# Management of Insecticide Resistance in *Helicoverpa armigera* by Conjunctive Use of Trap crops, Neem and Biocontrol agents in Cotton


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# Conjunctive use of trap crops, NSKE and Biocontrol agents in cotton


Cotton +Okra


Cotton + Pigeon pea


**Cotton + Marigold**

**Cotton sole crop**

# MATERIALS AND METHODS

- Field Experiment – ARS, Vaigaidam,TN (Summer,2003)

- Cotton (MCU 5)

- Trap crops
  Bhendi (Arka Anamika)
  Redgram (APK 1)

- Design : FRBD
- Plot Size : 100$m^2$
- Replication : 4

- Each plot - 10 rows of cotton (sown on one side of the ridge)
  - 5th row ( sown on other side of the ridge) – trap crops

# TREATMENTS

| Treatment combinations |
| --- |
| Cotton (NSKE) + Bhendi (biocontrol) |
| Cotton (NSKE) + Bhendi |
| Cotton + Bhendi (biocontrol) |
| Cotton + Bhendi |
| Cotton (NSKE) + Red gram (biocontrol) |
| Cotton (NSKE) + Red gram |
| Cotton + Red gram (biocontrol) |
| Cotton + Red gram |
| Cotton + NSKE + (biocontrol) |
| Cotton + NSKE |
| Cotton + (biocontrol) |
| Cotton sole crop |

NSKE 5 % spray (Only on cotton)

6 times on cotton

46 DAS at weekly interval upto 81 DAS

HaNPV/Bt/Trichogramma (Only on trap crops)

5 times on Bhendi

53 DAS at weekly interval upto 81 DAS

4 times on Red gram
60 DAS at weekly interval upto 81 DAS

# PREFERENCE RATIO






# Influence of trap crops, neem on the preference of cotton bollworms (ARS, Vaigaidam – Summer, 2003)

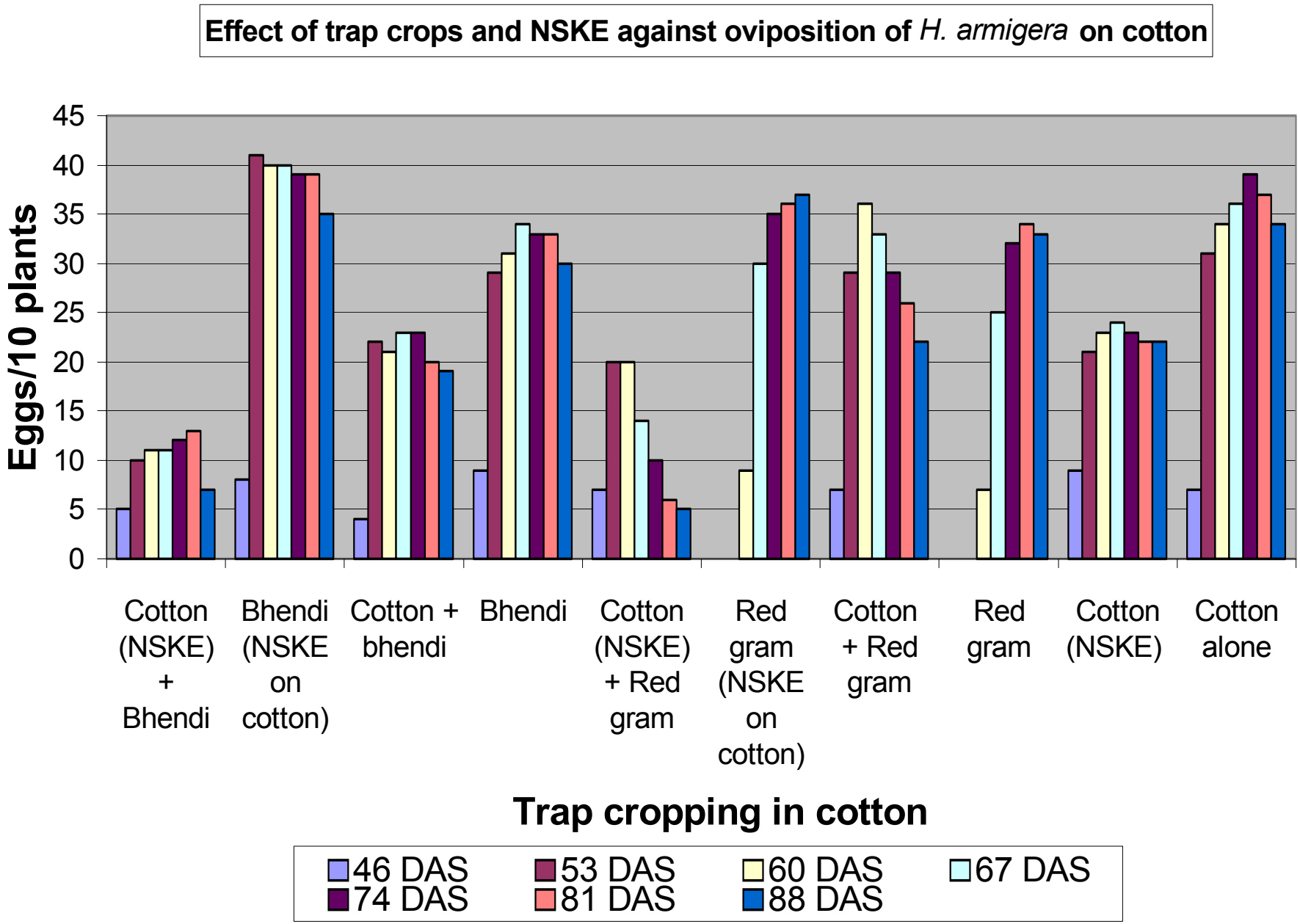
| Trap cropping Systems | *Helicoverpa armigera* | |
|---|---|---|
| | Preference Ratio | |
| | Egg | Larvae |
| Cotton + Bhendi | 1:1.49 | 1:1.48 |
| Cotton (NSKE) + Bhendi | 1:3.21 | 1:3.12 |
| Cotton + Red gram | 1: 1.01 | 1:1.03 |
| Cotton (NSKE) + Red gram | 1:2.25 | 1:2.12 |

P – Population per 10 plants
PR – Preference Ratio

# Influence of trap crops, neem on the preference of cotton bollworms (ARS, Vaigaidam – Winter, 2003)

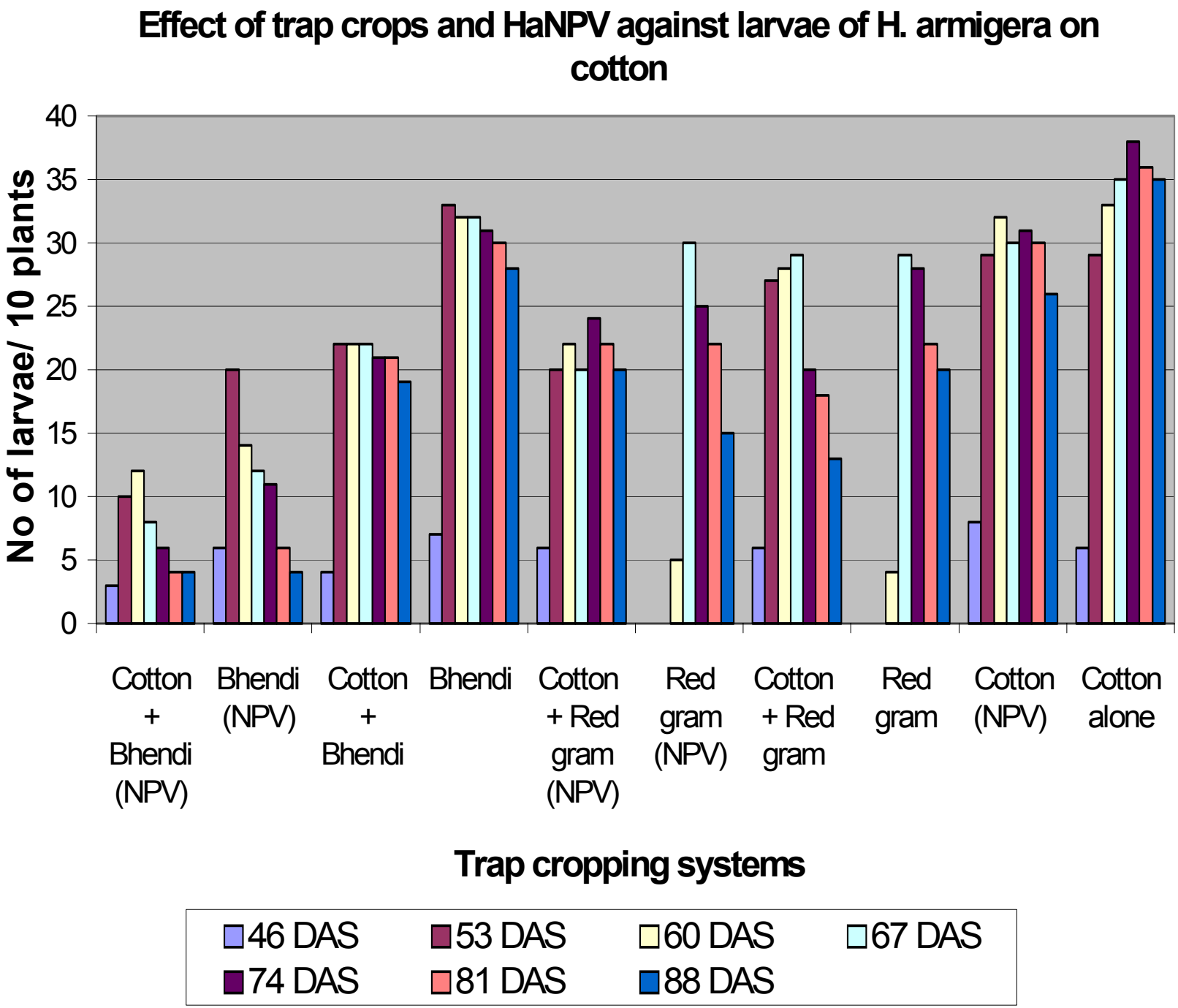
| Trap cropping Systems | *Helicoverpa armigera* | |
|---|---|---|
| | Preference Ratio | |
| | Egg | Larvae |
| Cotton + Bhendi | 1:1.32 | 1:1.07 |
| Cotton (NSKE) + Bhendi | 1:3.05 | 1:3.01 |
| Cotton + Red gram | 1:1.24 | 1:1.00 |
| Cotton (NSKE) + Red gram | 1:2.56 | 1:2.55 |

# IRM –TRAP CROPS+NSKE+NPV


Effect of trap crops and NSKE against oviposition of H. armigera on cotton
Eggs/10 plants
45
40
35
30
25
20
15
10
5
0
Cotton (NSKE) + Bhendi
Bhendi (NSKE on cotton)
Cotton + bhendi
Bhendi
Cotton (NSKE) + Red gram
Red gram (NSKE on cotton)
Cotton + Red gram
Red gram
Cotton (NSKE)
Cotton alone
Trap cropping in cotton
46 DAS
53 DAS
60 DAS
67 DAS
74 DAS
81 DAS
88 DAS

## Influence of trap crops and NSKE against incidence of *H. armigera* on cotton

| Incidence of *H. armigera* | NSKE treated (only on cotton) | | | NSKE untreated (only on cotton) | | |
|---|---|---|---|---|---|---|
| | Cotton + bhendi | Cotton + red gram | Cotton alone | Cotton + bhendi | Cotton + red gram | Cotton alone |
| Eggs/ 10 plants | 9.9 | 11.7 | 20.6 | 18.9 | 26.0 | 31.1 |
| Larvae/ 10 plants | 5.0 | 10.0 | 18.1 | 18.7 | 20.1 | 30.3 |
| % fruiting body damage | 14.1 | 22.2 | 25.0 | 25.2 | 28.1 | 31.0 |
| Boll damage | 14.4 | 25.4 | 29.0 | 28.0 | 31.0 | 40.0 |
| Locule damage | 10.4 | 18.0 | 21.0 | 21.0 | 23.2 | 35.0 |


Effect of trap crops and HaNPV against larvae of H. armigera on cotton
No of larvae/ 10 plants
40
35
30
25
20
15
10
5
0
Cotton + Bhendi (NPV)
Bhendi (NPV)
Cotton + Bhendi
Bhendi
Cotton + Red gram (NPV)
Red gram (NPV)
Cotton + Red gram
Red gram
Cotton (NPV)
Cotton alone
Trap cropping systems
46 DAS
53 DAS
60 DAS
67 DAS
74 DAS
81 DAS
88 DAS

## Influence of trap crops and NPV against incidence of *H. armigera* on cotton

| Incidence of *H. armigera* | NPV treated (only on trap crops) | | | NPV untreated (only on trap crops) | | |
|---|---|---|---|---|---|---|
| | Cotton + bhendi | Cotton + red gram | Cotton alone | Cotton + bhendi | Cotton + red gram | Cotton alone |
| Eggs/ 10 plants | 19.4 | 25.3 | 31.9 | 18.9 | 26.0 | 31.1 |
| Larvae/ 10 plants | 6.7 | 19.1 | 26.6 | 18.7 | 20.1 | 30.3 |
| % fruiting body damage | 16.1 | 26.0 | 29.1 | 25.2 | 28.2 | 31.0 |
| Boll damage | 19.3 | 29.1 | 37.0 | 28.0 | 31.0 | 40.0 |
| Locule damage | 11.4 | 19.4 | 28.9 | 21.0 | 23.2 | 35.0 |

(Duraimurugan and Regupathy, 2003)

## Resistance frequency (RF) to synthetic pyrethroids in Vaigai dam population of *H. armigera -NPV*

| Synthetic Pyrethroids | DD dose µg/µl | % resistance of $F_1$ field population before first spray | % resistance of $F_1$ field survived population after last spray |
|---|---|---|---|
| | | % resistance ±S.E | % resistance ±S.E |
| Fenvalerate | 0.2 | 93.1 ± 3.4 | 81.6 ± 5.6 |
| Cypermethrin | 0.1 | 91.4 ± 3.7 | 82.0 ± 5.5 |
| Deltamethrin | 0.0125 | 92.3 ± 3.7 | 79.2 ± 4.81 |
| λ -cyhalothrin | 0.025 | 87.5 ± 4.5 | 76.3 ± 5.78 |
| β-cyfluthrin | 0.2 | 89.5 ± 4.1 | 80.0 ± 5.20 |

# IRM –TRAP CROPS+NSKE+TRICHOGRAMMA



R2T5

## Influence of trap crops and Trichogramma against incidence of *H. armigera* on cotton

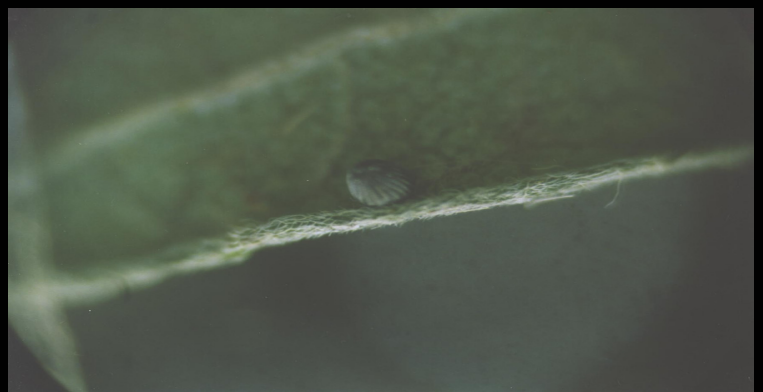
| Incidence of *H. armigera* | Trichogramma released (on trap crops) | | | Trichogramma not released (on trap crops) | | |
|---|---|---|---|---|---|---|
| | Cotton + bhendi | Cotton + red gram | Cotton alone | Cotton + bhendi | Cotton + red gram | Cotton alone |
| Eggs/ 10 plants | 23.71 | 25.71 | 30.80 | 24.14 | 26.14 | 36.14 |
| Larvae/ 10 plants | 18.71 | 17.20 | 21.29 | 22.86 | 22.14 | 33.14 |
| % fruiting body damage | 30.19 | 26.72 | 31.05 | 31.05 | 29.90 | 38.92 |
| Boll damage | 34.25 | 3032 | 38.87 | 36.43 | 33.62 | 46.45 |

## Influence of trap crops , NSKE and Trichogramma against incidence of *H. armigera* on cotton

| Incidence of *H. armigera* | NSKE treated (cotton only) + Trichogramma (trap crop only) | | | Control | | |
|---|---|---|---|---|---|---|
| | Cotton + bhendi | Cotton + red gram | Cotton alone | Cotton + bhendi | Cotton + red gram | Cotton alone |
| Eggs/ 10 plants | 14.43 | 15.57 | 22.14 | 24.14 | 26.14 | 36.14 |
| Larvae/ 10 plants | 10.71 | 9.00 | 14.00 | 22.86 | 22.14 | 33.14 |
| % fruiting body damage | 23.19 | 20.82 | 25.21 | 31.05 | 29.90 | 38.92 |
| Boll damage | 26.13 | 22.09 | 28.92 | 36.43 | 33.62 | 46.45 |

# Extent of percent parasitisation on *Helicoverpa armigera* by *T. Chilonis*

| | |
|---|---|
| Bhendi | 10.40 to 12.00 |
| Red gram | 14.50 to 15.50 |
| Cotton | 14.80 to 16.40 |



## Table : Resistance frequency (RF) to synthetic pyrethroids in Vaigai dam population of *H. armigera -TRICHOGHRAMMA*

| Synthetic Pyrethroids | DD dose µg/µl | % resistance of $F_1$ field population before first spray | % resistance of $F_1$ field survived population after last spray |
|---|---|---|---|
| | | % resistance ±S.E | % resistance ±S.E |
| Fenvalerate | 0.2 | 92.5 ± 3.7 | 89.1± 4.6 |
| Cypermethrin | 0.1 | 94.0 ± 3.4 | 90.4 ± 4.1 |
| Deltamethrin | 0.0125 | 88.2 ± 4.6 | 89.5 ± 4.6 |
| λ -cyhalothrin | 0.025 | 90.2 ± 4.2 | 92.1± 3.5 |
| β-cyfluthrin | 0.2 | 85.3 ± 5.1 | 84.8± 5.1 |

# IRM –TRAP CROPS +NSKE +Bt

## Influence of trap crops, NSKE and Bt against incidence of *H. armigera* on cotton

| Incidence of *H. armigera* | NSKE treated (cotton only) + Bt treated (trap crop only) | | | Control | | |
|---|---|---|---|---|---|---|
| | Cotton + bhendi | Cotton + red gram | Cotton alone | Cotton + bhendi | Cotton + red gram | Cotton alone |
| Eggs/ 10 plants | 9.45 | 12.30 | 20.5 | 26.53 | 26.15 | 36.2 |
| Larvae/ 10 plants | 4.68 | 6.25 | 12.30 | 20.2 | 17.30 | 35.23 |
| % fruiting body damage | 11.0 | 13.34 | 17.48 | 23.01 | 20.34 | 29.48 |
| Boll damage | 14.17 | 19.12 | 26.15 | 33.31 | 29.62 | 38.24 |

## Table : Resistance frequency (RF) to synthetic pyrethroids in Vaigaidam population of *H. armigera –Bt* Trial

| Synthetic Pyrethroids | DD dose µg/µl | % resistance of $F_1$ field population before first spray | % resistance of $F_1$ field survived population after last spray |
|---|---|---|---|
| | | % resistance ±S.E | % resistance ±S.E |
| Fenvalerate | 0.2 | 91.7 ± 4.0 | 83.3± 5.2 |
| Cypermethrin | 0.1 | 92.0 ± 3.9 | 86.7 ±5.1 |
| Deltamethrin | 0.0125 | 89.8 ± 4.4 | 84.6 ± 5.1 |
| λ -cyhalothrin | 0.025 | 91.3 ± 4.2 | 87.5± 4.8 |
| β-cyfluthrin | 0.2 | 88.0 ± 4.6 | 81.1± 5.4 |