MULTIPLE INSECT RESISTANCE IN SORGHUM

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Most germplasm and improved sorghum genotypes previously identified as resistant to shoot fly, stem borer, midge, and head bugs are resistant to only one of these insects which will usually infest the same crop. We developed a technique that will enable us to subject a crop of test entries to combinations of pest infestations and to evaluate them for resistance to one or more of these insects. In order to achieve optimum pest infestations, we manipulated and/or augmented pest populations by adjusting sowing dates, split sowing, use of infestor rows, fish-meal baits, insecticide applications, sprinkler irrigation, diapausing midge larvae, and artificial borer infestation (Mihm et al, 1978; Wiseman et al, 1980; Sharma et al, 1983; Taneja and Leuschner, 1985). Seven treatments, comprising single, double, and triple combinations of infestations by shoot fly, borer, and midge were used.

We standardized this technique over three seasons by evaluating 220 entries which consisted of 170 germplasm sources previously identified as resistant to single pests (shoot fly-60, stem borer-73 and midge-37), 42 improved breeding lines and F_4-F_6 progenies, and 8 commercial high-yielding cultivars. Results showed that less than 10% of shoot fly resistant sources had acceptable resistance (<3, on a scale of 1-9; where 1 = excellent and 9 = very poor) to shoot fly, but over 50% showed good resistance (scores of 1-3) to stem borer. IS18551 and IS2195 were the best entries with resistance to both shoot fly and stem borer. However, 80-90% of shoot fly and stem borer resistance sources were highly susceptible to midge (scores of >8). Similarly, all midge resistant sources were highly susceptible to shoot fly but less to stem borer. Seven midge lines had scores of <5 for stem borer. IS22464 was the best midge-resistant line with a score of 3 for stem borer resistance. In general, resistance sources tended to combine resistance to stem borer with resistance to other pest species, and there was a higher frequency for resistance to stem borer as a second component than for any other insect. Advanced breeding lines showed a wide range of resistance to all three pests and had a higher frequency for resistance to stem borer.

After standardization of our technique, we reduced the test entries to 75 and subjected them to another two seasons of testing. We selected 35 promising lines with various combinations of resistance to all three pests and re-evaluated them in late-sown rainy and post-rainy season nurseries in 1989 and 1990. Five entries were included as control. Apart from evaluating for primary resistance, entries were also evaluated on a 1-9 scale for recovery resistance to shoot fly and stem borer at 50 and 90 days after seedling emergence and for over-all plant performance at harvest. In the latter case, agronomic performance was a major criterion of evaluation. Yield data were recorded at harvest.

Under multiple insect infestations in the field, genotypes that combined reasonable levels of resistance (<5) to shoot fly and/or stem borer seemed to recover better and gave higher yields than those with good levels of resistance (<3) to midge. In this category, IS2122 and IS5613 were the best performing entries with yields of over 3 t ha^{-1}. Although ICSV197 is highly resistant to midge, it is very susceptible to stem borer and recovers very poorly. This affected its over-all performance and yield. Within the 35 entries, PS28060-3, a breeding line, had the best combination of resistance to all three pests, but grain yield was very low (1.05 t ha^{-1}). Our results also indicated that although considerable progress has been made at ICRISAT in the breeding for multiple insect resistance, more emphasis needs to be directed towards improving the grain yield potential of these entries.

References

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