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Studies on powdery mildew disease of advanced mutants lines in menthol mint

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Abstract
The present investigation was carried out during *rabi* - 2021-22 at Kittur Rani Channamma College of Horticulture, Arabhavi, Belagavi district, Karnataka. cv. Kosi and Kranthi were subjected to gamma irradiation and ten advanced mutants along with two checks cv. Kosi and CIM Kranthi were selected from M_4 generation and evaluated for powdery mildew disease reaction under natural ecosystem in the months of November 2020 to February 2021. Among all the mutants highest percent disease incidence of powdery mildew was recorded by $K_{20}P_{41}$ and $K_{20}P_{23}$ at 70 Days after planting(DAP), 80 DAP and 90 DAP by showing small patches of white colored powdery masses on the upper surface of menthol mint leaves with chlorotic lesions on the opposite surface. When the disease progressed, these powdery patches grew in size and covered the entire abaxial surface of leaves causing defoliation and it happens in the mutant lines of Kranthi lineages. Significantly it reduces the crop production and cause serious economic losses upto10-20 percent (Kalra *et al.*, 2005).

Keywords: Japanese mint, lamiaceae, mutant lines, *Erysiphe cichoracearum* disease, symptoms

Introduction
Aromatic plants are attracting a lot of interest because they provide a wide range of safe, affordable, preventive and curative therapies that are helpful in achieving the objective of "health for all" (Suresh *et al.*, 2012) [14]. While there are many aromatic plants, among them mint is the most important one growing in India. Many species of mints are being commercially cultivated in different parts of the world (Kumar *et al.*, 2008) [5]. Recently based on morphological, cytological and genetic characteristics genus Mentha has been classified into 42 species, 15 hybrids and hundreds of subspecies, varieties and cultivars (Rhouma *et al.*, 2021) [9]. Among them only four species including Menthol mint (*Mentha arvensis* L.), Peppermint (*Mentha piperita*), Bergamot mint (*Mentha citrata*) and Spearmint (*Mentha spicata*) are predominantly cultivated in India. India is a top supplier of Menthol mint oil in the world and a large number of farmers in India are benefitted by its cultivation (Sharma *et al.*, 2019) [11]. *Mentha arvensis* L. (2n = 96) is also called as Japanese mint, corn mint, field mint, or wild mint, It is believed that this species was originated in the Mediterranean basin and, from there it spread to the rest of the world by both natural and artificial means (Salehi *et al.*, 2018) [10]. It is cultivated on a huge scale in Brazil, China, Paraguay, Japan, Thailand, Angola and India. In India it is largely confined to North India specially Uttar Pradesh, Punjab and Haryana. Temperate to tropical climate is suitable and sunny weather along with moderate rainfall is required for its luxuriant growth. A deep soil, rich in humus which can retain moisture is suitable for mint cultivation.
Crop loss due to diseases has been identified as a major production constraint for mint. It has been reported to be affected by several diseases like rust (*Puccinia mentha*), leaf blight (*Rhizoctonia solani*), leaf spot (*Alternaria alternate*), wilt (*Verticillium dahliae*), stolon rot (*R. solani/bataticola*), stem rot (*Phoma stasseri*) and powdery mildew (*Erysiphe cichoracearum*) among them powdery mildew is very important in the view of crop loses (Kalra *et al.*, 2001) [3].

The causative agent of powdery-mildew disease

Powdery mildew fungi belong to the Erysiphaceae family (Rhouma *et al*., 2021) [9] and an order of Erysiphales (Braun, 2012).They commonly infect on leaves, young branches, and occasionally fruits of various ornamental plants. They can be easily identified by the powdery patches or a diffusive white layer, yellow, brown or grayish mycelia and conidiophores on plant surfaces; they are needle tip sized, yellow/brown- to black-colored sexual reproduction structures called ascomata, more specifically it is chasmothecia (Agrios 1997) [1].

Materials and Methods

The experiment was laid out in RCBD with three replication. Ten advanced mutant lines along with two checks *viz*., cv. Kosi and CIM Kranthi were used for planting. The entire area was initially prepared into 20 cm raised beds of 120 cm width and of convenient length. Later plots of 4.8 m width and 2.8 m length were laid out with leaving 1.2 m space between. Inline drip irrigation system with 16 mm laterals having emitters of 2 lph co extruded at 40cm interval was installed prior to planting. White, uniformly thick, 10-12 cm long stolons were collected for the purpose of planting in November.

An investigation on the occurrence of powdery mildew in menthol mint advanced mutant lines was caused by *Erysiphe cichoracearum* and it was confirmed by National fungal culture collection of India (NFCCI) Biodiversity and Plaeobiology group, Agharkar Research Institute, Pune**.** The severity of powdery mildew of advanced mutant lines was graded as follows:

Percent disease incidence	Grade of rating
No symptoms in plants	0
0 - 25 infected area	1
26 - 50 infected area	2
51-75 infected area	3
75 infected area or more	4

Further the percent disease incidence (PDI) was computed using the below given formula.

$$PDI = \frac{\text{Sum of numerical ratings}}{\text{Number of plant accessed x maximum rating}} \times 100$$

For identification of pathogen, the leaves of infected plants were collected from the experimental plot. Samples were packed in polythene bags and brought to the laboratory for further study. All the samples were closely examined for studying the characteristics of symptoms under the compound microscope. Some samples were sent to the National fungal culture collection of India (NFCCI) Biodiversity and Plaeobiology group, Agharkar Research Institute, Pune for identification of causal organism of powdery mildew in menthol mint. They identified the causal organism of the powdery mildew as *Erysiphe cichoracearum* with their microscopic spores and vegetative spores of conidia as shown in the Figure 2, 3 c, d, e and f.

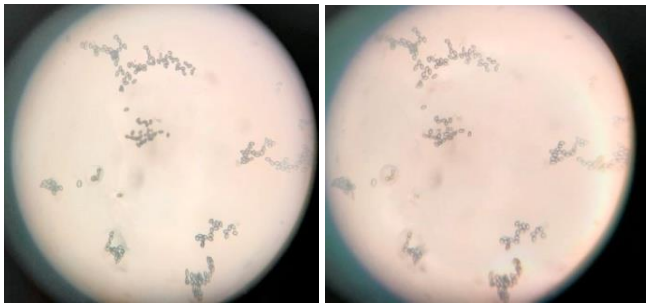
The occurrence of powdery mildew on advanced mutant lines were recorded in ten days interval in the month of December to February and PDI of occurrence of menthol mint plants infected with powdery mildew disease was also calculated for 70 DAP, 80 DAP and 90 DAP.

Results and discussion

The first symptoms of powdery mildew disease of advanced mutant lines produced by *Erysiphe cichoracearum* appeared in last week of December 2020 in the form of small patches of white coloured powdery masses on the lower surface of leaves then it appears on upper surface with chlorotic lesions on the opposite surface as shown in the Figure 1 a and b. When the disease progresses, these powdery patches grow in size and finally coalesce to cover the entire abaxial surface of leaves (Sharma *et al*., 2011) [12]. Severe infection of powdery mildew on leaves led to premature defoliation of the plant and it happens in kranthi mutant lines. Dark-brown dots representing the cleistothecia of the fungus appeared at the end of January 2020. These observations were also in agreement with those of Kumarswamy and Urs (1979) [6], Prasad and Siddaramaiah (1979) [8], Teotia and Sen (1994) [15] and Sulima *et al*. (2022) [13].

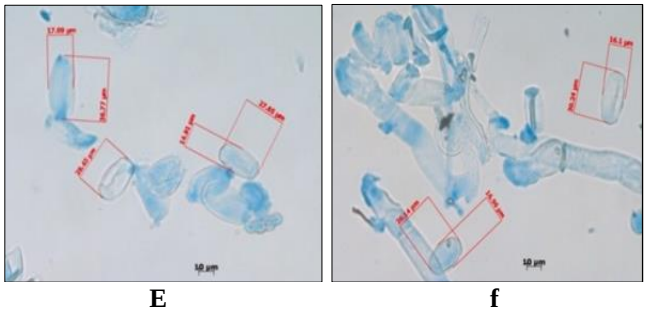
a **b**

Fig 1: a and b: Powdery mildew spores on leaves of mutant lines of $K_{20}P_{23}$ and $K_{20}P_{41}$



c **d**

Fig 2: c and d: Microscopic spores of *Erysiphe cichoracearum*



E **f**

Fig 3: E and f: Conidia vegetative spores of *Erysiphe cichoracearum*

Table 1: Powdery mildew disease incidence of advanced mutant lines in menthol mint (2021)

Varieties/Lines	PDI (%)		
	70 DAP	80 DAP	90 DAP
$K_{20}P_{23}$	34.57	18.59	36.01
$K_{20}P_{41}$	42.72	21.09	37.86
$K_{20}P_{26}$	20.99	10.35	22.02
$K_{20}P_{33}$	31.87	10.91	25.00
$K_{20}P_{13}$	24.31	11.73	33.64
cv. Kosi	24.16	10.00	24.59
$CK_{40}P_{17}$	32.00	14.32	34.37
$CK_{20}P_{113}$	26.85	15.31	31.58
$CK_{20}P_{43}$	20.94	12.97	29.50
$CK_{20}P_{22}$	30.86	15.59	29.43
$CK_{20}P_{79}$	21.21	14.85	28.86
cv. CIM Kranthi	30.97	16.58	35.07
Mean	25.57	14.36	30.66
S.Em ±	2.60	2.95	2.61
CD (p=0.05)	7.64	8.65	7.65

Table 2: Total herbage yield of advanced mutant lines in menthol mint (2021)

Varieties/Lines	Total herbage yield (tonnes/ha)
$K_{20}P_{23}$	15.06
$K_{20}P_{41}$	14.80
$K_{20}P_{26}$	19.70
$K_{20}P_{33}$	26.07
$K_{20}P_{13}$	16.75
cv. Kosi	17.40
$CK_{40}P_{17}$	29.31
$CK_{20}P_{113}$	32.08
$CK_{20}P_{43}$	27.82
$CK_{20}P_{22}$	29.50
$CK_{20}P_{79}$	33.17
cv. CIM Kranthi	26.45
Mean	24.01
S. Em±	2.01
CD (p=0.05)	5.91

Conclusion

Japanese mint can be infected by many diseases among all powdery mildew infects all foliar parts of plants producing a powdery appearance on the leaves or stems and it become severe when the climate has moderate to high humidity in late spring to early summer. Poor sun light and air circulation also help in disease development. Hence the effectiveness of *Erysiphe cichoracearum* purely depends on weather conditions and in the selected advanced mutant lines $K_{20}P_{41}$ and $K_{20}P_{23}$ were severely infected by fungi their by it affect the overall foliage production.

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