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Field Screening for Powdery Mildew Resistance (*Erysiphe polygoni* DC) in Cowpea

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Aim: The present study was conducted to identify the cowpea genotypes resistant to powdery mildew.
Study Design: One hundred and nine cowpea genotypes were laid out in Augmented Block Design in a single row plot of 4m length and 60cm distance between the rows.
Place and Duration of Study: In total 109 genotypes of cowpea were screened for powdery mildew under field conditions during winter 2018 and winter 2019.
Methodology: All these genotypes were screened under field conditions along with susceptible line VRCP-1444-5 as infector row.
Results: During winter powdery mildew incidence in cowpea was high under Varanasi conditions when cowpea is under maturity stage. Powdery mildew incidence was severe in winter months especially from second fortnight of November to January. Each genotype was grown in a single row. Scoring was done in 0-5 scale. The genotypes that had shown resistance to powdery mildew during winter 2018 were sown again in 2019 for identifying suitable resistant genotypes. Results

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showed that, 2 genotypes namely IC202280 and EC528412 were completely free from disease during both the seasons of screening and they falls under the category of immune.
Conclusion: Hence these genotypes may be used as resistant donor for development of varieties/lines resistant to powdery mildew.

Keywords: Powdery mildew; cowpea; genotypes; screening; disease-free.

1. INTRODUCTION

Cowpea is grown primarily in the third world for its cheap source of dietary protein, lysine and as a supplement for meat. It is one of the most important legumes which serve as vital source of protein in the diet of the people of developing countries. Cowpea species were abundant in Africa, Latin America, and Asia. India is the secondary centre of origin for cowpea because of the genetic diversity available in the country. Globally cowpea is consumed as dryseeds, fresh seeds, fresh green pods (as a vegetable in Asia and Caribbean), and fresh leaves (as vegetable in Africa) [1]. Vegetable cowpea refers to varieties of cowpea (*Vigna unguiculata* L.*)* grown for their immature succulent pods, popularly known as the long bean, bodi, bora, sitao, snake pea and aspargus bean in different parts of the world. Due to its nutritive value and soil-improving properties, cowpea is also used as a fodder, green manure, and cover crop. Being a legume crop, cow pea fits well in inter-cropping system. It is also used as a green manure crop, a nitrogen-fixing crop, or for erosion control.

In several legumes, powdery mildew (PM) caused by *Erysiphe polygoni* is an important fungal disease [2]. The causal organism for powdery mildew in cowpea has been indicated as *Podosphaera phaseoli* (syn. *Sphaerotheca phaseoli)* [3]. Powdery mildew is a biotrophic fungus that has a wide distribution. It is particularly important in climates with warm, dry days and cool nights [4]. Severe infection in cowpea causes 25-50% of yield loss [5]. The Efficiency of powdery mildew depends on the weather [6]. The most effective measure to control such a disease would be to breed resistant varieties.

2. MATERIALS AND METHODS

2.1 Screening of Cowpea Genotypes

Totally 109 cowpea genotypes were subjected to field screening for powdery mildew disease resistance consecutively for two years (2018 and 2019) at ICAR-Indian Institue of Vegetable Research farm located at 25°10′ N latitude and 82° 52′ E longitude at mean sea level of 128.93 m.Cowpea genotypes were sown in augmented block design with four checks during the first fortnight of August. Each genotype was grown in a single row plot of 4m in length with a spacing of 20cm between the plants. The row to row distance maintained was 60 cm. For every four rows, an infector row of susceptible genotype VRCP-144-5 was sown for uniform spread of powdery mildew. No spray of fungicide was done throughout the crop period. All other standard crop management practices were followed. Screening has been done in two phases: preliminary screening and advanced screening. In preliminary screening all the 109 genotypes were sown whereas in advance screening, those genotypes falling under the category of Immune, resistance, and moderately resistat were included.

2.2 Disease Scoring

Disease scoring was done based on the 0-5 scale as follows: 0 – No visible symptoms;1 – Powdery growth covered on <10% of leaf area; 2 - Powdery growth covered on 11-25% of leaf area; 3 - Powdery growth covered on 26-50% of leaf area; 4 - Powdery growth covered on 51-75% of leaf area; 5 - Powdery growth covered on >75% of leaf area [7]. Resistance of genotypes was categorized based on the average score as follows:

Table 1. Disease scoring scale of 0-5 for screening cowpea genotypes

0	Immune
0.1 - 1.0	Resistance
1.1 – 2.0	Moderately resistance
2.1 – 3.0	Moderately susceptible
3.1 – 4.0	Susceptible
4.1 – 5.0	Highly susceptible

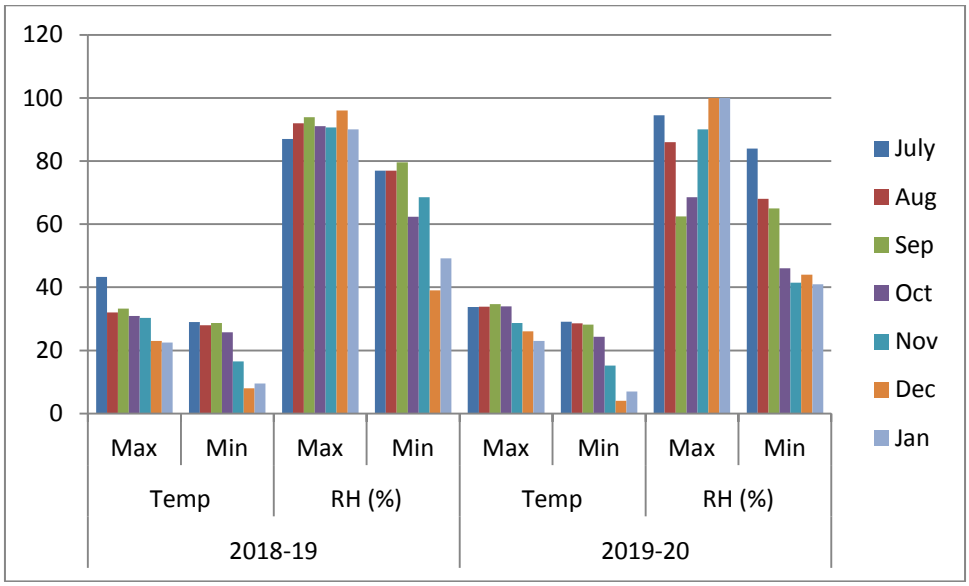

Fig. 1. Meteorological data during the crop growth period 2018-19 and 2019-20

2.3 Weather Parameters

Weather parameters of temperature (maximum and minimum) and relative humidity (maximum and minimum) for the entire crop period during 2018-19 and 2019-20 were provided in the Fig. 1. These data were collected from the Indian Meteorological Department (IMD) observatory located at the research farm of ICAR-IIVR.

3. RESULTS AND DISCUSSION

For a successful breeding program aimed at developing disease resistance cultivars, it is essential to establish a simple and verifiable method of identifying the resistant plant that can be reliably identified. It is necessary to create field epiphytotics for screening the cowpea genotypes for powdery mildew resistance under field conditions by using the susceptible genotype as infector rows. The powdery mildew incidence in cowpea was high under Varanasi conditions when the cowpea is in maturity stage. Powdery mildew incidence was severe especially from the second fortnight of November to January. Powdery mildew lesions were observed severely during December month in cowpea and then the disease lesions were enlarged, coalesced and cover the entire leaf area (Fig. 2). During this period, the temperature was a minimum (4-8°C) and RH was a maximum of 96-100%. This is in corroboration with the findings of (8) who showed maximum temperature of (29-31°C), minimum temperature of (14-19°C) and RH (55-95%) were lead to the disease development in Konkan region of Maharastra in cowpea.

A **B**

Fig. 2. Genotype with powdery mildew symptom A. RCV-395 (Highly susceptible) and B. EC390240 (Resistant)

Table 2. The grouping of 109 cowpea genotypes based on screening to powdery mildew on 0-5 scale

Score	Nature of resistance	Genotypes	Total genotypes
0	Immune	IC202280 and EC528412	2
0.1-1	Resistant	EC528382, IC3009, IC536638, ACP-1, EC160493/20, EC19735, EC390226, HACP-3, EC528412, EC390237, Indra Lal, Sweta, EC390240, Jaipur AC-2, EC390268, EC390241, EC97306, EC472272, EC528398, EC91171-A, IC34009, IC331250, IC202826, IC202776, IC202858, IC202717, IC334740, IC536635, Sel-16, Pant Lobia, BC244002, EC572715, VRCP-190, EC390240, EC472276, EC472260, EC91487, Ujjain AC, DR214, EC1738, EC390242, EC390216, EC9736, Ankur Gomti, LC-03-1, NDCP-13, EC160493/20, Sel-2-1, Jaipur AC-2, VRCP-190, Kashi Sudha, EC15296, BC244002	53
1.1-2.0	Moderately Resistant	EC19736, EC394756, EC9135-B, EC97738, EC390252, K.Nidhi, EC9738, EC160493/20, EC390242, EC9739, EC37587, EC399251, IC202790, IC209711, IC259063, IC559399, IC337932, IC201098, IC559387, IC222810, IC202718, IC559389, IC559391, IC337931, IC202824, Arka Garima, Cowpea 263, EC15296, EC390261, EC458455, ACP-1, Jaipur AC-2, Lobia Banarasi, Almora AC, Sel 2-1, EC390210, EC390240, Ajeet-1, VRCP-55-3	39
2.1-3.0	Moderately Susceptible	K.Kanchan, EC390210, IC202797, IC249588, IC39095, NDCP-8, VRCP-55-3, Sel-2-1, Kashi Sudha, ACP-1	10
3.1-4.0	Susceptible	EC572715	1
4.1-5.0	Highly Susceptible	RCV395, IC559405, VRCP-144-5, CP3	4

Upon screening of 109 cowpea genotypes under the field conditions, powdery mildewdisease symptoms appeared during pod development and maturation stage. The susceptible check has recorded an average disease score of more than 4.1 during both the seasons. This indicates the prevalence of a conducive environment and the availability of pathogen inoculum for disease development. Results showed that, 2 genotypes (Table 2) namely IC202280 and EC528412 were completely free from disease during both the seasons of screening and they falls under the category of immune. Further, 53 genotypes having the average disease score ranging between 1.1 to 2.0 were found to be resistant. 39 genotypes have the disease score of 1.1-2.0 were moderately resistant, Ten genotypes have the disease score of 2.1-3.0 regarded as moderately susceptible. Genotype EC572715 was found to be susceptible with disease score of 3.1-4.0. The genotypes that showed 75-100% of susceptibility were regarded as highly susceptible. Four genotypes RCV 395, IC559405, CP3 and VRCP 144-5 were identified as highly susceptible. Similar results were reported by [8-13] in cowpea, and [6] in mungbean.

4. CONCLUSION

It is concluded that 2 genotypes namely IC202280 and EC528412 were completely free from diseases during both the seasons of screening and they falls under the category of immune. Hence these genotypes may be used as resistant donor for development of varieties/lines resistant to powdery mildew.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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