Conclusions. Groundnut is an important crop in Mzuzu and Karonga ADDs. Late leaf spot and rust were the most predominant and destructive groundnut diseases in these areas, and the introduction of genotypes with resistance to these diseases should prove useful in northern Malawi. Groundnut rosette was observed for the first time in Karonga ADD.

Toward Standardization of a Laboratory Screening Technique for Early Leaf Spot Resistance in Groundnut

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Field screening for early leaf spot resistance in groundnut is not always successful because of fluctuations in weather conditions over seasons. Recent research (Butler et al. 1994) has indicated that duration of leaf wetness and temperature are important factors in disease development. The detached leaf culture technique developed by Melouk and Banks (1978) has many advantages, but the disease reactions may not always correspond with those shown on leaves still attached to plants. A laboratory screening technique was therefore developed, using whole plants held in a dew/growth chamber. We present the results of investigations on the effect of inoculum concentration on the efficiency of such a screening system using cultivars with varying levels of resistance to *Cercospora arachidicola*.

Plant material. Three genotypes (ICGs 9294, 10920, and 7892) with varying levels of resistance to early leaf spot and two susceptible genotypes (J 11 and TMV 2) were used in this study. Four seeds of each genotype were sown in each of twelve 15 cm diameter plastic pots containing autoclaved Alfisol and farmyard manure (4:1 ratio) in a greenhouse. Two plants were retained in each pot after germination. The temperature of the greenhouse was maintained at 25–30°C. The experiment was arranged in a randomized block design with four replications for each conidial concentration. Two fully opened quadrifoliate leaves (third and fourth from top) on each plant were inoculated when the plants were 30 days old.

Preparation of inoculum. Conidia were collected from sporulating lesions on the susceptible cultivar TMV 2 using a cyclone spore collector, and stored in small glass vials held at 4°C. Conidial inoculum was prepared

Table 1. Reaction of three known early leaf spot resistant and two susceptible groundnut genotypes 30 days after inoculation with the ICRISAT isolate of *Cercospora arachidicola* in dew/growth chamber, ICRISAT Asia Center, 1993/94.

	Number of lesions cm^{-2} leaf			Lesion diameter (mm)			Number of conidia per lesion			Percentage leaf area damaged			Percentage defoliation		
Genotype	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
Resistant															
ICG 7892	0.05	0.22	0.55	2.9	3.1	2.6	1250	1350	1100	0.8	2.3	4.3	2	19	41
ICG 9294	0.10	0.80	1.73	4.8	4.2	3.2	1300	1300	1400	4.0	10.9	17.2	2	45	72
ICG 10920	0.10	0.70	1.27	4.9	5.0	4.1	1550	1463	1525	1.5	11.0	14.6	0	19	49
Susceptible															
J 11	0.18	0.60	1.22	7.0	6.6	4.5	5000	5300	5300	2.3	9.4	15.8	6	45	72
TMV 2	0.10	0.49	1.26	5.7	5.6	4.3	3250	2800	3000	1.2	5.0	13.1	11	49	83
	SE	LSD		SE	LSD		SE	LSD		SE	LSD		SE	LSD	
Concentration × Genotype	±0.15	0.42		±0.3	0.85		±42.5	1215		±1.4	4.0		±8.3	23.7	
CV (%)	46.4			13.6			32.8			39.0			47.7		

T1 = 100 conidia per mL of inoculum, T2 = 500 conidia per mL of inoculum, T3 = 1000 conidia per mL of inoculum.
All LSDs at 5% probability level.

by suspending the conidia in sterilized water to which Tween 80® was added at the rate of 10 mL L^{-1}. Three conidial concentrations, 100 mL^{-1} (T1), 500 mL^{-1} (T2), and 1000 mL^{-1} (T3) were prepared by serial dilutions.

Inoculation. All the cultivars were arranged into three sets for inoculation with the three conidial concentrations. Using an atomizer, the tagged leaves were sprayed with inoculum to the point where run off occurred on both the sides of the leaf. This was done in the evening. Immediately after inoculation, the plants were placed in dew chambers (Clifford 1973) at 23°C to ensure wetness of the leaf surface, and held for 16 h in the dark.

Post-inoculation treatments. The plants were removed from the dew chamber on the morning of the following day and placed before a fan for about 30 min until the foliage had dried. They were then returned to the growth chamber and kept at 25°C for 8 h during the day (Butler et al. 1994). The plants were then returned to the dew chamber for 16 h. This alternate wet and dry period treatment was repeated for 5 days. The plants were then held in the growth chamber with 25°C constant temperature and relative humidity of 52–55% until the end of the experiment.

Observations. Observations on six parameters—number of lesions per leaf, total leaf area, lesion diameter, number of conidia per lesion, percentage leaf area damaged, and percentage defoliation—were recorded from 6 to 30 days after inoculation. Percentage defoliation was again recorded 45 days after inoculation.

Results. Disease symptoms appeared on the tagged leaves of all genotypes within 6 days after inoculation. Analysis of variance for the resistance components was done. Significant differences were found between the conidial concentrations for most of the components studied. In general, number of lesions, percentage leaf area damaged, and percentage defoliation were higher with the highest conidial concentration (1000 conidia mL^{-1}) used (Table 1). Number of conidia per lesion was significantly higher in susceptible genotypes than in resistant genotypes (Table 1). This parameter can be used to screen for early leaf spot resistance using a dew/growth chamber. Any of the three conidial concentrations would be satisfactory for laboratory screening based on components of resistance. The lower concentrations could be best for the study of lesion diameter, whereas the higher concentration could be more effective when measuring leaf area damage and defoliation.

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Comparison of Whole-Plant and Detached-Leaf Methods for Studying Components of Rust Resistance in Groundnut

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Groundnut rust caused by *Puccinia arachidis* is a serious problem worldwide, causing substantial losses in crop yield in many groundnut-growing regions (Subrahmanyam et al. 1985, Ghughe et al. 1981). The use of rust-resistant, high-yielding cultivars is the best means of reducing yield losses due to the disease. Research on host-plant resistance to rust has received increasing attention over the past 15 years, and many rust-resistant groundnut genotypes have been reported (Subrahmanyam et al. 1995). A few studies have reported components of rust resistance, using either the detached-leaf or whole-plant inoculation method (Subrahmanyam et al. 1983, Liao et al. 1990). The objective of this study was to compare the two methods for estimating components of rust resistance in selected genotypes.

Components of resistance were studied in 40 rust-resistant groundnut genotypes and one susceptible cultivar TMV 2, using the whole-plant and detached-leaf methods described by Subrahmanyam et al. (1983) and Liao et al. (1990). Five components were studied—infection frequency (number of pustules cm^{-2} leaf area), percentage of leaf area damaged, lesion diameter, incubation period (time taken for the appearance of 50% of the total pustules from the time of inoculation), and sporulation index (on 1–5 scale, where 1 = no sporulation, 2 = 1–25% lesion area covered with spores, 3 = 26–50% lesion area