# Comparative Performance of Sugarcane Genotypes against Stalk Borer (*Chilo auricilius* Dudgeon) in Punjab

**Smriti Sharma*, SK Sandhu, KS Thind and RS Gill**
*Department of Plant Breeding and Genetics, Punjab Agricultural University, Ludhiana-141 004, Punjab*

The present study was aimed at identification of the resistant/resistant clones of sugarcane against stalk borer (*Chilo auricilius*) for their exploitation in sugarcane economic breeding as the losses incurred by it to sugarcane cultivation in sub-tropical zone are upto 33% and there is no chemical control available for combating this pest in Punjab. The natural incidence of sugarcane stalk borer on 132 sugarcane genotypes/cultivars/elite clones/varieties, collected from 12 different sugarcane research centres of India, over two years has been reported. The experimental material exhibited large variations in the incidence of stalk borer ranging from 1 (Co Se 00421, Sel 18-01) to 32.91% (Co S 02258). Thirty-three genotypes showed less than five% incidence, categorized as resistant and, hence, suggested for genetic enhancement.

**Key Words: Germplasm, Resistance, Stalk borer, Sugarcane**



Amongst the large number of insect pests that regularly attack sugarcane crop, stalk borer (*Chilo auricilius* Dudgeon) is one of the most serious pests limiting sugarcane production especially in northern India, which can cause a loss upto 33% in cane yield and the 20.4% reduction in sucrose in juice (Jayanthi and Goud, 2002). It is active throughout the year but peak activity period is observed from July-February under Punjab conditions.

The losses caused by the borer must be minimized to increase profits but effective chemical control methods against this pest are not available and feasible (Chaudhary *et al.*, 1980). Aggravating this problem, the mechanical and cultural control methods against stalk borer are laborious and usually not followed by farmers. Hence, breeding for resistant varieties is the cheapest, reliable and most suitable method for the control of this pest. Keeping this consideration in view, the evaluation of genotypes for reaction against stalk borer was undertaken to identify promising genotypes.

## Materials and Methods

The field screening was conducted on 132 sugarcane genotypes/cultivars/elite clones/varieties, collected from 12 different sugarcane research centres of India under All India Coordinated Research Programme on Sugarcane (AICRP-S). These research centres included Indian Institute of Sugarcane Research, Lucknow, Uttar Pradesh (UP); Sugarcane Breeding Institute (SBI), Coimbatore, Tamil Nadu; Chaudhary Charan Singh Haryana Agricultural University (CCSHAU), Hisar, Haryana; Punjab Agricultural University (PAU), Ludhiana, Punjab; GB Pant University of Agriculture and Technology (GBPUAT), Pant Nagar, Uttarakhand; Rajendra Agricultural University (RAU), Pusa, Bihar; Acharya NG Ranga Agricultural University (ANGRAU), Hyderabad, AP; Orissa University of Agriculture and Technology (OUAT), Bhubaneshwar, Orissa; UP Council of Sugarcane research, Shahjahanpur, UP; GS Sugarcane breeding and research institute, Seorahi, UP, Regional research station SBI, Cuddalore and Regional Agricultural Research Station, Anakappale, AP; Agricultural Research Station (ARS), Kota, Rajasthan, and advanced sugarcane breeding clones of PAU, Ludhiana, along with commercial checks. The experiment was conducted at Sugarcane research farm Ladhowal, PAU, Ludhiana, from 2004-05 to 2006-07 as per the guidelines of AICRP on sugarcane entomology. Each genotype was raised in a plot measuring 13.5 $m^2$ with 3 replications in Randomized Block Design. All the recommended package of practices of PAU, Ludhiana, for cultivation of sugarcane crop except for any insecticidal applications were followed. Parameters recorded to assess population of stalk borer at harvest were % incidence and % intensity on the basis of 25 canes/replication. Observations were recorded based on the holes in the stalk and the internal damaged portion and infestation index was calculated on the basis of following formulae

$$\text{Infestation index} = \frac{\%\ \text{incidence} \times \%\ \text{intensity}}{100}$$

* *Author for Correspondence: E-mail: smritisharma80@yahoo.com*

## Results and Discussion

Stalk borer incidence varied widely among different genotypes tested in the present study as shown in Table 1. On the basis of overall comparison, no location-specific conclusions can be drawn which may be due to diverse parentage of test genotypes within the location. Moreover, the number of genotypes at one location is too less to draw conclusive interpretation (Table 2). But individual genotype information on stalk borer incidence is very useful to assess their potential for further utilization.

The comparison of the whole set of genotypes indicated wide variation for stalk borer incidence i.e. from 1.0% in Co Se 00421 and Sel 18-01 to 32.91% in Co S 02258. To accommodate the high level of variation, the genotypes were grouped into six different classes at an interval of 5% and designated as 1.0-5.0, 5.01-10.0, 10.01-15.0, 15.01-20.0, 20.01-25.0 and more than 25.01%. Thirty-three genotypes were present in the lowest incidence group of 1 to 5%, while four genotypes, namely, Co 98017, Co S 02258, Co S 88230 and Co S 96258 were grouped in maximum incidence group of >25% incidence. Rest of the 96 genotypes were grouped in four groups *viz.*, 42 genotypes in 5.1-10%, 40 genotypes in 10.1-15.0%, 10 genotypes in 15.1-20.0% and 4 genotypes in 20.1-25.0%. The observations indicated that most of the genotypes showed lesser incidence of stalk borer during testing, only a few genotypes showed higher level of incidence in these three years 2004 to 2007 (Table 3).

Similarly, the infestation index also varied from 0 in Co Se 00421 and Sel 18-01 to 6.45 in CoS 02258. Forty genotypes showed infestation index < 0.5, 30 genotypes were in the range of 0.5-1.0, 40 genotypes were in the range of 1.0-2.0, 13 genotypes were in the range of 2.0-3.0 and 10 genotypes showed infestation index > 3.0.

The variability in the incidence of stalk borer in different genotypes has also been reported in the earlier studies. In a field study conducted in Punjab, stalk borer incidence ranged from zero to 6.7% and 17 genotypes (CoH 92, CoLk 91238, CoLk 91239, CoJ 87, CoH 92201, CoH 92202, Co 88042, S 465-94, CoS 93227, S 8846-93, S 50-94, S 93-94, S 992-94, S 161-94, CoP 96219, S 126-93 and CoS 8436) were rated comparatively resistant to stalk borer (Anonymous, 1999). Similarly, among the 24 sugarcane varieties tested for stalk borer incidence at Nayagarh, CoC 91061 found to be moderately resistant whereas, the rest of 23 varieties were susceptible to this pest (Jena *et al.*, 1996).

In the present study genotypes CoS 8436 and CoS 767 behaved as moderately resistant against stalk borer. Similar findings have also been reported by Jaipal (1992) who found Co S 767 to be resistant to this pest amongst various sugarcane accessions and commercial hybrids evaluated.

Similarly in another screening of 15 sugarcane genotypes against *C. auricilius*, Co1148 had the highest level of stalk borer damage (7.4%) while S85-303 had the lowest (1.3%) and the genotypes S85-303 and S85-293 were least susceptible to stalk borer damage (Singh *et al.*, 1995).

The available pest management tools are inadequate to contain the losses caused by the pest. Hence, in sugarcane ecosystem varietal resistance could be a practical tool for pest management that can be fitted in the integrated pest management systems of the crop. Besides this, the resistant varieties having low pest population help in reducing the high cost of plant protection.

The promising 33 genotypes or elite clones identified in the present study are of a great significance in varietal development in sugarcane to confer insect pest resistance. Studies on parents and progeny derived from parents exhibiting a range of resistance levels for sugarcane borer *(Diatraea saccharalis)* revealed that mean percent borer-damaged internodes was higher among progeny derived from susceptible x susceptible crosses (22.8% in 1998 and 9.5%) compared to those derived from resistant x resistant crosses (20.8% in 1998 and 5.1%). Crossing a susceptible parent to a resistant parent also reduced mean percent borer-damaged internodes among the progeny compared to the susceptible parent or the susceptible x susceptible progeny and produced progeny showing transgressive segregation in both directions (Kimbeng *et al.*, 2004). Thus, the resistant genotypes identified in the present study can be further used in breeding programmes to genetically enhance resistance in sugarcane cultivars against this serious pest which can go a long way adding profitability and sustainability to the sugarcane cultivation.

A more concerted effort involving several cycles of screening and recurrent selection for resistance to borer damage is needed to identify germplasm that can withstand high levels of borer infestation.

**Table 1. Reaction of different genotypes/elite clones/varieties against stalk borer at Ludhiana**

| S.No | Genotype | Mean incidence (%) | Mean intensity (%) | Infestation index |
|---|---|---|---|---|
| 1 | BO 128 | 6.46 | 5.20 | 0.34 |
| 2 | BO 130 | 6.40 | 4.90 | 0.31 |
| 3 | BO 91 | 4.41 | 5.12 | 0.23 |
| 4 | Co 00120 | 4.61 | 12.92 | 0.60 |
| 5 | Co 00237 | 4.27 | 7.63 | 0.33 |
| 6 | Co 00238 | 6.19 | 11.11 | 0.69 |
| 7 | Co 00239 | 6.99 | 9.34 | 0.65 |
| 8 | Co 00240 | 8.65 | 19.55 | 1.69 |
| 9 | Co 00241 | 6.44 | 14.68 | 0.95 |
| 10 | Co 0116 | 7.32 | 7.76 | 0.57 |
| 11 | Co 0117 | 11.84 | 9.88 | 1.17 |
| 12 | Co 0118 | 11.10 | 10.55 | 1.17 |
| 13 | Co 0121 | 11.70 | 10.02 | 1.17 |
| 14 | Co 0122 | 7.14 | 7.79 | 0.56 |
| 15 | Co 0123 | 15.87 | 15.06 | 2.39 |
| 16 | Co 0124 | 9.73 | 7.81 | 0.76 |
| 17 | Co 1148 | 11.73 | 16.09 | 1.89 |
| 18 | Co 86249 | 19.34 | 13.80 | 2.67 |
| 19 | Co 89003 | 24.10 | 22.16 | 5.34 |
| 20 | Co 89029 | 4.51 | 4.66 | 0.21 |
| 21 | **Co 97009** | 13.08 | 15.64 | 2.05 |
| 22 | Co 98014 | 4.00 | 7.10 | 0.28 |
| 23 | Co 98017 | 28.36 | 12.99 | 3.68 |
| 24 | Co 99015 | 23.75 | 15.66 | 3.72 |
| 25 | Co 99016 | 13.01 | 17.21 | 2.24 |
| 26 | Co A 93081 | 11.68 | 21.39 | 2.50 |
| 27 | Co C 90063 | 9.75 | 21.35 | 2.08 |
| 28 | Co H 110 | 12.26 | 14.22 | 1.74 |
| 29 | Co H 115 | 8.38 | 5.43 | 0.46 |
| 30 | Co H 117 | 8.79 | 12.72 | 1.12 |
| 31 | Co H 118 | 13.38 | 13.46 | 1.80 |
| 32 | Co H 119 | 18.81 | 20.07 | 3.78 |
| 33 | **Co H 92201** | 21.15 | 8.10 | 1.71 |
| 34 | Co H 92202 | 4.23 | 7.69 | 0.33 |
| 35 | Co J 64 | 13.12 | 11.66 | 1.53 |
| 36 | **Co J 83** | 9.53 | 8.53 | 0.81 |
| 37 | Co J 85 | 6.72 | 11.26 | 0.76 |
| 38 | Co J 88 | 11.69 | 11.54 | 1.35 |
| 39 | Co J 89 | 2.38 | 1.80 | 0.04 |
| 40 | **Co J 99192** | 16.58 | 13.53 | 2.24 |
| 41 | Co Lk 9412 | 9.84 | 8.93 | 0.88 |
| 42 | Co Lk 9606 | 2.42 | 3.11 | 0.08 |
| 43 | Co Lk 9616 | 10.18 | 17.05 | 1.74 |
| 44 | Co Lk 9705 | 5.16 | 5.16 | 0.27 |
| 45 | Co Lk 9707 | 3.61 | 2.55 | 0.09 |
| 46 | Co Lk 9709 | 4.30 | 5.01 | 0.22 |
| 47 | Co Lk 9710 | 6.76 | 8.21 | 0.55 |
| 48 | Co Lk 97169 | 10.81 | 9.11 | 0.98 |
| 49 | Co Pant 01215 | 6.80 | 12.99 | 0.88 |
| 50 | Co Pant 01216 | 9.57 | 10.50 | 1.00 |
| 51 | Co Pant 02217 | 7.61 | 12.86 | 0.98 |
| 52 | Co Pant 02218 | 7.81 | 10.11 | 0.79 |
| 53 | Co Pant 84211 | 10.88 | 5.11 | 0.56 |
| 54 | Co Pant 84212 | 8.14 | 7.99 | 0.65 |
| 55 | Co Pant 90223 | 7.24 | 6.01 | 0.44 |
| 56 | Co Pant 99213 | 12.65 | 8.89 | 1.12 |
| 57 | Co Pant 99214 | 10.79 | 8.86 | 0.96 |
| 58 | Co Pk 1122 | 9.21 | 8.22 | 0.76 |
| 59 | Co Pk 174 | 6.06 | 15.49 | 0.94 |
| 60 | Co Pk 59 | 7.56 | 2.80 | 0.21 |
| 61 | Co Pk 78 | 8.41 | 7.59 | 0.64 |
| 62 | Co S 00221 | 8.21 | 15.26 | 1.25 |
| 63 | Co S 00257 | 12.05 | 11.12 | 1.34 |
| 64 | Co S 01256 | 12.10 | 8.81 | 1.07 |
| 65 | Co S 01268 | 9.89 | 19.35 | 1.91 |
| 66 | Co S 02252 | 5.40 | 6.50 | 0.35 |
| 67 | Co S 02258 | 32.91 | 19.59 | 6.45 |
| 68 | Co S 02264 | 9.23 | 12.19 | 1.13 |
| 69 | **Co S 767** | 9.35 | 6.22 | 0.58 |
| 70 | Co S 8436 | 12.29 | 4.97 | 0.61 |
| 71 | Co S 88230 | 26.90 | 18.90 | 5.08 |
| 72 | Co S 94257 | 11.02 | 12.10 | 1.33 |
| 73 | Co S 95258 | 2.62 | 1.11 | 0.03 |
| 74 | Co S 96258 | 28.33 | 12.86 | 3.64 |
| 75 | Co S 96275 | 12.93 | 14.61 | 1.89 |
| 76 | Co S 97248 | 7.15 | 6.86 | 0.49 |
| 77 | Co S 98259 | 4.66 | 8.44 | 0.39 |
| 78 | Co Se 00421 | 1.00 | 0.10 | 0.001 |
| 79 | Co Se 92423 | 1.85 | 0.66 | 0.01 |
| 80 | Co Se 95422 | 10.32 | 9.63 | 0.99 |
| 81 | Sel 761-98 | 11.74 | 12.34 | 1.45 |
| 82 | Sel 842-98 | 10.55 | 15.50 | 1.64 |
| 83 | Sel 906-98 | 2.13 | 5.74 | 0.12 |
| 84 | Sel 922-98 | 10.45 | 14.74 | 1.54 |
| 85 | Sel 928-98 | 14.21 | 12.61 | 1.79 |
| 86 | Sel 943-98 | 11.93 | 10.62 | 1.27 |
| 87 | Sel 95-98 | 9.77 | 12.70 | 1.24 |
| 88 | Sel 17-00 | 10.89 | 16.61 | 1.81 |
| 89 | Sel 18-00 | 8.21 | 6.10 | 0.50 |
| 90 | Sel 19-00 | 2.90 | 0.35 | 0.01 |
| 91 | Sel 21-00 | 6.60 | 0.89 | 0.06 |
| 92 | Sel 22-00 | 6.92 | 5.60 | 0.39 |
| 93 | Sel 24-00 | 4.41 | 0.69 | 0.03 |
| 94 | Sel 25-00 | 11.18 | 18.82 | 2.10 |
| 95 | Sel 28-00 | 19.20 | 13.87 | 2.66 |
| 96 | Sel 49-00 | 16.44 | 14.72 | 2.42 |
| 97 | Sel 56-00 | 19.49 | 11.84 | 2.31 |
| 98 | Sel 63-00 | 2.63 | 0.90 | 0.02 |
| 99 | Sel 64-00 | 9.36 | 10.17 | 0.95 |
| 100 | Sel 67-00 | 6.95 | 16.92 | 1.18 |
| 101 | **Sel 68-00** | 7.55 | 16.43 | 1.24 |
| 102 | Sel 69-00 | 4.65 | 9.11 | 0.42 |
| 103 | Sel 70-00 | 3.35 | 10.94 | 0.37 |
| 104 | Sel 77-00 | 8.11 | 8.50 | 0.69 |
| 105 | Sel 11-01 | 10.73 | 12.44 | 1.33 |
| 106 | Sel 12 -01 | 17.06 | 25.28 | 4.31 |
| 107 | Sel 17-01 | 11.65 | 8.85 | 1.03 |
| 108 | Sel 18-01 | 1.00 | 0.10 | 0.001 |
| 109 | Sel 56-01 | 17.48 | 14.65 | 2.56 |
| 110 | Sel 61-01 | 2.32 | 25.00 | 0.58 |
| 111 | Sel 69-01 | 10.16 | 15.12 | 1.54 |
| 112 | Sel 1046-03 | 10.01 | 8.23 | 0.82 |
| 113 | Sel 1059-03 | 10.50 | 11.44 | 1.20 |
| 114 | Sel 112-03 | 20.10 | 19.56 | 3.93 |
| 115 | Sel 113-03 | 9.32 | 23.45 | 2.19 |
| 116 | Sel 140-03 | 1.14 | 2.10 | 0.02 |
| 117 | Sel 145-03 | 1.44 | 0.50 | 0.01 |
| 118 | Sel 147-03 | 1.33 | 2.36 | 0.03 |
| 119 | Sel 149-03 | 10.51 | 9.58 | 1.01 |
| 120 | Sel 152-03 | 11.05 | 12.21 | 1.35 |
| 121 | Sel 164-03 | 1.04 | 0.31 | 0.003 |
| 122 | Sel 174-03 | 20.00 | 22.80 | 4.56 |
| 123 | Sel 187-03 | 10.01 | 10.23 | 1.02 |
| 124 | Sel 281-03 | 1.23 | 2.90 | 0.04 |
| 125 | Sel 33-03 | 10.10 | 10.80 | 1.09 |
| 126 | Sel 49-03 | 2.03 | 3.20 | 0.06 |
| 127 | Sel 50-03 | 1.50 | 2.50 | 0.04 |
| 128 | Sel 589-03 | 3.10 | 6.30 | 0.20 |
| 129 | Sel 806-03 | 2.40 | 5.68 | 0.14 |
| 130 | Sel 902-03 | 10.10 | 10.89 | 1.10 |
| 131 | Sel 91-03 | 4.26 | 22.41 | 0.95 |
| 132 | Sel 945-03 | 10.40 | 18.90 | 1.97 |

Contd.

Table 1 Contd.

**Table 2. Regional distribution of genotypes evaluated against stalk borer at Ludhiana**

| S.No. | Location | Series | Total No. of genotypes evaluated | <5 % incidence | | >15 % incidence | |
|---|---|---|---|---|---|---|---|
| | | | | No. | Per cent | No. | Per cent |
| 1 | Bihar and Orissa | BO | 3 | 1 | 33.3 | 0 | 0 |
| 2 | Tamil Nadu (Coimbatore) | Co | 22 | 4 | 18.18 | 5 | 22.73 |
| 3 | Andhra Pradesh (Anakapalli) | Co A | 1 | 0 | 0 | 0 | 0 |
| 4 | Kerala (Cuddalore) | Co C | 1 | 0 | 0 | 0 | 0 |
| 5 | Haryana (Karnal) | Co H | 7 | 1 | 14.29 | 2 | 28.57 |
| 6 | Punjab (Jalandhar) | Co J | 6 | 1 | 16.67 | 1 | 16.67 |
| 7 | UP (Lucknow) | Co Lk | 8 | 3 | 37.5 | 0 | 0 |
| 8 | Uttrakhand (PantNagar) | Co Pant | 9 | 0 | 0 | 0 | 0 |
| 9 | Rajasthan (Kota) | Co Pk | 4 | 0 | 0 | 0 | 0 |
| 10 | UP (Shahjahanpur) | Co S | 16 | 2 | 12.5 | 3 | 18.75 |
| 11 | UP (Seorahi) | Co Se | 3 | 2 | 66.67 | 0 | 0 |
| 12 | Punjab (Ludhiana 1998) | Sel | 7 | 1 | 14.29 | 0 | 0 |
| 13 | Punjab (Ludhiana 2000) | Sel | 17 | 5 | 29.41 | 3 | 17.65 |
| 14 | Punjab (Ludhiana 2001) | Sel | 7 | 2 | 28.57 | 2 | 28.57 |
| 15 | Punjab (Ludhiana 2003) | Sel | 21 | 10 | 47.62 | 2 | 9.52 |
| | | Total | 132 | 32 | 24.24 | 18 | 13.63 |

**Table 3. Percent incidence of Stalk borer in different genotypes**

| Range (%) | No. of genotypes |
|---|---|
| 1.0-5.0 | 33 |
| 5.01-10.0 | 42 |
| 10.01-15.0 | 40 |
| 15.01-20.0 | 10 |
| 20.01-25.0 | 4 |
| >25.01 | 4 |



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