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CHICKPEA AND PIGEONPEA DISEASES : PROBLEMS AND PROGRESS

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ABSTRACT

Important diseases of chickpea (*Cicer arietinum* L.) in India are wilt [*Fusarium oxysporum* Schlecht. emend Snyd. & Hans. f.sp. *ciceri* (Padwick) Snyd. & Hans.], dry root rot [*Rhizoctonia bataticola* (Taub.) Butler], collar rot (*Sclerotium rolfsii* Sacc.), ascochyta blight [*Ascochyta rabiei* (Pass.) Labr.], gray mold (*Botrytis cinerea* Pers. ex Fr.), and stunt (viruses). Pigeonpea [*Cajanus cajan* (L.) Millsp.] suffers from three major diseases in India. These are wilt (*F. udum* Butler), sterility mosaic (virus ?) and phytophthora blight [*Phytophthora drechsleri* Tucker f.sp. *cajani* (Pal *et al.*) Kannaiyan *et al.*]. Sources of resistance to fusarium wilts, dry root-rot, and sterility mosaic are now available. A high level of resistance to collar rot, ascochyta blight, botrytis gray mold and stunt in chickpea, and phytophthora blight in pigeonpea is not available. Lines with multiple disease resistance that meet the requirements of different agroecological zones in India are needed. Transfer of disease resistant genes from wild relatives of *Cicer* and *Cajanus* to the cultivated species will be useful. An integrated disease management system that includes use of resistant/moderately resistant cultivars, healthy seeds, modification of cultural practices, limited use of fungicides and use of biological agents to manage pathogens needs to be developed to reduce crop losses.

INTRODUCTION

Chickpea (*Cicer arietinum* L.) and pigeonpea (*Cajanus cajan* (L.) Millsp.) are the two most important pulse crops grown in India. Chickpea and pigeonpea are valued for their nutritive grain.However, these crops are generally treated as low priority crops by farmers in India, although recent price rises for pulses in India have led to increased interest in them. Grain yields in farmers fields are below the potential yields. This can invariably be attributed to their susceptibility to biotic and abiotic stress factors. In this paper, efforts have been made to highlight the progress made on economically important diseases of chickpea and pigeonpea during the last 20 years. The problems which need immediate attention are discussed under priorities for future research.

PROGRESS

Chickpea

Work on chickpea diseases has been reviewed by several workers (Nene and Reddy, 1987; Haware *et al.*, 1990; Kaiser *et al.*, 1990). The major yield constraints to chickpea production in India are fusarium wilt (*Fusarium oxysporum* f. sp. *ciceri*), dry root rot (*Rhizoctonia bataticola*), collar rot (*Sclerotium rolfsii*), ascochyta blight (*Ascochyta rabiei*), botrytis gray mold (*Botrytis cinerea*) and stunt. Stemphylium blight (*Stemphylium sarciniforme*) and stem rot (*Sclerotinia sclerotiorum*) are potentially important diseases of chickpea in North India.

The root diseases of chickpea (wilt and root rots) are important in areas between 10 to 25°N in India where the chickpea growing season is dry and warm. Solving the mystery of the so-called 'wilt-complex' is one of the major achievements of the recent past (Nene *et al.*, 1978). Different causes of plant mortality have been identified. Both fungi and viruses are found to be involved. The fungi involved are; *F. oxysporum* f.sp. *ciceri* (fusarium wilt), *R. bataticola* (dry root-rot), *S. rolfsii* (collar rot), *F. solani*, (black root-rot), *R. solani* (wet root-rot), and *Operculella padwickii* (foot-rot). Different pathogens produce specific symptoms. The involvement of viruses in the mortality of chickpeas has been the main cause of confusion.

Good progress has been made in understanding the fusarium wilt problem and its management. The wilt pathogen is seed-borne (Haware *et al.*, 1978). In the absence of chickpea, the fungus survives in soil for at least six years (Haware *et al.*, 1986). It exhibits physiologic specialization and four races have been reported from India (Haware and Nene, 1982a). Effective laboratory and field inoculation techniques have been developed (Nene *et al.*, 1981). Several sources of resistance were identified and resistance has been incorporated in high yielding wilt resistant varieties. Cultivars ICCV 2, JG 315, and Avrodhi are released for cultivation. Active work on resistance breeding is going on at several centers in India (Upadhyay *et al.*, 1983).

In recent years, progress has been made on root rots. A laboratory paper towel inoculation technique has been standardized for dry root rot (Nene *et al.*, 1981). Through multilocation testing in India, ICCs 2862, 9023, 10803, 11550 and 11551 were found to be resistant to wilt and root rots (Nene *et al.*, 1989a).

Two foliar diseases, ascochyta blight and botrytis gray mold occur in Punjab, Haryana, Rajasthan, Uttar Pradesh and Bihar. These diseases require cooler and relatively wet conditions. Research efforts for the development of resistant cultivars to ascochyta blight have been going on for the last 60 years (Luthra *et al.*, 1938). However, progress on the development of resistant cultivars has not been satisfactory. Chickpea lines with resistance in the vegetative stage are now available but none has resistance in both the vegetative and podding stage (Reddy *et al.*, 1990b). *Ascochyta rabiei* is variable and its spread is governed by environmental factors (humidity and temperature). Foliar fungicides are effective to control this disease. However, their use is not economical under farmers fields.

Importance of botrytis gray mold (BGM) in India was realized during 1979 and 1980, when BGM destroyed chickpea crop in parts of Punjab, Haryana, Uttar Pradesh and Bihar (Grewal and Laha, 1983). There have been reports on identification of lines with moderate levels of resistance to this disease (Haware and Nene 1982_; Rathi *et al.*, 1984; Shukla *et al.*, 1987). However, it appears that the reactions of the lines are not stable. Seed dressing and foliar fungicides effective against this disease have been found (Grewal and Laha, 1983; Singh and Bhan, 1986a). Further work is required to integrate the effective and economic use of chemicals with other methods of disease control. Singh and Bhan (1986b) reported four physiologic races of this pathogen from north Indian states. Field screening at Pantnagar has shown that *kabuli* types are comparatively less susceptible than *desi* types and the tall and compact types suffer less damage than the traditional bushy and spreading types (Reddy *et al.*, 1990b).

Chickpea stunt, a devastating disease present in Gujarat, Haryana, and Madhya Pradesh is caused by the bean (pea) leaf roll virus (BLRV). Recent investigations have shown that a geminivirus is also present in plants that produce symptoms similar to stunt. Luteovirus (BLRV) is transmitted by aphids (*Myzus persicae* and *Aphis craccivora*). The geminivirus is transmitted by leaf hopper (*Orosius orientalis*) (Nico Horn, Personal communication: ICRISAT). Several chickpea lines with field resistance to stunt were identified at Hisar. However, these lines failed when screened at Junagadh in Gujarat (Haware, Unpublished data).

Pigeonpea

Fusarium wilt (*Fusarium udum*) and phytophthora blight (*Phytophthora drechsleri* f.sp. *cajani*) are the two major fungal diseases of pigeonpea in India (Reddy *et al.*, 1990a). Wilt is prevalent throughout the country but it is relatively more serious in Vertisols in central India. Phytophthora blight is serious when fields are subjected to waterlogging.

Good progress has been made on the management of fusarium wilt. Disease sick plots have been developed at several places in India for evaluating pigeonpea for resistance to wilt. Several good sources of resistance such as ICP 8863, ICP 9174 are available (Nene *et al.*, 1989b). A few resistant/moderately resistant and high yielding varieties such as NP(WR) 15, BDN 1, Mukta, C 11, and ICPL 87 have been developed.

The wilt pathogen is seedborne in tolerant cultivars. It survives in soil for 3 years in the absence of pigeonpea (Kannaiyan *et al.*, 1981a). Crop rotation and intercropping with sorghum decreases wilt incidence in pigeonpea (Natarajan *et al.*, 1985).

Progress on the management of phytophthora blight is limited and relatively less research has been carried out on this disease. The pathogen appears to be highly variable. Reliable field and glasshouse inoculation techniques have been developed (Kannaiyan *et al.*, 1981b). While resistant lines are available against the P2 isolate at ICRISAT, these lines are not resistant to Kanpur isolate (Sharma *et al.*, 1982). Epidemiology of the pathogen; especially, the form in which it survives and duration of survival of the fungus in soil needs to be studied further. Ridomil seed dressing and two foliar sprays at 15 day intervals after sowing give good protection in short duration pigeonpeas under field conditions.

Alternaria blight (*Alternaria alternata* and *A. tenuissima*) and stem canker (*Macrophomina phaseolina*) are becoming important. A bacterial leaf spot and canker (*Xanthomonas campestris* pv. *cajani*) becomes serious in favorable environments.

Sterility mosaic disease, the cause of which is unknown, is wide spread throughout the country and along with wilt, causes significant economic yield loss (Kannaiyan *et al.*, 1984). The disease is spread by an eriophyid mite (*Aceria cajani* Channabasavanna). Several lines of pigeonpea are identified resistant to sterility mosaic. Some of them are resistant to wilt also. ICPs 7867, 10976, and 10977 were resistant to SM at several locations in India (Nene *et al.*, 1989c). Three lines, ICPs 11302, 11303, and 11304 are resistant to wilt, phytophthora blight, and sterility mosaic (Nene, 1988).

PRIORITIES FOR FUTURE RESEARCH

Chickpea

In case of soil-borne diseases, progress has been made on the management of fusarium wilt, and dry root rot. Collar rot (*S. rolfsii*) of chickpea is seen in wet soils and at warm temperatures during the seedling stage. Despite continuous research over 100 years, the pathogen continues to plague the growers of various crops and causes considerable loss. Recommendations for controlling *S. rolfsii* emphasizes the importance of sanitary and cultural practices. It may be difficult to obtain a high level of resistance to the root rot fungi unlike the wilt pathogen. The future emphasis may be placed on integrated management and durable resistance. Fungicidal seed-dressing, use of biological agents, and manipulation of agronomic practices such as sowing date, irrigation, and seed bed preparation should be integrated to reduce the inoculum in the soil. The use of short duration varieties which can mature before the temperature rises over 30°C may also help in minimizing the dry root rot problem.

There is a need to understand the epidemiology of ascochyta blight. The primary source of inoculum is not known. The means by which the disease spreads rapidly over very large areas needs to be understood. The extent of variability in *A. rabiei*, its distribution, and the means by which the variability occurs needs to be investigated. At present, high levels of resistance to ascochyta blight in chickpea are not available. Germplasm enhancement for blight resistance may prove fruitful. In the absence of resistant genes in *C. arietinum*, wild *Cicer* spp. should be utilized to transfer resistant genes to cultivated *Cicer*.

Ascochyta blight is seed-borne. Effective seed dressing fungicides such as thiabendazole and Calixin M[R] are now available. Effective and economic foliar fungicides with longer residual action are needed to control the blight.

Extensive screening for resistance at ICRISAT and Pantnagar against botrytis gray mold has failed to identify any genotype with high levels of resistance in the chickpea germplasm (Haware and Nene, 1982b, Rathi *et al.*, 1984). In areas of high disease severity, integrated disease management should be practiced. Field screening at Pantnagar during the 1988-91 seasons indicated that the disease incidence was much lower in tall and compact genotypes than in bushy and spreading types. Germplasm enhancement and utilization of related wild species is promising. Integrated disease management employing such strategies as use of tall and compact genotypes, modification of cultural practices and provision of disease-free seed should be developed.

Epidemiology of virus diseases of chickpea is not well understood. The relationship of sowing dates, insect vector biology, environmental conditions and role of alternate hosts in disease development and spread need further investigation.

Pigeonpea

Considerable progress has been made on some of the important diseases such as wilt and phytophthora blight. However, high levels of resistance are needed to reduce the losses in farmers' fields. In fusarium wilt, the ecology of the pathogen needs to be further understood. Though it is known that the incidence of the disease varies with location and soil type, the reasons for such a variation are not understood. The variability in the pathogen, mechanism of resistance in the host and genetics of resistance need to be fully understood. The reasons for loss in plant resistance to wilt with age are not experimentally established. Considerable scope exists for integrated management of wilt using host plant resistance and cultural practices such as crop rotations, mixed cropping, sowing time etc.

There is a need to understand the epidemiology of phytophthora blight and the variability in the pathogen. Identification of sources of resistance to leaf spot, stem canker caused by *M. phaseolina*, and bacterial leaf spot should be undertaken.

Breeding for disease resistance to sterility mosaic is in progress. The identity of the pathogen is to be determined. The relationship of plant density, sowing date, vector biology and alternate host to SM epiphytotics needs to be studied.

CONCLUSIONS

Disease management is an integral component of chickpea and pigeonpea production. Pulses are grown by those farmers whose resources are limited. Cultivars resistant to important diseases are now available. However, only an integrated management system can effectively reduce the losses in farmers fields. Studies on physical and biotic environmental factors associated with disease development will contribute to better understanding of the diseases for which high levels of resistance are not available. Progress has been made in identifying resistance to individual diseases. Chickpea and pigeonpea lines with multiple disease resistance (MDR) are also available. Efforts are needed to make these cultivars available to the farmers in India.

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