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# Screening of powdery mildew (*Erysiphe polygoni* DC.) tolerance in coriander (*Coriandrum sativum* L.) germplasm

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**Abstract**
Coriander is an annual seed spice crop, which belongs to family Apiaceae. It is native of Mediterranean region. The aromatic characters of plants are due to presence of linalool compound in essential oil of seeds. The green leaves of coriander are used in salads and are a good source of vitamin A and vitamin C. Powdery mildew of Coriander (*Coriandrum sativum* L.) caused by *Erysiphe polygoni* DC. Has become a serious and widespread problem in many parts of India, including Rajasthan. In order to manage air borne pathogens of coriander, resistant varieties serve as an eco-friendly approach. Field screening of coriander genotypes against this disease a study was conducted in agronomy research farm, Department of Plant breeding & genetics. Coriander one hundred twenty eight (128) accessions were screened to find out resistant sources against powdery mildew of coriander. Disease intensity (%) for coriander germplasm lines was calculated 110 days after sowing. Screening of germplasm lines revealed that minimum disease intensity of 32.40% was observed in UD-39 and maximum was found in UD-81 (92.40 %). Powdery mildew score ranged from 0.0 (free) to 5.0 (highly susceptible), 7 genotypes found moderately resistant, 31 genotypes showed susceptible and 90 genotypes comes under highly susceptible. Despite being high susceptible, some test entries produced good yield and showed tolerance to powdery mildew disease. Resistant genotype could be utilized as donar parent for powdery mildew resistance breeding programme. None of the line was found completely resistant against powdery mildew.

**Keywords:** Powdery mildew, coriander, *Erysiphe polygoni* DC., germplasm, screening, resistance

## Introduction
Coriander (*Coriandrum sativum* L.) is an important seed spice crop among the seed spices grown in India. It is herbaceous plant extensively grown in India almost in all states as spice. In 2019-20, Rajasthan is the second largest coriander producing state in India and it cultivated in 60.03 thousand hectors area and 86.00 thousand MT production with an average productivity of 1433 kg $ha^{-1}$. It is mainly grown in Jhalawar, Kota, Baran, Chittor and Bundi districts and holds the entire production in Rajasthan (Anonymous, 2020) [3]. However, the productivity of coriander is low compare to its potential yield. Growers are facing numerous problems in realizing the full production potential of coriander. It is realized that lack of suitable high yielding variety as well as poor knowledge of improved production technologies along with complex disease-pest syndrome, emergence of new biotypes and races of key pests and pathogens are major impediments in realizing the full potentialities of coriander production. With the development of high yielding, early maturing, fertilizer responsive varieties are a new proposition which would ensure stability and higher profit per unit area of land and has potential to produce 20-25% higher seed yield than other existing varieties (Nagar *et al*., 2009) [13].

Coriander (*Coriandrum sativum* L.) belongs to family Umbelliferae (Apiaceae) and is believed to be native of the Eastern Mediterranean region and Southern Europe. The aromatic characters of plants are due to presence of linolool compound in essential oil of seeds. The green leaves of coriander are used in salads and are a good source of vitamin A and vitamin C. The young plant leaves as well as the seed are used for the preparation of chutney and are also used as seasoning in curries, sauces, soup, cream sauce and fish sauce for chicken etc (Janardhan and Thoppil, 2004; Tiwary and Agarwal, 2004) [9, 20]. Coriander seeds have many medicinal properties also. The general chemical composition present in coriander fruits are water (11.37%), crude protein (11.49%), fat (19.15%), crude fibre (28.43%), starch (10.53%),

pentosans (10.29%), sugar (1.92%), mineral constituents (4.98%), essential oil (0.84%). (Diederichsen, 1996; Pathak *et al.*, 2011) [7, 16].

The crop suffers by several biotic stresses including powdery mildew. Powdery mildew is an important disease caused by *Erysiphe polygoni* DC (Dange *et al.*, 1992) [5]. It is also wide spread in distribution and appears in devastating form every year. It causes losses up to 15-40 per cent, in addition to considerable loss in quality of coriander seeds (Srivastava *et al.*, 1971) [19]. Under such favourable condition, losses may be as high as 50 percent in absence of effective control measures. The severity of the disease has increased in recent years due to changing in production practices, especially due to use of high yielding late maturing varieties in new environments (Singh, 2006) [18]. The great economic importance of coriander, powdery mildew disease is major problem of coriander cultivation in our country. Powdery mildew affected plants leading to production of small shrivelled seeds, thereby reducing the yield and quality. The pathogen (*Erysiphe polygoni*) attacks on coriander plants. It appears as small, white circular patches on young parts of stems and leaves. The increases in size, often coalesce to cover extensive areas of leaf surface. Affected leaves are reduced in size and distorted. Premature sterility is also common. In serve cases, the umbels dry up. Sometimes, the seeds are attached. Attack of this disease is seen during cloudy weather condition. White powdery growth appears on the leaves and bunds during its primary stage. Seed formation may not take place in affected plants due to this disease. In order to manage *Erysiphe polygoni* pathogens of coriander, chemical strategy is very effective but also delicate to environmental pollution, residual effect in grain and killing the non-target organisms (Kumar and Singh, 2017) [12]. Development of fungicide resistance in plant pathogens is a major obstacle of chemical strategy when use continuous and separately (Patel *et al.*, 2014) [14]. Keeping in view of an eco-friendly approach, the present study was conducted to explore the resistance source among various genotypes for management of coriander powdery mildew incidence.

## Materials and methods

The experiment was conducted at Agronomy Research Farm, ICAR-AICRP on Spices, SKN College of Agriculture, SKN Agriculture University, Jobner, Jaipur (Rajasthan) in *rabi* season of 2018- 2019 in an augmented randomised block design (Federer, 1956) [8]. The coriander seeds were sown in field in 4 blocks in one row plot of 3 x 0.3 sq.m. size with the spacing is 30 cm x 10 cm. The trial was sown in the month of November. All the recommended agronomic practices were followed during screening process. One hundred twenty eight (128) germplasm accessions were evaluated along with eight checks namely RCr-20, RCr-41, RCr-435, RCr-436, RCr-475, RCr-480, RCr-684 & RCr-728. Powdery mildew infected leaf samples were collected from the field. Spores were collected by tapping the leaf in sterile water. Powdery mildew spores collected in water was sprayed on to the coriander genotypes of flowering stage with the help of an atomizer. The reaction of each genotype for powdery mildew was scored, second, third and fourth week after inoculation. The observations on the powdery mildew disease was recorded from 10 randomly selected plants form each using as Anonymous (2004) [2] 0.0-4.0 scale. The scale used for the calculation of disease intensity is represented in table 1:

**Table 1:** Disease rating scale used for screening of coriander germplasm

| Rating | | Symptoms |
|---|---|---|
| 0.0 | : | Healthy/ No. incidence |
| 1.0 | : | Whitish small spots on the leaf |
| 2.0 | : | Whitish growth covering the entire leaf |
| 3.0 | : | Whitish growth on leaf and stem |
| 4.0 | : | Whitish growth on leaf, stem and umbel |

Number of lesions on each leaf were counted and per cent disease intensity (PDI) was calculated from the data recorded using the following formula:

The percent disease intensity (PDI) was calculated by using following formula:

$$PDI = \frac{\text{Sum of all numerical ratings}}{\text{No. of leaves observed X maximum rating}} \text{ X } 100$$

Based on the per cent disease intensity, the various genotypes were placed into different categories (Table 2) as per Datar & Mayee (1981) [6]:

**Table 2:** Categorization of germplasm lines based on disease intensity (%)

| Disease Intensity (%) | Category |
|---|---|
| 0 | Immune |
| 1-20 | Resistant |
| 21-40 | Moderately susceptible |
| 41-60 | Susceptible |
| >60 | Highly susceptible |

## Results

Field experiments were conducted to identify resistant sources against powdery mildew. Available genotypes were screened under field condition at the department of Plant Breeding & Genetics, SKN Agriculture University, Jobner during rabi 2018-19.Totally one hundred twenty eight along with eight checks genotypes were screened under artificial and natural field condition and the disease severity was recorded using 0.0-4.0 scale by randomly selecting ten plants. Screening of one hundred twenty eight (128) germplasm lines along with eight checks of coriander against powdery mildew (*Erysiphe polygoni* DC.) carried out under *in vivo* revealed that the minimum disease intensity of 32.40 % was observed in UD-39 followed by 34.80, 35.70, 36.60, 37.40, 38.40 and 39.60 % in UD-255, UD-361, UD-132, UD-37, UD-67 and UD-100 respectively, while it was recorded maximum in case of UD-81 with 92.40 % disease intensity. None of the line was found completely resistant against powdery mildew though UD-39 and UD-255 exhibited significantly low disease intensity as compared to other germplasm lines revealing wider adaptability of the pathogen.

Reaction of the genotypes for powdery mildew incidence was recorded after inoculation and is presented in Table 3. Further the genotypes were grouped into 5 categories by considering the disease intensity score at flowering and grain filling stage after inoculation (Table 4). The rabi season was favourable for powdery mildew disease incidence. Out of the one hundred twenty eight (128) genotypes screened at present 31 genotypes were susceptible and 90 genotypes were highly susceptible and none of them showed immune or resistant and 7 genotypes moderately resistant reaction. However, moderately resistant genotypes (UD-37, UD-39, UD-67, UD-100, UD-132, UD-255 and UD-361) and 31 susceptible genotypes which were showed slow progress of disease when compared to highly susceptible genotypes.

**Table 3:** Disease reaction of coriander genotypes against powdery mildew under field conditions

| S. No. | Genotypes | Powdery mildew (PDI) | Disease reaction | S. No. | Genotypes | Powdery mildew (PDI) | Disease reaction |
|---|---|---|---|---|---|---|---|
| 1. | UD-1 | 64.25 | HS | 70. | UD-207 | 71.90 | HS |
| 2. | UD-3 | 53.45 | S | 71. | UD-209 | 54.90 | S |
| 3. | UD-5 | 67.50 | HS | 72. | UD-211 | 49.50 | S |
| 4. | UD-8 | 78.90 | HS | 73. | UD-214 | 59.30 | S |
| 5. | UD-12 | 62.40 | HS | 74. | UD-218 | 54.30 | S |
| 6. | UD-14 | 58.30 | S | 75. | UD-220 | 58.60 | S |
| 7. | UD-15 | 72.50 | HS | 76. | UD-225 | 76.70 | HS |
| 8. | UD-20 | 78.40 | HS | 77. | UD-232 | 43.50 | S |
| 9. | UD-21 | 58.25 | S | 78. | UD-238 | 72.40 | HS |
| 10. | UD-25 | 74.60 | HS | 79. | UD-246 | 58.40 | S |
| 11. | UD-26 | 59.20 | S | 80. | UD-247 | 58.90 | S |
| 12. | UD-27 | 48.05 | S | 81. | UD-248 | 54.20 | S |
| 13. | UD-28 | 84.25 | HS | 82. | UD-255 | 34.80 | MR |
| 14. | UD-29 | 56.30 | S | 83. | UD-257 | 63.40 | HS |
| 15. | UD-30 | 77.40 | HS | 84. | UD-258 | 70.50 | HS |
| 16. | UD-35 | 78.95 | HS | 85. | UD-259 | 73.40 | HS |
| 17. | UD-37 | 37.40 | MR | 86. | UD-261 | 78.30 | HS |
| 18. | UD-38 | 63.25 | HS | 87. | UD-266 | 78.30 | HS |
| 19. | UD-39 | 32.40 | MR | 88. | UD-268 | 66.40 | HS |
| 20. | UD-40 | 87.60 | HS | 89. | UD-271 | 71.50 | HS |
| 21. | UD-41 | 68.90 | HS | 90. | UD-281 | 68.90 | HS |
| 22. | UD-46 | 82.40 | HS | 91. | UD-286 | 78.05 | HS |
| 23. | UD-50 | 75.90 | HS | 92. | UD-287 | 62.50 | HS |
| 24. | UD-52 | 79.80 | HS | 93. | UD-288 | 64.80 | HS |
| 25. | UD-53 | 88.50 | HS | 94. | UD-290 | 69.20 | HS |
| 26. | UD-54 | 76.30 | HS | 95. | UD-292 | 74.20 | HS |
| 27. | UD-57 | 65.35 | HS | 96. | UD-293 | 64.90 | HS |
| 28. | UD-58 | 65.85 | HS | 97. | UD-296 | 79.10 | HS |
| 29. | UD-60 | 76.75 | HS | 98. | UD-301 | 62.50 | HS |
| 30. | UD-61 | 52.40 | S | 99. | UD-303 | 58.30 | S |
| 31. | UD-62 | 65.40 | HS | 100. | UD-304 | 47.20 | S |
| 32. | UD-63 | 62.50 | HS | 101. | UD-307 | 77.60 | HS |
| 33. | UD-65 | 50.45 | S | 102. | UD-309 | 74.50 | HS |
| 34. | UD-66 | 55.50 | S | 103. | UD-310 | 79.50 | HS |
| 35. | UD-67 | 38.40 | MR | 104. | UD-311 | 72.80 | HS |
| 36. | UD-70 | 55.90 | S | 105. | UD-312 | 84.20 | HS |
| 37. | UD-71 | 76.40 | HS | 106. | UD-313 | 57.40 | S |
| 38. | UD-73 | 72.45 | HS | 107. | UD-317 | 78.40 | HS |
| 39. | UD-75 | 70.60 | HS | 108. | UD-343 | 73.60 | HS |
| 40. | UD-76 | 86.05 | HS | 109. | UD-344 | 72.60 | HS |
| 41. | UD-77 | 76.90 | HS | 110. | UD-354 | 76.20 | HS |
| 42. | UD-78 | 71.40 | HS | 111. | UD-355 | 67.30 | HS |
| 43. | UD-79 | 84.90 | HS | 112. | UD-356 | 66.90 | HS |
| 44. | UD-81 | 92.40 | HS | 113. | UD-357 | 78.40 | HS |
| 45. | UD-82 | 67.50 | HS | 114. | UD-361 | 35.70 | MR |
| 46. | UD-83 | 69.40 | HS | 115. | UD-380 | 58.30 | S |
| 47. | UD-86 | 73.50 | HS | 116. | UD-406 | 77.30 | HS |
| 48. | UD-87 | 81.70 | HS | 117. | UD-407 | 61.50 | HS |
| 49. | UD-88 | 90.50 | HS | 118. | UD-408 | 78.40 | HS |
| 50. | UD-90 | 58.45 | S | 119. | UD-409 | 57.90 | S |
| 51. | UD-91 | 79.60 | HS | 120. | UD-410 | 69.30 | HS |
| 52. | UD-92 | 82.60 | HS | 121. | UD-411 | 64.20 | HS |
| 53. | UD-93 | 50.30 | S | 122. | UD-412 | 61.40 | HS |
| 54. | UD-96 | 55.70 | S | 123. | UD-413 | 65.90 | HS |
| 55. | UD-99 | 68.05 | HS | 124. | UD-414 | 63.60 | HS |
| 56. | UD-100 | 39.60 | MR | 125. | UD-415 | 72.40 | HS |
| 57. | UD-120 | 79.90 | HS | 126. | UD-416 | 66.80 | HS |
| 58. | UD-123 | 64.20 | HS | 127. | UD-417 | 67.50 | HS |
| 59. | UD-125 | 76.40 | HS | 128. | UD-418 | 64.70 | HS |
| 60. | UD-132 | 36.60 | MR | Checks: | | | |
| 61. | UD-139 | 64.20 | HS | 1. | RCr-20 | 73.90 | HS |
| 62. | UD-150 | 55.90 | S | 2. | RCr-41 | 48.40 | S |
| 63. | UD-155 | 58.60 | S | 3. | RCr-435 | 61.60 | HS |
| 64. | UD-156 | 84.30 | HS | 4. | RCr-436 | 52.50 | S |
| 65. | UD-169 | 47.30 | S | 5. | RCr-475 | 68.40 | HS |
| 66. | UD-176 | 92.05 | HS | 6. | RCr-480 | 62.80 | HS |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 67. | UD-180 | 72.05 | HS | 7. | RCr-684 | 56.40 | S |
| 68. | UD-182 | 53.40 | S | 8. | Local check | 69.50 | HS |
| 69. | UD-202 | 78.50 | HS | | | | |

**Table 4:** Categorization of germplasm lines based on disease reaction

| S. No. | Disease reaction | No. of Genotypes | Percent of Genotype | Genotypes |
|---|---|---|---|---|
| 1 | No disease (0) | 0 | 0 | Nil |
| 2 | Resistant (1-20) | 0 | 0 | Nil |
| 3 | Moderately resistant (21-40) | 7 | 5.47 | UD-37, UD-39, UD-67, UD-100, UD-132, UD-255 and UD-361 |
| 4 | Susceptible (41-60) | 31 | 24.22 | UD-3, UD-14, UD-21, UD-26, UD-27, UD-29, UD-61, UD-65, UD-66, UD-70, UD-90, UD-93, UD-96, UD-150, UD-155, UD-169, UD-182, UD-209, UD-211, UD-214, UD-218, UD-220, UD-232, UD-246, UD-247, UD-248, UD-303, UD-304, UD-313, UD-380 and UD-409 |
| 5 | Highly susceptible (>60) | 90 | 70.31 | Rest of genotypes were high susceptible. |

## Discussion

Screening of various germplasm lines is essential to find out the potential resistance source. Though there are reports indicating use of resistant varieties against a number of diseases in many crops, a meager information is available with respect to coriander. In the present investigation, screening of various germplasm lines of coriander against powdery mildew under *in vivo* conditions indicated maximum disease intensity of 92.40 in UD-81 while a minimum of 32.40 % disease in UD-39.

One hundred twenty eight along with eight checks of coriander were screened against powdery mildew disease under this trial. Among the tested lot, seven entry *viz*., UD-37, UD-39, UD-67, UD-100, UD-132, UD-255 and UD-361 showed moderately resistant and thirty one entries *viz*., UD-3, UD-14, UD-21, UD-26, UD-27, UD-29, UD-61, UD-65, UD-66, UD-70, UD-90, UD-93, UD-96, UD-150, UD-155, UD-169, UD-182, UD-209, UD-211, UD-214, UD-218, UD-220, UD-232, UD-246, UD-247, UD-248, UD-303, UD-304, UD-313, UD-380 and UD-409 showed susceptible reaction against the disease (Table 1 & 2). Variation in degree of resistance among different varieties or genotypes of coriander against powdery mildew has also been reported by Keshwal and Khatri, (1998) [11], Kalra *et al*., (2003) [10], Patel *et al*., (2008) [15], Bandela *et al*., (2014) [4], Singh and Rao (2016) [17] and Amin *et al*., (2017) [1]. The management of the disease through host plant resistance has been the best and cheapest choice in all the crops. Utilisation of resistant cultivars in farming systems is the most simple, effective and economical method in the management of disease. Besides this, these resistant cultivars conserve natural resources and reduce the cost, time and energy compared to the other methods of disease management. This slow mildewing character could be studied in detailed and further utilized in breeding programme.

## Conclusion

The present study provides a feasible approach to screen and identify coriander accessions possessing resistance against pathogen *Erysiphe polygoni*. The accessions UD-37, UD-39, UD-67, UD-100, UD-132, UD-255 and UD-361 possessed moderately resistant against powdery mildew. These can be utilized as donors for disease resistance breeding.

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