

THE INTERNATIONAL TESTING PROGRAM: AIMS, PROGRESS AND PROBLEMS
SEEN FROM IITA

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During the period 1971 to 1975 a large portion of the cowpea world germplasm collection was screened at IITA for susceptibility to the major diseases occurring in the region, and more than 100 multiple resistant lines were identified. In 1974 the GLIP pathology program, in cooperation with several research workers in other tropical countries, initiated an International Cowpea Disease Nursery Program (ICPNP) in an attempt to identify broad spectrum stable resistance to many different populations of pathogens (including some that do not occur at IITA) over a broad range of environmental conditions. In addition to providing information on varietal resistance, the ICDNP also serves as a means of distributing useful cowpea germplasm to research workers in a position to make immediate use of desirable traits and as a means of promoting exchange of materials and ideas between research workers.

Two international disease nurseries were initiated in 1974. The International Cowpea Disease Nursery (ICDN), consisting of 100 lines which show multiple resistance at Ibadan, was sent to cooperators in Brazil, Colombia, Puerto Rico, Tanzania, India and the Philippines. The second nursery, the International Cowpea Mosaic Virus Nursery (ICPMVN), consisting of 12 lines that are resistant to the spherical beetle-transmitted cowpea mosaic virus at Ibadan, was sent to cooperators in Brazil, Colombia, El Salvador, Puerto Rico, Trinidad and India, for testing against local CPMV strains.

ICDN Results

At the time of writing results of the ICDN have been received from Puerto Rico, India and Nigeria. A summary of the results from each location follows:

A. Puerto Rico (Cooperator Dr. N.G. Vakili)

The ICDN was planted at Mayaguez (5 June 1974) and Isabela (19 June 1974) together with lines 10-R61 and 10-R65, which are resistant and susceptible respectively to cowpea mosaic virus (CPMV), powdery mildew and cercospora leaf spot. All entries were directly inoculated with a local CPMV isolate and a local bacterial blight isolate. Rhizoctonia stem rot and web blight, powdery mildew, cercospora leaf spot and target spot also occurred widely in both plantings. The data indicate that:

- (a) 13 ICDN lines were resistant, and 2 ICDN lines were moderately resistant, to the Puerto Rican CPMV strain. However several of the lines resistant to CPMV in Puerto Rico are highly susceptible

in Nigeria, and vice versa, indicating the presence of different pathogenic CPMV strains;

- (b) seven of the ICDN lines (including TVu 1190) remained free from bacterial blight after two heavy inoculations;
- (c) most lines were susceptible to *Rhizoctonia* web blight but entry 96 (TVu 4539) appeared to be resistant;
- (d) ninety of the 100 test lines were resistant to cercospora leaf spot (CLS).
- (e) forty-six ICDN lines were susceptible to powdery mildew. This is valuable information because there is no opportunity to screen for susceptibility to this disease at IITA.
- (f) only three entries developed target spot (*Corynespora cassiicola*) and these three lines are also susceptible to this disease in Nigeria.

B. India (Cooperator Dr. P. N. Patel).

The ICDN was grown at the IARI, New Delhi during the Kharif season, 1974. Poor rainfall distribution hampered disease development but information was obtained on susceptibility to aphid attack and cercospora leaf spot. The lines are presently being tested for reaction to bacterial blight and to three cowpea viruses; of major interest are the facts that:

- (a) none of the ICDN lines were susceptible to cercospora leaf spot, though the local susceptible line developed symptoms.
- (b) six lines were highly resistant to the aphid *Aphis craccivora* Kock and 16 lines were moderately resistant to the insect. The resistance has since been checked by careful laboratory experimentation and the high degree of resistance has been convincingly confirmed (P.N. Patel, personal communication).
- (c) TVu 410, TVu 1563, TVu 2331 and TVu 2276 appeared to be resistant to the spherical aphid-borne cowpea mosaic virus.

C. Nigeria (Cooperator Dr. R.J. Williams)

The ICDN lines were planted on the IITA farm in late April 1974 and were exposed to the pathogens causing anthracnose, bacterial pustule, cercospora leaf spot and rust by inoculating highly susceptible spreader lines planted two weeks before the test lines at both ends of each test row. Disease development was good during the heavy June rains, and in addition to the above diseases target spot bacterial blight and *Cercospora canescens* leaf spot also were widespread in the planting. In an adjacent field all the ICDN lines were mechanically inoculated with two CPMV isolates. The complete results are given in the full report but of major interest are the points:

- (a) 61 ICDN lines were immune or highly resistant to the four major bacterial and fungal diseases - anthracnose, bacterial pustule, cercospora leaf spot and rust.
- (b) 11 of the 61 lines with multiple resistance to the bacterial and fungal diseases were also resistant to the two CPMV isolates (TVu's 201, 347, 408-P₂, 410, 537, 697, 746, 1190, 1283, 2430-P₁ and 3415).
- (c) nine lines showed differential reactions to the two CPMV isolates indicating pathogenic variability amongst CPMV strains;
- (d) 19 lines were free from target spot and as the disease was so widespread in the planting they have been designated resistant.

D. Overall Resistance Rating of ICDN Lines

In order to compare overall performance numerical values have been given to the various disease reaction categories for each disease at all locations according to the following system:

Reaction Category	Numerical Score
HR and R (Resistant)	6
O (freedom from disease but line not directly exposed to Inoculum)	5
LS (low susceptible)	4
D, R/S (Differential reaction to isolates or segregating)	3
MS, MR (moderately susceptible)	2
S (susceptible)	1
HS (highly susceptible)	0

The overall resistance rating, derived by adding up the score for each disease at each location, is summarized in Table 1. The line TVu 1190 (recently registered as VITA 3) is outstanding with a resistance rating (RR) of 74 and is followed by TVu 410 (RR 70), TVu 2331, which was included as a rust susceptible indicator (RR 62), and TVu's 408-P₂ and 1563 (RR 61). The trial mean resistance rating was 50.67. Fifty-four lines had better ratings than the trial mean, and 86 lines had better ratings than 50% of maximum possible score.

ICPMVN Results

At the time of preparation of this report ICPMVN results have been received from cooperators in Brazil, El Salvador, India, Nigeria, Puerto Rico and Trinidad. The results are combined and summarized in Table 2.

Table 1. Resistance ratings of 104 cowpea lines in the 1974 ICDN program.

Resistance rating	Line(s) (TVu No's)
74	1190
70	410
62	2331*
61	408-P2, 1563
60	746, 3415
59	43, 347, 4535, 4538
58	2276
57	57* 857, 4539, 4640
56	196, 1404, 1593, 1962, 2430-P1, 3511
55	201, 317, 461, 563-P1, 1961, 3273
54	131, 455, 1233, 1461-P2, 1480-P1
53	853, 1037, 1452, 1460-P2, 2512
52	346, 401, 433, 647, 1560, 2455-P2, 2460, 4543
51	191, 984, 985, 1000, 1027, 1938, 2000, 4537
50**	154, 356, 515, 527, 697, 726, 1592, 2433, 2470, 3522-P1, 4536, 6665
49	62-P1, 264-P2, 1446, 1595, 2475-P2
48	381, 1614, 3349
47	476-P2, 735-2, 1065, 1113, 2366, 2480
46	459, 1566, 1963, 2616-P2, 4544, 6666
44***	1565, 2545, 2549, 4545, 6663
43	155-P1, 179-P1
42	528, 1637-P3, 2363-P1
40	91*, 280
39	1485-P1
38	1423-P1
37	662-P1
36	4541
35	612
31	76*

* Cowpea lines known to be susceptible to certain diseases included as indicators.

** Trial mean resistance rating 50.67

*** 45 is 50% of maximum possible rating

Table 2. Reactions of 12 cowpea lines to nine CPMV isolates in six countries in the 1974 ICPMVN.

Line	Brazil (2 isolates)	El Salvador (1 isolate)	India ^{1/} (1 isolate)	Nigeria (2 isolates)	Puerto Rico (1 isolate)	Trinidad (1 isolate)
113	(S) ^{2/}	NIL ^{3/}	HR	HR	S	R
274	(S)	N + CLL	HR	HR	HS	(S)
310	(S)	N + CLL	HR	HR	HS	(S)
410-P1	(S)	CLL	HR	HR	-	(S)
433	(S)	CLL	HR	HR	HS	(S)
470	(S)	CLL	HR	HR	HS	(S)
486	(S)	NLL	HR	HR	-	(S)
746	(S)	N + CLL	HR	HR	HS	(S)
1190	HR	N + CLL	HR	HR	MS/MR	(S)
2769	(S)	CLL	HR	HR	S	(S)
3563	(S)	CLL	HR	HR	S	(S)
3650	(S)	N + CLL	HR	HR	S	(S)

1/ Virus identity unsure but believed to be CPMV

2/ HR = No systemic symptoms

MR/MS = Moderately resistant/susceptible

S = Susceptible HS = Highly susceptible

(S) = Degree of susceptibility not indicated

3/ Systemic reaction not given. NLL = necrotic local lesions

CLL = chlorotic local lesion

All 12 lines were symptoms free in the Nigerian and Indian tests. It is not clear whether the reactions in El Salvador were local lesions only, with no systemic symptoms, and clarification has been requested from the cooperator in El Salvador. In Brazil and Puerto Rico the only line showing some degree of resistance was TVu 1190 (VITA 3) which was highly resistant to two CPMV isolates in Brazil and moderately resistant to one CPMV isolate in Puerto Rico. The susceptibility of ten of the lines at three locations whereas they were highly resistant at two locations indicates the presence of pathogenic strains of CPMV, but it is encouraging that TVu 1190 is resistant to most of them.

Discussion

The 1974 International Cowpea Disease Nursery Program, whilst being conducted at only a few locations, highlights the importance of a coordinated multilocational disease resistance testing program and provides information that indicates the possibilities for the achievement of the objectives stated at the beginning of this report. As a result of the 1974 program we know that: resistance to cercospora leaf spot or CPMV in Nigeria does not necessarily mean resistance to these diseases in Latin American countries; that we can screen for resistance to powdery mildew in Puerto Rico and to aphids in India; that lines like TVu's 1190, 410, 2331, 408-P and 1563 have a much broader spectrum of resistance than many other lines which are multiple-resistant lines at IITA and that already seed of these broadly resistant lines has already been distributed to researchers in several tropical countries.

The 1974 program marks a small and useful beginning to the ICDNP but many additional locations are required to increase the range of variability of pathogens and pathogen populations. Locations are required where ephiphytotics of Septoria leaf spot, Ascochyta leaf spot, Synchronium false rust, Fusarium wilt occur annually, and where the pathogens causing rust, mildew, anthracnose, mosaic and others may have evolved under different selection pressures to produce different pathogenes. It is hoped that possibilities for identification of broad based multiple disease resistance indicated by the results presented in this report will stimulate many other research workers to participate in the International Cowpea Disease Nursery Program.

Cooperators in the 1974 ICDNP

The ICDNP is an informal international cooperative effort. Scientists who participated in the 1974 ICDNP are:

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