# USE of IRRADIATION FOR ECONOMICAL PRODUCTION OF *TRICHOGRAMMA CHILONIS* AND ITS FIELD AUGMENTATION TO MANAGE INSECT PESTS OF SUGARCANE AND COTTON

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## Important insect pests of sugarcane and cotton

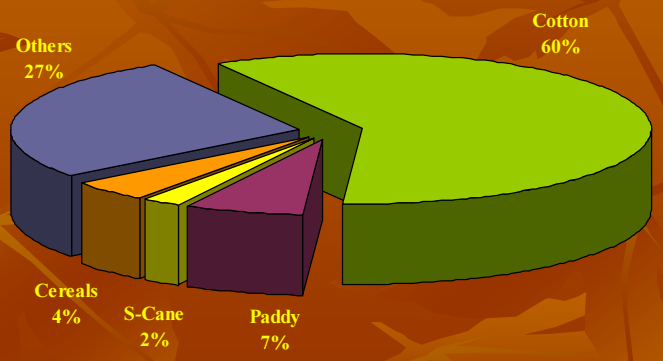
**Sugarcane**

- *Tryporhiza nivella*
- *Chilo infuscatellus*
- *Emmalocera depresella*
- *Pyrilla perpusila*
- Leaf hopper
- Mealy bug
- White fly

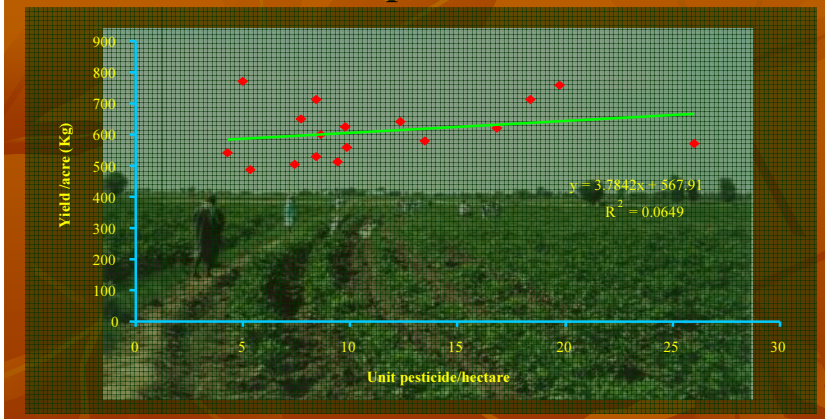
**Cotton**

- *Pectinophora gossypiella*
- *Earias vittella*
- *E. Insulana*
- *Helicoverpa armigera*
- Jassids
- Thrips
- White fly
- Mealy bug

## Crop-wise Pesticide Consumption in Pakistan




## Pesticide Consumption and Cotton Yield



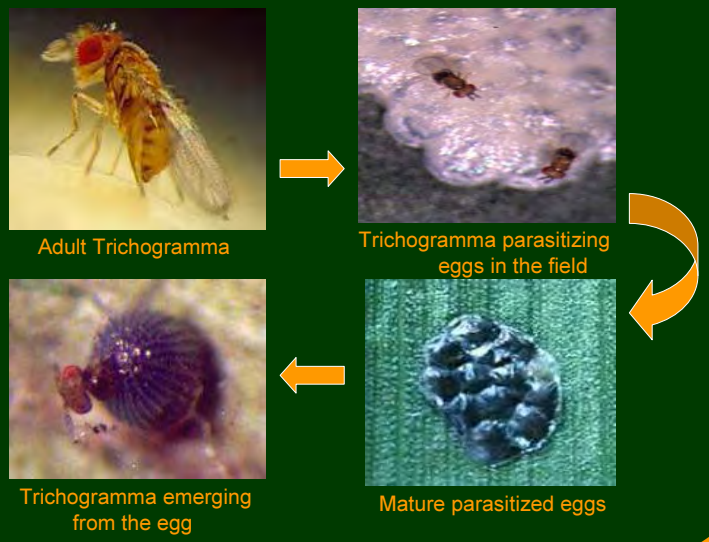

**Colossal increase in the pesticide consumption has not contributed toward per acre yield of crops especially in cotton**

# BIOLOGICAL CONTROL

Ineffectiveness of conventional insecticides and the desire to protect the environment, has proven biological control to be the method of choice for control of agricultural insect pests.

- most promising, environmentally sound
- and sustainable approach for insect pest management.
- The value of parasitoids/ predators in augmentative biological control is well documented.

## LIFE CYCLE OF *TRICHOGRAMMA CHILONIS*




## LIFE CYCLE OF *TRICHOGRAMMA CHILONIS*

Day1 *Trichogramma* wasp parasitizes egg

Days 1-4 after parasitism *Trichogramma larva* feeds internally in the egg.

Days 5-7the parasitized egg becomes black. *Trichogramma* is in pupal stage.

Days 8-10 Adult wasps emerge.

**Table: 1 Development of *Trichogramma chilonis* on *Sitotroga cerealella* eggs.**

| Development stage | Mean Duration |
|---|---|
| Egg to adult | 8.5 days |
| Adult emergence % | 82.5 |
| Mean adult longevity | 5.5 days |
| Fecundity | 57.5 eggs/female |
| Female longevity | 4.8 days |
| Male longevity | 5.9 days |
| Peak parasitism | On 1st day |

Table: 2 Effect of irradiation on the eggs of the *Sitotroga cerealella* a factitious host of *T. chilonis*

| Dose (Gy) | Hatch (%) | Pupal recovery (%) | Sex ratio (%) | |
|---|---|---|---|---|
| | | | Male | Female |
| 5 | 88.6 a | 64.3 a | 57.14 | 42.86 |
| 10 | 80.0 ab | 62.0 ab | 55.00 | 45.00 |
| 15 | 81.6 ab | 66.6 a | 42.29 | 35.71 |
| 20 | 76.3 bc | 51.3 b | 73.53 | 26.47 |
| 25 | 72.3 c | 50.3 b | 72.73 | 27.27 |
| 30 | 68.0 c | 40.3 c | 75.00 | 25.00 |
| 35 | 40.3 d | 27.6 d | 73.68 | 26.32 |
| 40 | 19.6 e | 12.3 e | 100.00 | 0.00 |
| 45 | 3.6 f | 2.0 f | 100.00 | 0.00 |
| 50 | 0.6 g | 0.6 g | 0.00 | 0.00 |
| Normal | 90.3 a | 68.3 a | 53.19 | 46.81 |
| LSD | 7.93 | 8.78 | | |

Table 3 Effect of irradiation on host eggs for parasitization of *Trichogramma chilonis*

| Dose (Gy) | Parasitization in the host eggs at different age of the eggs (days) | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 5 | 19.2 $^{b}$ | 16.4 $^{b}$ | 11.2 $^{c}$ | 6.4 $^{bc}$ | 0.6 $^{c}$ | 0.0 | 0.0 |
| 10 | 23.2 $^{a}$ | 21.0 $^{a}$ | 17.6 $^{a}$ | 11.0 $^{ab}$ | 0.0 | 0.0 | 0.0 |
| 15 | 20.2 $^{b}$ | 17.0 $^{b}$ | 12.6 $^{bc}$ | 11.8 $^{ab}$ | 0.8 $^{c}$ | 0.0 | 0.0 |
| 20 | 23.6 $^{a}$ | 20.0 $^{ab}$ | 15.2 $^{a}$ | 13.2 $^{a}$ | 9.0 $^{a}$ | 2.5 $^{a}$ | 0.2 b |
| 25 | 24.4 $^{a}$ | 19.8 $^{ab}$ | 13.2 $^{bc}$ | 9.2 $^{b}$ | 4.2 $^{b}$ | 6.7 $^{a}$ | 0.5 a |
| 30 | 19.2 $^{b}$ | 16 6 $^{b}$ | 13.2 $^{bc}$ | 9.4 $^{b}$ | 4.8 $^{b}$ | 0.5 $^{a}$ | 0.0 |
| 35 | 17 8 $^{bc}$ | 15.6 $^{bc}$ | 14.6 $^{ab}$ | 5.4 $^{c}$ | 0.8 $^{c}$ | 0.0 | 0.0 |
| 40 | 15.2 $^{c}$ | 13.4 $^{c}$ | 8.4 $^{d}$ | 1.4 $^{e}$ | 0.0 | 0.0 | 0.0 |
| 45 | 13 4 $^{cd}$ | 7.6 $^{d}$ | 5.4 $^{d}$ | 0.2 $^{e}$ | 0.0 | 0.0 | 0.0 |
| 50 | 11.6 $^{de}$ | 7.6 $^{d}$ | 1.4 $^{e}$ | 0.0 | 0.0 | 0.0 | 0.0 |
| Normal | 18.8 $^{b}$ | 11.2 $^{c}$ | 0.2 $^{d}$ | 0.0 | 0.0 | 0.0 | 0.0 |
| LSD | 2.07 | 1.88 | 2.13 | 2.01 | 2.43 | 2.72 | 0.99 |

Means followed by similar letters are non-significant at $P \leq 0.05$

Table 4 Effect of irradiation to increase the parasitism in *T. chilonis*

| Irradiation Dose (Gy) | Day-1 | | Day-2 | |
|---|---|---|---|---|
| | Parasitism/ female | Increase (%) over control | Parasitism/female | Increase (%) over control |
| 20 | 23.6 | 25.5 | 20.0 | 78.6 |
| 25 | 24.4 | 29.8 | 19.8 | 76.8 |
| Control | 18.8 | -- | 11.2 | -- |

Table: 5 Parasitism of *T. chilonis* on the eggs of cotton bollworms at different ages

| Age of host eggs (days) | Mean number of eggs parasitized | | | |
|---|---|---|---|---|
| | PBW | Spotted | Spiny | Angoumois |
| 0 – 1 | 23.82 a | 8.19 a | 7.33 a | 19.57 a |
| 1 – 2 | 17.61 b | 2.50 b | 1.14 b | 16.24 b |
| 2 – 3 | 8. 1 c | 0.00 | 0.00 | 4.26 c |
| 3 – 4 | 0.73 d | 0.00 | 0.00 | 0.51 c |
| LSD | 4.87 | 3.19 | 3.89 | 2.85 |

Means followed by similar letters are not significantly different ($P \leq 0.05$)

**Table: 6 Effect of age on *T. chilonis* to parasitize the eggs of bollworms**

| Age of the parasite (days) | Mean number of eggs parasitized | | | |
|---|---|---|---|---|
| | PBW | Spotted | Spiny | Angoumois |
| 0 – 1 | 27.39 a | 8.07 a | 7.23 a | 23.42 a |
| 1 – 2 | 16.56 b | 5.18 b | 4.96 b | 13.62 b |
| 2 – 3 | 11.09 c | 1.26 c | 0.83 c | 6.20 c |
| 3 – 4 | 3.71 d | 0.00 | 0.00 | 2.86 d |
| 4 – 5 | 0.00 | 0.00 | 0.00 | 0.00 |
| LSD | 4.22 | 2.91 | 1.95 | 2.77 |

Table 7 Quality assessment of *T. chilonis* reared on irradiated eggs

| Generation No. | Parasitism (%) | Emergence (%) | Sex ratio | |
|---|---|---|---|---|
| | | | Female | Male |
| $F_1$ | 83.4 ± 2.06 b | 90.2 ± 1.59 a | 74.2 ± 1.65 c | 25.8 ± 2.35 d |
| $F_2$ | 84.8 ± 1.88 a | 89.2 ± 1.71 a | 71.6 ± 0.87 b | 28.4 ± 1.74 c |
| $F_3$ | 89.2 ± 1.77 a | 93.4 ± 1.72 a | 70.0 ± 1.37 b | 30.0 ± 1.64 c |
| $F_4$ | 86.4 ± 2.22 b | 85.6 ± 3.61 a | 76.8 ± 2.76 a | 23.2 ± 3.52 b |
| Control | 81.4 ± 1.56 b | 90.2 ± 2.08 a | 79.4 ± 2.13 b | 20.6 ± 1.50 e |

**Table 8 Effect of supplement irradiated host for natural enemies to enhance their performance in the field.**

| Months | Suplemental host provided | | No suplemental host | |
|---|---|---|---|---|
| | Parasitism % | Infest. % | Parasitism % | Infest. % |
| February | 41.0 c | 0.6e | 11.6e | 0.3c |
| March | 49.3bc | 3.6 cd | 35..3 cd | 2.3c |
| April | 60.3ab | 5.6b | 44.6 ab | 5.7 b |
| May | 42.3c | 7.6ab | 35.6cd | 9.3 a |
| June | 39.3c | 9.0a | 29.3d | 10.3a |
| July | 43.3 c | 12.03bc | 34.3cd | 11.3a |
| August | 58.6 ab | 6.3bc | 43.6ab | 11.7a |
| Septem. | 63.3a | 2.6de | 50.6a | 9.0a |
| October | 56.3ab | 1.3e | 37.6bc | 5.7b |

**Table 9 Effect of low temperature in combination of irradiation (25 Gy) for prolong storage of *T. chilonis***

| Stor-age time (days) | Temperature 5 $^0$C | | | Temperature 7.5 $^0$C | | | Temperature 10 $^0$C | | |
|---|---|---|---|---|---|---|---|---|---|
| | Emergence (%) | Total eggs parasitized/ female | Adult life | Emer-gece (%) | Total eggs parasitized/ female | Adult life | Emergece (%) | Total eggs parasiti zed/ femal | Adult life |
| 5 | 79.4 a | 26.7 a | 4.7 a | 85.6 a | 28.0 a | 4.3 a | 82.4 a | 37.0 a | 4.3 a |
| 10 | 75.8 a | 22.6 a | 4.3 a | 80.0 a | 26.3 ab | 4.1 a | 81.4 a | 35.1 ab | 4.8 a |
| 15 | 65.4 b | 20.7 b | 4.5 a | 73.4 b | 25.3 ab | 4.6 a | 75.0 b | 30.3 b | 4.6 a |
| 20 | 52.0 c | 15.6 c | 3.0 a | 68.5 b | 23.6 b | 4.1 a | 74.0 b | 29.4 b | 4.4 a |
| LSD | 5.17 | 1.83 | 2.44 | 6.01 | 2.91 | 1.85 | 4.47 | 3.23 | 2.11 |

# BIOCONTROL LABORATORIES ESTABLISHED BY NIA

- Al-noor Sugar Mills Ltd., Moro
- Habib Sugar Mills Ltd., Nawabshah
- Fauji Sugar Mills Ltd., Khoski
- Matiari Sugar Mills Ltd., Matiari
- Mehran Sugar Mills, Ltd., T. Allahyar
- Ranipur Sugar Mills Khairpur
- Pungario Sugar Mills, Badin
- Nawazabad Farm Mirpur Khas
- TASSCO Farm Tando Allahyar

Table 10 Infestation percentage of sugarcane borers and cotton bollworms in *T. chilonis* treated area

| Crop Year | Area treated | Infestation percent range |
|---|---|---|
| 2008 – 09 | | |
| Sugar cane | 24750 | 3.8 – 7.72 |
| Cotton | 550 | 5.16 – 9.98 |
| | | |
| 2009 – 10 | | |
| Sugar cane | 25000 | 2.95 – 8.35 |
| Cotton | 600 | 4.27 – 10.05 |


## ACKNOWLEDGEMENT

We are enormously appreciative to the IAEA authorities for endowing us assistance through TCP No. PAK 5/043 and CRP No. PAK 13940 for establishing the bio-control Programme against the sugarcane and cotton pests. We are now expending the programme on area –wide basis with the collaboration of private sector