

Dow AgroSciences TC1507 maize bioefficacy against Indian pests

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INTRODUCTION

- Maize (corn) is the third most important crop in India, annually grown on 7-8 million hectares and the input hybrid seed business is estimated to be ~ 90 million USD for year 2008

- Spotted stem borer (*Chilo partellus* Swin.) is a major pest of maize in India, with estimated yield losses ranging from 25 to 80 % (Sarup, 1980)

- Initial profiling of transgenic maize event TC1507 containing Cry1F gene indicated potential value to Indian maize farmers for effective control of *Chilo partellus*

- With this background, transgenic maize lines of event TC1507 were imported into India and tested for its efficacy under contained greenhouse conditions

SPECIFIC KEY QUESTIONS

- Does TC1507 provide effective control against *Chilo partellus* and two secondary pests - *Helicoverpa armigera* (Hubner) and *Spodoptera litura* (Fabricius) ?

- Does TC1507 produce adequate amounts of Cry1F protein needed for insect control?

MATERIALS AND METHODS

- **DESIGN:** Completely Randomized Design with 4 replications, 8 plants/replication, planted in medium size pots

- **ENTRIES:** 3 transgenic TC1507 lines (TC1, TC2, TC3) + 1 non transgenic isohybrid (nTC-3) + 1 local non transgenic hybrid (nTC-6) = total 5

WHOLE PLANT ASSAYS: 15 neonates of *Chilo partellus* were released in the central whorls of the plants 30 days after of sowing in each of the test entries. **Leaf Damage Ratings** on 1-9 scale (1 least damage to 9 most damage) (Guthrie et al., 1960) were recorded up to 30 days after infestation. Additionally, **Stalk Tunneling Measurements** (number of tunnels, length of tunneling, number of nodes; and entry and exit holes) were recorded (results not presented here)



LEAF DISC BIOASSAYS: One leaf selected from each of the 8 plants/replication/entry prior to destructive tunnel measurements. 1.5x1.5 inch leaf blade placed on a moistened filter paper in plastic cups and ten neonates of target pests were introduced. Observations were recorded five days after infestation for % larval mortality



QUANTITATIVE ELISA: From an infested reserve plants of the three TC1507 lines, 2 randomly selected plants/replication/entry were tagged and leaf samples used for Cry1F protein extraction and quantification (SDI, Newark) at four different growth stages (15, 30, 45, and 60 days after sowing)

COMPLIANCE: Permitting, compliance, and study implementation done according to Indian biosafety regulations

REFERENCES

- Gomez KA and Gomez AA 1984. Statistical Procedures for Agricultural Research. 2nd Edition, John Wiley & Sons, New York.
- Guthrie WD, Dicke FF, and Neiswander CR 1960. Leaf and sheath feeding resistance to the European corn borer in eight inbred lines of dent corn. Ohio Agricultural Research Station, Columbus, Ohio, Research Bulletin no.860.
- Sarup, P. 1980. Insect Pest Management in Maize. In: Singh, J (ed) Breeding, Production and Protection Methodologies of Maize in India, pp. 193-197. IARI, New Delhi

RESULTS AND DISCUSSION



| | Leaf feeding rating (1-9)* (Mean ± SE) | | | |
|------------|--|----------------|----------------|----------------|
| | 40 DAS | 47 DAS | 54 DAS | 60 DAS |
| T1 (TC-1) | 1.03 ± 0.03 c | 1.03 ± 0.03 c | 1.03 ± 0.03 c | 1.03 ± 0.03 c |
| T2 (TC-2) | 1.09 ± 0.03 c | 1.12 ± 0.03 c | 1.12 ± 0.03 c | 1.12 ± 0.03 c |
| T3 (TC-3) | 1.00 ± 0.00 c | 1.03 ± 0.03 c | 1.03 ± 0.03 c | 1.03 ± 0.03 c |
| T4 (nTC-3) | 2.96 ± 0.14 ab | 4.12 ± 0.31 ab | 4.50 ± 0.20 ab | 4.50 ± 0.20 ab |
| T5 (nTC-6) | 3.37 ± 0.34 a | 4.46 ± 0.38 a | 4.75 ± 0.40 a | 4.75 ± 0.40 a |

Table 1: Whole Plant Assays indicated that all three TC1507 entries provided greater levels of resistance to *Chilo partellus* leaf feeding displayed by consistently low leaf damage ratings

| Maize genotype | Target pest | Larval mortality (%) | |
|----------------|--------------|-----------------------------|--------------------------|
| | | <i>Chilo partellus</i> | Secondary pests |
| | | <i>Helicoverpa armigera</i> | <i>Spodoptera litura</i> |
| | (Mean ± SE) | (Mean ± SE) | (Mean ± SE) |
| T1 (TC-1) | 83.9 ± 2.1 a | 86.8 ± 7.1 a | 100.0 ± 0.0 a |
| T2 (TC-2) | 80.4 ± 2.1 a | 88.7 ± 20.5 a | 100.0 ± 0.0 a |
| T3 (TC-3) | 88.1 ± 8.7 a | 84.8 ± 14.2 a | 100.0 ± 0.0 a |
| T4 (nTC-3) | 6.4 ± 6.6 b | 10.4 ± 10.4 b | 0.0 b |
| T5 (nTC-6) | 9.8 ± 1.9 b | 18.8 ± 13.8 b | 0.0 b |

Table 2. Leaf Disc Bioassays indicated significantly higher mortality of the target pests on all three TC1507 entries

| Days after sowing | Cry 1F concentration (µg/gm dry weight) | TC1507 entries | | |
|-------------------|---|----------------|----------------|-----|
| | | TC1 | TC2 | TC3 |
| 15 | 11.05 ± 0.81 a | 9.63 ± 0.29 a | 11.01 ± 1.00 a | |
| 30 | 7.53 ± 0.25 b | 6.58 ± 0.43 b | 8.07 ± 0.49 a | |
| 45 | 7.61 ± 1.19 b | 7.18 ± 0.90 b | 7.21 ± 0.79 b | |
| 60 | 7.68 ± 0.96 b | 6.63 ± 0.31 b | 6.05 ± 0.25 b | |

Table 3. Quantitative ELISA studies indicated high Cry1F protein expression levels in all three TC1507 entries

Note: Table 1, 2 & 3: Means within a column followed by the same letter are not significantly different [P > 0.05; LSD test (Gomez and Gomez, 1984).

CONCLUSIONS

- Present studies showed for the first time effective control of *C. partellus*, the most destructive among stem borers in India and secondary pests *H. armigera* and *S. litura* by Cry1F carrying TC1507 maize lines

-Based on results from these studies, first year regulated open field trials (Biosafety Research Level 1) will be planned to pursue deregulation of the trait in India