

RP/02085

**Pulse Pathology
Progress Report-10**

Pulse Pathology (Chickpea) Report of Work

(June 1979 - May 1980)



ICRISAT

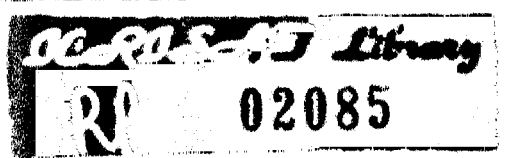
International Crops Research Institute for the Semi-Arid Tropics

ICRISAT Patancheru P.O.

Andhra Pradesh 502 324 . India

This report has been prepared to share the information with scientists having interest in chickpea improvement. This is not an official publication of the Institute and should not be cited.

YLN



PULSE PATHOLOGY SUB-PROGRAM (CHICKPEA)

STAFF

| | | |
|---------------------------|----|---|
| Dr. Y.L. Nene | .. | Leader, Pulses Improvement Program and Principal Plant Pathologist |
| Dr. M.V. Reddy | .. | Plant Pathologist S-2 |
| Dr. M.P. Haware | .. | Plant Pathologist S-2 |
| Mrs. Sheila Vijayakumar | .. | Research Technician |
| Mr. J. Narayan Rao | .. | Technical Assistant |
| Miss E. Deena | .. | Technical Assistant (From April 1979) |
| Mr. K. Prabhakar Reddy | .. | Field Assistant |
| Mr. G. Musala Reddy | .. | Field Assistant |
| Mr. A. Chandar | .. | Secretary I |
| Mr. R. Narsing Rao | .. | Stenographer |
| Mr. Mohd. Sharfuddin Khan | .. | Driver-cum-General Assistant II |
| Mr. M.M.S. Ali Baig | .. | Driver-cum-General Assistant I |

PULSE PATHOLOGY SUB-PROGRAM (CHICKPEA)

LIST OF APPROVED PROJECTS (1978-1980)

Sub-program Leader : Y. L. Nene

| No. | Title | <u>Project Scientist</u> | <u>Cooperators</u> |
|-----------|--|------------------------------|--|
| CP-Path-1 | Studies on Fusarium wilt of chickpea | M.P. Haware | J. S.C. Sethi C.L.L. Gowda O. Singh |
| CP-Path-2 | Studies on stem and root rots of chickpeas | M.P. Haware | J. S.C. Sethi C.L.L. Gowda O. Singh |
| CP-Path-3 | Studies on chickpea stunt and other viral diseases | M.V. Reddy | J.P. Verma (HAU, Hissar) J. Kumar C.L.L. Gowda O. Singh W. Reed |
| CP-Path-4 | Studies on Ascochyta blight | M.V. Reddy | O. Singh J. Kumar K.B. Singh (ICARDA) |
| CP-Path-5 | International chickpea disease nurseries | Y.L. Nene | M.P. Haware M.V. Reddy L.J.G. van der Maesen |

CONTENTS

Page Nos.

PROJECT: CP-PATH-1(78) : STUDIES ON THE FUSARIUM WILT OF CHICKPEA

| | | | |
|---|----|----|----|
| I. SUMMARY | .. | .. | 1 |
| II. INTRODUCTION | .. | .. | 1 |
| III. FIELD SCREENING FOR WILT RESISTANCE | .. | .. | 2 |
| A. Colletotrichum blight-promising lines | .. | .. | 2 |
| B. Stunt-promising lines | .. | .. | 2 |
| C. Ascochyta blight-promising lines | .. | .. | 2 |
| D. Germplasm | .. | .. | 2 |
| E. Breeders' material | .. | .. | 2 |
| IV. FURTHER STUDIES ON RACES | .. | .. | 3 |
| V. SURVIVAL OF THE WILT FUNGUS | .. | .. | 4 |
| A. Longevity | .. | .. | 4 |
| B. Longevity as influenced by depth of burial | .. | .. | 5 |
| VI. STUDIES ON INOCULUM POTENTIAL | .. | .. | 6 |
| VII. INHERITANCE STUDIES | .. | .. | 9 |
| VIII. YIELD TRIAL | .. | .. | 11 |

PROJECT: CP-PATH-2(78) : STUDIES ON STEM AND ROOT ROT OF CHICKPEA

| | |
|---|----|
| I. SUMMARY | 14 |
| II. INTRODUCTION | 14 |
| III. DRY ROOT ROT (<i>RHIZOCTONIA BATATICOLA</i>) | 15 |
| IV. SCREENING TECHNIQUE | 15 |
| 1. Multiplication of inoculum | 16 |

| | | | |
|---|----|----|----|
| 2. Raising of seedlings | .. | .. | 16 |
| 3. Inoculation | .. | .. | 16 |
| 4. Incubation | .. | .. | 16 |
| 5. Disease rating (Dry root rot) | .. | .. | 16 |
| 6. Wilt-promising lines screened against <i>R. bataticola</i> (dry root rot) | .. | .. | 17 |
| V. FIELD SCREENING | .. | .. | 17 |
| A. Wilt-promising lines from 1978-79 | .. | .. | 17 |
| B. Entries received from other locations | .. | .. | 18 |
| 1. New Delhi | .. | .. | 18 |
| 2. Kanpur | .. | .. | 18 |
| 3. Gurdaspur | .. | .. | 18 |
| 4. Badnapur | .. | .. | 18 |
| C. GIET | .. | .. | 18 |
| D. GCVT | .. | .. | 18 |
| VI. PERIODIC ISOLATIONS FROM WILTED/DRIED PLANTS COLLECTED FROM MULTIPLE DISEASE SICK PLOT | .. | .. | 19 |
| VII. SURVIVAL OF <i>SCLEROTIUM ROLFSSII</i> (COLLAR ROT PATHOGEN) IN SOIL | | | 20 |
| VIII. MISCELLANEOUS STUDIES | .. | .. | 21 |
| A. Screening against <i>Colletotrichum</i> blight | .. | .. | 21 |
| 1. Laboratory screening | .. | .. | 21 |
| 2. Field Screening | .. | .. | 22 |
| 3. Pathogenic behaviour of <i>C. dematium</i> and <i>C. capsici</i> | | | 22 |
| B. Leaf diseases | .. | .. | 23 |
| 1. <i>Botrytis</i> grey mold | .. | .. | 23 |

Page Nos.

| | |
|---------------------------|----|
| (a) Pathogenicity | 23 |
| (b) Symptoms | 23 |
| 2. Stemphyllium leaf spot | 23 |
| 3. Alternaria leaf spot | 24 |

PROJECT: CP-PATH-3(78) : STUDIES ON CHICKPEA STUNT AND OTHER
VIRAL DISEASES

| | | | |
|---|----|----|----|
| I. SUMMARY | .. | .. | 25 |
| II. INTRODUCTION | .. | .. | 26 |
| III. SCREENING NURSERY | .. | .. | 26 |
| IV. SCREENING FOR RESISTANCE | .. | .. | 26 |
| A. Germplasm | .. | .. | 26 |
| B. Advanced germplasm lines | .. | .. | 27 |
| 1. 1976-77 Selections | .. | .. | 27 |
| 2. 1977-78 Selections | .. | .. | 27 |
| 3. 1978-79 Selections | .. | .. | 28 |
| C. Crossing block entries | .. | .. | 29 |
| 1. Advanced lines | .. | .. | 29 |
| 2. Observations in 1979-80 crossing block nursery | | | 29 |
| D. Ascochyta blight-resistant lines | .. | .. | 31 |
| 1. Advanced lines | .. | .. | 31 |
| 2. Preliminary screening | .. | .. | 31 |
| E. Wilt and root rot resistant lines | .. | .. | 33 |
| 1. Advanced lines | .. | .. | 33 |
| 2. Preliminary screening | .. | .. | 33 |
| F. ICCM materials | .. | .. | 33 |

| | <u>Page Nos.</u> |
|--|------------------|
| G. GIET lines | 33 |
| H. GCVT lines | 36 |
| I. Ascochyta blight-promising lines from Gurdaspur | 36 |
| J. Multilocation testing .. | 36 |
| K. F ₂ materials | 36 |
| V. EFFECT OF PLANTING DATES | 37 |
| VI. EFFECT OF PLANT POPULATIONS | 37 |
| A. Sprayed conditions | 38 |
| B. Unsprayed conditions | 38 |
| PROJECT: CP-PATH-4(78) : STUDIES ON ASCOCHYTA BLIGHT | |
| I. SUMMARY | 41 |
| II. INTRODUCTION | 42 |
| III. SCREENING TECHNIQUE | 42 |
| IV. SCREENING FOR RESISTANCE | 42 |
| A. Kabuli germplasm | 42 |
| B. Repeat screening of germplasm | 43 |
| C. Materials from other locations | 44 |
| 1. ICARDA promising lines | 44 |
| 2. Gurdaspur promising lines | 44 |
| 3. GIET entries | 44 |
| 4. GCVT entries | 47 |
| D. Inheritance study | 47 |
| 1. Parents and F ₁ material | 47 |

| | <u>Page Nos.</u> |
|--|------------------|
| 2. F ₂ materials | 47 |
| 3. Collection of seed from resistant plants .. | 48 |
| E. Collection of new isolates | 49 |
| V. DISEASE CONTROL | 49 |
| A. Effect of fungicides on spore germination .. | 49 |
| VI. MECHANISM OF RESISTANCE | 49 |
| A. Leaf exudates | 49 |
| 1. Effect of exudates from susceptible and .. moderately resistant lines on spore germination | 51 |
| 2. Effect of different dilutions of exudates of .. susceptible and moderately resistant lines on spore germination | 51 |
| 3. pH of the exudates at different times of the day | 51 |
| 4. pH at different ages | 51 |
| B. Leaf extracts | 51 |
| C. Acid mixture | 55 |
| D. Role of yeast cells | 55 |
| VII. SEED MULTIPLICATION | 56 |
| VIII. SUMMARY OF WORK DONE AT ICARDA | 56 |
| IX. SUMMARY OF THE REPORT ON TRIPS TO ALGERIA, MOROCCO, AND TUNISIA BY DR. M.V. REDDY .. | 57 |

PROJECT: CP-PATH-5(78) : INTERNATIONAL CHICKPEA DISEASE
NURSERIES

| | |
|---------------------|----|
| I. SUMMARY | 59 |
| II. INTRODUCTION | 59 |
| III. ICRRWN 1979-80 | 60 |

| | <u>Page Nos.</u> |
|--|------------------|
| A. List of countries and cooperators | 60 |
| B. Entries .. | 63 |
| IV. TOURS .. | 64 |
| V. CONSULTANT .. | 65 |
| VI. SECOND INTERNATIONAL CHICKPEA PATHOLOGY TRAINING COURSE | • 65 |
| APPENDIX-1 .. | 68 |

PROJECT:CP-PATH-1(78): STUDIES ON THE FUSARIUM WILT OF CHICKPEA

I. SUMMARY

1. Of the 2628 additional germplasm accessions screened, 133 were found promising against the wilt by showing less than 20% mortality. These will be tested again.
2. None of the stunt-promising lines was found resistant.
3. Only one line ICC-3 was found promising against the wilt out of 19 Colletotrichum-blight-promising lines.
4. Ascochyta blight-promising line ICC-3935, was also found promising against the wilt.
5. Evidence was obtained to confirm the existence of at least 3 physiological races of *F. oxysporum* f. sp. *ciceri*.
6. The wilt fungus is able to survive up to 27 months in infected roots and stems buried in soil. It was isolated after 12 months from host tissues buried up to 24-inch depth in soil. The experiments are continuing.
7. About 3000 propagules of *F. oxysporum* f. sp. *ciceri* per gram of soil was found essential to get 100 percent mortality in the susceptible cultivar, JG-62.
8. Help was extended to breeders in the studies on inheritance of wilt resistance.
9. In a yield trial with 14 resistant cultivars and 4 check cultivars (for yield) conducted at Hyderabad, cultivars JG-74, NEC-790, and Annigeri performed well. JG-74 gave highest yield.

II. INTRODUCTION

The project became operative from January 1978 with the following objectives:

1. Study survival and spread of the pathogen (*Fusarium oxysporum* f. sp. *ciceri*),
2. Study the situation on pathogenic races, if any,
3. Further improve screening techniques, and
4. Screen germplasm/breeding material for resistance.

Work carried out during 1979-80 is reported here.

III. FIELD SCREENING FOR WILT RESISTANCE

Material was planted in a wilt-sick plot (BT-6C) in 4 meter rows, 75 cm apart. Susceptible check JG-62 was planted after every 2 test rows. Periodic observations on wilt incidence were recorded. The materials screened were:

| | |
|---------------------------------------|------|
| Colletotrichum-blight-promising lines | 19 |
| Stunt-promising lines | 6 |
| Ascochyta blight-promising lines | 141 |
| Germplasm | 2628 |

A. Colletotrichum-blight-promising lines

Of the 19 lines tested all, except ICC-3, showed more than 20% wilt.

B. Stunt-promising lines

None was promising.

C. Ascochyta blight-promising lines

Of the 141 lines tested, ICC-3935 was found promising.

D. Germplasm

The following 133 accessions showed less than 20% wilt.

ICC-154, 184, 240, 268, 301, 573, 585, 594, 647, 773, 805, 857, 859, 871, 884, 925, 933, 967, 1019, 1038, 1039, 1101, 1129, 1132, 1155, 1234, 1246, 1250, 1279, 1288, 1292, 1296, 1297, 1298, 1314, 1316, 1319, 1330, 1393, 1397, 1403, 1405, 1434, 1435, 1437, 1441, 1448, 1449, 1451, 1477, 1491, 1516, 1550, 1567, 1587, 1594, 1597, 1599, 1606, 1624, 1649, 1663, 1664, 1688, 1694, 1710, 1712, 1716, 1718, 1719, 1723, 1753, 1755, 1756, 1758, 1795, 1820, 1901, 1939, 1984, 1987, 2031, 2032, 2034, 2036, 2037, 2039, 2041, 2061, 2089, 2135, 2243, 2246, 2250, 2253, 2263, 2304, 2484, 2519, 2520, 2547, 2580, 2595, 2797, 2800, 2831, 3067, 3072, 3075, 3076, 3095, 3208, 3219, 3273, 3274, 3328, 3407, 3448, 3449, 3451, 3457, 3458, 3463, 3470, 3494, 3504, 3508, 3536, 3537, 3538, 3545, 3650, and 3768.

All these lines will be retested next year in a wilt-sick plot.

E. Breeders' material

The material from F₂ through F₉ generations was planted in a wilt-sick plot (M-5). Progenies considered superior by the pathologist had

been advanced by the breeders by individual plant selections or they were bulked. The materials screened were:

| | | |
|---|-------------------|-------------------------|
| F ₂ generation | 171 populations | |
| F ₃ generation | 1302 progeny rows | |
| F ₄ generation | 638 progeny rows | |
| F ₅ -F ₈ generation | 209 progeny rows | |
| Back cross F ₂ | 536 progeny rows | |
| F ₆ (bulk) | 36 entries | } 2 replications |
| F ₇ -F ₈ (bulk) | 31 entries | |
| F ₅ -F ₉ (bulk) | 11 entries | |
| F ₂ generation | 3989 | single plant selections |
| F ₃ generation | 653 | |
| F ₄ generation | 385 | |
| F ₅ -F ₈ generation | 93 | |
| Back cross F ₂ | 150 | |

F₆, F₇-F₈ and F₄-F₉ (bulks) will be retested. In addition 203 lines were bulked in F₃-F₈ generation.

IV. FURTHER STUDIES ON RACES

Studies during the last two years on 5 isolates *F. oxysporum* f. sp. *ciceri* collected from Hyderabad, Jabalpur, Kanpur, Hissar, and Gurdaspur provided us with the evidence that there are at least 3 physiological races of the chickpea wilt fungus (see Pulse Pathology (Chickpea) Report of Work 1978-79). The reaction of these isolates on 10 chickpea cultivars was generally consistent.

The isolates from Hyderabad, Kanpur, and Gurdaspur gave distinct reactions and were used in further study. Thirteen resistant and 2 susceptible lines (JG-62, C-104) to the Hyderabad isolate were used.

The inoculum was multiplied on sand-maize meal medium (9:1) in 250 ml flasks for 14 days. One hundred g of inoculum was mixed in a plastic pot (15-cm dia) containing 2 kg of autoclaved soil (Vertisol) sand mixture (1:1). All the plastic pots were washed in running water, dipped in 5% CuSO₄ solution and then air dried before use.

Seedlings for each cultivar were raised in autoclaved sand for a week, removed and then transplanted, 5 in each pot. Twenty seedlings were tested against each isolate. Non-inoculated checks for each cultivar were kept. Pots were irrigated with sterilized water and utmost care was taken to avoid cross contamination.

A critical look at the results in Table 1 indicates that out of 13 resistant lines at Hyderabad; BG-212, P-1265, and P-1353 were susceptible to the Kanpur isolate and P-165 showed moderate susceptibility. C-104 which is susceptible to the Hyderabad and Kanpur isolates was resistant to the Gurdaspur isolate. BG-212 and WR-315 and JG-62 were moderately susceptible to the Gurdaspur isolate; others were resistant.

These results have confirmed our earlier observations that these 3 isolates are different in their pathogenic behaviour and are distinct races.

Table 1. Reaction of chickpea cultivars to three isolates of *Fusarium oxysporum* f. sp. *ciceri*^a

| Cultivars | Reaction to isolate ¹ | | |
|-----------|----------------------------------|--------|-----------|
| | Hyderabad | Kanpur | Gurdaspur |
| JG-62 | S | S | M |
| WR-315 | R | R | M |
| C-104 | S | S | R |
| BG-212 | R | S | M |
| DA-1 | R | R | R |
| P-165 | R | M | R |
| P-289 | R | R | R |
| P-517 | R | R | R |
| P-678 | R | R | R |
| P-1265 | R | S | R |
| P-1270 | R | R | R |
| P-1353 | R | S | R |
| P-4116-1 | R | R | R |
| P-6099 | R | R | R |
| NEC-790 | R | R | R |

^aReadings were taken 60 days after inoculation (experiment was repeated); 20 seedlings for each cultivar were used.

^bR = Resistant (0-20% wilt); M = Moderately susceptible (21-50% wilt); S = Susceptible (51-100% wilt).

V. SURVIVAL OF THE WILT FUNGUS

A. Longevity

An experiment was initiated in March 1978 to find out how long *F. oxysporum* f. sp. *ciceri* survives in different plant parts of chickpea. In this experiment, roots with 5-cm stem base from naturally infected plants were buried in 45-cm pots (bottom removed) in soil. The pots themselves were buried in soil in a way that top of the pots was in level with soil surface. All the roots were weighed before burial. Four roots were carefully removed after every 3 months from the pots, dried and weighed. After washing in running water, the tissues were surface-sterilized in 2.5% sodium hypochlorite for 2 to 3 minutes and isolations were attempted. Pathogenicity was checked.

In the last year's report, we reported that the fungus could be isolated from these roots for 15 months. The isolations were con-

tinued further and the data indicated that the fungus could be isolated from disintegrating tissues even after 27 months. This indicates that the chickpea wilt fungus can survive in the soil in host tissues for more than 2 years in the absence of host. The experiment is continuing (Table 2).

The wilt fungus could be isolated from all the plant parts of chickpea. We reported (see Pulse Pathology (Chickpea) Report of Work 1978-1979) that the fungus could not be isolated from the leaflets after 2 months when stored in laboratory or buried in soil. After 12 months it could not be isolated from any part of the plant stored at room temperature but it could be isolated from stem and root tissues buried in soil even after 27 months.

Table 2. Survival of *F. oxysporum* f. sp. *ciceri* in buried roots^a

| Date of isolation | Original weight (g) | Weight at the time of isolation (g) | Isolation |
|---------------------------------|---------------------|-------------------------------------|-----------|
| 10-6-1979 (reported earlier) | 5.54 | 1.06 | + |
| | 5.42 | 1.05 | + |
| | 8.02 | 1.58 | + |
| | 8.45 | 1.48 | + |
| 10-9-1979 | 17.16 | 0.71 | + |
| | 4.20 | 0.36 | + |
| | 4.83 | 0.25 | + |
| | 2.01 | 0.15 | + |
| 10-12-1979 | 8.56 | 0.19 | + |
| | 5.82 | 0.19 | + |
| | 4.32 | 0.25 | + |
| | 2.97 | 0.80 | + |
| 10-3-1980 | 6.65 | 0.33 | + |
| | 11.33 | 0.73 | + |
| | 3.88 | 0.35 | + |
| | 3.98 | 0.20 | + |
| 10-6-1980 | 7.35 | 0.06 | + |
| | 2.19 | 0.02 | + |
| | 3.82 | 0.03 | + |
| | 3.24 | 0.06 | + |

^aRoots were buried on 10 March 1978.

B. Longevity as influenced by depth of burial

Roots from chickpea wilted plants were collected in March 1979. They were air-dried and made into small pieces of 20 to 25 mm. Each

sample consisted of 10 pieces and placed in nylon mesh after weighing. Diseased samples were kept at various depths in earthen pot (45 cm) in soil which itself was buried in soil after removal of bottom. Top of the pot was in level with soil. After every 3 months samples from one pot were assayed for chickpea wilt pathogen. The experiment is planned for 5 years.

F. oxysporum f. sp. *ciceri* could be isolated from host tissue buried up to 24" depth in soil after 12 months. Tissues buried in soil at 6" to 24" depth are disintegrating faster as compared to the tissues near the surface of the soil (Table 3).

Table 3. Survival of *F. oxysporum* f. sp. *ciceri* in host tissues buried at different depths of soil^a

| Date of isolation | | Observation | | | | |
|-------------------|---|-------------|------|------|----------------|------|
| | | Surface | 6" | 12" | 18" | 24" |
| 1-9-1979 | 1 | 2.42 | 2.68 | 2.69 | 2.36 | 2.66 |
| | 2 | 1.95 | 2.06 | 2.35 | 2.10 | 1.85 |
| | 3 | + | + | + | + | + |
| 1-12-1979 | 1 | 2.70 | 2.25 | 2.59 | 2.75 | 2.68 |
| | 2 | 1.53 | 0.96 | 1.33 | 1.38 | 0.98 |
| | 3 | + | + | + | + | + |
| 1-3-1980 | 1 | 2.71 | 2.19 | 2.55 | 2.48 | 2.32 |
| | 2 | 1.69 | 1.35 | | only in traces | |
| | 3 | + | + | + | + | + |
| 1-6-1980 | 1 | 2.58 | 2.42 | 2.34 | 2.47 | 2.49 |
| | 2 | 1.05 | 0.39 | 0.47 | only in traces | 0.12 |
| | 3 | + | + | + | + | + |

1 Original weight of root pieces

2 Weight of root pieces at the time of isolation

3 Isolation results (+ yes; - no)

^aRoots were buried in soil on 1 June 1979.

VI. STUDIES ON INOCULUM POTENTIAL

Density of inoculum distributed throughout the soil of a field having the same cropping and cultivation history will show an inoculum potential. The infectivity characteristics of such a population can be assessed by suitable sampling method. Such studies should be able to predict the disease risk that will attend the planting of a susceptible crop. There is a critical level of inoculum potential necessary for initiation of a progressive infection in a host plant. Frequent obstacle encountered by a root disease worker is the task of reproducing the disease by inoculation. The failures can be ascribed to an

inoculum potential inadequate to establish infection. Thus the information on inoculum potential in case of chickpea wilt will be useful to create the disease under artificial condition as well under natural condition in the field.

Soil was collected from the field (Vertisol) which did not have the history of chickpea plantings. To ensure further that it was free from *F. oxysporum* f. sp. *ciceri*, highly susceptible cv. JG-62 (collected from healthy plants) was sown in the soil in pot and watched for 40 days. All the plants were healthy. Seeds were treated with 2.5% sodium hypochlorite for 2 minutes.

The soil (10 kg) was filled in 30-cm earthen pots in a net-house. Inoculum grown on sand-maize meal medium for 15 days at 25°C was mixed in the soil at different rate. For each level of inoculum, 3 pots were used. Inoculum was mixed thoroughly in the soil. After 4 days soil samples were collected from the surface of each pot to determine the *Fusarium* propagules. Immediately after removing soil samples, 10 seeds of the susceptible cultivar JG-62 were sown in each pot. Final observations on wilt incidence were recorded 40 days after sowing (Table 4a).

Table 4a. Effect of the quantity of inoculum added to soil on wilt incidence in chickpea

| Inoculum added in soil (g/kg) | Propagules/g ^a of soil | Percent ^b wilt | No. of days for wilting |
|----------------------------------|--------------------------------------|------------------------------|----------------------------|
| 100.0 | 73,000 | 100 | 17 |
| 50.0 | 43,000 | 100 | 17 |
| 33.3 | 21,500 | 100 | 17 |
| 25.0 | 13,500 | 100 | 17 |
| 20.0 | 14,000 | 100 | 19 |
| 16.6 | 13,000 | 100 | 19 |
| 14.2 | 12,000 | 100 | 19 |
| 12.5 | 6,000 | 100 | 19 |
| 11.1 | 5,500 | 100 | 19 |
| 10.0 | 4,500 | 100 | 19 |
| No inoculum | 0 | 0 | - |

^aAverage of 4 replications

^bFinal observation taken 40 days after sowing

Soil was also collected from different fields of ICRISAT Center including wilt-sick plots. From each field 100 kg of soil was collected, mixed thoroughly and filled in 3 earthen pots (10 kg/pot). From these pots soil samples were taken to determine *Fusarium* propagules. The pots were then sown with JG-62 and observations on wilt incidence were recorded.

With 10 g/kg of inoculum (on SPM) added to the soil the mortality of chickpea was 100%. The number of inoculum propagules were 4500/g soil (Table 4a). This experiment was repeated twice and the mortality obtained at the lowest inoculum level (10 g/kg) in soil was complete. Therefore it was decided to conduct the experiment with lower dose of inoculum (Table 4b).

Table 4b. Effect of quantity of inoculum added to the soil on the wilt incidence in chickpea

| Inoculum added in soil (g/kg) | Propagules/gm ^a of soil | Percent ^b wilt | No. of days for wilting |
|----------------------------------|---------------------------------------|------------------------------|----------------------------|
| 25.0 | 11,000 | 100 | 14 |
| 20.0 | 10,500 | 100 | 14 |
| 16.6 | 11,000 | 100 | 20 |
| 14.2 | 8,000 | 100 | 20 |
| 12.5 | 8,500 | 100 | 20 |
| 11.1 | 6,000 | 100 | 20 |
| 10.0 | 4,500 | 100 | 20 |
| 5.0 | 4,000 | 100 | 20 |
| 2.5 | 3,000 | 100 | 20 |
| No inoculum | 0 | 0 | - |

^aAverage of 4 replications

^bFinal observation taken 40 days after sowing

These studies (Table 4b) indicated that the lower dose of inoculum (2.5 g/kg) was sufficient to cause 100% wilt in susceptible chickpea cultivar. Only the time required for wilting was 20 days against 14 days at 20 g/kg inoculum level.

The propagules of *Fusarium oxysporum* f. sp. *ciceri* in wilt-sick plots (BT-6, M-5, and B-5) ranged from 4000 to 7000/g of soil (Table 5). Our observations during early 2 to 3 years indicated that JG-62 showed 100% mortality within 30 days after planting in wilt-sick plots. In pots, 10 g of inoculum when mixed to the soil gave nearly 4,500 propagules/g of soil. At this level of inoculum, JG-62 gave 100% mortality.

These results indicate that our wilt-sick plots carry the sufficient inoculum potential (certain number of inoculum propagules) in soil, that is when susceptible cultivar like JG-62 is planted it gets killed uniformly in definite time period.

Table 5. Incidence of chickpea wilt in soil collected from different fields at ICRISAT

| Sl. No. | Field | Soil type | Crop during 1978-79 | Fusarium propagules/ g of soil | Percent wilt | No. of days for wilting |
|---------|----------|-----------|----------------------|--------------------------------|--------------|-------------------------|
| 1. | BT-6 A | Vertisol | Chickpea | 7,000 | 100 | 19 |
| 2. | BT-6 C-1 | Vertisol | Chickpea | 5,500 | 100 | 21 |
| 3. | BT-6 C-2 | Vertisol | Chickpea | 4,000 | 100 | 25 |
| 4. | M-5 A | Vertisol | Chickpea | 6,000 | 100 | 21 |
| 5. | M-5 B | Vertisol | Chickpea | 5,000 | 100 | 27 |
| 6. | B-5 A | Vertisol | Pigeonpea | 5,500 | 100 | 29 |
| 7. | B-5 B | Vertisol | Pigeonpea | 4,500 | 100 | 27 |
| 8. | BT-5 | Vertisol | Sorghum | 0 | 0 | - |
| 9. | BW-1 | Vertisol | Pigeonpea + Maize | 0 | 0 | - |
| 10. | R-2 | Alfisol | Pigeonpea | 0 | 0 | - |
| 11. | RA-9 | Alfisol | Pigeonpea | 0 | 0 | - |

Serial nos. 1-5 are wilt-sick plots

VII. INHERITANCE STUDIES

We are cooperating with ICRISAT chickpea breeders in screening the breeding material to get information on inheritance of wilt resistance. The screening is done in wilt-sick pots in a net house.

In each pot (45 cm) 10 seeds of test line were grown along with susceptible cv. JG-62. The surviving plants were allowed to grow and seed from individual plants was collected. The results are presented in Table 6 and will be interpreted by the breeders.

Table 6. Study on the inheritance of chickpea wilt resistance

| Sl. No. | Particulars | No. of plants | No. of wilted plants | Percent wilt |
|---------|---------------------------|----------------|----------------------|--------------|
| 1 | 2 | 3 | 4 | 5 |
| | <u>BC-1 F₂</u> | | | |
| | K-4 x (NEC-802 x K-4) | | | |
| 1. | Selection No. 3 | 2 | 2 | 100 |
| 2. | 5 | 7 | 7 | 100 |
| 3. | 6 | 2 | 2 | 100 |
| 4. | 7 | No germination | | |
| 5. | 8 | " | | |
| 6. | 9 | 1 | 1 | 100 |

contd.

Table 6. Contd.

| 1 | 2 | 3 | 4 | 5 |
|-----|----------------------------|----------------|---|--------|
| 7. | Selection No.10 | 1 | 1 | 100 |
| 8. | 11 | No germination | | |
| 9. | 12 | 3 | 3 | 100 |
| 10. | 13 | 2 | 2 | 100 |
| 11. | 14 | No germination | | |
| 12. | 15 | 8 | 8 | 100 |
| 13. | 17 | No germination | | . |
| 14. | 19 | 1 | 1 | 100 |
| 15. | 21 | No germination | | |
| 16. | 23 | 3 | 3 | 100 |
| 17. | 25 | No germination | | |
| 18. | 26 | 5 | 5 | 100 |
| 19. | 28 | No germination | | |
| 20. | 30 | 2 | 2 | 100 |
| 21. | 32 | 4 | 4 | 100 |
| 22. | 34 | 7 | 7 | 100 |
| 23. | 36 | 3 | 3 | 100 |
| 24. | 37 | 2 | 2 | 100 |
| 25. | 39 | 1 | 1 | 100 |
| 26. | 40 | 2 | 2 | 100 |
| 27. | 43 | 4 | 4 | 100 |
| 28. | 44 | 4 | 4 | 100 |
| 29. | 45 | 1 | 1 | 100 |
| 30. | 46 | 4 | 4 | 100 |
| 31. | 47 | No germination | | |
| 32. | 48 | 4 | 4 | 100 |
| 33. | 49 | 3 | 3 | 100 |
| | BG-203 x (BG-203 x WR-315) | | | |
| 34. | Selection No.31 | 4 | 1 | 25.00 |
| 35. | 42 | 2 | 1 | 50.00 |
| 36. | 33 | 14 | 8 | 57.14 |
| 37. | 34 | 11 | 2 | 18.18 |
| 38. | 35 | 6 | 3 | 50.00 |
| 39. | 36 | 17 | 5 | 29.41 |
| 40. | 37 | 10 | 8 | 80.00 |
| 41. | 38 | 6 | 2 | 33.33 |
| 42. | 39 | 10 | 5 | 50.00 |
| 43. | 40 | 10 | 3 | 30.00 |
| 44. | 43 | 3 | 0 | 0.00 |
| 45. | 44 | 4 | 1 | 25.00 |
| 46. | 45 | 8 | 4 | 50.00 |
| 47. | 46 | 4 | 2 | 50.00 |
| 48. | 47 | 4 | 1 | 25.00 |
| 49. | 48 | 1 | 1 | 100.00 |
| 50. | 49 | 12 | 4 | 33.33 |
| 51. | 50 | 5 | 2 | 40.00 |
| 52. | 51 | 10 | 8 | 80.00 |
| 53. | 52 | 17 | 9 | 52.94 |

contd.

Table 6. Contd.

| 1 | 2 | 3 | 4 | 5 |
|-----|---|----|----|--------|
| 54. | Selection No.54 | 11 | 3 | 27.27 |
| 55. | 55 | 6 | 5 | 83.33 |
| 56. | 56 | 13 | 2 | 15.38 |
| 57. | 57 | 8 | 1 | 12.50 |
| 58. | 58 | 17 | 8 | 47.05 |
| 59. | 60 | 8 | 2 | 25.00 |
| | <u>Parents</u> | | | |
| 60. | K-4 | 10 | 10 | 100.00 |
| 61. | NEC-802 | 10 | 4 | 40.00 |
| 62. | BG-203 | 10 | 6 | 60.00 |
| 63. | WR-315 | 10 | 1 | 10.00 |
| | <u>1977-78 diallel F₁ WR</u> | | | |
| 64. | CPS-1 x P-1353 | 5 | 2 | 40.00 |
| 65. | CPS-1 x P-6099 | 5 | 0 | 0.00 |
| 66. | CPS-1 x P-436 | 5 | 5 | 100.00 |
| 67. | P-1353 x P-6099 | 2 | 1 | 50.00 |
| 68. | P-6099 x P-436 | 8 | 8 | 100.00 |
| | <u>1977-78 diallel F₂ WR</u> | | | |
| 69. | CPS-1 x P-1353 | 88 | 44 | 50.00 |
| 70. | CPS-1 x P-6099 | 93 | 28 | 30.10 |
| 71. | CPS-1 x P-436 | 83 | 62 | 74.69 |
| 72. | P-1353 x P-6099 | 49 | 19 | 38.77 |
| 73. | P-1353 x P-436 | 81 | 61 | 75.30 |
| 74. | P-6099 x P-436 | 73 | 69 | 94.52 |
| | <u>Others</u> | | | |
| 75. | F ₁ WR-315 x P-1353 | 10 | 1 | 10.00 |
| 76. | F ₂ WR-315 x P-1353 | 65 | 26 | 40.00 |
| | <u>Parents</u> | | | |
| 77. | CPS-1 | 10 | 0 | 0.00 |
| 78. | P-1353 | 6 | 0 | 0.00 |
| 79. | P-6099 | 10 | 1 | 10.00 |
| 80. | P-436 | 9 | 9 | 100.00 |
| 81. | WR-315 | 10 | 0 | 0.00 |

VIII. YIELD TRIAL

In order to study the yield potential of wilt resistant lines, a field trial was conducted at ICRISAT Center and at Hissar sub-center with the help of breeders. Sixteen wilt resistant lines and 4 checks were included. The trial was planted in 4 replications in M-4 field. Each plot had 4 rows of 4 m length at 30 cm apart. 40 seeds were sown in each row. The results are presented in Tables 7 and 8.

Table 7. Yield testing of wilt resistant chickpea lines at Hyderabad (arranged in ascending order)

| Cultivar names | Average yield/ plot (g) | Yield/hectare (calculated) (kg) | Average yield/ plant (g) |
|------------------|----------------------------|------------------------------------|-----------------------------|
| H-208 (check) | 87.5 | 182.0 | 1.4 |
| BG-203 (check) | 192.5 | 400.4 | 1.9 |
| P-289 | 270.0 | 561.6 | 2.0 |
| P-1265 | 337.5 | 702.0 | 2.5 |
| P-165 | 360.0 | 748.8 | 2.7 |
| P-517 | 365.0 | 759.2 | 2.8 |
| P-4116-1 | 405.0 | 842.4 | 3.6 |
| BG-212 | 441.2 | 917.6 | 3.4 |
| P-678 | 447.5 | 930.8 | 3.3 |
| P-1270 | 452.5 | 941.2 | 3.4 |
| P-1353 | 460.0 | 956.8 | 3.4 |
| CPS-1 | 470.0 | 977.6 | 3.5 |
| WR-315 | 477.5 | 993.2 | 3.7 |
| BDN-9-3 (check) | 505.0 | 1050.4 | 4.3 |
| P-6099 | 512.5 | 1066.0 | 4.0 |
| NEC-790 | 601.2 | 1250.4 | 5.0 |
| Annigeri (check) | 663.7 | 1380.4 | 5.1 |
| JG-74 | 682.5 | 1419.6 | 5.2 |

| | | | |
|--|---------|---------------------|------|
| No. of treatments | 18. | No. of replications | 4 |
| Average yield of the experiment (plot) | 429.0 g | (plant) | 3.4 |
| CV% | 23.0 | | 21.1 |
| LSD (0.05) | 140.0 | | 1.0 |

Table 8. Yield testing of wilt resistant chickpea lines at Hissar (arranged in ascending order)

| Cultivar names | Average yield/ plot (g) | Yield/ha (calculated) (kg) | Cultivar names | Average yield/ plot (g) | Yield/ha (calculated) (kg) |
|----------------|----------------------------|----------------------------------|----------------|----------------------------|----------------------------------|
| P-1265 | 51.25 | 106.7 | WR-315 | 138.75 | 288.6 |
| Annigeri | 57.50 | 119.6 | JG-74 | 188.75 | 392.6 |
| BDN-9-3 | 90.00 | 187.2 | NEC-790 | 240.00 | 499.2 |
| P-517 | 95.00 | 197.6 | P-4116-1 | 246.00 | 511.6 |
| P-1270 | 105.00 | 218.4 | P-6099 | 250.00 | 520.0 |
| CPS-1 | 115.00 | 239.2 | BG-212 | 280.00 | 582.4 |
| P-165 | 130.00 | 270.4 | P-289 | 280.00 | 582.4 |
| P-1353 | 136.25 | 283.4 | H-208 | 303.75 | 631.8 |
| P-678 | 137.50 | 286.0 | BG-203 | 505.00 | 1050.4 |

| | |
|--|----------|
| Average yield of the experiment (plot) | 186.09 g |
| CV% | 61.86 |
| LSD (0.05) | 163.37 |

Of the 18 lines tested, BG-203, H-208, BDM-9-3, and Annigeri were the checks. Among the top high yielding cultivars, JG-74, and NEC-790, were the wilt resistant lines. JG-74 was the highest yielder among 18 cultivars at Hyderabad. Annigeri and JG-74 were also significantly superior over others on the basis of yield/plant. Incidentally H-208 and BG-203 were poor in yield performance (yield/plot and yield/plant).

At Hissar, BG-203 was significantly superior over other cultivars in yield performance. Low yield in general was because of the poor plant population at Hissar.

PROJECT: CP-PATH-2(78); STUDIES ON STEM AND ROOT ROTS OF CHICKPEA

I. SUMMARY

1. *Rhizoctonia bataticola*, the dry root rot fungus, survives in the soil on infected tissues for at least 24 months.

2. Blotting paper technique was developed to identify resistance to the dry root rot of chickpea. Clear differences between susceptible and resistant lines of chickpea were observed. Chickpea wilt-resistant cultivars were screened using the blotting paper technique. The infected roots were scored on 1 to 9 scale.

3. Following this technique ICC-554 and -6926 showed very little infection to roots and were considered resistant to the dry root rot.

4. Of the 168 lines tested, 39 lines showed 3 rating (slight infection) to the dry root rot.

5. During the year under report 354 wilt promising lines were sown in a multiple disease sick plot. Of these, 195 lines showed less than 10% wilt/root rots.

6. Nine entries from Kanpur were found promising. Of them PPK-1 has been included in the International Chickpea Root Rots/Wilt Nursery. GL-779 from Gurdaspur was found promising. MCK-4, 9, 10, 15, 31, 40, 43, 51, 74, and 83 from New Delhi showed less than 20% mortality in the multiple disease sick plot.

7. From the GIET entries, ICC-18, P-324, JG-2260, JG-1259 were promising. From GCVT entries, ICC-10 was found resistant.

8. The multiple disease sick plot had the following pathogens, *F. oxysporum* f. sp. *ciceri*, *Rhizoctonia bataticola*, *Sclerotium rolfsii*, *R. solani*, *F. solani* and white root rot fungus in that order.

9. Sclerotia of *Sclerotium rolfsii* (collar rot fungus) lost their viability in 3 months when buried in soil at 5 cm depth. While those stored in laboratory were viable.

II. INTRODUCTION

The project was initiated in January 1978 with the following objectives:

1. Collect more precise information on the prevalence of stem and root rots in the chickpea growing areas,
2. Study the etiology of pathogens leading to the understanding of epiphytology of these diseases, and
3. Develop efficient techniques to screen for resistance.

After the chickpea wilt, dry root rot caused by *Rhizoctonia bataticola* is widely prevalent in chickpea growing areas in the semi-arid tropics. During the year under report we have made progress in developing a laboratory screening technique for this disease and attempted to screen wilt-promising lines. For field screening we had to depend on natural incidence in the multiple disease sick plot.

The studies were also initiated on the surviving ability of sclerotia of *Sclerotium rolfsii* (the collar rot pathogen).

III. DRY ROOT ROT (*RHIZOCTONIA BATATICOLA*)

Survival of *Rhizoctonia bataticola* on host debris

Since April 1978 we were attempting the isolations of *R. bataticola* from the infected stems and roots buried in Vertisol-filled earthen pots and from the material kept in laboratory. Isolations were attempted every month starting from April 1979 on the CMR medium described by Mayer et al (Phytopathology 68: 613-620, 1973).

The composition of the medium is as follows:

| | |
|-----------------------|--------|
| Polished rice | 10 g |
| Agar | 20 g |
| Chloroneb | 300 mg |
| Mercuric chloride | 7 mg |
| Rose bengal | 90 mg |
| Streptomycin sulphate | 40 mg |
| Potassium penicillin | 60 mg |

Polished rice is boiled for 5 min in one litre water and strained through cheese cloth. Agar is added and the medium is autoclaved. The remaining ingredients are mixed after autoclaving and the pH adjusted to 6.0 with lactic acid.

The results obtained so far indicate that the fungus is able to survive in infected tissues for at least 24 months. The experiment is continuing.

IV. SCREENING TECHNIQUE

During the last two years several experiments were conducted to develop a screening technique which will be reliable and efficient in showing different degrees of resistance/susceptibility among chickpea cultivars. It was observed that high temperature (28 to 35°C) and water stress are most important factors in the disease development. Stage of plant growth (5 to 7-day-old seedlings) and use of fresh culture (5-day-old) are important in creating the disease under artificial conditions.

The following technique has been developed.

Blotting paper technique

1. Multiplication of inoculum

Inoculum is multiplied on potato-dextrose broth, 100 ml in 250 ml flasks for 5 days at 25°C. Growth of the fungus (mycelial mat) from 2 flasks is removed and blended in Waring blender for a minute with 100 ml of sterile distilled water.

2. Raising of seedlings

Seed of each test lines is surface disinfected with 2.5% solution of sodium hypochlorite (5 min) before sowing in autoclaved sand. Seedlings of 5-day-old are carefully removed from sand, washed in running water and used for inoculation. Normally 30 seedlings are inoculated for each cultivar. BG-212 and Chafa which are highly susceptible are used as checks.

3. Inoculation

Roots of the seedlings are dipped into the inoculum. The seedlings are then spread on fold-blotting paper in such a manner that roots along with cotyledons are covered. Paper towels are moistured before use.

4. Incubation

Inoculated seedlings in paper towel are then incubated at 35°C for 8 days. Paper towels are moistured daily. After 8 days of incubation seedlings are examined for the extent of root damage. The results are reported below.

5. Disease rating (Dry root rot)

We are rating the seedlings on the basis of 1-9 rating where 1 is healthy and 9 is completely rotted root. The interpretation of the scale is as follows:

- 1 - Clean root, no infection
- 3 - Infection slight, small lesions on few roots
- 5 - Infection moderate, lesions on 50 percent roots
- 7 - Infection severe, extended lesions on about 75 percent roots, shoots remain green
- 9 - Completely rotted roots, extended lesions on all roots, shoots show yellowing and drying

The wilt promising lines were screened in the laboratory using paper towel technique. The disease reaction was rated as follows.

6. Wilt-promising lines screened against *Rhizoctonia bataticola*
(Dry root rot)

2 - ICC-554, 6926

3 - ICC-444, 537, 999, 1910, 1913, 1918, 2086, 2461, 2874,
3181, 3392, 3428, 4716, 4902, 4994, 5901, 6081, 6366,
6411, 6455, 6501, 6570, 6608, 6668, 6687, 6772, 6816,
6840, 6939, 7681, 8971, 9018, 9023, 9042, 10466, 10500,
10539, 10630, 11550.

5 - ICC-338, 438, 519, 1376, 1443, 1611, 2354, 2450, 2566,
2616, 2774, 2858, 3439, 4552, 4847, 5006, 6384, 6474,
6502, 6743, 6800, 6874, 6815, 7254, 7489, 8585, 8979,
9025, 9032, 9033, 9042, 9112, 10803, 10823, 11531.

7 - 43, 202, 267, 391, 858, 1338, 1450, 2862, 2872, 2935,
2950, 4519, 4843, 4850, 6344, 6383, 6817, 6880, 7248,
8222, 8612, 8933, 8988, 9030, 9043, 10130, 10809, 11551,
11552.

9 - 229, 434, 595, 658, 867, 2089, 2354, 2616, 2660, 2803,
2883, 2917, 2943, 3058, 3117, 3354, 3513, 3528, 3531,
3533, 3539, 3782, 4485, 4994, 6098, 6381, 6385,
6386, 6411, 6440, 6488, 6491, 6494, 6671, 6680, 6711,
6730, 7254, 7336, 7481, 8166, 8446, 8454, 8499, 8622,
8980, 8982, 8985, 9006, 9021, 9028, 9032, 9034, 9035,
9036, 9039, 9040, 9041, 9055, 9103, 9117, 10104, 10394

Susceptible check BG-212 (ICC-11088)

V. FIELD SCREENING

We have developed a multiple disease sick plot wherein different soil-borne pathogens have been encouraged to build up through incorporation of dead plant debris every year. Chickpea lines found promising against the wilt were planted in multiple disease sick plot. In addition, GCVT and GIET entries were planted. This year we received the entries from New Delhi, Kanpur, and Gurdaspur which were also planted in this plot.

A. Wilt-promising lines from 1978-79

This year 354 wilt promising lines were sown in a multiple disease sick plot. They were sown in 2 rows of 4 meters. After every 2 test rows JG-62 (susceptible check) was sown. Of these, 195 lines showed less than 10% wilt and root rots. These were:

ICC-102, 104, 182, 229, 267, 338, 391, 434, 438, 444, 449, 460,
516, 519, 554, 595, 606, 658, 858, 867, 999, 1338, 1376, 1450, 1611,

1891, 1910, 1913, 1918, 2072, 2083, 2086, 2089, 2104, 2200, 2328, 2337, 2354, 2450, 2461, 2566, 2616, 2660, 2664, 2774, 2812, 2835, 2858, 2862, 2883, 2950, 3058, 3099, 3103, 3181, 3310, 3354, 3392, 3396, 3415, 3428, 3439, 3513, 3528, 3531, 3534, 3539, 3684, 3782, 4129, 4485, 4519, 4552, 4716, 4843, 4847, 4850, 4902, 4918, 4920, 4994, 5006, 5864, 5901, 6081, 6098, 6366, 6381, 6383, 6384, 6385, 6411, 6440, 6455, 6460, 6474, 6480, 6488, 6489, 6491, 6494, 6501, 6502, 6570, 6608, 6630, 6643, 6668, 6671, 6687, 6711, 6730, 6743, 6761, 6772, 6774, 6800, 6815, 6816, 6817, 6874, 6880, 6926, 6939, 7111, 7248, 7254, 7336, 7481, 7489, 7681, 8166, 8170, 8222, 8612, 8622, 8933, 8971, 8979, 8980, 8982, 8985, 8988, 8999, 9001, 9003, 9006, 9018, 9021, 9023, 9025, 9028, 9029, 9030, 9031, 9032, 9033, 9034, 9035, 9037, 9039, 9041, 9042, 9043, 9055, 9085, 9103, 9112, 9127, 10104, 10130, 10382, 10384, 10394, 10397, 10399, 10492, 10500, 10514, 10517, 10536, 10537, 10539, 10630, 10662, 10802, 10803, 10809, 10823, ICC-10, DA-1, RAVP-52, GW-9, F-496, and BG-228.

B. Entries received from other locations

1. New Delhi

Of the 100 lines received from Dr. H.K. Jain, Director, IARI, New Delhi, none was found resistant. However, MCK-4, 9, 10, 15, 31, 40, 43, 51, 74, 83 showed less than 20% wilt and root rots.

2. Kanpur

Of the 23 wilt-resistant lines (at Kanpur), KW-4, KW-5, KW-2B, KW-17B, BA-1, GW-6, GW-3-1, PPK-1, and PPK-2 showed less than 10% wilt and root rots.

3. Gurdaspur

Of the 7 lines, GL-779 showed less than 10% wilt and root rots.

4. Badnapur

Of the 9 lines received, none was found promising.

C. GIET

Of the 35 entries planted, ICC-18, P-324, JG-2260, and JG-1259 were promising.

D. GCVT

Of the 12 entries planted, only ICC-10 showed less than 10 percent mortality.

VI. PERIODIC ISOLATIONS FROM WILTED/DRIED PLANTS COLLECTED FROM MULTIPLE DISEASE SICK PLOT

To monitor the presence of different root pathogens from October through February (chickpea season at Hyderabad) we made periodic isolations from diseased plants. The results have been presented in Table 9.

Table 9. Periodic isolations from wilted/dried plants of chickpea collected from multiple disease sick plot^a

| Date of collection | <i>F. oxysporum</i> f.sp. <i>coarctata</i> | <i>R. bataticola</i> | <i>S. rolfsii</i> | <i>R. solani</i> | <i>F. solani</i> | White root rot fungus |
|--------------------|--|----------------------|-------------------|------------------|------------------|-----------------------|
| 26-11-1979 | 43.85 | 4.38 | 37.71 | 3.50 | 0.87 | - |
| 14-12-1979 | 47.60 | 24.41 | 10.46 | 4.65 | 3.48 | 5.81 |
| 4-1-1980 | 65.00 | 25.00 | - | 6.00 | 1.00 | - |
| 25-1-1980 | 60.00 | 35.00 | - | - | 3.00 | - |
| 10-2-1980 | 37.00 | 62.00 | - | - | - | - |

^aFigures are percentage of isolations

The wilt fungus *F. oxysporum* f. sp. *coarctata* was predominant all through the season except in February when the day temperature rose close to 30°C (Table 10). That time *R. bataticola* became more dominant. *S. rolfsii* (Collar rot) was very much active in the early stage of plant growth. Other pathogens present were, *R. solani*, *F. solani* and the white root rot fungus.

Table 10. Ambient temperature data from November 1979 through February 1980

| Standard week | Dates | Average temperature (°C) | | Rainfall (mm) |
|---------------|----------------------------|--------------------------|---------|---------------|
| | | Maximum | Minimum | |
| 44 | 29 October-4 November 1979 | 30.2 | 19.7 | 1.0 |
| 45 | 5 November-11 November | 29.0 | 19.8 | 61.0 |
| 46 | 12 November-18 November | 27.3 | 20.3 | 10.0 |
| 47 | 19 November-25 November | 29.7 | 17.7 | 0.4 |
| 48 | 26 November-2 December | 28.1 | 19.0 | 7.7 |
| 49 | 3 December-9 December | 27.9 | 15.2 | 0.0 |
| 50 | 10 December-16 December | 27.5 | 14.5 | 0.0 |
| 51 | 17 December-23 December | 28.2 | 17.7 | 0.0 |
| 52 | 24 December-31 December | 27.4 | 12.2 | 0.0 |
| 1 | 1 January-7 January 1980 | 28.7 | 16.4 | 0.0 |
| 2 | 8 January-14 January | 28.0 | 14.6 | 0.0 |
| 3 | 15 January-21 January | 28.4 | 13.8 | 0.0 |
| 4 | 22 January-28 January | 30.1 | 15.8 | 0.0 |
| 5 | 29 January-4 February | 30.1 | 16.0 | 0.0 |
| 6 | 5 February-11 February | 31.1 | 17.5 | 0.0 |
| 7 | 12 February-18 February | 32.0 | 17.7 | 0.0 |
| 8 | 19 February-25 February | 33.7 | 18.2 | 0.0 |
| 9 | 26 February-4 March | 35.0 | 17.7 | 4.0 |

These isolations gave us a clear picture of the performance of wilt-promising lines planted in multiple disease sick plot against at least 2 pathogens, *S. rolfsii* and *R. bataticola*.

VII. SURVIVAL OF *SCLEROTIUM ROLFSII* (COLLAR ROT PATHOGEN) IN SOIL

Sclerotium rolfsii causes the collar rot in chickpea during seedling stage with high soil moisture. The disease appears whenever the chickpea field is irrigated. The fungus forms the black, small mustard-seed-like sclerotia in culture as well as on host tissues. The sclerotial bodies are resistant and it is presumed that the fungus survival depends on these bodies. An experiment was conducted to know the ability of the fungus to survive in the soil and in laboratory through the sclerotia.

The fungus was isolated from diseased chickpea plants during December 1979 on Potato-dextrose-agar (PDA). Pathogenicity was proved by inoculating 10-day-old chickpea seedlings (JG-62) grown in plastic pots (15 cm) containing autoclaved soil. Sclerotia developed on PDA were placed at the base of the plants. Pots were watered adequately. Within 10 days after inoculation diseased plants were observed. Fungus was reisolated. It is being multiplied and maintained on PDA.

S. rolfsii was grown on PDA in petri plates for 15 days at 25°C. Sclerotia were harvested from medium, aseptically air-dried and kept in sterilized petri plates. Since sclerotia had to be buried in soil, the surface disinfection after their removal from soil was essential. For this purpose an experiment was conducted to study the effect of surface disinfectants on germination of sclerotia. Mercuric chloride solution (1:1000) and sodium hypochlorite (2.5%) were used to disinfect the sclerotia. After disinfection they were kept on PDA in petri plates and incubated at 25°C for 10 days.

There was no adverse effect on germination of sclerotia treated with mercuric chloride (1:1000) for 8 to 10 seconds and washed subsequently twice with sterilized water and sodium hypochlorite (2.5%) for 2 to 3 minutes. Also the study indicated the viability of sclerotia harvested from medium (Table 11).

Table 11. Effect of surface disinfection on the germination of sclerotia of *S. rolfsii*

| Treatment | No. of sclerotia kept on PDA | No. of sclerotia germinated | Percent germination |
|----------------------------|------------------------------|-----------------------------|---------------------|
| Mercuric chloride (1:1000) | 20 | 20 | 100 |
| Sodium hypochlorite (2.5%) | 20 | 20 | 100 |
| Sterilized water | 20 | 20 | 100 |

In our experiments we decided to use sodium hypochlorite as surface disinfectant.

Sclerotia (nearly 30) were enclosed in small nylon mesh pieces and buried in Vertisol at 5 cm depth in pots. These pots were kept open so as to expose to field conditions. One lot of sclerotia was kept at room temperature (25-28°C) in petri plates. The viability of sclerotia was tested every month (Table 12).

Table 12. Viability of *Sclerotium rolfsii* in soil and in laboratory^a

| Date of isolation | From soil | | | From laboratory | | |
|-------------------|------------------|-----------------------------|---------------------|------------------|-----------------------------|---------------------|
| | No. of sclerotia | No. of sclerotia germinated | Percent germination | No. of sclerotia | No. of sclerotia germinated | Percent germination |
| 13-4-1980 | 20 | 20 | 100 | 20 | 18 | 90 |
| 13-5-1980 | 25 | 23 | 92 | 25 | 25 | 100 |
| 13-6-1980 | 25 | 0 | 0 | 25 | 25 | 100 |

^aSclerotia were buried in soil or kept in the laboratory on 13-3-1980.

The studies indicated that sclerotia removed from soil after 3 months lost their viability while those from laboratory were viable with 100% germination on PDA.

VIII. MISCELLANEOUS STUDIES

A. Screening against Colletotrichum blight

1. Laboratory screening

Germplasm lines that were found promising under natural conditions against the *Colletotrichum* blight last year (1978-79) were tested for their reaction using Isolation Plant Propagator, as being done in case of *Ascochyta* blight.

Colletotrichum dematium isolated from chickpea at ICRISAT was used. Inoculum was multiplied on potato-dextrose-broth (PDA) (100 ml in 250 ml flask) for 15 days at 25°C. The growth from 2 flasks was mixed in 500 ml sterilized distilled water and that served as inoculum. Promising lines selected from field (with 5 rating on a 9-point scale) were grown in a plant propagator. Ten-day-old seedlings were sprayed with the inoculum and covered for 5 days with plastic covers. In addition 19 *Ascochyta* blight-promising lines were screened.

The disease developed within 4 days, killing most of the lines. Two lines which showed 1 (ICC-4925) and 5 (ICC-8923) rating on 9 point

scale after 4-day incubation period also succumbed to disease ultimately. All 19 lines resistant to *Ascochyta* blight were also susceptible. A list of susceptible lines (rating 9) is given below:

Colletotrichum blight-promising lines: ICC-3, 1611, 1903, 1909, 2223, 2267, 2619, 3032, 3230, 4925, 4939, 4948, 5035, 5098, 5107, 5119, 5127, 5165, 6213, 6261, 6319, 6671, 6743, 6805, 6819, 6901, 7287, 7359, 7722, 8284, 8542, 8920, 8923, 8927, 9150, and 10259.

Ascochyta blight-promising lines: ICC-150, 280, 377, 931, 1009, 1465, 1903, 1911, 2153, 2156, 2160, 2237, 3259, 3277, 3330, 6067, 7513, 7514, 7520, and Pb-7 (check).

2. Field screening

The Microbiology sub-program had sown 416 chickpea entries from the germplasm in Alfisol (R-2) on 31 August 1979 to study nodulation. These cultivars were evaluated during October-November for the *Colletotrichum* blight resistance.

Most of these cultivars were affected by blight during early October and disease was uniform in the field. Within 2 months after sowing most of the cultivars succumbed to disease.

There was no cultivar with 1-3 rating. Lines, ICC-341, 693, 893, 8920, and K-1170 showed a rating of 5.

3. Pathogenic behaviour of *C. dematium* and *C. oaxsi*

C. dematium and *C. oaxsi* are the two species reported to cause chickpea blight in India. *C. dematium* was isolated from infected leaves of chickpea collected at ICRISAT, Hyderabad and also from summer plantings at Taparwaripura (Kashmir) in 1978. *C. oaxsi* was isolated in 1975 from infected leaves of chickpea collected from Coimbatore. Both species were identified by the Commonwealth Mycological Institute, London.

To study their pathogenic behaviour, 3 chickpea cultivars; JG-62 Pb-7, and 850-3/27 were inoculated artificially using a Isolation Plant Propagator.

The fungi were grown separately on potato-dextrose broth (100 ml medium in 250 ml flask) for 15 days at 25°C. The growth from 2 flasks was removed and mixed in 250 ml sterilized water. The inoculum was sprayed on 10-day-old seedlings and seedlings covered with plastic tops to provide humidity. There were 5 seedlings in each pot and 5 pots were sprayed with each fungus. The reactions were recorded on a 9-point scale progressively after every 3 days (Table 13).

The experiment indicated that *C. dematium* was aggressive and killed all the seedlings in 3 cultivars within 9 days. The disease intensity in seedlings inoculated with *C. oaxsi* was low even after 12-day incubation.

Table 13. Reaction of three chickpea cultivars to two species of *Colletotrichum*

| Cultivar | <i>C. dematium</i> | | | | <i>C. oosperei</i> | | | |
|----------|--------------------|----|----|-----|--------------------|----|----|-----|
| | 3d | 6d | 9d | 12d | 3d | 6d | 9d | 12d |
| JG-62 | 5 | 7 | 9 | - | 3 | 5 | 5 | 7 |
| Pb-7 | 5 | 7 | 9 | - | 3 | 5 | 7 | 9 |
| 850-3/27 | 3 | 7 | 9 | - | - | 5 | 7 | 7 |

B. Leaf diseases

1. Botrytis grey mold

The disease is prevalent in chickpea growing areas of Uttar Pradesh and Bihar. It has also been reported from Australia.

The culture of the fungus was collected from Kanpur during a visit on 7 February 1980.

(a) Pathogenicity

The fungus was multiplied on potato-dextrose-broth at 25°C for 15 days in 250 ml flask containing 100 ml medium. The growth from one flask was blended with 100 ml sterilized water in a blender and 10-day-old seedlings (JG-62) grown in Isolation Plant Propagator were sprayed with the inoculum suspension and covered for increasing humidity.

(b) Symptoms

The symptoms on leaves were observed 2 days after inoculation. The leaflets were discoloured, discoloration started along the margin or at the tip of the leaflet. There was a dropping of terminal branch. On 5th day, the leaflets turned grey in colour. Fungal growth could be seen on infected tissues. The infection spread further to branches and main stem and rotting was evident. No definite lesions were seen. The infected portions in humid condition produced a lot of erect hairy sporophores and one-celled hyaline conidial mass.

The fungus was successfully reisolated. It is being maintained in pure culture on PDA.

2. Stemphyllium leaf spot

Stemphyllium species was isolated from the diseased chickpea leaves brought from Dholi (Bihar) during the last week of March 1980. The pathogenicity of the fungus was proved. The disease spots were identical to those observed in field. The *Stemphyllium* leaf spot is reported to be prevalent in Bihar and West Bengal.

3. Alternaria leaf spot

Another leaf blight pathogen *Alternaria alternata* was brought in pure culture from chickpea diseased specimens brought from Sehore (Madhya Pradesh). The disease was severe in December 1979 in that area. The pathogenicity of the fungus was proved. The fungus is being maintained in pure culture in the laboratory.

PROJECT:CP-PATH-3(78): STUDIES ON CHICKPEA STUNT AND OTHER
VIRAL DISEASES

I. SUMMARY

1. Work on chickpea stunt was mainly confined to screening of germplasm and breeding materials for resistance.
2. Screening was done in a plot at Hissar in the Haryana State of India, where the natural incidence of the disease is high. To enhance the natural incidence of the disease, advance planting of hosts of pea leaf-roll virus and its aphid vectors and susceptible chickpea cultivar was undertaken, to create a 'reservoir' and have 'spreader' hosts, respectively.
3. Out of a total of 1398 germplasm lines planted at Hissar by the Genetic Resources Unit of ICRISAT, 27 and 22 lines with 0-7% and 8-15% incidence, respectively were identified.
4. Of the 21 germplasm lines that were selected during 1976-77 season and tested for the past 3 years, 18 showed less than 10% infection and were considered to be highly promising.
5. Of the 22 germplasm lines that were selected during 1977-78 season and tested for the past 2 seasons, five lines showed less than 10% infection and were considered to be promising.
6. Of the 153 lines that were selected in the last season, 19 and 41 lines showed no or less than 10% infection, respectively. These will be tested further.
7. Of the 38 advanced crossing block entries which were tested last year also, 11 and 15 lines showed no and less than 10% infection, respectively and were considered promising.
8. Of 37 advanced Ascochyta blight-resistant lines, 9 and 14 lines showed no and less than 10% infection, respectively.
9. In the preliminary screening only one line out of the 37 Ascochyta blight-resistant lines tested was found promising.
10. Some of the wilt and root rot resistant lines were found promising to chickpea stunt.
11. Three ICC lines showed less than 10% infection for two seasons.
12. Nine out of 36 GIET lines tested were found to show no infection. Fourteen lines had less than 10% infection.
13. Two of the 12 GCVT lines tested showed less than 10% infection.
14. Twenty-two lines that were found promising during the last 3 seasons were sent for multilocation testing.

15. Seven F_2 populations involving resistant parents were screened and selections made.
16. Early plantings were found to develop more infection than the later plantings.
17. Low plant populations (8 plants/m²) both under sprayed and unsprayed conditions had higher disease incidence than at higher plant populations (33 and 67 plants/m²).

II. INTRODUCTION

During the year under report, work on chickpea stunt was mainly confined to the screening of germplasm lines and breeding materials for resistance. Lines that were found resistant during the last two seasons were sent for multilocation testing.

III. SCREENING NURSERY

Screening of the materials was carried out in a 0.75 ha plot at Hissar on the campus of Haryana Agricultural University in northern India. One month before planting of the test materials (15 September 1979) a mixture of the important hosts of pea leaf-roll virus (PLRV) and aphid vectors (Peas, Broadbeans, Alfalfa, Berseem, *Brassica* sp., Cowpeas, Beans, Lentil, Chickpea, Groundnut, Mungbean, Urdbean) was planted in and around the field to serve as reservoirs for both the virus and vectors. The field was ridged 0.75 m apart. The distance between two rows of 'reservoir' hosts was 9 m. Fifteen days later, WR-315, a susceptible cultivar of chickpea was planted between these rows to serve as spreader rows. Planting of the test materials was done 15 days later and WR-315 was planted after every two test rows to serve as 'indicator rows' (Fig. 1). Observations on the incidence of disease were recorded twice, first 3 months after planting and second at the time of maturity.

IV. SCREENING FOR RESISTANCE

A. Germplasm

A total of 1398 lines planted by the Genetic Resources Unit of ICRISAT at Hissar were observed for the incidence of stunt. Twenty-seven lines with 0-7% and 22 with 8-15% incidence were identified. The lines with 0-7% incidence were; ICC-614, 624, 628, 660, 827, 881, 947, 1029, 1022, 1023, 1216, 1404, 1416, 1447, 1578, 1821, 1868, 1962, 1972, 1974, 2254, 2258, 2264, 2265, 2304, 2306, and 8930. The lines with 8-15% incidence were; ICC-845, 1044, 1061, 1130, 1421, 1563, 1576, 1581, 1817, 1867, 1971, 1973, 1977, 2009, 2019, 2175, 2227, 2229, 2273, 2292, 2294, and 2307.

The seed of the above lines was collected and will be tested in the stunt screening nursery next season.

B. Advanced germplasm lines

1. 1976-77 selections

The results of screening of twenty-one lines that were selected in 1976-77 season and screened in the subsequent two seasons are presented in Table 14. One line, ICC-3133 did not show any infection. Of the remaining 20, except three, ICC-1003, -4869, and -8252 which showed more than 10% all others showed less. These lines have now been tested for 4 seasons and considered to be highly promising.

Table 14. Results of advanced screening of chickpea stunt resistant lines (1976-77 selections) to pea leaf-roll virus (stunt) at Hissar during 1979-80 season

| <u>Lines</u> | <u>Total plants</u> | <u>Infected plants</u> | <u>Percent infection</u> |
|--------------|---------------------|------------------------|--------------------------|
| ICC-1003 | 31 | 6 | 19.3 |
| -2233 | 36 | 2 | 5.5 |
| -2385 | 45 | 1 | 2.2 |
| -2430 | 44 | 3 | 6.8 |
| -2925 | 29 | 1 | 3.4 |
| -3034 | 36 | 2 | 5.5 |
| -3133 | 42 | 0 | 0.0 |
| -3718 | 34 | 3 | 8.8 |
| -3735 | 34 | 1 | 2.9 |
| -4869 | 39 | 4 | 10.2 |
| -6433 | 47 | 2 | 4.2 |
| -6934 | 41 | 3 | 7.3 |
| -8252 | 39 | 4 | 10.2 |
| -10490 | 49 | 2 | 4.0 |
| -10495 | 47 | 1 | 2.1 |
| -10508 | 46 | 1 | 2.1 |
| -10586 | 47 | 2 | 4.2 |
| -10587 | 36 | 2 | 5.5 |
| -10592 | 45 | 2 | 4.4 |
| -10594 | 50 | 3 | 6.0 |
| -10800 | 45 | 1 | 2.2 |

2. 1977-78 selections

The results of screening of 22 germplasm lines that were selected during 1977-78 season and screened in the last season also are presented in Table 15. One line, ICC-2356 did not show any infection.

Four lines, ICC-613, 2617, 7003, and 10597 showed less than 10% infection and these lines will be checked in the next season again. Others showed higher infection.

Table 15. Results of advanced screening of chickpea germplasm lines (selected in 1977-78 season) to pea leaf-roll virus (stunt) at Hissar during 1979-80 season

| <u>Lines</u> | <u>Total plants</u> | <u>Infected plants</u> | <u>Percent infection</u> |
|--------------|---------------------|------------------------|--------------------------|
| ICC-613 | 51 | 3 | 5.8 |
| -2336 | 38 | 13 | 34.2 |
| -2341 | 34 | 4 | 11.7 |
| -2352 | 35 | 10 | 28.5 |
| -2356 | 39 | 0 | 0.0 |
| -2362 | 35 | 15 | 42.8 |
| -2367 | 36 | 9 | 25.0 |
| -2369 | 38 | 6 | 15.7 |
| -2617 | 25 | 1 | 4.0 |
| -3637 | 38 | 13 | 34.2 |
| -3782 | 33 | 14 | 42.4 |
| -4094 | 45 | 10 | 22.2 |
| -6371 | 33 | 5 | 15.1 |
| -6457 | 40 | 7 | 17.5 |
| -6634 | 39 | 16 | 41.0 |
| -6896 | 38 | 9 | 23.6 |
| -7003 | 50 | 4 | 8.0 |
| -8786 | 45 | 7 | 15.5 |
| -8856 | 36 | 12 | 33.3 |
| -8867 | 35 | 12 | 34.2 |
| -8897 | 41 | 6 | 14.6 |
| -10597 | 50 | 2 | 4.0 |

3. 1978-79 selections

Screening of 153 lines was carried out. Summarised results are presented in Table 16. Nineteen lines, ICC-575, 577, 678, 690, 767, 787, 981, 1067, 1876, 1881, 2090, 2226, 2277, 2534, 2546, 2572, 2604, 2713, and 5012 did not show any infection. Forty-one lines showed 10% or less infection. These were ICC-130, 159, 248, 279, 403, 526, 539, 591, 599, 685, 705, 706, 735, 773, 774, 817, 1112, 1113, 1126, 1404, 1510, 1563, 1564, 1882, 1893, 1963, 2039, 2089, 2092, 2108, 2191, 2212, 2228, 2236, 2267, 2276, 2289, 2292, 2388, 2516, and 2521.

Table 16. Summarised results of preliminary screening of chickpea germplasm lines (selected in 1978-79 season) to pea leaf-roll virus (stunt) at Hissar during 1979-80 season

| Percent infection | | No. of lines | Percent lines |
|-------------------|-------|--------------|---------------|
| | 0.00 | 19 | 12.4 |
| 0.01 | 10.00 | 41 | 26.7 |
| 10.01 | 20.00 | 31 | 20.2 |
| 20.01 | 30.00 | 18 | 11.7 |
| 30.01 | 40.00 | 16 | 10.4 |
| 40.01 | 50.00 | 14 | 9.1 |
| 50.01 | 60.00 | 7 | 4.5 |
| 60.01 | 70.00 | 3 | 1.9 |
| 70.01 | 80.00 | 4 | 2.6 |
| 80.01 | 90.00 | 0 | 0.0 |
| 90.01 | 99.00 | 0 | 0.0 |
| 100.00 | | 0 | 0.0 |

Total lines 153

C. Crossing block entries

1. Advanced lines

The results of screening of 38 entries from the crossing block selected in 1977-78 season and screened in the last year's stunt nursery are presented in Table 17. Eleven lines, NEC-2368, E-235, RS-11, Coll.-327, P-1774, P-2202-2, P-4353-1, G-24, G-130, G-543, and Pant G-115 did not show any infection. Fifteen lines, NEC-472, NEC-550, NEC-701, NEC-746, NEC-1135, NEC-2296, BG-482, F-61, F-370, P-1072, P-1781, P-2019-1, T-3, Coll.-238, and ICC-5 showed less than 10% infection. These lines have now been tested for 3 seasons and are considered to be promising.

2. Observations in 1979-80 crossing block nursery

High natural incidence of the disease was observed in the crossing block nursery raised by the breeders. Early and spaced planting of the nursery seemed to have encouraged high natural incidence. Observations were made to identify the most susceptible and promising lines. The lines that showed high susceptibility (> 50% incidence) were Phule-G-3, Phule-G-4, Annigeri, P-9800, P-2591, Giza, No.501, C-2201, P-2530, 35168, 1400, K-1170, K-1174, K-1184, K-1189, K-1258, K-1286, K-1481, K-56567, P-9847, BDN-9-3, NEC-139, NEC-329, K-1480, Kourosh, L-534, NEC-10, NEC-694, NEC-1604, NEC-1640, NEC-1663, Caina, CPS-1 Ponaflar, and NEC-2148. The lines that showed no incidence or less than 10% infection were ICC-4, H-208, 850-3/27, 73111-8-2-B-BP x

(850-3/27 x H-208), JM-485, JM-2292, GL-629, HMS-8, HMS-10, L-559, 737B-18-5-2H-EP x (L-550 x H-208), Coll.-327, T-3, NEC-2296, NEC-2404 and No.501. These lines will be tested in the next year's screening nursery.

Table 17. Results of advanced screening of chickpea crossing block entries to pea leaf-roll virus (stunt) at Hissar during 1979-80 season

| Lines | Total plants | Infected plants | Percent infection |
|--------------------|--------------|-----------------|-------------------|
| NEC-177 | 43 | 12 | 27.9 |
| -240 | 45 | 13 | 28.8 |
| -472 | 48 | 2 | 4.1 |
| -550 | 45 | 3 | 6.6 |
| -555 | 47 | 6 | 12.7 |
| -701 | 46 | 4 | 8.6 |
| -746 | 45 | 3 | 6.6 |
| -1128 | 43 | 9 | 20.9 |
| -1135 | 46 | 1 | 2.1 |
| -2296 | 46 | 2 | 4.3 |
| -2368 | 43 | 0 | 0.0 |
| H-208 | 37 | 9 | 24.3 |
| H-556-1 | 35 | 5 | 14.2 |
| H-208 x Pant G-114 | 33 | 5 | 15.1 |
| H-556-1 | 42 | 5 | 11.9 |
| BG-203 | 35 | 4 | 11.4 |
| BG-482 | 28 | 2 | 7.1 |
| C-235 | 39 | 0 | 0.0 |
| C-104 | 37 | 5 | 13.5 |
| F-61 | 39 | 1 | 2.5 |
| F-370 | 38 | 1 | 2.6 |
| F-378 | 35 | 5 | 14.2 |
| RS-11 | 45 | 0 | 0.0 |
| K-468 | 48 | 5 | 10.4 |
| Coll.-238 | 37 | 1 | 2.7 |
| Coll.-327 | 44 | 0 | 0.0 |
| P-1092 | 39 | 2 | 5.1 |
| P-1774 | 40 | 0 | 0.0 |
| P-1781 | 34 | 2 | 5.8 |
| P-2019-1 | 40 | 1 | 2.5 |
| P-2202-2 | 41 | 0 | 0.0 |
| P-4353-1 | 36 | 0 | 0.0 |
| T-3 | 34 | 2 | 5.8 |
| G-24 | 42 | 0 | 0.0 |
| G-130 | 42 | 0 | 0.0 |
| G-543 | 35 | 0 | 0.0 |
| Pant G-115 | 37 | 0 | 0.0 |
| IOCC-5 | 43 | 3 | 6.9 |

D. Ascochyta blight resistant lines

1. Advanced lines

The results of screening of 37 lines that were found promising to *Ascochyta* blight in the propagator screening and that were screened in the last year's stunt screening nursery are presented in Table 18. Nine lines, ICC-539, 838, 1005, 1012, 1272, 1583, 1911, 4939, and 4989 did not show any infection. Fourteen lines, ICC-666, 667, 693, 954, 1003, 1006, 1024, 1202, 1283, 1407, 1504, 2294, 3330, and 4935 showed less than 10% infection. Performance of these lines needs to be confirmed for one more year.

Table 18. Results of advanced screening of chickpea *Ascochyta* blight resistant lines to pea leaf-roll virus (stunt) at Hissar during 1979-80 season

| Lines | Total plants | Infected plants | Percent infection | Lines | Total plants | Infected plants | Percent infection |
|---------|--------------|-----------------|-------------------|----------|--------------|-----------------|-------------------|
| ICC-118 | 19 | 6 | 10.6 | ICC-1149 | 16 | 5 | 31.2 |
| -272 | 18 | 5 | 27.7 | -1202 | 24 | 1 | 4.1 |
| -539 | 10 | 0 | 0.0 | -1219 | 37 | 4 | 10.8 |
| -567 | 4 | 1 | 25.0 | -1272 | 32 | 0 | 0.0 |
| -666 | 17 | 1 | 5.8 | -1283 | 26 | 2 | 7.6 |
| -667 | 38 | 1 | 2.6 | -1329 | 14 | 8 | 57.1 |
| -693 | 41 | 1 | 2.4 | -1407 | 41 | 2 | 4.8 |
| -838 | 26 | 0 | 0.0 | -1504 | 30 | 2 | 6.6 |
| -843 | 23 | 3 | 13.0 | -1583 | 8 | 0 | 0.0 |
| -903 | 27 | 4 | 14.8 | -1911 | 31 | 0 | 0.0 |
| -904 | 18 | 2 | 11.1 | -2264 | 26 | 3 | 11.5 |
| -954 | 20 | 1 | 5.0 | -2294 | 34 | 3 | 8.8 |
| -1003 | 23 | 1 | 4.3 | -3330 | 63 | 1 | 1.5 |
| -1005 | 11 | 0 | 0.0 | -4935 | 30 | 2 | 6.6 |
| -1006 | 10 | 1 | 10.0 | -4939 | 23 | 0 | 0.0 |
| -1012 | 28 | 0 | 0.0 | -4989 | 29 | 0 | 0.0 |
| -1017 | 14 | 2 | 14.2 | -6067 | 33 | 6 | 18.1 |
| -1024 | 37 | 2 | 5.4 | -7513 | 19 | 5 | 26.3 |
| -1078 | 37 | 4 | 10.8 | | | | |

2. Preliminary screening

Thirty-seven lines that were found promising to *Ascochyta* blight in the propagator screening were tested for their reaction to stunt. The results are presented in Table 19. Only one line, ICC-3587 did not show infection but the plant number was low and it needs further checking. All the other lines had more than 10% infection indicating that none of them is promising.

Table 19. Results of preliminary screening of *Ascochyta* blight-resistant lines (propagator screening) to pea leaf-roll virus (stunt) at Hissar during 1979-80 season

| Lines | Total plants | Infected plants | Percent infection |
|----------|--------------|-----------------|-------------------|
| ICC-3377 | 32 | 5 | 15.6 |
| -3378 | 20 | 13 | 65.0 |
| -3432 | 27 | 18 | 66.6 |
| -3495 | 20 | 5 | 25.0 |
| -3496 | 8 | 3 | 37.5 |
| -3497 | 16 | 8 | 50.0 |
| -3509 | 5 | 3 | 60.0 |
| -3573 | 21 | 7 | 33.3 |
| -3577 | 19 | 4 | 21.0 |
| -3578 | 18 | 11 | 61.1 |
| -3580 | 21 | 7 | 33.3 |
| -3581 | 34 | 9 | 26.4 |
| -3582 | 6 | 3 | 50.0 |
| -3585 | 10 | 2 | 20.0 |
| -3586 | 21 | 9 | 42.8 |
| -3587 | 5 | 0 | 0.0 |
| -3737 | 23 | 21 | 91.3 |
| -3738 | 28 | 9 | 32.1 |
| -3739 | 9 | 6 | 66.6 |
| -3740 | 30 | 7 | 23.3 |
| -3744 | 7 | 6 | 85.7 |
| -4751 | 9 | 2 | 22.2 |
| -4762 | 29 | 21 | 72.4 |
| -4765 | 20 | 8 | 40.0 |
| -4907 | 22 | 7 | 31.8 |
| -5252 | 18 | 4 | 22.2 |
| -6330 | 29 | 10 | 34.4 |
| -6354 | 25 | 15 | 60.0 |
| -6843 | 14 | 7 | 50.0 |
| -6856 | 19 | 8 | 42.1 |
| -7560 | 29 | 17 | 58.6 |
| -7563 | 32 | 15 | 46.8 |
| -7589 | 32 | 7 | 21.8 |
| -7611 | 22 | 8 | 36.3 |
| -7633 | 20 | 5 | 25.0 |
| -7664 | 18 | 9 | 50.0 |
| -7674 | 17 | 10 | 58.8 |

E. Wilt and root-rot resistant lines

1. Advanced lines

The results of screening of 5 of the wilt and root-rot resistant lines that showed less than 10% in the last year's screening are presented in Table 20. One line, ICC-7254 was found free from infection, but its plant number was very low and needs further checking. Another line, ICC-3426 showed less than 10% and the remaining 3 had higher infection.

Table 20. Results of advanced screening of chickpea wilt and root-rot resistant lines to pea leaf-roll virus (stunt) at Hissar during 1979-80 season

| Lines | Total plants | Infected plants | Percent infection |
|---------|--------------|-----------------|-------------------|
| ICC-391 | 23 | 6 | 26.0 |
| -1450 | 5 | 3 | 60.0 |
| -2860 | 17 | 3 | 17.6 |
| -3426 | 16 | 1 | 6.2 |
| -7254 | 3 | 0 | 0.0 |

2. Preliminary screening

The results of screening of 46 wilt and root-rot resistant lines are presented in Table 21. Two lines, ICC-516 and 1891 did not develop any infection but in both the cases the plant number was very low and therefore their performance needs further checking. Seven lines, ICC-2089, 6880, 8982, 10104, ICC-10, G-543, and GG-669 showed less than 10% infection.

F. IOCC materials

The results of screening of 9 IOCC materials are presented in Table 22. These lines were tested in the last season also and were found to show less than 10% infection. Six lines IOCC-2, 3, 5, 9, 11, and 12 had less than 10% infection in the second screening also.

G. GIET lines

The results of screening of 35 GIET lines are presented in Table 23. Nine lines, H-76-105, IOCC-19, JG-1261, IOCC-17, GNG-88, BG-402, BG-239, GG-588-2509, and GNG-84 did not show any infection. Another 14 lines had less than 10% infection.

Table 21. Results of preliminary screening of chickpea wilt and root rot resistant lines to pea leaf-roll virus (stunt) at Hissar during 1979-80 season

| <u>Lines</u> | <u>Total plants</u> | <u>Infected plants</u> | <u>Percent infection</u> |
|--------------|---------------------|------------------------|--------------------------|
| ICC-102 | 14 | 4 | 28.5 |
| -229 | 7 | 2 | 28.5 |
| -267 | 27 | 9 | 33.3 |
| -338 | 10 | 3 | 30.0 |
| -434 | 8 | 5 | 62.5 |
| -516 | 5 | 0 | 0.0 |
| -519 | 8 | 2 | 25.0 |
| -554 | 30 | 7 | 23.3 |
| -867 | 9 | 2 | 22.2 |
| -1891 | 1 | 0 | 0.0 |
| -1910 | 10 | 2 | 20.0 |
| -2072 | 6 | 6 | 100.0 |
| -2089 | 29 | 2 | 6.8 |
| -2104 | 20 | 9 | 45.0 |
| -2461 | 31 | 6 | 19.3 |
| -2566 | 10 | 5 | 50.0 |
| -2660 | 14 | 5 | 35.7 |
| -2812 | 6 | 3 | 50.0 |
| -2835 | 13 | 5 | 38.4 |
| -2883 | 13 | 2 | 15.3 |
| -3099 | 27 | 8 | 29.6 |
| -3103 | 14 | 3 | 21.4 |
| -3396 | 28 | 12 | 42.8 |
| -3439 | 17 | 6 | 35.2 |
| -2539 | 25 | 10 | 40.0 |
| -3684 | 27 | 10 | 37.0 |
| -4519 | 24 | 4 | 16.6 |
| -5864 | 24 | 13 | 54.1 |
| -5901 | 21 | 4 | 19.0 |
| -6098 | 15 | 8 | 53.3 |
| -6880 | 27 | 2 | 7.4 |
| -7111 | 22 | 5 | 22.7 |
| -7248 | 23 | 8 | 34.7 |
| -7254 | 27 | 10 | 37.0 |
| -7681 | 36 | 14 | 38.8 |
| -8933 | 32 | 18 | 56.2 |
| -8982 | 42 | 4 | 9.5 |
| -9001 | 24 | 8 | 33.3 |
| -10104 | 41 | 1 | 2.4 |
| -10394 | 40 | 10 | 25.0 |
| ICCC-10 | 38 | 2 | 5.2 |
| G-543 | 30 | 2 | 6.6 |
| GG-588 | 28 | 3 | 10.7 |
| GG-663 | 19 | 3 | 15.7 |
| GG-669 | 33 | 1 | 3.0 |
| GG-688 | 37 | 12 | 32.4 |

Table 22. Results of advanced screening of ICCO materials to pea leaf-roll virus (stunt) at Hissar during 1979-80 season

| <u>Particular</u> | <u>Total plants</u> | <u>Infected plants</u> | <u>Percent infection</u> |
|-------------------|---------------------|------------------------|--------------------------|
| ICCO-2 | 3 | 0 | 0.0 |
| -3 | 23 | 2 | 8.6 |
| -4 | 28 | 12 | 42.8 |
| -5 | 34 | 1 | 2.9 |
| -7 | 27 | 8 | 29.6 |
| -9 | 21 | 1 | 4.7 |
| -11 | 2 | 0 | 0.0 |
| -12 | 38 | 3 | 7.8 |
| -13 | 34 | 4 | 11.7 |

Table 23. Results of preliminary screening of GIET lines to pea leaf-roll virus (stunt) at Hissar during 1979-80 season

| <u>Lines</u> | <u>Total plants</u> | <u>Infected plants</u> | <u>Percent infection</u> | <u>Lines</u> | <u>Total plants</u> | <u>Infected plants</u> | <u>Percent infection</u> |
|--------------|---------------------|------------------------|--------------------------|--------------|---------------------|------------------------|--------------------------|
| H-76-105 | 24 | 0 | 0.0 | BG-403 | 16 | 2 | 12.5 |
| ICCO-14 | 28 | 1 | 3.5 | BG-234 | 14 | 1 | 7.1 |
| ICCO-15 | 30 | 1 | 3.3 | H-772 | 16 | 1 | 6.2 |
| HMS-6 | 22 | 2 | 9.0 | BG-404 | 16 | 1 | 6.2 |
| HMS-23 | 31 | 3 | 9.6 | BG-240 | 14 | 1 | 7.1 |
| JG-1258 | 22 | 1 | 4.5 | BG-402 | 18 | 0 | 0.0 |
| ICCO-19 | 26 | 0 | 0.0 | BDN-9.3 | 11 | 3 | 27.2 |
| BG-406 | 23 | 4 | 17.3 | BG-239 | 18 | 0 | 0.0 |
| BG-405 | 26 | 2 | 7.6 | BG-236 | 14 | 2 | 14.2 |
| BG-401 | 30 | 4 | 13.3 | GG-588-2509 | 13 | 0 | 0.0 |
| JG-1261 | 29 | 0 | 0.0 | BG-237 | 10 | 4 | 40.0 |
| ICCO-18 | 32 | 1 | 3.1 | GNG-15 | 14 | 5 | 35.7 |
| ICCO-16 | 31 | 5 | 16.1 | H-77-61 | 10 | 2 | 20.0 |
| BG-235 | 27 | 2 | 7.4 | P-324 | - | - | - |
| ICCO-17 | 17 | 0 | 0.0 | JG-2260 | 15 | 1 | 6.6 |
| H208 | 32 | 3 | 9.3 | GNG-84 | 16 | 0 | 0.0 |
| GNG-88 | 14 | 0 | 0.0 | JG-1259 | - | - | - |
| RSG-40 | 13 | 2 | 15.3 | | | | |

Observations not recorded.

H. GCVT lines

The results of screening of 12 GCVT lines are presented in Table 24. None of them was free from infection. Two lines; ICOC-10 and ICOC-13 had 10 or less than 10% infection. Others had more infection.

Table 24. Results of preliminary screening of GCVT lines to pea leaf-roll virus (stunt) at Hissar during 1979-80 season

| <u>Lines</u> | <u>Total plants</u> | <u>Infected plants</u> | <u>Percent infection</u> |
|--------------|---------------------|------------------------|--------------------------|
| ICOC-4 | 25 | 12 | 48.0 |
| RAV-52 | 15 | 5 | 33.3 |
| BDN-9.3 | 9 | 3 | 33.3 |
| ICOC-6 | 32 | 8 | 25.0 |
| Phule-2 | 33 | 17 | 51.5 |
| ICOC-9 | 26 | 3 | 11.5 |
| RAV-54 | 25 | 8 | 32.0 |
| ICOC-10 | 37 | 1 | 2.7 |
| BG-220 | 27 | 7 | 25.9 |
| ICOC-13 | 30 | 3 | 10.0 |
| Phule G-4 | 23 | 18 | 78.2 |
| Phule G-1 | 21 | 15 | 71.4 |

I. Ascochyta blight-promising lines from Gurdaspur

Nineteen lines that were found promising to Ascochyta blight at Gurdaspur were screened (Table 25). Four lines, C-235, G-588, G-609, and G-679 did not show any infection. Another four lines; BG-216, G-543, G-570, and GG-677 had less than 10% infection.

J. Multilocation testing

Twenty-two of the promising lines were sent to Chile, Sudan, The Netherlands (only 5), New Zealand and New Delhi, India for testing. The results from the Netherlands showed that all the 5 lines were susceptible. Results from other places are awaited.

K. F₂ materials

In collaboration with breeders, seven F₂ populations involving resistant parents were screened. Resistant and agronomically good looking plants were selected and bulked. The F₃ bulks will be tested next season.

Table 25. Results of preliminary screening of chickpea lines found promising to Ascochyta blight at Gurdaspur to pea leaf-roll virus (stunt) at Hissar during 1979-80 season

| Lines | Total plants | Infected plants | Percent infection |
|---------|--------------|-----------------|-------------------|
| BG-216 | 28 | 1 | 3.5 |
| C-235 | 32 | 0 | 0.0 |
| G-543 | 12 | 1 | 8.3 |
| G-549 | 17 | 6 | 35.2 |
| G-570 | 32 | 2 | 6.2 |
| GG-575 | 28 | 4 | 14.2 |
| GG-578 | 31 | 8 | 25.8 |
| GG-580 | 28 | 4 | 14.2 |
| GG-588 | 26 | 0 | 0.0 |
| GG-589 | 36 | 6 | 16.6 |
| GG-609 | 31 | 0 | 0.0 |
| GG-612 | 19 | 2 | 10.5 |
| GG-677 | 26 | 1 | 3.8 |
| GG-679 | 30 | 0 | 0.0 |
| GG-684 | 27 | 19 | 70.3 |
| GG-685 | 25 | 12 | 48.0 |
| GG-686 | 16 | 5 | 31.2 |
| H-75-35 | 26 | 3 | 11.5 |
| IOCC-11 | 7 | 2 | 28.5 |

V. EFFECT OF PLANTING DATES

Experiment to find out the effect of planting date on the disease incidence was continued for the third year. The planting dates were 20-9-1979, 30-9-1979, 15-10-1979, 30-10-1979, 15-11-1979, and 30-11-1979. Experimental design was RBD with 3 replications. The cultivar used was WR-315 and the plot had five five-meter rows.

Observations in the first week of February indicated higher disease incidence in the earlier dates of planting compared to later dates. Final observations could not be relied because of general drying of the plants due to some soil problem that affected the stands.

VI. EFFECT OF PLANT POPULATIONS

In an experiment conducted in collaboration with Physiology and Entomology Subprograms, the effect of plant population on the incidence of disease in 3 cultivars varying in the degree of susceptibility was studied both under sprayed and unsprayed conditions. The number of plants per m² studied were 8, 33, and 67 and the cultivars were G-130, 850-3/27 and WR-15. The design was split plot with 4 replications. Final observations were recorded at the time of maturity.

A. Sprayed conditions

The results are presented in Table 26. The disease incidence was more in low plant population (8 plants/m²) in all the three cultivars when compared to higher populations (33 out of 67 plants/m²). The differences among the varieties were negligible.

B. Unsprayed conditions

The results are presented in Table 27. The results were similar as under sprayed conditions.

Table 26. Effect of plant population on the incidence of pea leaf-roll virus (stunt) in chickpea under insecticide spray conditions (1979-80, Hissar)

| Cultivar | Spacing (plants/m ²) | Total plants | | | | Infected plants | | | | Percent infection | | | | |
|----------|-------------------------------------|--------------|-----|-----|-----|-----------------|----|----|----|-------------------|-----|------|------|------|
| | | R1 | R2 | R3 | R4 | R1 | R2 | R3 | R4 | R1 | R2 | R3 | R4 | Mean |
| G-130 | 8 | 124 | 156 | 162 | 152 | 21 | 14 | 15 | 12 | 16.9 | 8.9 | 9.2 | 7.8 | 10.7 |
| | 33 | 631 | 554 | 843 | 542 | 13 | 7 | 4 | 72 | 2.0 | 1.2 | 0.4 | 4.0 | 1.9 |
| | 67 | 996 | 882 | 956 | 887 | 13 | 24 | 0 | 15 | 1.3 | 2.7 | 0.0 | 1.6 | 1.4 |
| 850-3/27 | 8 | 152 | 162 | 189 | 145 | 19 | 13 | 20 | 7 | 12.5 | 8.0 | 10.5 | 4.8 | 8.9 |
| | 33 | 524 | 568 | 565 | 518 | 20 | 16 | 6 | 19 | 3.8 | 2.8 | 1.0 | 3.6 | 2.8 |
| | 67 | 600 | 604 | 612 | 504 | 32 | 16 | 8 | 13 | 5.3 | 2.6 | 1.3 | 2.5 | 2.9 |
| WR-315 | 8 | 147 | 151 | 197 | 164 | 17 | 8 | 23 | 17 | 11.5 | 5.3 | 11.6 | 10.3 | 9.7 |
| | 33 | 641 | 603 | 558 | 504 | 11 | 6 | 15 | 16 | 1.7 | 1.0 | 2.6 | 3.1 | 2.1 |
| | 67 | 886 | 762 | 801 | 572 | 5 | 26 | 15 | 11 | 0.5 | 3.4 | 1.8 | 1.9 | 1.9 |

Table 27. Effect of plant population on the incidence of pea leaf-roll virus (stunt) in chickpea under unsprayed conditions (1979-80, Hissar)

| Cultivar | Spacing (plants/m ²) | Total plants | | | | Infected plants | | | | Percent infection | | | | |
|----------|-------------------------------------|--------------|------|------|------|-----------------|----|----|----|-------------------|------|-----|-----|------|
| | | R1 | R2 | R3 | R4 | R1 | R2 | R3 | R4 | R1 | R2 | R3 | R4 | Mean |
| G-130 | 8 | 271 | 278 | 289 | 284 | 12 | 28 | 8 | 26 | 4.4 | 10.0 | 2.7 | 9.1 | 6.6 |
| | 37 | 1081 | 1198 | 1070 | 858 | 29 | 31 | 20 | 9 | 2.6 | 2.5 | 1.8 | 1.5 | 2.0 |
| | 67 | 1514 | 1340 | 1460 | 1013 | 10 | 22 | 12 | 7 | 0.6 | 1.6 | 0.8 | 0.6 | 0.9 |
| 850-3/27 | 8 | 278 | 290 | 241 | 235 | 29 | 12 | 18 | 6 | 10.4 | 4.1 | 7.4 | 2.5 | 6.1 |
| | 33 | 998 | 1148 | 1095 | 889 | 55 | 60 | 22 | 10 | 5.5 | 5.2 | 2.0 | 1.1 | 3.4 |
| | 67 | 1711 | 860 | 1290 | 1069 | 14 | 32 | 30 | 6 | 0.8 | 3.7 | 2.3 | 0.5 | 1.8 |
| WR-315 | 8 | 268 | 286 | 300 | 273 | 17 | 14 | 19 | 5 | 6.3 | 4.9 | 6.3 | 1.8 | 4.8 |
| | 33 | 1084 | 1118 | 1145 | 802 | 12 | 22 | 21 | 16 | 1.1 | 1.9 | 1.8 | 2.0 | 1.7 |
| | 67 | 1455 | 1190 | 1347 | 1279 | 49 | 14 | 22 | 9 | 3.3 | 1.1 | 1.6 | 0.7 | 1.7 |

PROJECT:CP-PATH-4(78); STUDIES ON ASCOCHYTA BLIGHT

I. SUMMARY

1. Work at ICRISAT Center was mainly confined to screening of the kabuli germplasm lines in Isolation Plant Propagators. At ICARDA Center, Aleppo, Syria, extensive field screening of germplasm and breeding materials was carried out.
2. A total of 743 additional kabuli germplasm lines were screened and 116 lines showing 5 or less rating were identified.
3. Of the 195 lines that showed 5 or less rating in the last year's screening, 104 lines showed consistent reaction in a repeat screening.
4. None of the 7 desi germplasm lines that were found resistant at ICARDA Center, Syria, was found resistant to the IARI-isolate of the blight fungus indicating the possibility that the two isolates are different.
5. None of 19 lines that were found promising under natural conditions at Gurdaspur in Punjab state of India was found resistant to the IARI-isolate of the fungus indicating the possibility that the two is-lates are different.
6. None of the 47 GIET and GCVT entries tested was found promising.
7. Some F₁ and F₂ materials involving resistant lines were screened to help the breeders in understanding the inheritance of resistance.
8. Of the five fungicides tested Dihane M-45 and Difolatan completely inhibited spore germination *in vitro* tests.
9. No difference was found in the germination of spores of *Ascochyta rabiei* in exudates of susceptible and some moderately resistant lines. There was also not much difference in the exudate pH. The pH of the exudates was lower at one month age compared to early stages.
10. There was no difference in the germination of spores of *A. rabiei* in the extracts of susceptible and moderately resistant lines tested.
11. Germination of spores of *A. rabiei* at higher concentration of a mixture of organic acids (1.3%) consisting of malic acid, oxalic acid and citric acid was inhibited.
12. Yeast cells in leaf exudates seemed to inhibit spore germination by increasing the pH of the exudates.

13. Seed of 56 promising lines was multiplied for multilocation test through the Chickpea International Ascochyta Blight Nursery (CIABN) as well as for supplying to cooperators.
14. A large number of germplasm lines and breeding materials was screened at ICARDA and several promising materials were identified.
15. Ascochyta blight and pea leaf-roll virus were found to be the major disease problems of chickpea in Algeria, Morocco, and Tunisia.

II. INTRODUCTION

Work on Ascochyta blight at ICRISAT Center was mainly confined to screening of kabuli germplasm in Isolation Plant Propagators. Lines received from other locations were also tested. The role of leaf exudates in disease resistance was further studied. Extensive field screening of germplasm and breeding materials was carried out at ICARDA Center, Aleppo, Syria.

III. SCREENING TECHNIQUE

As in the previous years, screening was carried out using Isolation Plant Propagators. In the preliminary screening for each germplasm entry, 10 seeds were planted in a single pot and were inoculated with spore suspension (IARI-isolate, 40,000 spores/ml) when the seedlings were 10-15 days old. Observations on incubation period, percent plants infected and killed were recorded. The disease severity was scored on a 9-point scale two times; first 10 days after inoculation and second 10 days later (recovery rating). The lines that showed 5-rating and less were rescreened with a larger plant population for confirmation. With each lot of screening, a susceptible check (Pb-7) was included.

IV. SCREENING FOR RESISTANCE

A. Kabuli germplasm

Screening of the additional germplasm lines was continued to identify additional promising lines. A total of 743 lines was screened. The summary of results indicating the percent of lines in each category of the scale used are presented in Table 28. Only one line; ICC-8078 showed a rating of 1. Sixteen lines; ICC-8030, 8084, 8085, 8086, 8131, 8463, 8820, 8821, 9147, 9149, 9150, 9258, 9278, 9284, 9367, and 9402 showed a rating of 3.

Additional 16 lines; ICC-9198, 9202, 9203, 924-, 9251, 9252, 9253, 9259, 9260, 9275, 9277, 9285, 9288, 9369, 9374, and 9403 showed a rating of 4. A total of 83 lines showed a 5-rating. These were ICC-7904, 7907, 7909, 7926, 7928, 7932, 7966, 79993, 8007, 8011, 8029, 8042, 8043,

8050, 8062, 8067, 8071, 8072, 8076, 8087, 8088, 8089, 8090, 8091, 8092, 8093, 8094, 8095, 8096, 8097, 8098, 8099, 8127, 8132, 8134, 8137, 8148, 8175, 8203, 8205, 8206, 8207, 8210, 8223, 8286, 8507, 8678, 8818, 8819, 8822, 8823, 8913, 8914, 8915, 8920, 8925, 8926, 8927, 8929, 8934, 8935, 8942, 8945, 8949, 8952, 8957, 8960, 9142, 9143, 9146, 9211, 9245, 9254, 9255, 9256, 9264, 9265, 9283, 9319, 9326, 9368, 9379, and 9394. Others showed 6 or higher rating. Lines with 5 or less rating will be rechecked.

B. Repeat screening of germplasm

A total of 195 germplasm lines that showed 5 or less rating in the last year's propagator screening were tested again. The summarised results are presented in Table 29. A total of 104 lines showed 5 or less rating. One line, ICC-3582, showed 1-rating. Two lines, ICC-3698 and 3724 showed 2-rating. Sixteen lines, ICC-3141, 3296, 3346, 3377, 3576, 3578, 3585, 3586, 3597, 3599, 3916, 3917, 6840, 6843, 6847, and 7676 showed 3-rating.

A total of 43 and 42 lines showed 4 and 5 ratings, respectively. The lines that showed 4-rating were ICC-3252, 3269, 3270, 3304, 3334, 3376, 3378, 3386, 3387, 3573, 3577, 3581, 3589, 3592, 3594, 3598, 3606, 3634, 3737, 3915, 3918, 3919, 4826, 4827, 4855, 4856, 4857, 4861, 4864, 5124, 6045, 6314, 6354, 6887, 6888, 7559, 7562, 7567, 7589, 7592, 7609, 7655, and 7773.

The lines that showed 5-rating were; ICC-3102, 3254, 3259, 3268, 3394, 3509, 3580, 3593, 3725, 3738, 3854, 3855, 3927, 4784, 4785, 4787, 4882, 4899, 5046, 5106, 5119, 5122, 5123, 6235, 6312, 6345, 6837, 6838, 7198, 7198, 7212, 7243, 7246, 7249, 7251, 7287, 7359, 7353, 7633, 7638, 7653, 7668, and 7718.

Table 28. Summarised results of screening of chickpea kabuli germplasm lines for resistance to *Ascochyta* blight in Isolation Plant Propagators at ICRISAT during 1979-80

| Rating on 9-point scale | No. of entries | Percent entries |
|----------------------------|-------------------|--------------------|
| 1 | 1 | 0.1 |
| 2 | 0 | 0.0 |
| 3 | 16 | 2.1 |
| 4 | 16 | 2.1 |
| 5 | 83 | 11.1 |
| 6 | 16 | 2.1 |
| 7 | 468 | 62.9 |
| 8 | 38 | 5.1 |
| 9 | 104 | 13.9 |
| | <hr/> | |
| Total | 743 | |

Table 29. Summarised results of the repeat screening of chickpea germplasm lines for resistance to *Ascochyta* blight in Isolation Plant Propagators at ICRISAT during 1979-80

| <u>Rating on 9-point scale</u> | <u>No. of entries</u> | <u>Percent entries</u> |
|--------------------------------|-----------------------|------------------------|
| 1 | 1 | 0.5 |
| 2 | 2 | 1.0 |
| 3 | 16 | 8.2 |
| 4 | 43 | 22.0 |
| 5 | 42 | 21.5 |
| 6 | 43 | 22.0 |
| 7 | 34 | 17.4 |
| 8 | 9 | 4.6 |
| 9 | 5 | 2.5 |
| | Total | 195 |

C. Materials from other locations

Materials received from ICARDA and the Indian National Programs were tested for their resistance to *Ascochyta* blight.

1. ICARDA promising lines

Seven Desi germplasm lines that were found resistant at ICARDA during 1978-79 screening were tested against the IARI-isolate. The results are presented in Table 30. Except ICC-5889 which showed a rating of 6, all others showed 8 or 9 rating. These results suggest that there may be different races of *A. rabiei*.

2. Gurdaspur promising lines

Nineteen lines sent by Dr. Gurdip Singh of Punjab Agricultural University, Ludhiana, India, were screened. These were found promising against the blight at Gurdaspur in Punjab under natural conditions during 1978-79 season. The results are presented in Table 31. All the lines showed a rating of 7. The difference in the reaction to the two isolates may be again due to difference in the race situation.

3. GIET entries

A total of 35 entries included in the Gram Initial Evaluation Trial (GIET) were screened. The results are presented in Table 32. None of them was found promising. All showed 6 or higher rating.

Table 30. Results of propagator screening of lines found promising at Syria

| S.No. | ICC No. | Total plants | Percent infection | Percent killed | Rating on 9-point scale | |
|-------|---------|--------------|-------------------|----------------|----------------------------|--|
| | | | | | 10th day after inoculation | 20th day after inoculation (Recovery rating) |
| 1. | 1256 | 48 | 100.0 | 0.0 | 8 | 8 |
| 2. | 2459 | 43 | 95.3 | 16.2 | 6 | 8 |
| 3. | 4111 | 59 | 0.0 | 0.0 | 9 | 9 |
| 4. | 4112 | 51 | 0.0 | 0.0 | 7 | 8 |
| 5. | 4113 | 56 | 0.0 | 0.0 | 7 | 8 |
| 6. | 5889 | 33 | 96.9 | 21.2 | 5 | 6 |
| 7. | 8227 | 47 | 0.0 | 0.0 | 7 | 8 |

Table 31. Results of screening of chickpea lines found resistant to blight at Gurdaspur (India) to IARI-isolate in Isolation Plant Propagator at ICRISAT, Hyderabad (1979-80)

| S.No. | Particular | Total plants | Percent infection | Percent killed | Rating on 9-point scale | |
|-------|------------|--------------|-------------------|----------------|----------------------------|----------------------------|
| | | | | | 15th day after inoculation | 20th day after inoculation |
| 1. | BG-216 | 22 | 95.4 | 0.0 | 4 | 7 |
| 2. | G-235 | 21 | 100.0 | 0.0 | 5 | 7 |
| 3. | G-543 | 18 | 100.0 | 0.0 | 4 | 7 |
| 4. | G-549 | 25 | 100.0 | 0.0 | 5 | 7 |
| 5. | GG-570 | 19 | 100.0 | 0.0 | 4 | 7 |
| 6. | GG-575 | 21 | 100.0 | 0.0 | 5 | 7 |
| 7. | GG-578 | 22 | 100.0 | 0.0 | 5 | 7 |
| 8. | GG-580 | 23 | 95.6 | 0.0 | 4 | 7 |
| 9. | GG-588 | 22 | 100.0 | 0.0 | 5 | 7 |
| 10. | GG-589 | 22 | 100.0 | 0.0 | 5 | 7 |
| 11. | GG-609 | 20 | 100.0 | 0.0 | 5 | 7 |
| 12. | GG-612 | 22 | 100.0 | 4.5 | 5 | 7 |
| 13. | GG-677 | 20 | 100.0 | 0.0 | 5 | 7 |
| 14. | GG-679 | 19 | 100.0 | 0.0 | 5 | 7 |
| 15. | GG-684 | 24 | 100.0 | 0.0 | 5 | 7 |
| 16. | GG-685 | 19 | 100.0 | 0.0 | 5 | 7 |
| 17. | GG-686 | 20 | 80.0 | 0.0 | 4 | 7 |
| 18. | H-75-35 | 20 | 90.0 | 0.0 | 4 | 7 |
| 19. | ICCC-11 | 18 | 100.0 | 0.0 | 5 | 7 |

Table 32. Results of screening of GIET entries to *Ascochyta* blight in Isolation Plant Propagator at ICRISAT during 1979-80

| Sl. No. | Particular | Total plants | Percent infection | Percent killed | Rating on 9-point scale | |
|---------|--------------|--------------|-------------------|----------------|----------------------------|--|
| | | | | | 10th day after inoculation | 20th day after inoculation (Recovery rating) |
| 1. | BG-240 | 16 | 100.0 | 93.7 | 9 | 9 |
| 2. | BG-404 | 34 | 100.0 | 97.0 | 8 | 9 |
| 3. | H-772 | 28 | 100.0 | 85.7 | 8 | 8 |
| 4. | ICCC-17 | 34 | 100.0 | 67.6 | 9 | 7 |
| 5. | BG-235 | 27 | 100.0 | 92.5 | 8 | 8 |
| 6. | ICCC-16 | 31 | 100.0 | 93.5 | 9 | 9 |
| 7. | ICCC-18 | 15 | 100.0 | 93.3 | 9 | 9 |
| 8. | P-324 | 25 | 100.0 | 96.0 | 9 | 9 |
| 9. | BG-236 | 29 | 100.0 | 86.2 | 8 | 9 |
| 10. | H-77-61 | 40 | 100.0 | 95.0 | 8 | 9 |
| 11. | GNG-15 | 24 | 100.0 | 87.5 | 9 | 8 |
| 12. | BG-237 | 33 | 100.0 | 0.0 | 8 | 6 |
| 13. | GG-588-2509 | 28 | 100.0 | 32.1 | 7 | 7 |
| 14. | ICCC-14 | 15 | 100.0 | 100.0 | 9 | 9 |
| 15. | H-208 | 29 | 100.0 | 100.0 | 9 | 9 |
| 16. | BG-406 | 33 | 100.0 | 90.9 | 9 | 9 |
| 17. | ICCC-19 | 5 | 100.0 | 60.0 | 9 | 9 |
| 18. | BG-402 | 33 | 100.0 | 93.9 | 9 | 9 |
| 19. | JG-2260 | 25 | 100.0 | 84.0 | 9 | 8 |
| 20. | GNG-84 | 31 | 100.0 | 96.7 | 9 | 9 |
| 21. | JG-1259 | 25 | 100.0 | 96.0 | 9 | 9 |
| 22. | RSG-40 | 29 | 100.0 | 96.5 | 8 | 9 |
| 23. | BG-239 | 27 | 100.0 | 62.9 | 9 | 8 |
| 24. | GNG-88 | 31 | 100.0 | 74.1 | 9 | 8 |
| 25. | ICCC-15 | 30 | 100.0 | 73.3 | 9 | 8 |
| 26. | HMS-6 | 19 | 100.0 | 78.9 | 6 | 8 |
| 27. | HMS-23 | 32 | 100.0 | 34.3 | 7 | 8 |
| 28. | JG-1258 | 27 | 100.0 | 70.3 | 7 | 7 |
| 29. | H-76-105 | 23 | 100.0 | 56.5 | 7 | 7 |
| 30. | BDN-9-3 | 35 | 100.0 | 85.7 | 9 | 9 |
| 31. | JG-1261 | 31 | 100.0 | 80.6 | 9 | 8 |
| 32. | BG-401 | 25 | 100.0 | 12.0 | 7 | 6 |
| 33. | BG-234 | 26 | 100.0 | 7.6 | 7 | 7 |
| 34. | BG-403 | 29 | 100.0 | 48.2 | 7 | 7 |
| 35. | BG-405 | 31 | 100.0 | 45.1 | 7 | 6 |
| 36. | Pb-7 (check) | 35 | 100.0 | 62.8 | 9 | 8 |

4. GCVT entries

Twelve entries involved in the Gram Coordinated Varietal Trial (GCVT) were screened. The results are presented in Table 33. None of them was found promising. All showed 7 or more rating.

Table 33. Results of screening of GCVT entries to *Ascochyta* blight in Isolation Plant Propagator at ICRISAT during 1979-80

| Particular | Total plants | Percent infection | Percent killed | Rating on 9-point scale | |
|------------|--------------|-------------------|----------------|----------------------------|---|
| | | | | 10th day after inoculation | 20th day after inoculation ^a |
| ICCC-6 | 12 | 100.0 | 91.6 | 8 | 8 |
| BDN-9-3 | 34 | 100.0 | 88.2 | 9 | 7 |
| RAV-52 | 42 | 100.0 | 100.0 | 9 | 9 |
| ICCC-4 | 36 | 100.0 | 100.0 | 8 | 9 |
| Phule G-1 | 36 | 100.0 | 52.7 | 7 | 7 |
| Phule G-4 | 40 | 100.0 | 75.0 | 8 | 8 |
| ICCC-13 | 35 | 100.0 | 82.8 | 9 | 8 |
| BG-220 | 29 | 100.0 | 100.0 | 9 | 9 |
| ICCC-10 | 32 | 100.0 | 100.0 | 9 | 9 |
| RAV-54 | 22 | 100.0 | 100.0 | 9 | 9 |
| ICCC-9 | 25 | 100.0 | 92.0 | 9 | 9 |
| Phule-2 | 32 | 100.0 | 96.8 | 9 | 9 |

D. Inheritance study

The study was carried out in collaboration with chickpea breeding subprogram (Dr. Jagdish Kumar). In all 4 F_1 s and F_2 s involving one moderately resistant (ICC-1903), one tolerant (Pant G-114) and two susceptible parents (BG-203 and P-690) were tested

1. Parents and F_1 material

The results of screening of the 4 parents and F_1 s are presented in Table 34. The F_1 s between resistant and susceptible parents remained resistant. The F_1 between the tolerant and susceptible parents remained tolerant. The F_1 between susceptible parents showed susceptibility. The results were passed on to Dr. Jagdish Kumar for further interpretations.

2. F_2 materials

The results of screening of the F_2 populations are presented in Table 35. The experiment was repeated using the crosses between the moderately resistant parent and similar results were obtained. The results were handed over to Dr. Jagdish Kumar.

Table 34. Results of screening of some chickpea parental lines and F₁s to IARI-isolate of *A. rabiei* in Isolation Plant Propagator at ICRISAT (1979-80)

| Particular | Total plants | Percent infection | Percent killed | Rating on 9-point scale |
|-----------------------|--------------|-------------------|----------------|----------------------------|
| <u>Parents</u> | | | | |
| Pant G-114 | 9 | 100.0 | 0.0 | 5 - Tolerant |
| ICC-1903 | 10 | 100.0 | 0.0 | 3-5 - Moderately resistant |
| BG-203 | 9 | 100.0 | 0.0 | 7 - Moderately susceptible |
| P-690 | 9 | 100.0 | 0.0 | 7 - " |
| <u>F₁s</u> | | | | |
| ICC-1903 x BG-203 | 10 | 90.0 | 0.0 | 3 |
| P-690 x Pant G-114 | 10 | 90.0 | 0.0 | 5 |
| ICC-1903 x Pant G-114 | 10 | 70.0 | 0.0 | 3 |
| P-690 x BG-203 | 9 | 88.8 | 0.0 | 7 |

Table 35. Results of screening of some F₂ chickpea materials to IARI-isolate of *Ascochyta rabiei* in Isolation Plant Propagators at ICRISAT (1979-80)

| S.No. | Cross | Total plants | No. of plants with a rating of | | | | |
|-------|-----------------------|--------------|--------------------------------|----|----|----|---|
| | | | 1 | 3 | 5 | 7 | 9 |
| 1. | ICC-1903 x BG-203 | 181 | 26 | 79 | 25 | 46 | 5 |
| 2. | P-690 x Pant G-114 | 92 | 2 | 41 | 25 | 24 | 0 |
| 3. | ICC-1903 x Pant G-114 | 208 | 15 | 75 | 49 | 65 | 4 |
| 4. | P-690 x BG-203 | 84 | 0 | 0 | 10 | 61 | 3 |

3. Collection of seed from resistant plants

Seedlings showing 5 or less rating from the crosses involving moderately resistant and tolerant parents were transplanted into bigger pots for collection of seed. Seeds from plants with 1, 3, and 5 ratings in each cross were collected separately, bulked and handed over to breeders for further advancement.

E. Collection of new isolates

Isolations were made from blight infected chickpea samples collected from Hissar, Haryana state of India and pure cultures of *Ascochyta rabiei* were obtained. The cultures were found to be pathogenic and were preserved for future use.

V. DISEASE CONTROL

As a follow up of last year's fungicide spray experiment in plant propagator, the effect of 5 fungicides on spore germination of *A. rabiei* *in vitro* was studied.

A. Effect of fungicides on spore germination

Five fungicides; Bavistin, Benlate, Dithane M-45, Difolatan and Daconil were used at three concentrations; 0.1, 0.2 and 0.3%. To one drop of spore suspension (16-day-old culture) one drop of fungicide suspension was added in cavity slides which were placed in petri plates with moist filter paper. The plates were incubated at 24°C and observations were recorded after 24 hrs. The results are presented in Table 36 (repeated 4 times).

When compared to control all the five fungicides tested significantly inhibited spore germination at all the concentrations. Inhibition increased with the increase in the concentration. Two fungicides Dithane M-45 and Difolatan completely inhibited spore germination at all the concentrations tested. Bavistin was least effective. Benlate and Daconil gave complete inhibition at 0.2 and 0.3% concentrations.

VI. MECHANISM OF RESISTANCE

Studies on the role of leaf exudates and extracts in resistance in chickpeas was further explored. The effect of exudates and extracts from susceptible and some moderately resistant lines on spore germination was studied. The pH of the exudates of different lines was also studied.

A. Leaf exudates

Exudates were prepared by shaking one gram of leaf tissue collected early morning in 1 ml of sterile distilled water (standard). The suspension was given a low speed of 3000 rpm for 5 minutes to remove the dust particles. Effect of the exudates on spore germination was studied using cavity slides placed in petri plates with moist filter paper (24°C). Observations on spore germination were recorded after 24 hrs.

Table 36. Effect of different fungicides on conidial germination of *Ascochyta rabiei*, in vitro^a

| Fungicide | Concentration | No. of conidia observed | | | | No. of conidia germinated ^b | | | | Percent germination | | | | Average percent- age |
|--------------|---------------|-------------------------|-----|-----|-----|--|----|----|----|---------------------|------|------|------|-------------------------|
| | | R1 | R2 | R3 | R4 | R1 | R2 | R3 | R4 | R1 | R2 | R3 | R4 | |
| | | | | | | | | | | | | | | |
| Bavistin | 0.1 | 100 | 100 | 100 | - | 34 | 40 | 35 | - | 34.0 | 40.0 | 35.0 | - | 37.3 |
| | 0.2 | 100 | 100 | 100 | - | 10 | 20 | 17 | - | 10.0 | 20.0 | 17.0 | - | 15.6 |
| | 0.3 | 100 | 100 | 100 | - | 12 | 17 | 16 | - | 12.0 | 17.0 | 16.0 | - | 15.0 |
| Benlate | 0.1 | 75 | - | 60 | 80 | 5 | 0 | 3 | 4 | 6.6 | - | 5.0 | 13.3 | 8.3 |
| | 0.2 | 100 | 100 | 100 | 100 | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 0.3 | 100 | 100 | 100 | 100 | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Dithane M-45 | 0.1 | 100 | 100 | 100 | 100 | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 0.2 | 100 | 100 | 100 | 100 | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 0.3 | 100 | 100 | 100 | 100 | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Difolaton | 0.1 | 100 | 100 | 100 | 100 | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 0.2 | 100 | 100 | 100 | 100 | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 0.3 | 100 | 100 | 100 | 100 | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Daconil | 0.1 | 100 | 100 | 40 | 100 | 0 | 0 | 1 | 0 | 0.0 | 0.0 | 2.5 | 0.0 | 0.6 |
| | 0.2 | 100 | 100 | 100 | 100 | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 0.3 | 100 | 100 | 100 | 100 | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Control | - | 100 | 100 | 100 | - | 90 | 90 | 87 | - | 90.0 | 90.0 | 87.0 | - | 89.0 |

^a 16-day old culture.

^b Observations recorded after 24 hours.

1. Effect of exudates from susceptible and moderately resistant lines on spore germination

The effect of exudates from three moderately resistant lines on spore germination of *A. rubi* compared to exudates from susceptible Pb-7 and distilled water was studied. The results are presented in Table 37. No appreciable differences in spore germination were observed.

2. Effect of different dilutions of exudates of susceptible and moderately resistant line on spore germination

The effect of different dilutions of the exudates of susceptible cultivar Pb-7 and ICC-1256, a moderately resistant line on spore germination was studied. The results are presented in Table 38. No difference in the germination of spores was however found

3. pH of the exudates at different times of day

The pH of the exudates of susceptible and moderately resistant lines at different times of the day was measured to see if there is any difference. The results are presented in Table 39. Not much difference among the cultivars and between different times of the day was found.

4. pH at different ages

The pH of the exudates at different ages starting from 6 to 32 days was measured. The results are presented in Table 40. The pH seemed to decrease with age.

B Leaf extracts

The effect of leaf extracts from susceptible and some moderately resistant lines on the germination of spores was studied. To one drop of extract prepared by squeezing the leaf tissue, one drop of spore suspension was added. Incubation and observations recorded were same as described earlier. The results are presented in Table 41. No clear trend was obtained and the germination in the extracts was more than in distilled water.

Table 37. Effect of exudates of chickpea^a on conidial germination of *Ascochyta blight*.^b

| Cultivar | No. of conidia observed | | | | No. of conidia germinated | | | | Percent germination | | | | Average |
|---------------|-------------------------|-----|-----|-----|---------------------------|-----|-----|-----|---------------------|------|------|------|---------|
| | R1 | R2 | R3 | R4 | R1 | R2 | R3 | R4 | R1 | R2 | R3 | R4 | |
| Pb-7 (S) | 530 | 300 | 750 | 675 | 505 | 759 | 675 | 550 | 95.2 | 53.0 | 90.0 | 81.4 | 79.9 |
| ICC-1256 (MR) | 350 | 827 | 725 | 525 | 342 | 653 | 575 | 160 | 97.7 | 79.1 | 79.3 | 30.4 | 71.6 |
| ICC-4112 (MR) | 953 | 415 | 550 | 470 | 927 | 385 | 430 | 210 | 97.2 | 92.7 | 78.1 | 44.6 | 78.2 |
| ICC-8227 (MR) | 200 | 515 | 975 | 600 | 2 | 492 | 650 | 125 | 1.0 | 91.6 | 66.6 | 20.8 | 45.0 |
| Control | 459 | 100 | 575 | - | 405 | 90 | 500 | - | 88.2 | 90.0 | 86.9 | - | 88.3 |

^a30 days old seedlings; 1 g leaf tissue/1 ml of water.

^b15 days old culture

S - Susceptible; MR - Moderately resistant.

Table 38. Effect of different dilutions of chickpea leaf exudates on conidial germination of *Ascochyta rabiei*

| Cultivar | Dilution | No. of conidia observed | | | No. of conidia germinated | | | Percent germination | | | Average |
|---------------|----------|-------------------------|-----|-----|---------------------------|-----|-----|---------------------|------|------|---------|
| | | R1 | R2 | R3 | R1 | R2 | R3 | R1 | R2 | R3 | |
| Pb-7 (S) | 1:2 | 500 | 675 | 280 | 375 | 550 | 104 | 75.0 | 81.4 | 37.1 | 64.5 |
| | 1:4 | 225 | 650 | 360 | 175 | 575 | 110 | 77.7 | 88.4 | 30.5 | 65.5 |
| | 1:8 | 450 | 800 | 100 | 350 | 600 | 50 | 77.7 | 75.0 | 50.0 | 67.5 |
| | 1:16 | 400 | 625 | 100 | 250 | 525 | 30 | 62.5 | 84.0 | 30.0 | 58.8 |
| ICC-1256 (MR) | 1:2 | 425 | 575 | 315 | 370 | 400 | 201 | 87.0 | 69.5 | 63.8 | 73.4 |
| | 1:4 | 225 | 725 | 190 | 140 | 525 | 134 | 62.2 | 72.4 | 70.5 | 68.3 |
| | 1:8 | 350 | 400 | 100 | 225 | 375 | 40 | 64.2 | 93.7 | 40.0 | 66.0 |
| | 1:16 | 225 | 400 | 101 | 90 | 300 | 52 | 40.0 | 75.0 | 51.4 | 55.4 |

S - Susceptible; MR - Moderately resistant.

Table 39. pH of leaf exudates of different cultivars of chickpea estimated at different times of the day^a

| Cultivar | pH of the leaf exudates ^b | | | | | |
|---------------|--------------------------------------|-----|-------|-----|-------|-----|
| | 9 hr | | 12 hr | | 16 hr | |
| | R1 | R2 | R1 | R2 | R1 | R2 |
| Pb-7 (S) | 3.5 | 4.8 | 3.7 | 3.9 | 4.1 | 3.7 |
| ICC-1256 (MR) | 3.7 | 3.5 | 3.7 | 3.5 | 4.3 | 3.4 |
| ICC-4112 (MR) | 3.3 | 3.9 | 3.5 | 3.8 | 3.5 | 3.7 |
| ICC-8227 (MR) | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.4 |

^a92-days-old seedlings.

^b1 g leaf material washed in 1 ml water.

S - Susceptible; MR - Moderately resistant.

Table 40. pH of chickpea leaf exudates of different cultivars at different ages

| Cultivar | pH of the leaf exudates at the age of ^a | | | |
|---------------|--|--------|---------|---------|
| | 6 days | 9 days | 14 days | 32 days |
| Pb-7 (S) | 4.7 | 5.0 | 5.0 | 3.5 |
| ICC-1256 (MR) | 4.6 | 5.2 | 5.0 | 3.7 |
| ICC-4112 (MR) | - | 5.2 | 5.3 | 3.3 |
| ICC-8227 (MR) | - | 5.7 | 5.6 | 3.8 |

^a1 g leaf tissue washed in 3 ml water.

Table 41. Effect of leaf extracts of different cultivars of chickpea on conidial germination^a

| Cultivar | No. of conidia observed | | No. of conidia germinated | | Percent germination | | Average |
|---------------|-------------------------|-----|---------------------------|----|---------------------|------|---------|
| | R1 | R2 | R1 | R2 | R1 | R2 | |
| Pb-7 (S) | 100 | 100 | 50 | 50 | 50.0 | 50.0 | 50.0 |
| ICC-1256 (MR) | 100 | 100 | 64 | 68 | 64.0 | 68.0 | 66.0 |
| ICC-8227 (MR) | 100 | 100 | 38 | 34 | 38.0 | 34.0 | 36.0 |
| Control (DW) | 100 | 100 | 28 | 32 | 28.0 | 32.0 | 30.0 |

^a32-days-old seedlings.

S - Susceptible; MR - Moderately resistant; DW - Distilled water.

C. Acid mixture

The effect of different concentrations of organic acid mixture prepared by mixing malic acid, oxalic acid, and citric acid in same concentration and proportion as found in the leaf exudates on spore germination was studied (Table 42). No germination was obtained in higher concentrations and at lower concentrations slight stimulation was obtained.

Table 42. Effect of different concentrations of acid mixture on conidial germination of *Ascochyta rabiei*^{a,b}

| Treatment | No. of conidia observed | | No. of conidia germinated ^c | | Percent germination | | Average |
|--|-------------------------|------|--|-----|---------------------|------|---------|
| | R1 | R2 | R1 | R2 | R1 | R2 | |
| Concentrated acid mixture + spore suspension | 1000 | 1000 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| 10 fold dilution + spore suspension | 1000 | 1000 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| 100 fold dilution + spore suspension | 1000 | 370 | 25 | 180 | 2.5 | 48.6 | 25.5 |
| 1000 fold dilution + spore suspension | 1000 | 595 | 360 | 470 | 36.0 | 78.9 | 57.4 |
| Control (only spore suspension) | 10000 | 430 | 498 | 160 | 49.8 | 37.2 | 43.5 |

^aAcid mixture 1.3% (94.2% malic acid + 5.6% oxalic acid + 0.2% citric acid).

^b8-days-old culture.

^c24 hrs after incubation.

D. Role of yeast cells

During the course of studies on the effect of exudates on spore germination, contamination with yeast cells was found. Whenever contamination with yeast cells occurred, germination of spores was inhibited. It was suspected that yeast cell play some role in spore germination through their action on the acid exudates. When yeast cells (30 hrs culture multiplied on media: yeast extract 3 g + malt extract 3 g + glucose 10 g + peptone 5 g + water 1000 ml) were added to the organic acid mixture 1.3% (malic acid 94.2% + oxalic acid 5.6% + citric acid 0.2%) the pH which was 3.2 at 0 hr was increased to 6.53 after 6 hrs. It is suspected that the yeast cells inhibit spore germination by increasing pH which may be deleterious to spore germination. This was further supported by the observation where spore germination in the

leaf exudate of ICC-1256 where yeast cells were added was only 4.6% against 50% germination in the control (exudate without yeast cells). This aspect needs further study.

VII. SEED MULTIPLICATION

Seeds of 56 lines that were found promising in the repeated screenings last year was multiplied for multilocation testing through Chickpea International Ascochyta Blight Nursery (CIABN) operated from ICARDA, Aleppo, Syria and for supply to cooperators.

VIII. SUMMARY OF WORK DONE AT ICARDA

A period of 3 months was spent by Dr. M.V. Reddy at ICARDA, Aleppo, Syria to help Dr. K.B. Singh, ICRISAT's Chickpea Breeder, in Ascochyta blight screening. In the later part of the stay, a brief trip to north Africa was undertaken to assess disease problems in that region and see the performance of the entries in CIABN-80. A detailed report on the work carried at ICARDA and visit to north Africa are being prepared separately and salient features of the work carried out at ICARDA are given. The work at ICARDA was conducted in close consultation and collaboration with Drs. K.B. Singh and G.C. Hawtin.

1. The causal agent of the fungus causing blight at ICARDA, Syria, was confirmed to be *Ascochyta rabiei* (Pass.) Lab.
2. Very high disease pressure was created artificially in an area of 5.0 ha where large amount of germplasm, breeding materials and others was screened.
3. Further standardization of the field screening procedure in terms of method of inoculation, date of inoculation, frequency of spreader rows, and row direction was carried out.
4. A total of 4789 entries in 21 trials were screened and 3 highly resistant, 156 resistant, and 335 tolerant lines/materials were identified.
5. The entries of CIABN-80 were screened in the plastic house by artificial inoculation and the results showed good correlation with field results.
6. Seed infection in a susceptible cultivar was found to be 10% and Calixin M and Benlate mixture gave very good eradication.
7. The leaf exudates and extracts were found to play no role in resistance in chickpea.
8. No difference in the stomatal count of susceptible and resistant lines studied was found.

IX. SUMMARY OF THE REPORT ON TRIPS TO ALGERIA, MOROCCO, AND TUNISIA
BY DR. M.V. REDDY

The trips were made in the first half of May 1980. Summaries are given below:

A. Algeria

1. Present yields are low because of low plant densities, Ascochyta blight and weeds.
2. Tall, blight resistant cultivars (bold seeded kabuli) for closer spacings suitable for mechanical harvesting are urgently needed.
3. Blight and pea leaf roll virus resistant lines identified at ICARDA/ICRISAT Centers will be very useful.
4. Winter planting has great potential for increasing the yields. The problems associated with winter plantings are: (i) coincidence of cereal plantings with the legume plantings, (ii) delay of rains, (iii) cold and frost damage, and (iv) weeds.
5. The IDRC project on grain legumes has helped in conducting agronomic trials and initiating breeding program.

B. Morocco

1. Morocco is one of the countries with a great potential for increased chickpea production.
2. The most important need is development of kabuli cultivars with Ascochyta blight resistance suitable for mechanical harvesting.
3. Winter chickpeas will go a long way in increasing production and bringing changes in the cropping pattern.
4. The blight and pea leaf-roll virus resistant lines identified at ICARDA/ICRISAT Centers will be of immediate use.

C. Tunisia

1. Chickpea is a major food legume crop grown and is given good attention.
2. Introduction of winter chickpeas in southern parts of Tunisia where rainfall is less than 400 mm has good potential. Also winter chickpeas in light soils in northern parts may be more productive.

3. Blight appears to be the major disease problem and resistant lines identified at ICARDA should be very usefu.
4. Tall, bold seeded kabuli types with blight resistance for mechanical harvesting are desirable.
5. At present mostly trials sent by ICARDA are being tested and there is no breeding program.
6. Desi chickpeas are not yet all cultivated and sending desi material either in yield trials or disease nurseries may not be of much use.

PROJECT CP-PATH-5(78): INTERNATIONAL CHICKPEA DISEASE
NURSERIES

I. SUMMARY

1. The International Chickpea Root Rots/Wilt Nursery (ICRRWN) was sent to 33 cooperators in 19 countries. The nursery was sent for planting at 35 locations and had 56 entries. A separate report on the performance of these entries will be prepared.
2. Twenty entries from ICRISAT were sent to Dr. K.B. Singh, ICRISAT's Chickpea Breeder at ICARDA for inclusion in the Chickpea International Ascochyta Blight Nursery (CIABN). These entries were found promising in the 'propagator screening' at ICRISAT Center.
3. Several nursery locations were visited in Algeria, India, Nepal, Syria, Tunisia, and Turkey.
4. A large number of scientists from several countries visited ICRISAT to see our work and exchange information.
5. The second International Chickpea Pathology Training Course was held in January-February 1980. Eight scientists from Egypt and India participated.

II. INTRODUCTION

The first Cooperative Chickpea Disease Nursery with 30 entries was operated during 1976-77. In January 1978 we formally initiated a project on nurseries with the following objectives:

1. Share promising material with cooperators in different countries,
2. Identify stable sources of resistance for use in breeding program at ICRISAT, and
3. Get a feed-back on susceptibilities of the entries to other locally serious diseases.

Since 1977-78 two separate nurseries were organised. These are (i) International Chickpea Root Rots/Wilt Nursery and (ii) International Chickpea Ascochyta Blight Nursery (ICABN). The reports for 1977-78 and 1978-79 nurseries were compiled and circulated (ICRISAT Pulse Pathology Progress Reports 4 & 7). We have now integrated our ICABN with the one operated from ICARDA and from here on it will be a joint ICARDA-ICRISAT nursery. It will be called Chickpea International Ascochyta Blight Nursery (CIABN). Results of the ICRRWN 1979-80 have come from most of the locations. The results are being compiled and a separate report will be prepared.

In order to further strengthen our international activities, our staff undertook tours to different cooperating locations. We also invited well-known scientists as consultants.

III. ICRISAT 1979-80

A. List of countries and cooperators

| <u>No.</u> | <u>Country</u> | <u>Cooperator(s)</u> |
|------------|----------------|--|
| 1. | Afghanistan | Dr. M. Ghuffran President of Agricultural Research Research Department Ministry of Agriculture and Land Reforms Kabul |
| 2. | Algeria | Mr. M.N. Bakhtri Regional Dryland Agronomist C/o UNDP BP: 823 <u>Algiers</u> |
| 3. | Chile | Dr. Gabriel Bascur B. Programa de Leguminosas de Grano Estacion Experimental la Platina Instituto de Investigaciones Agropecuarias, Casilla 114-D <u>Santiago</u> |
| 4. | Egypt | Dr. Ali Abdel Aziz Head, Grain Legume Section Field Crops Institute Agricultural Research Center Giza |
| 5. | Ethiopia | Mr. Alemu Mengistu Plant Pathologist Agricultural Experiment Station Addis Ababa University P.O. Box 32 Debre Zeit |
| 6. | Iraq | Mr. Issam Najjar Food Legumes Programme Directorate General of Field Crops Abu-Gharib <u>Baghdad</u> |

| <u>No.</u> | <u>Country</u> | <u>Cooperator (s)</u> |
|------------|----------------|---|
| 7. | Jordan | Dr. Hassan Gharaybeh Director Department of Agricultural Research and Extension P.O. Box 226 <u>Amman</u> |
| 8. | Kenya | The Director ARD-KARI P.O. Box 30148 <u>Nairobi</u> |
| 9. | Mexico | Ing. Santiago Sanchez INIA Auxiliar de Leguminosas Comestibles Apartado Posta No.6-882 Y 6-883 <u>Mexico 6 D.F.</u> |
| 10. | Nepal | Mr. R.P. Sah Assistant Agronomist (Pulses) Parwanipur Agriculture Station Birganj, Parwanipur <u>Narayani Zone</u> |
| 11. | Pakistan | Dr. S.J. Hamid Assistant Plant Pathologist B-6, Al-Markaz, F-7/2 Cereal Diseases Research Institute Pakistan Agricultural Research Council <u>Islamabad</u> |
| 12. | Peru | The Director Centro Regional Investigacion Agraria de Norte APTDO 116 <u>Chiclayo</u> |
| 13. | Argentina | Ing. Agr. Susana Carica Medina Mejoramiento de Legumbres Instituto Nacional de Tecnologia Agropecuaria Estacion Experimental Regional Agropecuaria Salta <u>Cerrillos (Salta)</u> |
| 14. | Sudan | Dr. Farouk Ahmed Salih Agricultural Research Corporation Hudieba Research Station P.O. Box 31 <u>Ed-Damer</u> |

| <u>No.</u> | <u>Country</u> | <u>Cooperator(s)</u> |
|------------|---------------------|---|
| 15. | Syria | Dr. K.B. Singh ICRISAT Chickpea Breeder The International Center for Agricultural Research in the Dry Areas (ICARDA) P.O. Box 5466 <u>Aleppo</u> |
| 16. | Tunisia | Dr. M LAIKI Ahmed Head, INRAT Pathology Laboratory Republique Tunisienne Ministere de L'Agriculture, INRAT Ariana, <u>Tunis</u> |
| 17. | U.S.A. | Dr. John C. Philips Assistant Professor Crop Science Department California Polytechnic State University San Luis Obispo <u>California 93407</u> |
| 18. | Yemen Arab Republic | Mr. K.M. Ahmed Pest Control Assistant (FAO) Central Agricultural Research and Training Center UNDP/FAO Project Post Box 4788, <u>Taiz</u> Yemen Arab Republic C/o FAO, Rome, Italy |
| 19. | India | Dr. K.K. Zote Badnapur Mr. M.D. Gupta Gwalior Dr. K. Sengupta Berhampore Dr. R.N.S. Tyagi Durgapura Dr. Gurdip Singh Ludhiana Dr. Prabhakar Shukla Kanpur Dr. S.R. Kotasthane Jabalpur |

| <u>No.</u> | <u>Country</u> | <u>Cooperator(s)</u> |
|------------|----------------|--|
| 19. | India | Dr. J.S. Grewal New Delhi |
| | | Dr. R.N. Singh Faizabad |
| | | Dr. U.P. Singh Varanasi |
| | | Dr. M. Mahmood Dholi |
| | | Dr. B.L. Jalali Hissar |
| | | Dr. K.C. Agarwal Raipur |
| | | Dr. R.V. Hiremath Gulbarga |
| | | Dr. B.G. Desai Dantiwada |
| | | Dr. Y.L. Nene/Dr. M.P. Haware ICRISAT |

B. Entries

Following were the entries

| <u>S.No.</u> | <u>IOC No.</u> | <u>Pedigree</u> | <u>Origin</u> |
|--------------|----------------|-----------------|---------------|
| 1. | 102 | P-79 | India |
| 2. | 229 | P-180-1 | " |
| 3. | 267 | P-212-1 | " |
| 4. | 338 | P-253 | " |
| 5. | 434 | P-319 | " |
| 6. | 516 | P-392 | " |
| 7. | 519 | P-394 | " |
| 8. | 554 | P-436-2 | " |
| 9. | 867 | P-690 | " |
| 10. | 1891 | P-1514 | " |
| 11. | 1910 | P-1542 | Unknown |
| 12. | 1913 | P-1546 | " |
| 13. | 2072 | P-1670 | India |
| 14. | 2083 | P-1679-2 | Mexico |
| 15. | 2086 | P-1683 | " |
| 16. | 2089 | P-1684 | " |

| <u>S.No.</u> | <u>ICC No.</u> | <u>Pedigree</u> | <u>Origin</u> |
|--------------|----------------|-----------------|---------------|
| 17. | 2104 | P-1696-1 | Mexico |
| 18. | 2461 | P-2249 | Iran |
| 19. | 2566 | P-2559 | Iran |
| 20. | 2660 | P-2686-2 | " |
| 21. | 2812 | P-3036 | " |
| 22. | 2835 | P-3107-1 | Unknown |
| 23. | 2883 | P-3251 | Iran |
| 24. | 3099 | P-3614 | " |
| 25. | 3103 | P-3617 | Unknown |
| 26. | 3396 | P-4083 | Iran |
| 27. | 3439 | P-4116-1 | " |
| 28. | 3539 | P-4237 | India |
| 29. | 3684 | P-4321-2 | Iran |
| 30. | 4519 | P-6067 | India |
| 31. | 5864 | T-3 (Owalior) | " |
| 32. | 5901 | T-32 | " |
| 33. | 6081 | JG-57 | " |
| 34. | 6098 | JG-74 | " |
| 35. | 6366 | NEC-312 | Iran |
| 36. | 6385 | NEC-348 | " |
| 37. | 6455 | NEC-460 | " |
| 38. | 6494 | NEC-529 | " |
| 39. | 6880 | NEC-1089 | " |
| 40. | 6926 | NEC-1166 | " |
| 41. | 7111 | NEC-1470 | " |
| 42. | 7248 | NEC-1621 | India |
| 43. | 7254 | NEC-1627 | Pakistan |
| 44. | 7681 | P-1179 | India |
| 45. | 8933 | WR-315 | " |
| 46. | 8982 | NEC-346 | Iran |
| 47. | 9001 | NEC-426 | Iran |
| 48. | 9117 | NEC-847 | " |
| 49. | 10104 | P-6131 | India |
| 50. | 10394 | Coll.No. 129 | " |
| 51. | - | ICOC-10 | ICRISAT |
| 52. | - | G-543 | India |
| 53. | - | GG-588 | " |
| 54. | - | GG-663 | " |
| 55. | - | GG-669 | " |
| 56. | - | GG-688 | " |
| 57. | 4951* | JG-62 | India |

*Wilt susceptible check

IV. TOURS

Dr. M.V. Reddy spent 6 weeks in the laboratory of Dr. Myron K. Brakke, world-renowned plant virologist located at the University of Nebraska, USA.

Dr. Y.L. Nene participated in the IX International Plant Protection Congress in Washington, USA. He also visited the Commonwealth Mycological Institute, UK.

Dr. Y.L. Nene also visited Bangladesh at the invitation of that country's Government to study disease situation in pulse crops, particularly chickpeas. His tour report is separately available. The diseases observed in chickpeas were: Zinc deficiency, Collar rot (*Sclerotium rolfsii*), root rot (*Rhizoctonia solani*), wilt (*Fusarium oxysporum* f.sp. *ciceri*), stunt (pea leaf-roll virus), root-knot (*Meloidogyne* spp.), and iron chlorosis. Of these zinc deficiency was widespread and the next in importance was collar rot. Other problems can be considered minor ones.

Dr. M.P. Haware spent 6 weeks at Commonwealth Mycological Institute, U.K., during September-October 1979 to participate in Refresher Course on the Taxonomy and Identification of Microfungi. He also visited Danish Government Institute of Seed Pathology for the Developing Countries, Copenhagen, on his return journey.

Dr. M.V. Reddy was deputed for a period of three months to work as a chickpea pathologist with Dr. K.B. Singh, ICRISAT's Chickpea Breeder at ICARDA. He worked specifically on the screening of chickpea for *Ascochyta* blight resistance. He also visited Algeria, Morocco, and Tunisia. His tour report is available separately. Chickpea diseases that he observed in these three countries were:

Algeria: *Ascochyta* blight, Stunt, Rust, Alfalfa mosaic virus.

Morocco: *Ascochyta* blight, Stunt, Rust, Stem rot, Alfalfa mosaic virus.

Tunisia: *Ascochyta* blight, Wilt, Stem blight, Stunt, Iron chlorosis.

Drs. M.P. Haware, M.V. Reddy, and Y.L. Nene undertook several tours in India, visiting locations where the nursery was planted.

V. CONSULTANT

Dr. L. Bos, Plant Virologist, Research Institute for Plant Protection, Wageningen, The Netherlands, was invited to serve as a consultant in pulse virology. He submitted a report and made several important recommendations for future work on pigeonpea and chickpea viruses.

VI. SECOND INTERNATIONAL CHICKPEA PATHOLOGY TRAINING COURSE

ICRISAT, with its world mandate for chickpea improvement, considered it necessary to share the knowledge on chickpea pathology with

5. Field visits and discussions to get acquainted with other related activities of ICRISAT, such as cereals pathology, groundnut pathology, quarantine, etc.
6. Visit to the Central Plant Protection Training Institute.
7. Visits to farmers' fields in northern India (Delhi-Agra; Delhi-Hissar).
8. Visit to ICRISAT and Haryana Agricultural University chickpea fields at Hissar.
9. Presentation by participants summaries of the research activities at their respective research stations.
10. Distribution of relevant literature, books and sets of 20 colored transparencies, etc.

Staff members of the pulse pathology subprogram, who were closely associated with the course were Dr. M.P. Haware, Dr. M.V. Reddy, Dr. Y.L. Nene, Dr. J. Kannaiyan, Mrs. Sheila Vijayakumar, and Mr. Narayan Rao. Other ICRISAT scientists who gave lectures and/or were associated with laboratory/field activities were: Dr. P.J. Dart (Microbiology); Dr. L.J.G. van der Maesen (Genetic Resources Unit); Dr. Jagdish Kumar (Chickpea Breeding); Dr. W. Reed (Pulse Entomology); Dr. R.J. Williams (Millet Pathology); Dr. L.K. Mughogho and Dr. S.R.S. Dange (Sorghum Pathology); Dr. D. McDonald and Dr. D.V.R. Reddy (Groundnut Pathology); and Dr. K.K. Nirula (Plant Quarantine). All administrative arrangements were made by the Training Unit of ICRISAT.

A program evaluation sheet was given to each participant and very useful comments for making improvements in the course and for further cooperation among chickpea pathologists have been received. We will make sincere efforts to act on the suggestions that have been made.

One thing has disappointed us and i.e., less participation of cooperators from countries other than India, inspite of our efforts. We will in future intensify our efforts to ensure more participation from other cooperating countries.

APPENDIX-I

LIST OF PUBLICATIONS

Published

1. Haware, M.P., and Y.L. Nene. 1979. Non-seed borne nature of powdery mildew of chickpea. PANS 25(4): 464-465.
2. Haware, M.P., and Y.L. Nene. 1979. Symptomless carriers (hosts) of the chickpea wilt fungus. International Chickpea Newsletter No. 1: 8.
3. Haware, M.P., and Y.L. Nene. 1979. Physiologic races of the chickpea wilt pathogen. Chickpea Newsletter No. 1: 7-8.
4. Haware, M.P., and Y.L. Nene. 1980. Blight observed in the off-season chickpea nursery in Kashmir. Chickpea Newsletter No. 2: 12.
5. Nene, Y.L., and M.P. Haware. 1980. Screening of chickpea for resistance to wilt. Plant Disease 64: 379-380.
6. Reddy, M.V., and Y.L. Nene. 1979. A case for induced mutation in chickpea for Ascochyta blight resistance. Proc. of the Symposium on the role of induced mutations in crop improvement.
7. Reddy, M.V., Y.L. Nene, and K.B. Singh. 1980. Field screening of chickpeas for resistance to Ascochyta blight. International Chickpea Newsletter.
8. Reddy, M.V., Y.L. Nene, and J.P. Verma. 1980. Pea leaf-roll virus is the causal agent of chickpea stunt. International Chickpea Newsletter.

Accepted

1. Haware, M.P., and Y.L. Nene. 1980. Phoma blight - A new disease of chickpea. Plant Disease.
2. Haware, M.P., and Y.L. Nene. 1980. Sources of resistance to wilt and root rots of chickpea. International Chickpea Newsletter.
3. Nene, Y.L., M.P. Haware, and M.V. Reddy. 1980. Techniques to screen for resistance to some important chickpea diseases. ICRISAT Information Bulletin.
4. Singh, K.B., G.C. Hawtin, Y.L. Nene, and M.V. Reddy. 1980. Resistance in chickpeas to Ascochyta blight. Plant Disease.

Communicated

1. Haware, M.P., and Y.L. Nene. 1980. Symptomless carriers of chickpea wilt fungus. Plant Disease.