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Potential donors for powdery mildew resistance in cowpea [*Vigna unguiculata* (L.) Walp.]

S. K. Mishra, B. B. Singh and V. Hegde[1]

Division of Genetics, Indian Agricultural Research Institute, New Delhi 110 012
[1]IARI Centre for Improvement of Pulses in South, Dharwad 580 005

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Abstract

Powdery mildew is one of the serious diseases of cowpea [*Vigna unguiculata* (L.) Walp.] prevalent in southern India. Therefore, the present investigation was carried out at the IARI Centre for Improvement of Pulses in South, Dharwad during kharif 2002 and 2003. A set of 120 germplasm accessions (excluding local checks) of cowpea germplasm of diverse origin were grown in augmented design. The cowpea variety V 240 (Rambha) and a local variety (Dharwad local) were used as checks after every 10th entry. Observations on the severity of powdery mildew disease were recorded at podding and maturity stages. The observations on the ancillary characters were also recorded at appropriate stages. Out of 120 germplasm accession under study, 101 turned out to be susceptible (PMS) and only 11 resistant to powdery mildew (PMR). Notably, five germplasm accessions namely, C 7, C 200, C 265, C 347 and C 402 maintained high level of resistance during both the years. These genotypes may be good parents for genetic analysis of the PMR trait and and resistance breeding of cowpea.

Key words : Cowpea, germplasm, powdery mildew, resistance

Introduction

Cowpea, [*Vigna unguiculata* (L.) Walp.] is an important grain legume crop grown under arid or semiarid climate for diverse uses like pulse, vegetable, fodder, and green manuring. It is also grown as a cover crop to conserve soil moisture and improve soil fertility. Although cowpea is endowed with a high yield potential, its productivity is hampered by several biotic and abiotic factors. Among biotic factors, the incidence of several diseases simultaneously is a common problem in cowpea cultivation. Yellow mosaic virus (YMV), bacterial leaf blight (BLB), leaf curl virus (LCV), powdery mildew and anthracnose are some of the common diseases affecting the cowpea production. Emechebe and Florini [1] have listed 11 fungal diseases affecting the cowpea crop severely. Powdery mildew, a fungal disease, is a serious problem in cowpea especially in the southern parts of India (Karnataka, A. P., Tamil Nadu etc.). Cowpea powdery mildew is important in Zambia [2], Zimbabwe [3], Florida, USA [4], Puerto Rico, and other cowpea growing countries of Latin America [5, 6]. Under severe condition the whole crop seems to be covered with a white powdery mass leading to complete crop failure. Stable sources of resistance is a prerequisite to initiate breeding for powdery mildew resistance. Keeping this in view, the present experiment was conducted with the main objective of identifying sources for powdery mildew resistance by growing cowpea germplasm accessions of diverse origin for two consecutive seasons.

Materials and methods

A set of 120 germplasm accessions (excluding local checks) of indigenous and exotic origin were grown during kharif 2002 and 2003 at the IARI Centre for Improvement of Pulses in South, Dharwad (Table 1). The exotic germplasm were received from the International Institute of Tropical Agriculture (IITA), Nigeria through NBPGR. New Delhi. All the accessions were grown in a single-row plots of 2.5 meter length in augmented design. The variety V 240 (Rambha) and a Local Check (Dharwad Local) were repeated after every 10th entry. The Local Check was also sown all around the experimental block to ensure adequate inoculum for heavy disease incidence. Since powdery mildew appears regularly, the natural epidemic was used as screening criteria for powdery mildew reaction. The disease incidence was recorded twice, *viz.*, at podding stage and at the maturity in both the seasons. The average disease incidence was considered for categorization of germplasm accessions. The germplasm accessions were classified into five groups on 1-5 scale 1 being highly resistant and 5 as highly susceptible based on severity of disease incidence on individual germplasm accession as suggested in peas [7]. Observations were also recorded on ancillary characters like days to flowering, days to maturity, plant height, growth habit, pod length, number of pods per plant, number of peduncle per plant, seeds per pod. 100-seed weight (g) and seed yield per plant (g) as per standard procedures.

Table 1. Details of the materials used in the study

Source/origin	Identification number
IARI, New Delhi	C 2 (Cowpea 60-1), C 5 (Cowpea 6-1-1), C 6 (V 70-3-2), C 7 (V 7779-3-1), C 11 (V 240-1), C 13 (Cowpea Selection 5), C 23 (Cowpea 716-1- 881), C 25 (Cowpea 889-9-4), C 39 (Cowpea 2), C 42 (Cowpea Selection 3-3), C 45 (Cowpea Selection 5-1), C 46 (Cowpea Selection 5-2), C 50 (Cowpea 9), C 51 (Cowpea 9A), C 52 (Cowpea 9-1), C 57 (Cowpea 9-4-1), C 60 (Cowpea 9-6), C 80 (Selection from V 16), C 98 (Pusa Phalguni), C 100 (Pusa Dofasali), C 102 (Selection from Pusa Phalguni), C 104 (V 37-277-6-1), C 1 10 (V 37-277-6-3B), C 120 (V 38-588-2), C 128 (V 70-3-2-4) , C 142 (V 218-1A), C 152 (released variety), C 153 (V 322), C 178 (Cowpea 60-1-1-2), C 179 (Cowpea 60-1-1-3), C 180 (Cowpea 60-1-1-36-4), C 181 (Cowpea 60-1-1-3B), C 199 (Cowpea 716-1-4), C 200 (Cowpea 716-561-2-2-3), C 224 (Cowpea 789-18-3), C 238 (Cowpea 889-4-4A), C 239 (Cowpea 889-4-4B), C 249 (Cowpea 889-25), C 252 (Cowpea 889-6-4), C 254 (P 1552-663-1-1), C 257 (Selection from P 1552), C 264 (P 1552-663-14), C 265 (Cowpea 25-8-1-3), C 344 (Mutant of EC 170604), C 345 (V 604-31), V 130 (Mutant of Pusa Phalguni), V 240 (check)
NBPGR, New Delhi	C 580 (NIC 12877), C 584 (NIC 15302), C 592 (NIC 15320), C 600 (NIC 22633), C 614 (NIC 22795), C 620 (NIC 22806), C 672 (1C 91556), C 680 (1C 91563), C 688 (EC 332358), C 689 (EC 332359), C 693 (EC343047), C 694 (1C 91480), C 700 (1C 4506)
ARS, Durgapura	C81 (RC 19-1)
GAU, Gujarat	C 28 (GC 89-35), C 70 (GC 89-24), C 71 (GC 89-24-1), C 72 (GC 89-23-1), C 74 (GC 89-49)
IITA, Nigeria	C 14 (EC 170571-5-1), C 15 (EC 170582-1), C 16 (EC 170584), C 19 (EC 170585-12-1), C 33 (83F-731-7-3), C 276 (EC 170417-3), C 277 (EC 1704 17-1 A), C 288 (EC 170574-1 A), C 289 (EC 170574-5-1 A), C 290 (EC 170575-1), C 291 (EC 170575-1-1), C 295 (EC 1 70582-1 A- 1), C 302 (EC 170584B), C 304 (EC 1705841-1), C 305 (EC 170584-1-1-1), C 309 (EC 170584-2-2), C 322 (EC 170584B-7), C 324 (EC170595-1), C 338 (EC 170604-3), C 346 (EC 170604-1), C 347 (EC 170606-2), C 371 (IT 86D-719), C 385 (IT 86D-716), C 387 (IT 87D-941-1), C 397 (IT 89D-455), C 398 (IT 90K-59), C 400 (IT 90K-82-2), C 402 (EC 394813), C 405 (IT 91K-91-11), C 407 (IT 91K-1 18-18), C 410 (IT 92KD-371-1), C 416 (IT 93K-370), C 422 (IT 93K-398-2), C 423 (IT 93K-452-1), C 430 (IT 93K-593-8), C 433 (EC 394708), C 435 (IT 91K-573-3), C 436 (IT 91K-573-5), C 441(EC 394721), C 442 (IT93K-619-1), C 450 (IT 93K-692-1), C 463 (IT 93K-2046-1), C 467 (IT93K-2271-1), C 515 (IT 84D-345), C 519 (IT 87D-879-1), C 533 (IT 86F-2062-5), C 540 (IT85F-867), C 552 (ZVU 283), C 560 (EC 240818-1), C 568 (EC 291430), C 578 (EC 170578), C 689 (EC 332358), C 693 (EC 343047), C 733 (IT 86D-719), C 851 (IT 90K-1039), C 888 (IT90K-277-5)
UAS, Dharwad	Dharwad Local (check)

Results and discussion

The powdery mildew appears as a white powdery mass covering all the plant parts including leaves, stem and pods. The disease symptoms initially start from the older leaves (lower portion of plant) and grows gradually towards the top portion. The diagnostic features of this disease include copious, white, powdery fungal growth mainly consisting of oidia, the repeating spores of the fungus [1]. Under severe infection, the whole plant looks like as covered with white powder which later turns black with the advancement of the crop age. The severely affected plants are partially or completely defoliated due to leaf drop. The powdery mildew in cowpea is induced by the oidial phase (*Oidium* spp.) of *Erysiphe polygoni* DC and *Sphaerothecia fuliginea* [1]. *E. polygoni* is prevalent in all cowpea growing regions. It may be because of its wide range of hosts including many annual and perennial species as also suggested by Ainsworth [8]. However, the occurrence of *S. fuliginea* has been reported only from India [9]. Most of the germplasm accessions under study were highly susceptible to powdery mildew in both the seasons (Table 2). Few accessions which showed resistant response during initial scoring at podding stage (C2, C 252, C 371, C 398) developed powdery mildew at old age and turned highly susceptible at maturity. Therefore, sufficient care must be taken about the stage of recording observations on disease incidence. On the other hand, a very small proportion (about 4 %) of cowpea accessions under study (5 out of 120) maintained a high level of resistance against powdery mildew till the maturity in both seasons. These genotypes include C 7, C 200, C 265, C 347 and C 402 (Table 2). Minor variations were recorded in the nature and magnitude of disease incidence in two seasons. However, this did not affect the overall denomination of the PMS and PMR genotypes. The effect of climatic conditions on the development of powdery mildew disease have been noticed by several workers [2, 6, 10]. The stable sources of resistance against powdery mildew in cowpea have been reported from several countries [2, 6], including India [11]. The study also revealed six moderately resistant accessions (C 14, C 153, C 180, C 288, C 345, C 371) (Table 2). However, these genotypes can not be considered as stable sources as they may turn susceptible under extreme disease pressure. Therefore, major emphasis should be given on highly resistant genotypes. The detailed agronomic features of these genotypes have been described in Table 3. The data presented in Table 3 reveals a wide range of variation for different ancillary characters studied. Interestingly, four out of five resistant genotypes were also dwarf. Thus, there exist a good possibility of developing dwarf, high yielding

Table 2. Classification of cowpea germplasm based on average incidence of powdery mildew during 2002 and 2003

Group	No. of genotypes	Identification number
Highly resistant (1)	5	C 7, C 200, C 265, C 347, C 402
Moderately resistant (2)	6	C 14, C 153, C 180, C 288, C 345, C 371
Moderately susceptible (3)	8	C 2, C 50, C 52, C 102, C 128, C 181, C 252, C 442
Susceptible (4)	21	C 13, C 16, C 19, C 42, C 46, C 104, C 110, C 142, C 179, C 224, C 239, C 264, C 276, C 289, C 291, C 304, C 322, C 338, C 385, C 398, C 436
Highly susceptible (5)	80	C 5, C 6, C 11, C 15, C 23, C 25, C 26, C 28, C 33, C 39, C 45, C 51, C 57, C 60, C 70, C 71, C 72, C 74, C 80, C 81, C 98, C 100, C 120, C 152, C 178, C 199, C 238, C 249, C 254, C 257, C 277, C 290, C 295, C 302, C 305, C 309, C 324, C 344, C 346, C 387, C 397, C 400, C 405, C 407, C 410, C 416, C 422, C 423, C 430, C 433, C 435, C 441, C 450, C 463, C 467, C 515, C 519, C 533, C 540, C 552, C 560, C 568, C 578, C 580, C 584, C 592, C 600, C 614, C 620, C 672, C 680, C 688, C 689, C 693, C 694, C 700, C 733, C 851, C 888, V 130

Note : The classification scores have been given in parenthesis.

Table 3. Agronomical features of the highly resistant accessions of cowpea against powdery mildew

Agronomical features	Germplasm accessions				
	C7	C 200	C 265	C 347	C 402
Days to 50% flowering	40.0	55.0	48.0	56.0	50.0
Days to maturity	90.0	108.0	102.0	105.0	116.0
Plant height	Dwarf	Dwarf	Dwarf	Tall	Dwarf
Growth habit	Erect	Erect	Trailing	Trailing	Medium
Pod length (cm)	13.2	17.8	15.2	17.4	20.4
Pods per plant	10.3	9.7	9.3	5.0	8.6
Peduncles per plant	7.6	6.7	8.3	5.3	9.0
Seeds per pod	16.2	12.6	14.2	17.4	12.8
100-seed weight (g)	13.2	14.9	9.8	15.2	20.3
Seed yield per plant (g)	6.7	8.1	6.6	9.2	7.4

and powdery mildew resistant varieties of cowpea suitable for high density planting. The genotypes C 7, C 200, C 265, C 347 and C 402 are best suited to study the inheritance of powdery mildew resistance in cowpea. It was also noted that the ruling cowpea variety C 152, especially in southern part of the country, was highly susceptible to powdery mildew. Although the disease can be controlled effectively by chemical application [5, 12], the development of genetically resistant varieties is the only viable, cheap and eco-friendly option for disease management.

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