Selection of High Yielding and Anthracnose Resistant *Stylosanthes* for Brazil, India and China

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SELECTION OF HIGH YIELDING AND ANTHRACNOSE RESISTANT *STYLOSANTHES* FOR BRAZIL, INDIA AND CHINA

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Abstract

Resistance to anthracnose, dry matter yield (DMY) and seed yield (SY) was assessed for germplasm and breeding lines of *Stylosanthes* in Brazil, India and China. Overall, *Stylosanthes guianensis* produced higher DMY than *S. scabra, S. capitata* and *S. macrocephala* at most sites in Brazil. Data from China suggest that there are high yielding anthracnose resistant *S. guianensis* lines that can reduce the reliance on CIAT 184. *S. seabrana* might also prove successful. *S. seabrana* in India produced the highest DMY and SY and it can form nodules with native *Bradyrhizobium* strains. Regional differences in resistance within accessions stress the importance of targeting germplasm to combat the suite of pathogen races present at a local level.

Keywords: *Stylosanthes,* anthracnose, international collaboration, improved germplasm, disease resistance

Introduction

Stylosanthes-based pastures can increase meat and milk production in animals on a low protein diet in the semi-arid and arid environments of tropical and sub-tropical countries. *S. scabra* and *S. hamata* are suitable for the semi-arid to sub-humid regions of Australia, India, Thailand, Africa and China; and *S. guianensis* is of highest potential for humid regions in South America, China, South-East Asia and Africa. Over 5000ha of *S. guianensis* accession CIAT 184 has been established in China during the last few years (Guodao et al., 1997). *S. capitata* and *S. macrocephala* have high potential for humid regions in Latin America but are yet to succeed commercially (Miles and Grof, 1997). *S. seabrana* is a newly commercialized species in Australia for clay soils in semi arid regions (Edye, 1997).

Susceptibility to anthracnose disease has severely limited the use of *Stylosanthes* cultivars. At least five out of eight cultivars in South America (Miles and Lascano, 1997) and 9 out of 13 in Australia including all 4 cultivars of *S. guianensis* have been abandoned. In recent years the CIAT *S. guianensis*-breeding program, CSIRO *S. scabra* breeding program and the EMBRAPA *S. capitata*-*S. macrocephala* programs have identified new anthracnose resistant materials. Elite lines from these programs and germplasm of the newly described *S. seabrana* were evaluated to select well-adapted, high yielding and anthracnose resistant materials for Brazil, China and India through an international collaboration. In this paper we summarize the performance of these lines.

Material and Methods

Three different sets of germplasm and elite lines were selected to match specific agro-climatic and utilization (cut and carry or sown pasture) requirements for Brazil, China and India (Table 1). Three regional sites were established in Brazil at Chapadão do Sul in Mato Grosso do Sul, Goiania in Goias and Teresina in Piau State during the 1997-98 seasons. Sites in India and China were established in the 1998-99 season. The nine Indian sites are Dharwad in Karnataka, Rahuri and Uruli Kanchan in Maharashtra, Anand in Gujarat, Kalyani in West Bengal, Trivandrum in Kerala, Coimbatore in Tamil Nadu, Hyderabad in Andhra Pradesh, and Palampur in Himachal Pradesh. Four sites were established in China: CATAS in Hainan, Wuchang in Hubei, and Shaoguan in Guandong province. Manzhongtian in Yunan province was added in 1999-2000. Germination, establishment, flowering date and dry matter (DMY) and seed yield (SY) were recorded from 3-5 replicate plots of each line from at least 2x3 m plots established using a randomized block design. Anthracnose was monitored by visually assessing leaf area affected by anthracnose either at monthly intervals or at the end of a growing season. Data on monthly assessments were combined as Area under the Disease Progress Curve (AUDPC) for each plot using the following formula where y_i and y_{i+1} are anthracnose severity at times t_i and t_{i+1}, respectively.

$$AUDPC = \sum_{i}^{n-1} \left(\frac{y_i + y_{i+1}}{2} \right) (t_{i+1} - t_i)$$

For each site, lines were separated into species, and anthracnose resistance, SY and DMY within each species were compared by analysis of variance.

Results and Discussion

Performance in Brazil: The 23 accessions and lines used in the regional evaluation were selected from a pilot study of 28 *S. capitata*, 27 *S. scabra* and 20 *S. guianensis* accessions at Planaltina (Brasilia DF) and Campo Grande during 1995 and 1996 seasons. At Chapadão do Sul all *S. capitata* and *S. scabra* were more susceptible than *S. guianensis* (GC 984 was most resistant) or *S. macrocephala* (*S. macrocephala* GC 1511 was the most resistant). *S. guianensis* produced the highest DMY, 8-13 t/ha compared with 5-6 t/ha for *S. scabra*.

All species developed low levels of anthracnose at Teresina with no significant difference among lines. In this semi-arid environment accessions of *S. capitata* produced the highest DMY. The SY in *S. capitata* (300-700 kg/ha) was 20-fold higher than in *S. guianensis* (2-22 kg/ha).

At Goiania *S. scabra* and *S. capitata* were the most susceptible species, followed by *S. macrocephala* and *S. guianensis,* respectively. Overall, *S. guianensis* GC 1585 and 348 were the most resistant and susceptible, respectively, among all 23 lines from 4 species.

If these preliminary results are confirmed from ongoing evaluation, there will be opportunities to target selected lines to specific agro-ecological regions in Brazil. The *S. capitata-S. macrocephala* multiline selected at EMBRAPA-CNPGC shows promise at a number of sites, although a blanket recommendation must be avoided without a detailed inventory of pathogen races for each site. Further evaluation of promising lines including those of *S. seabrana* needs to continue.

Performance in India: All 14 lines of *S. scabra*, *S. seabrana*, *S. hamata and S. guianensis*, common to all regional sites, established well at Anand, Coimbatore, Dharwad, Hyderabad and Rahuri but poorly at the other 4 sites. In Australia, *S. seabrana* requires specific *Bradyrhizobium* strains, but experiments at Dharwad (in pots) and Rahuri (in field) have not shown major differences in the number of well-formed nodules and DMY between the specific Australian strain and native Indian strains. If the excellent performance without inoculation at other sites continues over the next few years with declining residual soil nitrogen, this will indicate that *S. seabrana* is able to do well without inoculation with specific strains.

Overall, *S. seabrana* had the highest DMY (2-7 t/ha) and SY (150-1400 kg/ha) among all species. *S. seabrana* 115945, 110370 and 110372 produced highest DMY at Anand and Coimbatore, but 104710 and 115995 were among the best at Dharwad and Rahuri. *S. hamata* 61670 consistently performed well at all three sites but with lower DMY and SY than *S. seabrana*. Although anthracnose was present at all sites, most lines showed good level of resistance except *S. scabra* cv. Fitzroy and Q10042 at Dharwad. The promise shown by *S. seabrana* in our preliminary results must be confirmed from long-term data from a more extensive range of regional sites and complemented with an improved knowledge of anthracnose epidemiology.

Performance in China: Based on a preliminary evaluation of 44 *S. guianensis* lines at CATAS, 14 were selected for further evaluation. Overall, CIAT 136, CIAT 184 and FM parcela 9405-6 were the most resistant to anthracnose and FM parcela 9405-1, GC 1578 and Reyan5 most susceptible at most sites. CIAT 136, FM parcela 9405-2 and FM parcela 9405-3 have high DMY (5-6 t/ha), although CIAT 136 suffers frost damage at CATAS. FM parcela 9405-3 produced the highest SY at both CATAS and Manzhongtian and GC 1681 and cv. Mineirao are among the lowest. CIAT 184, used widely in China, performed well with 5t/ha DMY and over 160 kg/ha SY. Recent data from China show a high degree of genetic variation in the anthracnose pathogen. Given this, research must continue to find other high yielding resistant materials from *S. guianensis, S. hamata* and perhaps *S. seabrana* to reduce the heavy reliance placed on CIAT 184 (Guodao et al., 1997).

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Table 1 - Accessions and cultivars of *Stylosanthes* species evaluated at field sites in Brazil, India and China

Species	Accession/cultivar	Countries where evaluated and local reference		
		Brazil	China	India
Stylosanthes capitata	CIAT 2814	GC 1082		
Stylosanthes capitata	CIAT 1914	GC 1084		
Stylosanthes capitata	CIAT 1982	GC 1466		
Stylosanthes capitata	CIAT 11096	GC 1469		
Stylosanthes capitata-*S. macrocephala* multiline	GC 2260	GC 2260		
Stylosanthes guianensis	CIAT FM 9405-1	GC 1468	CIAT FM 9405-1	
Stylosanthes guianensis	CIAT FM 9405-2		CIAT FM 9405-2	
Stylosanthes guianensis	CIAT FM 9405-3		CIAT FM 9405-3	
Stylosanthes guianensis	CIAT FM 9405 Par 3		CIAT FM 9405 Par 3	
Stylosanthes guianensis	CIAT FM 9405 Par 6		CIAT FM 9405 Par 6	
Stylosanthes guianensis	CIAT 136		CIAT 136	
Stylosanthes guianensis	CIAT 184 selection		Reyan No 2	
Stylosanthes guianensis	CIAT 184 selection		Reyan No 5	
Stylosanthes guianensis	CIAT 184 selection		CIAT 184	
Stylosanthes guianensis	Local selection		E3	
Stylosanthes guianensis	Local selection		L8	
Stylosanthes guianensis	Local selection	GC 1557		
Stylosanthes guianensis	Local selection	GC 1585		
Stylosanthes guianensis	Local selection	GC 1586		
Stylosanthes guianensis	GC 1581		GC 1581	
Stylosanthes guianensis	GC 1578		GC 1578	
Stylosanthes guianensis	CIAT 2950/Mineirao	GC 984	Mineirao	
Stylosanthes guianensis	GC 348	GC 348		
Stylosanthes hamata	CPI 61670			EC 408411
Stylosanthes macrocephala	Pioneiro	GC 1511		
Stylosanthes macrocephala	GC 1582	GC 1582		
Stylosanthes macrocephala	CIAT 10009	GC 1508		
Stylosanthes macrocephala	CIAT 10007	GC 1507		
Stylosanthes macrocephala	GC 1587	GC 1587		
Stylosanthes scabra	CPI 93116	GC 1498		
Stylosanthes scabra	CPI Q10042			Q10042
Stylosanthes scabra	CPI 40205 (Fitzroy)	GC 1496		Fitzroy
Stylosanthes scabra	CPI 40292 (Seca)	GC 1500		Seca
Stylosanthes scabra	CPI 36260			36260
Stylosanthes scabra	RRR 93 86 -I-8	GC 1493		
Stylosanthes scabra	RRR 93 38-II-1	GC 1490		
Stylosanthes scabra	RRR 94-16			RRR 94-16
Stylosanthes scabra	RRR 94-35	GC 1536		
Stylosanthes scabra	RRR 94-56	GC 1538		
Stylosanthes scabra	RRR 94-86			RRR 94-86
Stylosanthes scabra	RRR 94-96			RRR 94-96
Stylosanthes scabra	RRR 94-97			RRR 94-97
Stylosanthes seabrana	CPI 115995			EC 408415
Stylosanthes seabrana	CPI 110372			EC 408418
Stylosanthes seabrana	CPI 110370C			EC 408412
Stylosanthes seabrana	CPI 104710			EC 408413
Stylosanthes seabrana	CPI 105546B			EC 408410
Country Total		23	14	14