Mycopath (2011) 9(1)**:** 29-32

Screening of mint germplasm under field and glasshouse conditions

Atif Jamal, Muhammad Naeemullah, M. Shahid Masood, Muhammad Zakria, Riffat Tahira, Umer Iqbal and S. M. Iqbal.

National Agricultural Research Centre, Park Road, Islamabad, 45500, Pakistan.
Corresponding Author: atif75j@gmail.com

Abstract

Eighteen accessions of mint were screened under natural conditions in glass house and field to identify resistant germplasm compromising of local as well exotic accessions against powdery mildew (*Erysiphe cishoracearum*) and rust (*Puccina menthae*). In the glass house, rust was found on eight accessions with catnip mint being worst affected exhibited an incidence of 77%. Powdery mildew was noticed on five accessions of mint and lavender mint showed the highest disease incidence 86%. Five accessions were found free of disease which included cool mint, nana asavi, nana magrabhi, field mint and chinese mint both. In field, one accession (pahari pudina) was affected by powdery mildew whereas rust was found in all the plots with again catnip mint showing disease incidence of 95%.

Keywords: Screening, natural condition, Mint (*Mentha arvensis)*, Powdery mildew (*Erysiphe cishoracearum*), Rust (*Puccina menthae*), glass house, field.

Introduction

Mint (*Mentha arvensis*) has been cultivated for thousands of years for the unique fragrances produced by its volatile oils. The genus *Mentha* contains more than 45 accepted species and subspecies (Tzanetakis *et al*., 2010), however, commercial production of mint oil is based primarily on *M. arvensis* L. (Corn Mint), *M. spicata* L. (spearmint), and *M. piperita* L. (peppermint). The leading countries in mint production are the USA, India, China, and Brazil. The essential oils of their herbage are used in the food, pharmaceutical, cosmetic and perfumery industries. In recent years, interest in the cultivation of mints has increased due to a surge in the international market demand for mint oils and oil fractions. The herb itself is used in fresh, dried, and processed forms for flavouring food items and preparation of traditional medicines. Mints are widely cultivated on almost all types of soils and climates. The major commercially produced species are: Japanese or menthol mint (*Mentha arvensis* L. var. piperascens), peppermint (*M. piperita* L.), common or native spearmint (*M. spicata* L.), Scotch spearmint (*M. cardiaca* Baker), garden mint (*M. viridis* L.) and bergamot mint (*M. citrata* Ehrh). China, India, USA, Japan, France, Italy, Russia and Bulgaria are some of the major producers of mint oils (Kalra *et al*., 2004).

Mints are susceptible to a variety of diseases; these diseases impose significant production constraints that affect both yield and overall quality of mint oils. Some of these diseases reduce the yield of mint crops, especially when virulent forms of one or more diseases attack the monoclonal mint crops spread over wide areas. There have been 30 or more pathogens recorded on mints. The most economically threatening fungal diseases of mints are rust (*Puccinia menthae*), powdery mildew (*Erysiphe cischoracearum*), leaf spot (*Alternaria alternate*), aerial blight (*Rhizoctonia solani*), wilt (*Verticillium dahlia*), stem rot (*Phoma stasseri*) and root and stolon rot *(Rhizoctonia solani/bataticola)*. The intensity of damage caused by these organisms varies according to location. Wild rust and stem rot are frequently reported in the USA, while leaf blight, powdery mildew, and root cause severe disease problems in India (Kalra *et al.*, 2004).

The rust causes a serious problem in the cultivation of commercial peppermint crops. The rust diseases are the most devastating diseases effecting aromatic and medicinal plants. They cause leaves to wither and fall, and also reduce the yield affecting thus the quality of essential oils and biologically active substances (Parbery, 1996). Rust diseases can affect over 50% of the leaves; however, a prolonged infection can almost completely defoliate the plant (Margina and Zheljazkov, 1995). If uncontrolled, mint rust reduces oil yield by 50% or more and also reduces the quality and quantity of oil produced by commercially grown peppermint (Vaverkova *et al*., 2009).

Present study was conducted to identify resistant germplasm of mint compromising of local as well exotic accessions against powdery mildew (*Erysiphe cishoracearum*) and rust (*Puccina menthae*).

Materials and Methods

Eighteen accessions of mint obtained from Plant Genetics Resources Programme (PGRP) germplasm were evaluated at PGRP, NARC under glass house and field conditions. The germplasm included four exotic accessions viz. cool mint (Canada), nana Asavi, nana Magrabi (Saudi Arabia) and chinese mint (China) (Table 1). The seeds were surface sterilized with 3% H_2O_2 for 15 min followed by 3 to 4 washings with sterilized distilled water and were germinated on moist filter paper in a Petri dish. Ten uniformly germinated seedlings were planted in each 17 cm × 15 cm pot filled with 1.5 kg pasteurized soil. The pots were placed in a shaded glasshouse (25 to 29^{o}C; 16 h photoperiod) and were watered. Uniform watering in the pots was maintained by keeping them at 70% field capacity by frequent watering to a constant weight. Uniform seeds of all eighteen accessions were sown in 5 × 5 ft plots in the fields of PGRP and NARC, Islamabad. Diseases were recorded using the following severity rating scale defined by Gallian *et al*. (2002).

Scale	Description	Reaction
0	No disease	HR
1	1-10%	R
2	11-35%	MR
3	36-65%	MS
4	66-90%	S
5	91-100%	HS

Disease incidence (%) and Disease index (%) were calculated with the help of following formulas.

$$\text{Incidence} = \frac{\text{No of diseased plants}}{\text{Total no of plants}} \text{ X } 100$$

Disease Index=

$$\frac{\text{SS0(no of plants)+SS5(no of plants)}}{\text{Total no of plants} \times \text{maximum of SRS}} \times 100$$

*Severity Scale; *Severity rating scale

Results and Discussion

The results of screening are tabulated in Table 1, revealed that two diseases viz. rust and powdery mildew were found uniformly in glass house. Rust was found on eight accessions with catnip mint being worst affected exhibited an incidence of 77% (Table 1). In case of powdery mildew five accessions of mint showed symptoms and lavender mint showed the highest disease incidence of 86% (Table 1). Five accessions were found free of disease which included cool mint, nana asavi, nana magrabhi, field mint and chinese mint. In field only one accession (pahari pudina; Table 1) was affected by powdery mildew whereas rust was found in all the plots with again catnip mint showing disease incidence of 95% (Table 1). The accessions which were found affected by rust in glass house were also heavily infected in the field.

In case of rust both in glass house and field, characteristic dark brown uredial pustules were seen followed by the leaf fall. The disease cycle of *Puccinia menthe* had been extensively studied (Niederhauser 1945; Baxter 1952; Baxter and Curnrnins 1953; Fletcher 1958; Stone 1963). In late winter the teliospores germinate, producing basidiospores which infect young host tissue as it emerges through the soil surface. Spermogonia and aecia are formed on the young shoots, which become foci for the disease in the field. Infection of newly emerging mint leaves by aeciospores results in the production of urediniospores, which are aerially dispersed and can travel long distances. Urediniospores infect both leaves and stems to produce new uredinia, and successive uredinial cycles occur throughout summer. As winter approaches, the existing uredinia convert to telia, and overwintering teliospores are produced as the host dies back and becomes dormant as underground rhizomes (Edwards *et al*., 1999).

Gangulee and Pandotra (1962) found 20% of *M. arvensis* leaves abscised by rust attack. Similarly Margina and Zheljazkov (1994) showed that severe disease in Bulgaria caused losses of 50%. The reason that only eight accessions were infected with could be rust due to presence of high degree of physiological specialization among *P. menthe* (Walker and Corroy, 1969; Bruckner, 1972). Rust isolates from *M. spicata* have been observed to infect *M. cardiaca*, but not *P. xpipperita*. The biotypes that infected *M. xpiperita* were avirulent on *M. spicata* (Roberts and Horner, 1981). Six races were detected in the northeastern United States (Neiderhaauser, 1945), nine races from England (Fletcher, 1963), and three races were detected in New Zealand (Breesford, 1982).

The other disease which was found on mint germplasm was powdery mildew and it appeared as white to gray coating of fungal mycelium and spores. Four out of five accessions were disease free in the field compared to glass house only pahari mint showed infection in field. The only reason for the escape of disease can be attributed to the fact that the humid conditions like warm days and cool nights favours powdery mildew and the environment was suited in glass house then field for disease infection. It has been also reported that powdery mildew is often severe on mint grown in green house due to humid shady conditions (Johnson, 2010). It was observed that all the exotic accessions were free of disease and no symptoms of both diseases were seen that reflects the presence of resistant gene to these diseases as compare to local accessions and can be used for the incorporation of genes in local germplasm which is the key finding of the current study.

Table 1: Incidence, severity and disease index of rust and powdery mildew on mint screened in glass house and field conditions.

Accessions	Botanical name	Origin	Disease reaction	Incidence (%)		Severity Scale (0-5)		Disease Index (%)	
				Glass house	Field	Glass house	Field	Glass house	Field
Common mint	*M. arvensis*	Local	R*	53	85	4	5	27.3	78
Mint Camphor		Local	R	56	80	3	5	22.6	66
Mint Pennyroyal	*M. pulegium*	Local	R	47	0	3	0	22.6	0
Lavender mint	*M. xpipeerita var lavender mint*	Local	P*	86	0	5	0	28.6	0
Cool mint	*M. sepicata*	Canada	ND*	0	0	0	0	0	0
Catnip mint	*Nepata cataria*	Local	R	77	95	3	5	21.3	92
Lemon mint	*Mellissa officianlis*	Local	P	37	0	3	0	10.6	0
Nana Asavi	*Mentha* sp.	Saudi Arabia	ND	0	0	0	0	0	0
Nana Maghrabi	*Mentha* sp.	Saudi Arabia	ND	0	0	0	0	0	0
Mentha local White flower	*M. arvensis*	Local	R	20	0	2	0	6.6	0
Aquatica mint	*M. aquatica*	Local	P	17	0	2	0	3.3	0
Pahari pudina	*M. rolyana*	Local	P	13	80	2	5	2	72
Field Mint	*M. arvensis*	Local	ND	0	0	0	0	0	0
Pepper Min	*M. x piperita*	Local	R	10	0	1	0	1.33	0
Spear mint	*M. spicata*	unknown	R	33	0	3	0	11.5	0
White mint	*Mentha* sp.	Local	R	36	68	3	4	12	64
Mentha local purple flower	*M. arvesis*	Local	P	23	0	3	0	7.5	0
Chinese mint	*M. arvensis*	China	ND	0	0	0	0	0	0

*R, Rust ; *P, Powdery mildew; *ND, No disease

References

Baxter JW, 1952. A biological study of the mint rust organism, *Puccinia menthae* Pers. PhD Thesis, Purdue University, West Lafayette, USA.

Baxter JW, Cummins GB, 1953. Physiologic specialization in *Puccinia menthae* Pers., and notes on epiphytology. *Phytopathology*, **43**:178-180.

Breesford RM, 1982. Races of mint rust on cultivated peppermint and other host in New Zealand. *New Zealand J. Agri. Res*., **25**: 431-434.

Bruckner K, 1972. Studies on the problem of physiological specialization of mint rust. *Arcieves fur Pflanzenschutz*, **8:** 15-27.

Edwards J, Taylor PA, Parbery DG, Halloran GM, 1999. Peppermint rust in Victoria: the incidence-severity relationship and its implication for the development of an action threshold. *Aus. J. Agri. Res*., **51**: 91–95.

Fletcher JT, 1958. The biology of *Puccinia menthae* Pers. PhD Thesis, The University of Birmingham, UK.

Fletcher JR, 1963. Experiments on the control of mint rust. *Plant Pathol*., **11**: 115-120.

Gangulee D, Pandotra, 1962. Some of the commonly occurring disease of important medicinal and aromatic plants in Jammu and Kashmir. *Indian Phytopath*., **15:** 50-54.

Gallian JJ, Vargas D, Foote P, 2002. fungicides for control of sugarbeet powdery mildew. University of Idaho, Twin Falls Research and Extension Center, PO Box 1827, Twin Falls, Idaho 83303-1827, and Research Technician, Amalgamated Sugar Company, P.O. Box 700, Paul, ID 83347.

Johnson DA, 2010. Managing Powdery Mildew on Mint. http://www.docstoc.com/documents/technology/most-recent

Kalra A, Singh HB, Pandey R, Samad A, Patra NK, Kumar S, 2004. Diseases in mint: causal organisms, distribution, and control measures. *J. Herbs Spices Med. Plants*, **11**: 71-95.

Margina A, Zheljazkov V, 1994. Control of mint rust on mints with fungicides and their effect on essential oil content. *J Ess. Oil Res*., **6**: 607-615.

Margina A, Zheljazkov V, 1995. Fungal pathogens from uredinales on some medicinal and aromatic plants in Bulgaria and their control. In: ISHS Acta Horticulturae Symposium on Medicinal and Aromatic Plants. 426 pp.

Neiderhaauser JS, 1945. The rust of green house grown mint and its control. Nemers Cornell Agricultural Research Station. 263, 30.

Parbery DG, 1996. Trophism and the ecology of fungi associated with plants. *Biol. Rev*., **71**: 473-527.

Roberts DD, Horner CE, 1981. Sources of resistance to *Puccinia menthae* in mints. *Plant Dis.*, **6**: 322- 324.

Stone WJH, 1963. Epiphytology and physiology of spearmint rust, caused by *Puccinia menthae* Pers. PhD Thesis, Purdue University, West Lafayette, USA.

Tzanetakis IE, Postman JD, Samad A, Martin RR, 2010. Mint Viruses: Beauty, Stealth, and Disease. *Plant Dis*., **94**: 4-12.

Vaverková Š, Mistríková I, Hollá M, 2009. Qualitative properties of *Mentha piperita* (L.) after application of the fungicide Hattrick DP-50. *Plant Soil Environ*., **55**: 454–459.

Walker J, Corroy RJ, 1969. *Puccinia menthae* in Australia. *Aust. J. Agric.* Sci., **32**: 164-165.