Indian J. Genet., **54** (2): 164–169 (1994)

NATURAL BEHAVIOUR OF SUGARCANE GERMPLASM AGAINST *SCIRPOPHAGA EXCERPTALIS* WLK. INFESTATION

K. P. PANDEY, R. K. SINGH, D. N. SINGH AND S. B. SINGH

G. S. Sugarcane Breeding and Research Institute Seorahi
P. O. Tamkuhi Raj. Distt. Deoria 274407

(Received: October 26, 1992; accepted: April 5, 1994)

ABSTRACT

Two hundred forty five accessions of sugarcane including *Saccharum officinarum, S. barberi, S. sinense,* foreign commercial cultivars of Barbados, Canal Point, Hawaii, Mauritius, Queensland, Africa, Argentina, Jawa and Indian commercial cultivars were evaluated against the top borer pest under natural infested condition. Twelve accessions (4.9%) were found resistant, 79 (32.3%) were moderately resistant, 152 (62.0%) were susceptible and only 2 (0.8%) were highly susceptible. Maximum percentage (18.2%) of accessions of *S. barberi* were resistant to top borer infestation, followed by foreign commercial cultivars (10.5%), and Indian commercial cultivars (2.3%).

Key words: Germplasm, sugarcane, *Saccharum* spp., *Scirpophaga excerptalis*, top borer, resistance.

Among the known insect pests of sugarcane in India, top borer (*Scirpophaga excerptalis* Wlk.) causes serious damage, especially in Eastern U.P. The yield loss of 18.5 tonnes/ha has been assessed at 55% pest incidence in U. P. [1]. Under heavy infestation, loss up to 30% has been reported [2]. The development of resistant/tolerant varieties is a better alternative to chemical control through granular insecticides.

The present study has been undertaken to identify new sources of resistance to top borer and exploit them in resistance breeding.

MATERIALS AND METHODS

Two hundred forty five germplasm accessions of sugarcane, including *Saccharum officinarum, S. barberi, S. sinense,* foreign and Indian commercial cultivars received from Coimbatore (India) related to different geographical and ecological conditions of the world were planted in augmented design in 6 m long rows at a distance of 90 cm. The canes of the above accessions damaged by top borer were counted in June–July when the conditions are

most favourable for top borer attack (mean max. temp. 37.0 ± 1°C, mean min. temp. 22.3 ± 1°C; average humidity 87.5% in forenoon and 68.2% in afternoon). Three hundred plants were counted in each genotype and the damage was expressed in percentage.

The varieties were graded in relation to top borer infestation on the basis of economic threshold level taken as 15% incidence [3], viz., 0–15% resistant (R), 15.1%–30.0% moderately resistant (MR), 30.1–60.0% susceptible (S), and above 60% highly susceptible (HS).

RESULTS AND DISCUSSION

Tables 1 and 2 show that 12 out of 245 accessions (4.9%) of world germplasm of sugarcane were resistant, 79 (32.3%) moderately resistant, 152 (62.0%) susceptible, and only

Table 1. Performance of world accessions of sugarcane in relation to top borer damage in field conditions

Groups of genotypes
Resistant
Buxeria, Pathari, Pararia-257, Putli Khijee, CoS 770, CoS 8315, Gr. 2572/74, B 49119, BO 36, NCo 376, M 64-68, H 53/363.
Moderately resistant
57 NG 78, Mungo 252, Kewali-14G, Khali, Moneira, Ram Saran, Khelia, Pararia Shaj, Levosi old, Teria, Hemza II, Bhoria I, Patri, BO 25, BO 33, BO 38, BO 39, BO 51, BO 56, BO 70, BO 74, BO 75, BO 77, BO 87, BO 90, BO 91, BO 92, BO 99, Co 321, Co 370, Co 1007, Co 1301, Co 1321, Co 1347, Co 6425, Co 6601, Co 6612, Co 6613, Co 6616, Co 6619, Co 6802, Co 6911, Co 7639, Co 8000, Co 8008, CoS 564, CoS 630, CoS 633, CoS 730, CoS 767, CoS 771, CoS 832, CoS 8009, CoS 8103, CoS 8118, CoS 8420, CoS 86224, CoS 87225, CoS 87237, CoS 88217, UP 2, UP 3, UP 13, CoLk 7701, NCo 37610, B 37160, B 34104, B 39246, B 43/967, CP 29/116, CP 44/150, H 35/163, H 1154/775, M 72/101, Q 58, Q 61, Q 66, Q 68, Q 116.
Susceptible
Keong, Fizi-40, Reha, Bhoria II, Kansar, Sunnebile, Manjuria, Uba, Khakai, Bhurli, Dhaur-Alig, Seratha, Sarbatia, Mungo II, Barkhua, Pauri, Oramboo, Cheri, Ikri, BO 10, BO 17, BO 26, BO 28, BO 34, BO 37, BO 45, BO 50, BO 52, BO 55, BO 57, BO 59, BO 61, BO 62, BO 76, BO 78, BO 80, BO 82, BO 83, BO 88, BO 89, BO 95, BO 96, BO 100, BO 101, BO 110, BO 111, BO 112, BO 113, BO 114, Co 213, Co 395, Co 842, Co 846, Co 853, Co 854, Co 857, Co 859, Co 950, Co 997, Co 1046, Co 1148, Co 1157, Co 1158, Co 1167, Co 1186, Co 1223, Co 1328, Co 1349, Co 6404, Co 6415, Co 6520, Co 6602, Co 6611, Co 6618, Co 6801, Co 6812, Co 7220, Co 7638, Co 7708, Co 7915, Co 62095, Co 62182, Co 62199, Co 62399, Co 66005, CoS 109, CoS 517, CoS 575, CoS 629, CoS 659, CoS 687, CoS 705, CoS 733, CoS 753, CoS 757, CoS 766, CoS 776, CoS 788, CoS 793, CoS 796, CoS 822, CoS 836, CoS 837, CoS 856, CoS 7918, CoS 7921, CoS 7922, CoS 7931, CoS 8001, CoS 8010, CoS 8119, CoS 8120, CoS 8122, CoS 8123, CoS 8301, CoS 8432, CoS 8439, CoS 85233, CoS 87220, CoS 87232, CoS 87233, CoS 87235, CoS 88229, CoS 88236, UP 1, UP 4, UP 5, UP 12, CoLk 7708, CoLk 774, Seo 174/82, Gr 1602/74, Gr 1602/74, Gr 1970/76, B 36161, B 37172, B 29240, B 41211, B 46/365, B 37161, CP 44155, CP 44179, CP 44153, CP 44154, H 35/38, H 54/775, M 64-38, NCo 2911, POJ 2823, Q 30, Q 49, Q 94, TUC 521.
Highly susceptible
CoS.826, CoS 87222.

2 (0.8%) were highly susceptible to top borer. The borer resistance is known to be associated with a high degree of rind hardness [4], high leaf area index [5], hardness of midrib and spindle [6], density of vascular bundles associated with sclerenchymatous sheath [7] and dry matter content of the leaf spindle [8]. The cumulative effect of these morphological characters increases the overall hardness of the plant which leads to pest resistance in sugarcane [9].

The relative frequency of top borer resistant genotypes in the collections received from different agroclimatic zones of the world is shown in Table 2. Out of the three *Saccharum*

Table 2. Distribution of 245 sugarcane accessions in relation to top borer infestation in field conditions

Source of genotypes	Total No. of genotypes	Field reaction			
		R	MR	S	HS
Saccharum officinarum	4	—	1 (25.0)	3 (75.0)	—
S. barberi	22	4 (18.2)	10 (45.5)	8 (36.3)	—
S. sinense	10	—	2 (20.0)	8 (80.0)	—
Foreign commercial cultivars:	38	4 (10.5)	15 (39.5)	19 (50.0)	—
(a) Barbados	11	1 (9.1)	4 (36.4)	6 (54.5)	—
(b) Canal : Point	6	—	2 (33.3)	4 (66.7)	—
(c) Hawaii	5	1 (20.0)	2 (40.0)	2 (40.0)	—
(d) Mauritius	3	1 (33.3)	1 (33.3)	1 (33.3)	—
(e) Queensland	8	—	5 (62.5)	3 (37.5)	—
(f) Africa	3	1 (33.3)	1 (33.3)	1 (33.3)	—
(g) Argentina	1	—	—	1 (100.0)	—
(h) Jawa	1	—	—	1 (100.0)	—

(Contd.)

Table 2. (contd.)

Source of genotypes	Total No. of genotypes	Field reaction			
		R	MR	S	HS
Indian Commercial cultivars:	171	4 (2.3)	51 (29.8)	114 (66.7)	2 (1.2)
(a) Coimbatore	53	—	17 (32.1)	36 (67.9)	—
(b) Coimbatore-Shahjahanpur	58	2 (3.4)	15 (25.9)	39 (67.2)	2 (3.5)
(c) Coimbatore-Lucknow	3	—	1 (33.3)	2 (66.7)	—
(d) Bihar-Orissa	46	1 (2.2)	15 (32.6)	30 (65.2)	—
(e) Gorakhpur	3	1 (33.3)	—	3 (66.7)	—
(f) Seorahi	1	—	—	1 (100.0)	—
(g) Uttar Pradesh	7	—	3 (42.9)	4 (57.1)	—
Total	245	12 (4.9)	79 (32.3)	152 (62.0)	2 (0.8)

Note. Values in parentheses are percentage.
R—resistant, MR—moderately resistant, S—susceptible, HS—highly susceptible.

spp. compared, only *S. barberi* showed overall 18.2% resistant reaction to top borer. The maximum percentage of moderately resistant genotypes (45.5%) was also observed in *S. barberi*, followed by *S. officinarum* (25.0%) and *S. sinense* (20.0%). Similar results were earlier reported by other workers [7, 10, 11].

Among the thirty eight foreign commercial cultivars evaluated 4 accessions (10.5%) were resistant, 15 (39.5%) moderately resistant, and 19 (50%) genotypes were susceptible. Accessions originating from Mauritius and Africa had highest proportion of resistant genotypes (33.3%), followed by those from Hawaii (20.0%) and Barbados (9.1%), while 100% genotypes were susceptible among the accessions from Argentina and Jawa (Table 2). Low frequency of genes for plant hardness could be the reason for high susceptibility of these accessions. *S. spontaneum* when used as parent imparts hardness to the hybrids which makes them resistant to borers [12].

Among the Indian commercial hybrids, the Gorakhpur accessions showed highest percentage of resistant genotypes (33.3%), followed by those from Coimbatore–

Shahjahanpur (3.4%) and Bihar–Orissa (2.2%). Maximum proportion (42.9%) of accessions from U.P. was in the MR group (15.1%–30.0% infestation), followed by the germplasm collections from Coimbatore–Lucknow (33.3%), Bihar–Orissa (32.6%), Coimbatore (32.1%), and Coimbatore–Shahjahanpur (25.9%). The Seorahi accessions showed maximum (100%) top borer infestation. Only two accessions of the Coimbatore–Shahjahanpur group showed highly susceptible reaction to top borer (Table 2). The relatively resistant behaviour of the above groups of canes against top borer has already been reported [10, 11, 13].

It is evident that accessions of Coimbatore, Coimbatore–Shahjahanpur, Coimbatore–Lucknow and Bihar–Orissa origin had more or less similar trend in the two categories of top borer infestation (MR and S). This is due to commonness in geneology of these genotypes bred for the subtropical belt at Coimbatore.

The importance of broadening the genetic base for breeding sugarcane genotypes resistant to pests needs no emphasis. As early as in 1935 *S. barberi* and *S. spontaneum* were used as a parent in breeding for resistance against stem borer and internode borer, respectively [10]. Thus, the information presented here will help in identifying the best borer resistant parents for breeding programmes.

REFERENCES

1. B. D. Gupta. 1959. Insect pest of sugarcane in India. III. The top borer (*Scirpophaga nivella* Fabr.). Indian Sugar, **9**: 127–149.

2. V. G. Rajani. 1960. Estimation of losses caused by insect pests of sugacane crop in Uttar Pradesh. Proc. Bienn. Conf. Sug. Cane Res. Dev. Wkrs. Waltair (Andhra Pradesh), India. 4–8 Jan. 1960, **4**: 476–487.

3. R. A. Agrawal, D. K. Butani and C. B. Tiwari. 1974. Resistance of sugarcane varieties to top borer (*Tryporhiza nivella* Fabricius). Int. Sug. J., **76**: 263–266.

4. S. Rao, M. Puttarudriah and K. S. Shashtri. 1956. Influence of borer attack in several varieties of sugarcane grown in the Vishveshwarayya Canal tract, Mysore State. Proc. Int. Soc. Sugarcane Tech., **9**: 895–901.

5. P. A. Adalakha. 1964. Studies on various factors responsible for resistance to top borer in the different varieties of sugarcane. Indian J. Sug. Cane Res. Dev., **8**: 343–344.

6. J. T. Rao. 1947. Leaf midrib structure of sugarcane as correlated with resistance to top borer (*Scirpophaga nivella* F.). Indian J. agric. Sci., **17**: 203–210.

7. R. A. Agrawal. 1969. Morphological characteristics of sugarcane and insect resistance. *In*: Insect and Host Plant. Proc. Int. Symp. Insect and Host Plant (eds. J. de Wilde and L. M. Schoonhovan). Wageningen, The Netherlands, vol. **2**: 751–776.

8. P. C. Hart. 1932. Top borer attack in relation to hardness of growing point of PoJ 2878. Arch Suiber Indus Netherland Indie, **43**: 915–932.

9. H. David. 1979. A Critical Evaluation of the Factors Associated with the Resistance to Internode Borer (*Chilo sacchariphagus indicus* K.) in *Saccharum* sp., Allied Genera and Hybrid Sugarcane. Ph.D. Thesis. Calicut University, Calicut.

10. R. Jayanthi and H. David. 1986. Varietal Resistance. *In*: Sugarcane Entomology In India (eds. H. David, S. Easwarmoorthy and R. Jayanthi). Sugarcane Breeding Institute (ICAR), Coimbatore, India: 363–381.

11. Annual Report. 1985. Sugarcane Breeding Institute, Coimbatore: 69.

12. T. S. Venkataraman. 1929. Problems for the sugarcane breeder. Proc. Int. Soc. Sug. Cane Technol., **3**: 429–445.

13. M. S. Duhra, M. L. Sigla and R. S. Kanwar. 1991. Screening varieties to insect pests under field conditions. Indian Sugar, **60**: 735–736.