CP546

1316

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

Proceedings of the International Symposium on

MOLECULAR AND GENETIC APPROACHES TO PLANT STRESS

Ashok Hotel, New Delhi, 14-17 February 1990

Sponsored and organized by:

INTERNATIONAL CENTRE FOR
GENETIC ENGINEERING AND BIOTECHNOLOGY

With additional funding from:

The Rockefeller Foundation
and
The Australian International Development Assistance Bureau

UNDERSTANDING AND MANIPULATING RESISTANCE MECHANISMS IN SORGHUM FOR CONTROL OF THE SHOOT FLY[1]

Kanayo F. Nwanze, K. E. Prasada Rao and P. Soman
International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru P.O., Andra Pradesh 502 324, India

The sorghum shoot fly, *Atherigona soccata* Rondani, is a major pest of sorghum in Africa and Asia where infestations can result in severe crop loss. Resistance, as a method of control, has been associated with non-preference for oviposition (Blum, 1967) and antibiosis (Blum, 1968; Raina, 1981, 1985). Several factors are involved in antibiosis: dense hairs, trichomes, glossy trait, lignin and silica deposits, surface waxes and wetness of the central whorl leaf (Blum, 1968; ICRISAT, 1978; Maiti & Bidinger, 1979; ICRISAT, 1988).

In an attempt to identify resistant genotypes, over 15000 germplasm accessions of cultivated sorghums have been screened for resistance to shoot fly at the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT). The level of resistance in the genotypes identified has so far not resulted in significant genetic improvement when transferred into agronomically improved cultivars. Two new approaches were initiated: an introgression of genes from wild sorghums and a manipulation of resistance factors for the control of this insect.

In the introgression project, (Prasada Rao *et al.*, 1989) over 340 wild relatives of sorghum belonging to the Chaeto, Hetero, Stipo, Para and sorghum sections (Gu *et al.*, 1984) were evaluated for resistance to the shoot fly. Four accessions of parasorghum, three from *S. versicolor* (IS 14262, IS 14275, IS 18938) and one from *S. dimidiatum* (IS 18945) which possess dense hairs and trichomes, showed very high levels of resistance. Egg laying and deadheart formation were very low (range of 0-2 eggs/plant and 22-59% deadhearts, respectively) compared to 4.3 eggs/plant and 99% deadhearts in the control CSH 1.

These accessions, with chromosome number 2n=10, were crossed with cultivated sorghum (2n=20). Very few F1s of crosses with *S. dimidiatum* were recovered with varying degrees of sterility. Segregating populations were advanced to F3 and F4 and were subjected to optimum shoot fly infestation. Out of 587 individual plants which were selected for resistance both in terms of low egg laying and deadhearts, 315 set seed and are being further tested.

Studies on shoot fly larval behaviour have also led to successful management of this pest. The unexpanded central shoot leaf is the path of the newly hatched larva as it moves downwards from the oviposition site towards the growing apex. The wetness of this leaf has been associated with larval survival and seedling damage (ICRISAT, 1988, 1989). Leaf surface wetness (LSW) was generally low (<2, thin film of moisture) in resistant lines, e.g., IS 2146 and IS 18551, but high (>4, leaves densely covered with water droplets) in susceptible lines, e.g., IS 1046 and CSH 1. The reduction of LSW in highly susceptible commercial cultivars by artificial manipulation will enhance the breeding for resistance by reducing the threshold level of desirable resistance.

At ICRISAT Center, we were able to manipulate LSW in commercial CSH 5 by reducing irrigation during the first four weeks of a rabi-sown crop. This was achieved by giving 25 mm sprinkler irrigation at sowing and 10 mm five days after seedling emergence, and maintaining a dry spell for the next two weeks. The control involved a normal schedule of a total of >120 mm furrow irrigation given at the rate of >40 mm at sowing and at 12-day intervals thereafter. Reduced irrigation resulted in a decrease in LSW from 4.6 to 3.2. Egg laying was reduced by 50%, deadhearts by 30% while plant biomass was increased by 20%.

[1]Submitted as Summary of a Conference Presentation CP - 546 by the Internal Crops Research Institute for the Semi-Arid Tropics (ICRISAT)

References

Blum, A. (1967). Varietal resistance of sorghum to the sorghum shoot fly (*Atherigona varia* Var. *soccata*). Crop Sci. 7, 461-462.

Blum, A.,(1968). Anatomical phenomena in seedlings of sorghum varieties resistant to the sorghum shoot fly (*Atherigona varia soccata*). Crop Sci. 8, 388-391.

Gu, M.H., Ma, H.T., and Liang, G.H. (1984). Karyotype analysis of seven species in the genus Sorghum. J. Hered. 75, 196-202.

ICRISAT (International Crops Research Institute for the Semi-Arid Tropics) (1978). Annual Report 1977-78. (Patancheru, A.P. 502 324, India).

ICRISAT (1988). Annual Report 1987. (Patancheru, A.P. 502 324, India).

ICRISAT (1989). Annual Report 1988. (Patancheru, A.P. 502 324, India).

Maiti, R.K. and Bidinger, F.R. (1979). A simple approach to the identification of shoot fly tolerance in sorghum. Ind. J. Plant Prot. 7, 135-140.

Prasada Rao, K.E., Mengesha, M.H. and Reddy, V.G. (1989). International use of sorghum germplasm collection. In: 'The use of plant genetic resources' (Brown, A.H.D., Frankel, O.H., Marshall, D.R., and Williams, J.T., eds.) pp. 49-67, Cambridge University Press, Cambridge.

Prasada Rao, K.E., Saideswara Rao, Y., and Mengesha, M.H. (1989). *Sorghum purpureosericeum* (A. Rich) Aschers, and Schweinf. sub sp. *dimidiatum* (Stapf) Garber: occurrence, morphology and cytology. Current Science 58, 385-386.

Raina, A.K. (1981). Movement, feeding behaviour and growth of larvae of the sorghum shoot fly, *Atherigona soccata*. Ins. Sci. Appli. 2, 77-81.

Raina, A.K. (1985). Mechanisms of resistance to shoot fly in sorghum: a review. In: 'Proceedings of the International Entomology Workshop, 15-21 July 1984, Texas A& M University, College Station, Tx., USA'. (Kumble, V., ed.) pp. 131-136 (ICRISAT: Patancheru, India).