Table 2 *Chemical analysis of leaves of some cotton germplasm*

Germplasm	Total sugars (%)	Reducing sugars as glucose (%)	Non-reducing sugars as sucrose (%)	Sucrose as percentage of total sugars	(N) (%)	P(%)	(K)(%)	Moisture (%)	Cell-sap (pH)	Cell-sap (conc) m. mhos/cm
Tamcot SP23	3.1	2.5	0.5	17.6	2.7	0.2	1.3	74.0	5.5	28.4
TX ORSC-78	2.8	2.4	0.5	17.0	2.6	0.2	1.2	69.5	5.5	24.0
TX ORHU 1-78	2.9	2.3	0.6	19.7	2.7	0.2	1.7	70.5	5.4	26.3
Tamcot SP-215	2.9	2.5	0.4	13.7	2.5	0.2	2.0	71.0	5.5	26.6
Reba B-50	3.3	2.7	1.0	30.0	2.5	0.2	1.3	71.0	5.6	23.7
Laxmi	3.4	2.6	0.8	24.0	2.4	0.2	1.8	75.0	6.0	28.0

Smooth leaf types, like Deltapine 61, Deltapine 62 and AET 5 have been reported resistant to whitefly[2] as compared to pubescent cotton varieties. Hairy varieties of cotton have been observed susceptible to thrips and whiteflies[3].

Chemical analysis of leaves of some germplasm lines (where population of whitefly was very low and high) was carried out. Preliminary studies indicated positive relationship between susceptibility to whitefly and sugar content particularly of non-reducing sugars as sucrose. Susceptible lines contained more of non-reducing sugars as sucrose compared to other fairly resistant lines. Sucrose constituted about 24 and 30% of the total sugars in whitefly susceptible lines, (viz. Laxmi and Reba B 50 respectively) while in other fairly resistant lines, it varied from 14 to 20% of the total sugars (table 2). Preference of whitefly for higher sucrose concentration has been reported[4]. No definite trends were observed in leaf N, P and K contents and cell sap pH between susceptible and fairly resistant lines.

Studies indicate that moderately hairy cotton germplasm lines with higher level of non-reducing sugars (as sucrose) are susceptible, while lines having less hairs coupled with relatively low sucrose content appear to be fairly resistant to whitefly.

Thanks are due to Dr Sheo Raj and Dr N. D. Mannikar for assistance and to the Division of Crop Improvement for supplying seeds of germplasm materials.

11 November 1987

1. Reddy, A. S., Rosaiah, B., Bhaskara Rao, T., Rama Rao, B. and Venugopal Rao, N., *Proceedings of seminar 'Problems of whitefly on cotton'* Pune, March, 1986.
2. Butler, G. D. and Wilson, F. D., *J. Econ. Entomol.*, 1984, **77**, 1137.
3. Baloch, A. A., Soomro, B. A. and Mallah, G. H., Cotton Research Institute, Sakrand, Pakistan, Ann. Rep., 1982.
4. Berlinger, M. J., Magal, J. and Benzioni, A., *Phytoparasitica*, 1983, **11**, 51.

GROWTH AND SPORULATION OF MILLET LEAF BLAST FUNGUS *PYRICULARIA PENNISETI*: ROLE OF POLYAMINES

S. C. GAUR, N. S. SHEKHAWAT and H. C. ARYA
Department of Botany, University of Jodhpur, Jodhpur 342 001, India.

LEAF blast of millet (*Pennisetum americanum*) caused by *Pyricularia penniseti* Prasad and Goyal adversely affects the yield of the crop as it attacks green leaves and damages photosynthetic tissues. We are working on the biology of the fungus and the factors which influence its growth and sporulation. Polyamines are essential for the growth of the plant as well as for the fungal cells[1,2]. The physiology and biochemistry of polyamines and their metabolism in normal plants and plants under stress have been reviewed[3-5]. Rajam and Galston[6] have studied the effect of inhibitors of polyamine biosynthesis on the growth and morphology of various phytopathogenic fungi and have observed that polyamines are essential for fungal growth and development. They reported on the fungicidal and plant protective efficacy of DL-difluoromethylornithine (DFMO), a specific inhibitor of ornithine decarboxylase, the enzyme that provides fungi with the necessary polyamines[2]. Birecka *et al*[7], reported that DFMO inhibited mycelial growth and sporulation of *Helminthosporium maydis* and the inhibition could be reversed with putrescine. We report here on the

role of spermidine, a polyamine required for the growth and sporulation of the fungus *P. penniseti.*

The pure culture of the fungus *P. penniseti* was maintained on Czapek's liquid medium. The medium was supplemented with thiamine and biotin. Biotin was found to be an essential component of the medium for sporulation of the fungus. The inhibitor D-arginine was added to sterile culture medium to get final concentrations of 0.1, 0.5 and 1 mM. Inhibitor-amended culture media were dispensed aseptically into 125 ml Ehrlenmeyer flasks (35 ml per flask). For experiments involving reversal of inhibition, we used 1 mM D-arginine (which yielded about 50% inhibition of mycelial growth and allowed no sporulation) with two concentrations (0.1 and 1 mM) of polyamines (PAS). The control flasks contained only the culture medium with no inhibitor.

Six replicate flasks were used for each treatment and were incubated at 28±2°C with a 12 h dark/12 h light cycle. Fungal growth and sporulation were recorded on the 5th, 10th and 15th days of culture. Dry weight of the fungus was determined at the end of the experiment. The experiments were repeated thrice and were highly reproducible. The results given are averages of 18 replicates.

Table 1 shows the effect of D-arginine on mycelial growth and sporulation of *P. penniseti.* The inhibitor at 0.1, 0.5 and 1 mM produced successively greater inhibition of mycelial growth and allowed no sporulation. It is clear that the effect of inhibitor on vegetative growth was reversible with L-arginine, putrescine, spermidine and spermine. The dry weight of the fungus was greater than that of the control when L-arginine and spermidine (1 mM) were added along with D-arginine. L-Arginine was the most effective in the reversal of inhibition. However, sporulation could be recovered only with spermidine (1 mM).

The results clearly indicate that D-arginine, an antagonist of L-arginine, induced inhibition of fungal growth and sporulation. L-Arginine is a basic precursor of polyamines[4]. Probably D-arginine is incorporated into proteins in place of L-arginine and inhibits polyamine biosynthesis. The hypothesis is further supported by the addition of L-arginine and polyamines (putrescine, spermidine and spermine) along with D-arginine. The reversibility of the D-arginine effect was most significantly marked with spermidine followed by L-arginine. The reversal of inhibition of sporulation was obtained only with 1 mM spermidine and not with other polyamines. These findings are unique because the D-arginine effect on sporulation could not be reversed with L-arginine and putrescine from which spermidine is derived in the biosynthetic pathway. Probably, D-arginine forms some linkage with another substance which is not easily displaced when L-arginine or putrescine is added (Galston, personal communication).

Table 1 *Growth and sporulation of Pyricularia penniseti on D-arginine alone and in combination with polyamines*

Treatment (mM)		Dry weight of fungal mycelium per flask (mg)	Sporulation
Control		207.2±10.5	Profuse
D-Arginine,	0.1	153.3±7.1	No
	0.5	110.4±7.0	No
	1.0	50.2±5.2	No
D-Arginine, + Putrescine,	0.5 + 0.1	149.7±7.2	No
	0.5 + 1.0	186.2±8.1	No
D-Arginine, + Spermidine,	0.5 + 0.1	140.5±5.7	No
	0.5 + 1.0	215.2±10.5	Profuse, more than in control
D-Arginine, + Spermine,	0.5 + 0.1	138.8±6.3	No
	0.5 + 1.0	173.2±7.8	No
D-Arginine, + Putrescine + Spermidine + Spermine	0.5 + 0.3 + 0.3 + 0.3	165.5±6.9	No
D-Arginine, + L-Arginine,	0.5 + 0.1	182.7±8.2	No
	0.5 + 1.0	219.9±10.7	

The results of the present investigation might be of practical importance, particularly for control of millet leaf blast. Prevention of a plant disease by specific inhibition of fungal polyamine biosynthesis was reported by Rajam *et al*[8] and Walters[9].

The authors thank Prof. A. W. Galston, Department of Biology, Yale University, USA, for help.

6 December 1988

1. Stevens, L., *Med. Biol.*, 1981, 59, 308.
2. Tabor, C. W. and Tabor, H., *Microbiol. Rev.*, 1985, 49, 81.

3. Slocum, R. D., Kaur-Sawhney, R. and Galston, A. W., *Arch Biochem. Biophys.*, 1984, 235, 283.
4. Flores, H. E., Young, N. D. and Galston, A. W., In: *Cellular and molecular biology of plant stress*, Alan R. Liss, Inc., New York, 1985, p. 93.
5. Kaur-Sawhney, R., Shekhawat, N. S. and Galston, A. W., *Plant Growth Regulation*, 1985, 3, 329.
6. Rajam, M. V. and Galston, A. W., *Plant Cell Physiol.*, 1985, 26, 683.
7. Birecka, H., Garraway, M. O., Baumann, R. J. and McCann, P. P., *Plant Physiol.*, 1986, 80, 798.
8. Rajam, M. V., Weinstein, L. H. and Galston, A. W., *Proc. Natl. Acad. Sci. USA*, 1985, 82, 6874.
9. Walters, D. R., *New Phytol.*, 1986, 104, 613.

FOLIAR NECTARIES IN *ERYTHRINA STRICTA* L.

M. JOHNCY, R. B. SUBRAMANIAN and J. A. INAMDAR
Department of Biosciences, Sardar Patel University, Vallabh Vidyanagar 388 120, India.

EXTRAFLORAL nectaries in the genus *Erythrina* have been studied by several workers[1–4]. Reports on extrafloral nectaries[5–7] show that they are helpful in reducing herbivore activity. The present study describes the structure, secretion and function of stipellar nectaries in *Erythrina stricta*.

FAA fixed materials were used for paraffin embedding and sectioning. For scanning electron microscopic (SEM) studies, materials were dehy-

Figures 1–4. Morphology and anatomy of foliar nectaries of *Erythrina stricta*. **1.** SEM micrograph showing a pair of stipels (Note the pores (circled)) (× 250); **2.** SEM of a pore (× 5000); **3.** Fluorescence micrograph of a section of a stipel showing the thick cuticle and cuticular insulation to the wall of the pore (× 550); and **4.** Bright field micrograph showing the pyramid-shaped nectary with large basal cells, stalk cells and secretory cells (× 570). (BC, Basal cell; C, Cuticle; CI, Cuticular insulation; S, Stipel; SC, Secretory cell; ST, Stalk cell).