

TABLE I  
Changes in dye-containing media due to growth of *Azospirillum*\*

	Dye used in the medium	Concn. ( $\mu\text{g/ml}$ )	pH		Colour	
			initial	final	initial	final
Acidic	Bromothymol blue (BTB)	25	6.8	9	green	blue
	Bromocresol purple (BCP)	10	6.5	9	yellow	purple
Basic	Brilliant green (BG)	1	7	9	green	colourless
	Congo red (CR)	10	7	9	Orange	colourless

\*alkali producing strains especially *Azospirillum brasilense*.

the search for suitable methods to quantitatively enumerate the organism in pure and carrier based inocula, these reactions could be advantageously made use of as is well documented in the case of the popular congo red containing yeast extract mannitol medium for enumeration of *Rhizobium*. The application of the present method has already proved its value in our studies on the survival of *Azospirillum brasilense* in carrier based inocula<sup>10</sup> and is recommended for similar studies.

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#### CHANGES IN PHENOLIC CONTENTS OF SORGHUM AND MAIZE CULTIVARS RESISTANT AND SUSCEPTIBLE TO SORGHUM DOWNY MILDEW

Downy mildew caused by *Peronosclerospora sorghi* (Weston and Uppal) Shaw does considerable damage to sorghum and maize crops. The source of primary infection is soil-borne oospores which germinate and invade host seedlings. Some varieties of sorghum and maize show a natural resistance to downy mildew. Many workers<sup>1-5</sup> have correlated the presence of high amount of phenols with resistance to various pathogens and non-pathogens. The purpose of this study is to estimate the total phenolic content at different growth stages in leaf and root tissues of resistant and susceptible sorghum and maize plants and to look for a possible correlation with disease resistance.

Sorghum [susceptible: DMS 652 and Swarna; resistant: CSV-5 (148) and I.S. 184] and maize (susceptible: CM 500 and Eto 25; resistant: Phil. DMR-1 and DMR-5) leaves and roots from one, two and three-week old diseased and healthy plants were selected. One gram leaf and root samples of each diseased and healthy cultivars were collected separately, cut into pieces and put into boiling 80% ethyl alcohol. After 5 min it was cooled, ground in a pestle and mortar, filtered through cheese cloth and the residue was re-extracted with alcohol. The combined filtrate was made to 5 ml and the total phenols estimated<sup>6</sup>. The results are expressed in "tannic acid equivalents".

The results in Tables I and II indicate that the total phenols were higher in the leaves than in the roots irrespective of the variety or infection. The leaves

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TABLE I

*Total phenols in leaves of susceptible and resistant sorghum and maize cultivars to downy mildew (P. sorghi)*

Cultivar		Age of plants in weeks		
		mg/g (fresh weight)		
		1	2	3
Sorghum				
Susceptibl.				
DMS 652	Healthy	1.32	2.56	3.78
	Diseased	1.53	2.73	4.93
	Adjacent to diseased area	1.72	3.93	5.12
Swarna	Healthy	1.25	2.65	3.89
	Diseased	1.62	2.83	4.97
	Adjacent to diseased area	1.80	3.98	5.21
Resistant				
	Healthy			
	CSV-5 (148)	1.31	2.82	3.92
	I.S. 184	1.29	2.63	3.94
Maize				
Susceptible				
CM 500	Healthy	2.52	3.25	5.92
	Diseased	3.98	4.72	7.26
	Adjacent to diseased area	4.67	6.12	8.99
Eto 25	Healthy	2.54	3.32	5.98
	Diseased	3.23	4.89	7.99
	Adjacent to diseased area	4.73	6.32	8.13
Resistant				
	Healthy			
	Phil. DMR-1	2.51	3.87	5.82
	Phil. DMR-5	2.47	3.60	5.91

and roots of susceptible sorghum and maize cultivars infected with *P. sorghi* contain more of total phenols than their healthy counterparts. The total amount of phenols in sorghum and maize cultivars was more in the healthy regions adjacent to the areas colonised by the fungus. The concentration increased in 2-week old plants and it was still more in the 3-week old plants. Maize cultivars contained a higher amount of phenolic compounds compared to sorghum. There is no appreciable difference in phenolic contents of resistant and susceptible cultivars of uninfected sorghum and

maize. The resistant reaction may be due to the fact that following infection, phenols accumulate faster in resistant varieties than the susceptible ones to check the fungal growth. Accumulation of higher amount of phenols in the diseased area and also in the tissues adjacent to infection is suggestive of active metabolic changes taking place in the diseased plant. Cruickshank and Perrin<sup>7</sup> have shown that the metabolic changes occurring in diseased plants, frequently lead to accumulation of aromatics, especially phenolic compounds. Rubin and Artsikhovskaya<sup>8</sup> commenting

TABLE II

Total phenols in roots of sorghum and maize cultivars susceptible and resistant to downy mildew (*P. sorghi*)

Cultivar		Age of plants in weeks		
		mg/g (fresh weight)		
		1	2	3
<b>Sorghum</b>				
Susceptible				
DMS-652	Healthy	0.67	1.85	2.10
	Diseased	1.25	2.32	2.70
Swarna	Healthy	0.62	1.92	2.42
	Diseased	1.65	2.92	3.15
Resistants				
CVS-5 (148)	Healthy	0.63	2.00	2.18
	I.S. 184	0.61	1.92	2.25
<b>Maize</b>				
Susceptible				
CM 500	Healthy	1.96	3.10	3.62
	Diseased	2.96	4.15	4.53
Eto 25	Healthy	1.96	3.10	3.62
	Diseased	2.61	3.83	4.11
Resistant				
Phil. DMR-1	Healthy	1.92	2.92	3.52
	Phil. DMR-5	1.93	3.22	3.54

on the role of phenol in resistance suggest that phenols are oxidized to highly reactive quinones which are effective inhibitors of enzymes having sulphhydryl groups, thereby preventing metabolic activities of host and the fungal cells.

The increase in the total phenolic compounds in the mature plants can be correlated with the increase in resistance to the infection by the downy mildew (*P. sorghi*). Sorghum and maize plants are usually very susceptible to downy mildew upto three weeks and become resistant after this period. The susceptible plants become resistant as the phenolic compounds increase.

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