CP 679

Fifth International Symposium on Parasitic Weeds, Nairobi, Kenya; June 24th - 30th, 1991. pp 435-441

STRIGA RESEARCH IN SORGHUM AND MILLETS IN SOUTHERN AFRICA: STATUS AND HOST PLANT RESISTANCE

1456

A. Tunde Obilana [1], W. A. J. de Milliano [1] and A. M. Mbwaga [2]

There are 13 species of *Striga* in Southern Africa. Earlier reports on some of these species were reviewed and discussed while a few of the observations were updated. The distribution of the different species in the 10 countries of the region are discussed. Screening and evaluating (in 'field pot' experiments and 'hot spot' locations) sorghum germplasm from Angola, Botswana, Lesotho, Swaziland and Zimbabwe, exotic lines and varieties from outside the region, indicate resistance shown by some cultivars in the two groups of materials. From the region, between 2.0% and 20.0% of country accessions in the germplasm were found resistant. Among the introduced lines, some cultivars with previous identification for resistance to *Striga asiatica* white (SAR lines) in India were also found to be resistant to *S. asiatica* red, *S. forbesii* and *S. hermonthica*, the three most economically significant species in the region. The cultivar SAR 19 was shown to have multiple resistance to *Striga* being resistant to the two species *S. asiatica* red and *S. forbesii* and tolerant to *S. hermonthica*. Cultivars SAR 16, SAR 26, SAR 29 and SAR 35 were also resistant to *S. asiatica* red and *S. forbesii*, while SAR 29 and its hybrid SPL 38A x SAR 29 show potential for resistance to *S. hermonthica*. Host specificity of *S. asiatica* red and *S. hermonthica* on sorghum and maize was demonstrated in Tanzania, while pearl millet was not attacked by any of the two species. Some evidence of intracrop-specific and intercrop - specific strains of these two species were obtained in Botswana and Tanzania in sorghum. Implications of these were indicated in terms of identifying stable host plant resistance.

INTRODUCTION

In Southern Africa, witchweeds were described and recognized as parasitic as early as 1905 (Burtt-Davy, 1905). Local farmers named witchweeds in their local languages, suggesting a familiarity to the problem by the parasite. *Striga asiatica* (L) O. Kuntze is called kam; hiti, kaufiti or likala in Chichewa (Malawi) (Binns and Logah, 1972), kaloyi in Chinyanja (eastern and central Zambia), and kabanza in Chitonga (southern Zambia) (Vernon, 1983). *Striga aspera* is called mfiti in Chichewa (Binns and Logah, 1972). The economic importance of witchweeds was recognized in particular for sorghum (*sorghum bicolor* (L) Moench) and maize (*Zea mays L.*) in South Africa (Saunders, 1942), Tanzania (Doggett, 1965), Zambia (Vernon, 1983), Zimbabwe (Timson, 1929; 1931) and research to control the parasites was undertaken (Saunders, 1942; Hattigh, 1965; Doggett, 1965; Visser and Botha, 1974).

Sorghum cultivars were developed with some resistance to the red flowered *Striga asiatica* such as Radar (Saunders, 1942), to *Striga hermonthica* (Del.) Benth. and Framida (Housley et al., 1987). In 1984, the SADCC/ICRISAT Sorghum and millet Improvement Program was initiated (SADCC/ICRISAT 1985), and addressed two major objectives in *Striga* research.

1. To establish the status of *Striga* in southern Africa
2. To identify sources of stable resistance to the different major species of Striga in southern Africa as partly *Striga* control and management.

This paper reviews the progress made to meet these two objectives.

MATERIALS AND METHODS

Three groups of materials were used for *Striga* studies in southern Africa. The first set comprising nineteen SAR (*Striga asiatica* - white flowered, resistant) lines were introduced from ICRISAT in India. Two hundred and fifteen sorghum germplasm from nine countries of the SADCC region together with 267 exotic lines formed the

1. SADCC/ICRISAT Sorghum and Millets Improvement Program, P.O. Box 776, Bulawayo, Zimbabwe

2. Agricultural Research and Training Institute, P.O. Ilonga, Kilosa, Tanzania.

recorded in all three replicates of the pot trials compared to other three resistant and four varieties in the test. He also found a significant (p = 0.05) *Striga* source x sorghum variety interaction which also accounted for 20% of total variation in the trial. The popular improved local selection ,Segaolane, was found susceptible to *S. asiatica*. With such observation of intra heterogeneity in *Striga* species, it follows that multi-locational testing would need to be used to identify and confirm selected resistant varieties that are stable across any country. The potential stability of two sorghum varieties SAR 16 and SAR 19 across Botswana for resistance to *S. asiatica* is useful in breeding programs. Preliminary screening of seven maize lines earlier selected for resistance to *S. hermonthica* in West Africa and introduced from IITA Ibadan, showed only one, 8322-13, to have any degree of resistance to *S. asiatica* in Botswana.

In Zimbabwe, potential success as parasites in terms of seed productivity of the two economically significant *Striga* species, *S. asiatica* and *S. forbesii* from the region, were compared. The average number of seeds produced by *S. forbesii* was estimated to be 24,654 per plant, less than half of theat produced by *S. asiatica* (57,794). The higher seed number in *S. asiatica* was due to higher number of capsules produced per plant on average (71) as compared with *S. forbesii* (14) despite the latter producing more seeds per capsule (1761) relatively to the former (814). These estimates (Obilana et al., 1988) were obtained using two methodologies involving the Grid System for seed count under steromicroscope and weight System with Metler balance. The estimates reported by Obilana et al. (1988) were the first kind for *S. forbesii* while those for *S. asiatica* lie in the range estimated by Jones (1985) but higher than those of Ramaiah et al. (1983) for seeds per capsule, while seeds per plant vary widely from other estimates but closer to that of Jones (1985).

Screening for host resistance in sorghum to the *Striga* species of significance indicated potential and confirmed resistance in different cultivars in three countries of the region. Obilana et al. (1988) using the checkerboard screening method, found resistance to *S. forbesii* in three sorghum varieties SAR 19, SAR 29 and SAR 33, in Zimbabwe. From studies on biology and control of parasitic weeds, Riches et al. (1986) reported four sorghum cultivars, SAR 19, SAR 16, SAR 29 and SAR 35 to be resistant to the red flowered *S. asiatica*. Of significance is that all these SAR lines reported here, especially, SAR 29 and SAR 16, were also found to be resistant to the white flowered *S. asiatica* in India. Also it is important to note that from these resistance studies, SAR 19 has been found to have multiple resistance to *S. asiatica* red flowered and *S. forbesii*, in two countries of southern Africa. In preliminary observation nurseries to observe *Striga* reaction of selected 419 germplasm accessions from SADCC (southern African) region and exotic lines from Karper's and Alad's nurseries, only twelve lines (2.9%) were found resistant with nil *Striga* in their replicated plots. From among the SADCC germplasm, 2.4% from Zimbabwe, 2.0% from Botswana, 10.0% from Swaziland, 9.6% from Angola, and as high as 20.0% from Lesotho were found resistant (Obilana et al., 1988). These resistant exotic varieties and indigenous cultivars found resistant in southern Africa have been crossed among themselves and to high yielding varieties and parents of high yielding hybrids in an effort to transfer resistance, improve the agronomic background of resistant lines; and study the genetics of resistance to the *Striga* species and their interaction with host plants and the environment.

Sorghum hybrids developed, initially, in this fashion have been screened in a "Hot Spot" location at Ukiriguru in Tanzania for resistance to *Striga* species in the location. Table 2 shows the reaction of 81 test entries, to infestation by *S. asiatica*, *S. hermonthica* both combined in two years, as compared with the check variety CK60B, at Ukiriguru. The number of emerged *Striga* plants and entry plant stand per plot, expressed as percent *Striga*. Infestation Per Plant (PSIP), were used as indices of resistance. In 1988/89 counts and PSIP were made for both *Striga* species occurring in the Hot-Spot test field. Infestation was high with PSIP ranging from 0 to 350, 3 to 45 and 11 to 380 for replications one, two and three, respectively. The PSIP was good enough to identify resistant or tolerant entries from susceptibles. Two test entries, SAR 29 and hybrid SPL38A x SAR 29 had less than 20% infestation level ranging from 0 to 13 percent PSIP relative to the extremely high susceptible check infestation levels of 182 to 304 percent. These two entries SAR 29 and its hybrid with SPL 38A, (SPL38A x SAR 29), thus showed some level of resistance to the two species *S. asiatica* red-flowered and *S. hermonthica* in this trial. In the following year in 1989/90, *Striga* counts and PSIP were obtained for the two species separately (Table 2). Estimates of PSIP were also very high for *S. asiatica*, 257 to 957 percent, fairly high for *S. hermonthica*, 186 to 375 percent, in both check entry plots. Two entries, hybrids SPL 38A x SAR 29 and ATX 623 x SDS 1406 were found to show fair resistance level to *S. asiatica* red-flowered by having less than 30% infestation levels (0 to 27 per cent and 0 to 26 percent PSIP respectively). However, nine test entries, SPL109A x SDS 2106, SPL23A x SAR 33, ICSA 20 x SAR 19, SAR 19, ATX 623 x SDS 1412, CK60A x SDS 1412, ICSA19 x SAR 19, ICSA 21 x SDS 1412, and ICSA 21 x SAR 29, have less than 20% *Striga hermonthica* infestation levels (0 to 10 percent PSIP) thus showing some level of resistance to this species.

From these two-year studies, resistance potentials were found in some sorghum lines, varieties and hybrids to the two species of *Striga* causing serious damage in Tanzania. The variety SAR 29 and its hybrid SPL38A x SAR 29 show good resistance levels in the two years to *S. asiatica* red-flower. The hybrid ATX623 x SDS1406 also exhibited some tolerance to *S. asiatica*. Resistance to *S. hermonthica* has been shown in this preliminary study by nine hybrids with SAR 19, SAR 29, SAR 33 and SDS 1412 (all as male pollinator lines); and ICSA 21 as female (male sterile) parent lines.

Parker, C., A. M. Hitchcock and K. V. Ramaiah. 1977. The germination of *Striga* species by crop root exudates: techniques for selecting resistant cultivars. Sixth Asian-Pacific Weed Science Society Conference. July 11-17, 1977. Jakarta, Indonesia. 67 pp.

Ralston, D. M., C. R. Riches and L. J. Musselman. 1986. Morphology, floral syndrome, and host specificity of *Striga* spp. in Botswana. OICD Report. Dept of Agricultural research, Gaborone, Botswana, 41pp.

Ramaiah, K. V., C. Parker, M. J. Vasudeva Rao and L. J. Musselman. 1983. *Striga* Identification and control Handbook. Information Bulletin No. 15. Patencheru, A.P., India, ICRISAT.

Riches C. R. 1988. The biology and control of parasitic witchweeds of grain legumes and cereal crops in Botswana. EEC Science and Technology for Development TSD-A-0273-RB Final Technical Report. Department of Agricultural Research. Gaborone, Botswana, 1988. 46 pages.

Riches, C. R., W. A.J. de Milliano, A. B. Obilana and L. R. House. 1986. Witchweeds (*Striga* spp) of sorghum and pearl millet in the SADCC region - distribution and control. Third SADCC/ICRISAT Sorghum and Millets Improvement Program Regional Workshop. 20-25 September, 1986. Lusaka, Zambia. 22pp.

SADCC/ICRISAT. 1986. Proceedings. Second Regional Workshop. Gaborone, Botswana, 23-27 September 1985. SADCC/ICRISAT Sorghum and Millet Improvement Program, Bulawayo, Zimbabwe (Limited distribution).

Saunders, A. R. 1942. Field experiments at Potchefstroom. A summary of investigations of Agriculture; Agricultural and Faculty Science Bulletin 14:19-21.

Timson, S. D. 1929. Witchweed. *Striga lutea* methods of control. Rhodesia Agricultural Journal 26: 1103-1113.

Timson, S. D. 1931. Witchweed. Progress report and warning. Rhodesia Agricultural Journal 28: 1101-1111.

Vasudeva Rao. M. J. 1987. Techniques for screening sorghum for resistance to *Striga*. In: Musselman, L.J. Parasitic Weeds in Agriculture Vol 1: *Striga*. CRC Press, Boca Raton, Florida, USA. pp 281-306

Vernon., R. 1983. Field guide to important arable weeds of Zambia. Mount Makulu Central Research Station, Chilanga, Zambia. Balding and Mansell Ltd., London, England; 68-69.

Visser, J. H. and P. J. Botha. 1974. Chromatographic investigations of the *Striga* seed germplasm stimulant. Pflanzephysiology 72:352