INFLUENCE OF TEMPERATURE AND *RHIZOBIUM* STRAIN ON NODULATION AND GROWTH OF TWO TROPICAL LEGUMES

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ABSTRACT

The influence of three temperatures on the symbiosis between three strains of Rhizobium *and* Macroptilium atropurpureum (*Siratro*) *and* Macrotyloma axillare (*axillaris*) *was studied in controlled environment cabinets. Growth of Siratro was best at* 31/26°C (*day/night*) *while axillaris grew best at* 26/21°C *i.e. lower than that reported for other tropical legumes although higher than for temperate species. Growth of all host/strain combinations was inferior to their respective nitrate controls at* 21/16°C *and all control and inoculated plants of axillaris grew poorly at* 31/26°C.

INTRODUCTION

The influence of temperature on tropical legume—*Rhizobium* associations has not been studied as intensively as with temperate legumes. With the latter, attention has been directed to the effects of temperature on particular stages in development of the associations viz. nodule initiation (Gibson 1967, Roughley and Dart 1970) nodule development (Gibson 1963, 1967; Pate 1961, 1962) nodule structure (Roughley 1970) and nodule function (Mes 1959, Gibson 1961, 1963, Joffe *et al* 1961).

We report on the influence of temperature and *Rhizobium* strain on growth and nodulation of two tropical legumes, axillaris (*Macrotyloma axillare* (E. Mey.) Verdc.) and Siratro (*Macroptilium atropurpureum* (D. C. Urb.)).

EXPERIMENTAL

Pre-germinated, sterilized seeds of each host were planted in 27 mm diameter test tubes and inoculated immediately with the particular strain of *Rhizobium*. Strains used were CB1024 and CB756, two effective strains on axillaris and Siratro and NA800/1, a less effective variant of CB756 on these hosts (Herridge and Roughley 1975). Fifteen replicate plants of each host/strain combination, including uninoculated and NO_3 controls, were grown at temperatures of 31/26°, 26/21° and 21/16°C (day/night) in controlled environment cabinets providing 20,000 lx for a 12 hr day. After 2 weeks each treatment was culled to 10 uniform plants which were harvested at 7 weeks.

RESULTS

The growth of both hosts as influenced by temperature and strain is shown in Table 1.

TABLE 1

Influence of temperature and RHIZOBIUM strain on yield axillaris and Siratro

Temp	Plant dry weight mg									
	Axillaris					Siratro				
°C	U.C.*	NO3†	NA800/1	CB756	CB1024	U.C.	NO3	NA800/1	CB756	CB1024
21/16	19	110	24	52	28	53	161	51	76	92
26/21	31	184	93	372	345	51	244	124	317	300
31/26	8	31	14	10	17	47	270	327	519	600

L.S.D. (P = 0.05) 31.

* Uninoculated control.
† Nitrate control.

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Both host plants grew better when supplied with nitrate at 21/16°C than when dependent on fixed nitrogen. At temperatures favouring nitrogen fixation strains CB1024 and CB756 were more effective than NA800/1.

The growth of axillaris plants relying on symbiotically fixed nitrogen was more sensitive to temperature than when supplied with nitrate. With the exception of a small increase in yield at 21/16°C when nodulated with CB756, nodulated plants of axillaris grew better than uninoculated plants only at 26/21°C.

Siratro, nodulated by each of the three strains, grew better with increasing temperature over the range 21/16 to 31/26°C. At 26/21 and 31/26°C the symbiosis with strain NA800/1 could not meet the nitrogen demand of the host.

Table 2 records the effect of temperature and *Rhizobium* strain on the number of plants nodulated.

TABLE 2

Influence of temperature and RHIZOBIUM strain on nodulation of axillaris and Siratro plants (number of plants nodulated out of 10).

Temp °C	Axillaris			Siratro		
	NA800/1	CB756	CB1024	NA800/1	CB756	CB1024
21/16	8	10	9	10	10	10
26/21	10	10	10	10	10	10
31/26	0	8	5	10	10	10

The most favourable temperature for nodulation varied with the host. All plants of axillaris nodulated at 26/21°C. At 31/26°C none of the axillaris plants inoculated with the less effective strain NA800/1 formed nodules; 20% and 50% of plants inoculated with CB756 and CB 1024 respectively also failed to nodulate. At the lowest temperature (21/16°C), 20% of plants inoculated with NA800/1 and 10% of plants inoculated with CB 1024 did not nodulate. A visual assessment of the amount of nodule tissue formed indicated that Siratro formed more than axillaris at all three temperatures with a maximum at 31/26°C.

DISCUSSION

The two species in the present experiment are both cultivated in sub-tropical to tropical regions but their symbiotic responses to temperature are significantly different. Generally, nodulation and growth of axillaris was more sensitive to temperature than Siratro particularly when inoculated with a less effective culture of CB756 (NA800/1). Both hosts grew better at the lowest temperature when supplied with nitrate. Mes (1959) reported maximum growth of the tropical species of *Arachis hypogaea* (ground nut) and Glycine max. (L.) (soybean) at 30°C which agreed with our results for Siratro. The most favourable temperature for growth of axillaris in our experiments (26°C) was lower than the optimum for tropical species but higher than the optimum for temperate species (Mes 1959).

In the field axillaris starts growth early in spring and continues production late in the season (Barnard 1972). Its symbiotic and growth responses in the present experiment are consistent with the field performance and suggest that the general growth response to temperature of axillaris may be similar to that of *Glycine wightii*, *Desmodium uncinatum* and *D. intortum* (Sweeney and Hopkinson 1975).

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