International Journal of Economic Plants

https://ojs.pphouse.org/index.php/IJEP

Crossref

IJEP July 2025, 12(4): 01-05

Article IJEP6162a

Full Research

Natural Resource Management

Doi: HTTPS://DOI.ORG/10.23910/2/2025.6162a

Screening of Cucumber (*Cucumis sativus* L.) Genotypes for Resistant Sources under Low Hill Regions of Himachal Pradesh

Riya Rani*, Pallavi Sharma[1], B. S. Dogra[1], Monica Sharma[2], Manisha Kumari[1] and Shivali Dhiman[1]

[1]Dept. of Vegetable Science, Dr. Y. S. Parmar University, College of Horticulture & Forestry, Neri, Hamirpur, Himachal Pradesh (177 001), India

[2]Dept. of Plant Pathology, College of Horticulture & Forestry, Neri, Hamirpur, Himachal Pradesh (177 001), India

Corresponding Author

Riya Rani

e-mail: riyakanungo99@gmail.com

Article History

Received on 20th March, 2025

Received in revised form on 28th May, 2025

Accepted in final form on 10th June, 2025

Published on 18th June, 2025

Abstract

The experiment was conducted during June, 2021 to September, 2021 at the Experimental Farm of Department of Vegetable Science, College of Horticulture & Forestry, Neri, Hamirpur, Himachal Pradesh, India with aim to identify downy and powdery mildew resistant genotype in cucumber. Twenty genotypes of cucumber were evaluated in Randomized Complete Block Design during rainy season (June–September), 2021. During periodic survey, downy mildew and powdery mildew diseases recorded in the field. Percent disease index in all genotypes of cucumber for downy mildew and powdery mildew ranged between 9.53–52.77 and 6.78–36.66, respectively. Maximum Percent disease index for downy mildew was observed in LC-C-2-21 (52.77) and minimum in LC-C-9-21 (9.53), whereas maximum Percent diseases index for powdery mildew was observed in LC-C-10-21(36.66) and minimum in Solan Srijan (6.78). Seven genotypes viz., LC-C-4-21, LC-C-6-21, LC-C-7-21, LC-C-9-21, LC-C-12-21, LC-C-14-21, Solan Srijan were found resistant and LC-C-2-21, LC-C-10-21 were susceptible to downy mildew diseases and rest of genotypes were found to be moderately resistant to disease. None of genotype was observed to be immune, resistant and highly susceptible to powdery mildew diseases. Two genotypes were found moderately resistant while ten genotypes were moderately susceptible and eight genotypes viz., LC-C-2-21, LC-C-3-21, LC-C-4-21, LC-C-7-21, LC-C-10-21, LC-C-14-21, LC-C-15-21, LC-C-16-21were susceptible to powdery mildew. From our study, LC-C-9-21 and Solan Srijan genotypes were recommended to farmer for getting higher production under low hill of Himachal Pradesh and to breeder for further resistance breeding programme.

Keywords: Percent disease index (PDI), downy mildew, powdery mildew, genotypes

1. Introduction

Cucumber (*Cucumis sativus* L.) belonging to family Cucurbitaceae is one of the important vegetable crops of tropical and sub-tropical areas in India. It is a thermophilic, day neutral and frost susceptible crop, which require warm weather and bright light for its better growth and development. However, it can be grown in both summer and rainy seasons. Its fruits are consumed either raw as salad, cooked as vegetable or as pickling cucumber in its immature stage. It is also used as medicinally important crop as it is rich source of vitamin C, carbohydrate, protein, minerals like calcium and phosphorus; possess astringent, antipyretic and cooling properties (Sambou et al., 2023). Downy and powdery mildew are serious diseases affecting cucurbitaceous crops in India, causing significant yield losses. These diseases can result in yield reductions of up to 50–70% (Sarhan et al., 2020). Downy mildew is caused by *Pseudopernospora cubensis* (Berk & Curt) (Sun et al., 2022), while powdery mildew is caused by *Erysiphe cichoracearum* (Schlecht Fr) (Mostafa et al., 2021). Downy and powdery mildew diseases mainly affect on leaves of cucumber, whereas in case of downy mildew undersides of the leaves, a grayish to purplish downy growth can be seen, especially under humid conditions Whereas, the resistant genotypes show hypersensitive response (HR) with small necrotic spots (Call et al., 2012 and Gautam et al., 2020). In powdery mildew, powdery spots are developed all over the leaves (Morishita et al., 2003). As this significantly cause the losses in cucumber production. For management of these diseases intensive sprays are required but that causes pesticides residue problems (Sharma et al., 2022). So the most effective way of combating diseases is the production of cucumber hybrids with multiple disease resistance. Due to the unfavorable climatic conditions, resistant varieties are becoming susceptible and also not showing consistent resistance (Charoenwattana, 2017 and Chakraborty, 2022). A few commercial cucumber varieties or hybrids resistant to downy and powdery mildew diseases are currently available in India.

In recent studies, researchers have focused on understanding the genetic basis of disease resistance in cucumbers to facilitate the development of resistant varieties. For instance, sequencing of the cucumber genome has provided valuable insights into the genes responsible for disease resistance, enabling targeted breeding programs (Huang et al., 2009). Marker-assisted selection (MAS) is being utilized to enhance breeding efficiency for disease-resistant traits (Ren et al., 2015). Cultural practices also play a crucial role in managing cucumber diseases. Crop rotation, the use of resistant cultivars, and maintaining proper plant spacing can reduce disease incidence. Integrated Pest Management (IPM) strategies, combining biological control agents, resistant varieties, and reduced pesticide use, have shown promising results in managing downy and powdery mildew in cucumbers (McGrath, 2017). Considering the impact of climate change on disease dynamics, continuous monitoring and adaptation of management practices are essential. Climate-resilient varieties and sustainable agricultural practices will be pivotal in ensuring the long-term productivity and sustainability of cucumber cultivation in India (Choudhury et al., 2018). Research indicates that elevated CO_2 levels and temperature fluctuations can influence the incidence and severity of cucumber diseases, necessitating the development of adaptive strategies (Pangga et al., 2011). There is need to evaluating various genotypes for disease resistance, yield performance, and adaptability to local climatic conditions, providing valuable data for breeding programs (Singh et al., 2021). Thus, this research was conducted with the objective to identify genotypes with inherent resistance to downy and powdery mildew diseases, contributing to the development of resilient cucumber varieties that suitable to local climatic condition.

2. Materials and Methods

The present investigation was conducted from June, 2021 to September, 2021 at the Experimental Farm of Department of Vegetable Science at College of Horticulture & Forestry, Neri, Hamirpur, Himachal Pradesh, India situated in the low hill zone of Himachal Pradesh. Twenty different genotypes of cucumbers were collected from various locations and screened against downy and powdery mildew under natural field conditions. Three to four seeds hill^{-1} were sown in the mid of June at spacing of 1.25×0.5 m^2 in a plot having size of 2.5×2.5 m^2 each, accommodating 10 hills plot^{-1}. To ensure healthy crop other cultural operations like thinning, hoeing, weeding, irrigations and plant protection measures were carried out as per package of practices. Percent Disease Index (PDI) of diseases viz., downy mildew and powdery mildew, was recorded periodically in the month of July–August and September, respectively. Twelve leaves were randomly selected from three vines of each genotype. Percent disease index (PDI) of downy mildew was recorded on 0–4 scale, suggested by Bhardwaj et al. (2018) (Table 1).

Table 1: Scale to record downy mildew disease in cucumber

Leaf area infected (%)	Rating/ Score	Symptoms
0.0	0	Plants completely healthy with no downy mildew symptoms
0.1–25.0	1	Plants show slightly infection roughly one in every four leaves infected
25.1–50.0	2	Upto 50% of the leaves infected
50.1–75.0	3	Upto 75% of the foliage infected, the plants appear to be mildewed
75.1–100.0	4	Almost all the leaves are infected

Using symptomatic leaf area data, the PDI was calculated using the formula given by (McKinney, 1923) and the genotypes were categorized into four groups namely resistant (0-20%), moderately resistant (21–40%), susceptible (41–60%) and highly susceptible (>60%), suggested by Reddy (2002). Percent disease index (PDI) of powdery mildew recorded on 0-5 scale adopted by Sen and Kapoor (1974) (Table 2).

Table 2: Scale to record powdery mildew disease in cucumber

Leaf area infected (%)	Rating/ Score	Category	Symptoms
0.0	0	Immune	No spots
0.1–0.5	1	Resistant	Leaves apparently free from spots or 2–3 specks on the lower leaves only
5.1–15.0	2	Moderately resistant	25% leaf area covered with specks, spots restricted
15.1–25.0	3	Moderately susceptible	50% leaf area covered on both the surfaces with specks
25.1–50.0	4	Susceptible	75% leaf area covered with specks which coalesce at places. Both sides of the leaves affected
Above 50	5	Highly susceptible	Leaves heavily infected with spots coalescing to cover almost the whole leaf on both surfaces; stems and petioles also infected

Percent disease index was calculated (McKinney, 1923) as follows:

PDI=(Sum of all disease rating/Total no.of ratings×Maximum disease grade)×100

3. Results and Discussion

Twenty genotypes were screened against downy mildew and powdery mildew disease under natural field conditions to identify the resistance source during rainy season 2021. Data recorded on PDI of downy mildew and powdery mildew, revealed the presence of significant difference among all the genotypes. The downy mildew disease is usually favoured by high rainfall with moderate temperature and a relative humidity of more than 80% and these conditions were met during the month of July–August in the experimental field. The prevalence of dry weather with moderate to warm temperature in field resulted in causing powdery mildew diseases during September month in field. Percent Disease Index (PDI) of downy mildew ranged from 9.53–52.77 with a mean of 24.72 (Table 3). Minimum PDI (9.53) was recorded in genotype LC-C-9-21, which was statistically at par with Solan Srijan (10.41) and LC-C-7-21 (10.41). Maximum PDI was observed in LC-C-2-21 (52.77) followed by LC-C-10-21 (52.07). Seven genotypes viz., LC-C-4-21, LC-C-6-21, LC-C-7-21, LC-C-9-21, LC-C-12-21, LC-C-14-21, Solan Srijan were found resistant while eleven genotypes viz., LC-C-1-21, LC-C-3-21, LC-C-5-21, LC-C-8-21, LC-C-11-21, LC-C-13-21, LC-C-15-21, LC-C-16-21, Punjab Naveen, Pant Khira, K-75 recorded moderately resistant and rest of the genotypes viz., LC-C-2-21, LC-C-10-21 were susceptible to downy mildew diseases. None of the genotype

Table 3: Percent disease index of different diseases and mean performance of cucumber genotypes for total yield plot^{-1}

Genotype	Downy mildew		Powdery mildew		Total yield plot^{-1} (kg)
	Percent disease index*	Diseases reaction	Percent disease index*	Diseases reaction	
LC-C-1-21	27.08 (31.33)	Moderate resistant	20.89 (27.09)	Moderately susceptible	16.34
LC-C-2-21	52.77 (46.57)	Susceptible	25.27 (30.10)	Susceptible	2.97
LC-C-3-21	27.50 (31.55)	Moderate resistant	32.77 (34.90)	Susceptible	7.27
LC-C-4-21	17.24 (24.52)	Resistant	26.11 (30.69)	Susceptible	19.00
LC-C-5-21	22.21 (28.01)	Moderate resistant	20.55 (26.94)	Moderately susceptible	10.02
LC-C-6-21	18.75 (25.62)	Resistant	21.66 (27.65)	Moderately susceptible	12.00
LC-C-7-21	10.41 (18.76)	Resistant	29.11 (32.59)	Susceptible	13.79
LC-C-8-21	23.61 (29.02)	Moderate resistant	17.10 (24.42)	Moderately susceptible	14.56
LC-C-9-21	9.53 (17.94)	Resistant	7.52 (15.87)	Moderately resistant	15.76
LC-C-10-21	52.07 (46.17)	Susceptible	36.66 (37.25)	Susceptible	3.00
LC-C-11-21	31.25 (33.96)	Moderate resistant	18.70 (25.61)	Moderately susceptible	10.57
LC-C-12-21	16.66 (23.97)	Resistant	17.22 (24.50)	Moderately susceptible	10.86
LC-C-13-21	22.91 (28.57)	Moderate resistant	20.55 (26.92)	Moderately susceptible	9.27
LC-C-14-21	16.66 (30.42)	Resistant	27.70 (31.74)	Susceptible	18.03
LC-C-15-21	31.94 (34.39)	Moderate resistant	29.44 (32.69)	Susceptible	4.57
LC-C-16-21	25.69 (30.42)	Moderate resistant	35.55 (36.58)	Susceptible	12.36
Punjab Naveen	25.69 (30.42)	Moderate resistant	19.09 (25.87)	Moderately susceptible	11.28
Pant Khira	25.69 (30.38)	Moderate resistant	24.99 (29.92)	Moderately susceptible	14.38
K-75	26.39 (30.79)	Moderate resistant	23.33 (28.86)	Moderately susceptible	8.99
Solan Srijan	10.41 (18.76)	Resistant	6.78 (14.98)	Moderately resistant	15.06
Mean	24.72		23.05		11.50
Range	9.53–52.77		6.78–36.66		2.97–19.00
SEm±	1.34		1.32		0.38
C.V%	7.96		8.07		5.78
CD (p=0.05)	3.86		3.78		1.10

*values in the parenthesis are the angular transformed values was found to be highly susceptible to downy mildew diseases (Table 4). However, these results are in agreement with the findings of Gaikwad et al., 2011 who had also reported significant variation for percent disease index of downy mildew disease in cucumber. The downy mildew disease is usually favoured by high rainfall with moderate temperature and a relative humidity of more than 80% and these conditions are met during the month of July–August at Neri conditions.

Table 4: Disease reaction of downy mildew disease on genotypes of cucumber

Diseases reaction	Genotypes
Resistant (0–20%)	LC-C-4-21, LC-C-6-21, LC-C-7-21, LC-C-9-21, LC-C-12-21, LC-C-14-21, Solan Srijan
Moderately resistant (21–40%)	LC-C-1-21, LC-C-3-21, LC-C-5-21, LC-C-8-21, LC-C-11-21, LC-C-13-21, LC-C-15-21, LC-C-16-21, Punjab Naveen, Pant Khira, K-75
Susceptible (41–60%)	LC-C-2-21, LC-C-10-21
Highly susceptible (>60%)	

Percent Disease Index (PDI) of powdery mildew is ranged from 6.78–36.66 (Table 3). The minimum PDI was observed in Solan Srijan (6.78) which was statistically at par with LC-C-9-21 (7.52). Maximum PDI was observed in LC-C-10-21 (36.66) which was statistically similar with LC-C-16-21 (35.55) and LC-C-3-21 (32.77). Two genotypes viz., LC-C-9-21, Solan Srijan were found moderately resistant while ten genotypes viz., LC-C-1-21, LC-C-5-21, LC-C-6-21, LC-C-8-21, LC-C-11-21, LC-C-12-21, LC-C-13-21, Punjab Naveen, Pant Khira, K-75 were moderately susceptible and eight genotypes viz., LC-C-2-21, LC-C-3-21, LC-C-4-21, LC-C-7-21, LC-C-10-21, LC-C-14-21, LC-C-15-21, LC-C-16-21were susceptible to powdery mildew. None of genotype was observed to be immune, resistant and highly susceptible to diseases (Table 5). The prevalence of dry weather with moderate to warm temperature in field resulted in causing powdery mildew diseases. Pitchaimuthu et al., 2012, Sharma et al., 2017 and Chakraborty et al., 2019, Sarhan et al., 2020 and Singh et al., 2021 had also reported sufficient variation for powdery mildew disease among the different cucumber genotypes.

In relation to yield, the result revealed that the genotypes show maximum Percent disease index have minimum yield plot^{-1} and which shows minimum Percent disease index had maximum yield plot^{-1}. Thus, this concluded that genotypes having resistance as well as maximum yield used as source for further breeding programme (Table 3).

The management of the disease through resistance lines/ variety has been the best choice in the entire disease management programme. Utilization of resistant varieties in farming system 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.

Table 5: Disease reaction of powdery mildew disease on genotypes of cucumber

Diseases reaction	Genotypes
Immune (0%)	
Resistant (0.1–5%)	
Moderately resistant (5.1–15%)	LC-C-9-21, Solan Srijan
Moderately susceptible (15.1–25%)	LC-C-1-21, LC-C-5-21, LC-C-6-21, LC-C-8-21, LC-C-11-21, LC-C-12-21, LC-C-13-21, Punjab Naveen, Pant Khira, K-75
Susceptible (25.1–50%)	LC-C-2-21, LC-C-3-21, LC-C-4-21, LC-C-7-21, LC-C-10-21, LC-C-14-21, LC-C-15-21, LC-C-16-21
Highly susceptible (>50%)	

4. Conclusion

LC-C-9-21 and Solan Srijan used as resistant source for development of resistant variety in cucumber for low hill region of Himachal Pradesh. Genotypes that show both resistance to the disease (minimum disease index) and high yield plot^{-1} are identified as ideal candidates for further breeding programs. These LC-C-9-21 and Solan Srijan genotypes were valuable because they combine disease resistance with high productivity, become desirable for developing new varieties with disease resistant trait. Thus, this research become valuable for low hill region farmer for higher cucumber production as well as for breeder to conduct further breeding programme.

5. References

Bhardwaj, D.R., Gautam, K.K., Saha, S., Nagendran, K., Pandey, K.K., Singh, A.K., Singh, P.M., Singh, B., 2018. Mining the source of resistance for downy mildew and gummy stem blight in bottle gourd (*Lagenaria siceraria*) accessions. Indian Journal of Agricultural Sciences 88, 746–750.

Call, A.D., Criswell, A.D., Wehner, T.C., Klosinska, U., Kozik, E.U., 2012. Screening cucumber for resistance to downy mildew caused by *Pseudoperonospora cubensis* (Berk. and Curt.) Rostov. Crop Science 52(2), 577–592.

Chakraborty, D., Kumar, M., Wangchu, L., Singh, S., Pandey, A.K., 2019. Genetic diversity among landraces of cucumber (*Cucumis sativus* L.) from North East India. Bangladesh Journal of Botany 48, 481–488.

Chakraborty, S., Chattopadhyay, A., Asit, Mandal, K., 2022. Screening of cucumber genotypes against downy mildew disease and its relationship with biochemical parameters. Indian Phytopathology 75(2). DOI: 10.1007/s42360-022-00488-7.

Charoenwattana, P., Khanobdee, C., Udomyotin, A., 2017. Screening techniques for downy mildew resistance in gherkin cucumbers. International Journal of GEOMATE 13(40), 35–42.

Choudhury, B.U., Mohanty, M., Das, A., 2018. Climate change and its impact on disease dynamics in cucurbit crops. Journal of Environmental Management 222, 103–112.

Gaikwad, A.G., Musmade, A.M., Dhumal, S.S., Sonawane, H.G., 2011. Variability studies in cucumber (*Cucumis sativus* L.). Ecology, Environment and Conservation 17, 799–802.

Gautam, D., Nath, R., Gaikwad, A.B., Bhat, K.V., Mondal, B., Akhtar, J., Jat, G.S., Iquebal, A.M., Tiwari, B., Archak, S., 2020. Identification of new resistant sources against downy mildew disease from a selected set of cucumber germplasm and its wild relatives. Indian Journal of Genetics 80(4), 427–431.

Huang, S., Li, R., Zhang, Z., Li L., Gu, X., Fan, W., Lucas, W.J., Wang, X., Xie, B., Ni, P., Ren, Y., Zhu, H., Li, J., Lin, K., Jin, W., Fei, Z., Li, G., Staub, J., Kilian, A., Vossen, E.V., Wu, Y., Jia, Z., Li. S., 2009. The genome of the cucumber, *Cucumis sativus* L. Nature Genetics 41(12), 1275–1281.

McGrath, M.T., 2017. Integrated management of downy and powdery mildew in cucumbers. Plant Disease Management Reports 11, 42–48.

McKinney, H.H., 1923. A new system of grading plant diseases. Journal of Agricultural Research 26, 195–218.

Morishita, M., Sugiyama, K., Saito, T., Sakata, Y., 2003. Powdery mildew resistance in cucumber. Japan Agricultural Research Quarterly 37(1), 7–14.

Mostafa, Y.S., Hashem, M., Alshehri, A.M., Alamri, S., Eid, E.M., Ziedan, E.S.H.E., Alrumman, S.A., 2021. Effective management of cucumber powdery mildew with essential. Agriculture 11*,* 1177. https://doi.org/10.3390/agriculture11111177.

Pangga, I.B., Hanan, J., Chakraborty, S., 2011. Pathogen dynamics in a crop canopy and their evolution under changing climate. Plant Pathology 60(1), 70–81.

Pitchaimuthu, M.K., Souravi, Ganeshan, G., Kumar, S., Pushpalatha, R., 2012. Identification of sources of resistance to powdery and downy mildew diseases in cucumber (*Cucumis sativus* L.). Pest Management in Horticultural Ecosystems 18(1), 105–107.

Reddy, N.S., 2002. Biochemical mechanism of downy mildew resistance in muskmelon (*Cucumis melo* L.) caused by *Pseudoperonospora cubensis* (Berk and Curt) Rostow. Ph.D. Thesis. University of Agricultural Sciences, Bangalore, 96.

Ren, Y., McGregor, C., Zhang, Y., Xie, B., 2015. Marker-assisted selection for disease resistance in cucumber. Plant Breeding Reviews 38, 205–240.

Sambou, A., Ayessou, N., Samb, N.W., 2023. Nutritional values of green and white cucumber (*Cucumis sativus* L.) and African horned cucumber (*Cucumis metuliferus* E.). Journal of Horticulture and Postharvest Research 6, 221–234.

Sarhan, E.A.D., Abd-Elsyed, M.H.F., Ebrahiem, A.M.Y., 2020. Biological control of cucumber powdery mildew (*Podosphaera xanthii*) (Castagne) under greenhouse conditions. Egyptian Journal of Biological Pest Control 30, 65.

Sen, B., Kapoor, I.J., 1974. Field trials of systemic and non-systemic fungicides against powdery mildew of cucurbits. Pesticides 8, 43–46.

Sharma, A., Jarial, K., Jarial, R.S., Sharma, D., 2022. Effect of sowing dates on the bacterial leaf spot of bottle gourd and pumpkin caused by *Xanthomonas cucurbitae*. International Journal of Bio-resource and Stress Management 13(1), 106–113.

Sharma, S., Kumar, R., Sharma, H.R., 2017. Studies on variability, heritability and genetic gain in Cucumber (*Cucumis sativus* L.). Indian Journal of Ecology 44, 829–833.

Singh, A., Yadav, D., Kumar, V., Sharma, V., 2021. Screening of cucumber genotypes for resistance to downy and powdery mildew under field conditions. Journal of Plant Protection Research 61(3), 234–240.

Sun, Z., Yu, S., Hu, Y., Wen, Y., 2022. Biological control of the cucumber downy mildew pathogen *Pseudoperonospora cubensis*. Horticulturae 8(5), 410.