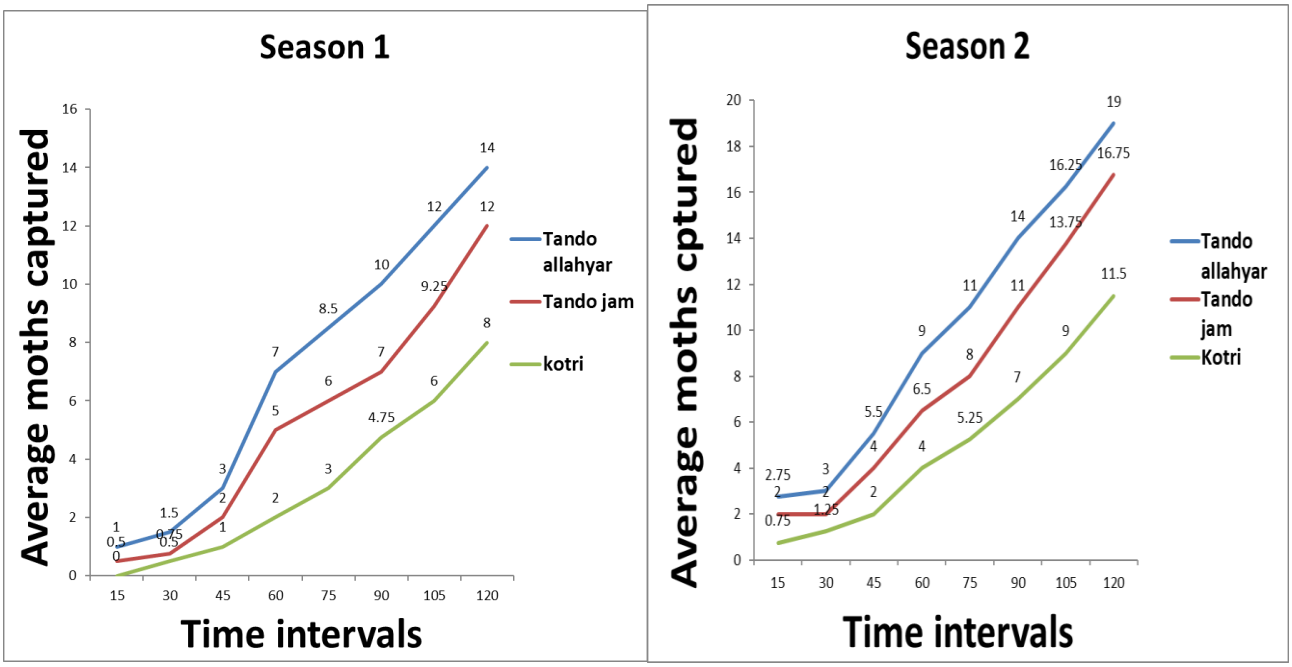



**Figure 9 Co relation between average no of *T. absoluta* moths captured through pheromonal traps and crop development at different time intervals in Hyderabad region**

## DISCUSSION

Devastating tomato leaf miner *T. absoluta* has established itself in almost entire tomato growing regions of the world rapidly (Biondi et al., 2018 and Tarusikirwa et al., 2020) since emergence in 2006 from Spain

(Desneux et al 2010). Current study revealed that for the first time that *T. absoluta* is present in Tando allahyar and Kotri region of Sindh province. The average number of *T. absoluta* captured per plot at all locations was very low initially and increased gradually along with development of crop and reached to significantly higher numbers as crop matured and fruiting started. The mean number of *T. absoluta* population ranged from 0 at Kotri to 19 at Tando allahyar and showed almost a linear progression with respect to time and maturation of tomato crop throughout the monitoring period over all locations. During both cropping seasons overall highest number of *T. absoluta* was recorded from Tando Allahyar 137.5, followed by Tando jam 106 and Kotri 66.25. High population abundance at Tando allahyar and relatively low difference with Tando jam proved both locations more favourable for *T. absoluta* infestation than Kotri in terms of climatic and soil conditions which were also fit for tomato cultivation because tomato crop growth and yield was not exceptionally good at Kotri as compared to Tando allahyar and Tando jam. The average sum of captured moths at all locations has been relatively low (125) in 1$^{st}$ season as compared to second (185.5) which could be attributed to the very short or no gap of time in between the two seasons resulted in continuous availability of tomato plants as source of food which facilitated reproduction and multiplication of *T. absoluta* to successfully establish in second season. This current observation aligns with the conclusions that with the presence of suitable host plants, the adult moths persist in laying their eggs by (Chen et al.,2022). Additionally, *T. absoluta* has the ability to survive year-round in greenhouses by persisting on remaining and spontaneously growing plants (Liu et al., 2023). Our Observations also suggests that eliminating the residue of host plants after harvesting could potentially decrease the *T. absoluta* population.

## CONCLUSION

The study proved that *T. absoluta* has effectively invaded the agro-geographical zones of Hyderabad region and is rapidly increasing on tomato crop. Higher numbers of *T. absoluta* was recorded during all the cropping seasons of Tomato crop as well as *T. absoluta* infestation was higher in Tando allahyar than all other experimental regions. It is recommended to take immediate actions to adopt management practices of *T. absoluta* to protect tomato crop in Pakistan and Further studies should be done to figure out the distribution of *T. absoluta* and its host plants in Sindh as well as in Pakistan.

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