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Research Article

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Current Scenario on the Prevalence of Diseases in Economically Important Medicinal and Aromatic Crops of Tamil Nadu

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ABSTRACT

A roving survey for disease assessment was performed in major medicinal plants growing areas of Tamil Nadu during the period from April 2018 to March 2019. The observations indicated that root rot caused by Macrophomina phaseolina recorded maximum disease incidence even up to 16.5 to 35 % in Coleus forskohlii at Tiruchengode, Perundurai and Nambiyur villages.The Macrophomina root rot and Meloidogyme root knot nematode complex was also recorded up to 2 per cent. Recently, the M.phaseolina has expanded its host range to the medicinal crop Andrograpahis paniculta as recorded at Coimbatore with incidence up to 30%. In Gloriosa superba, severe incidence of root rot caused by M.phaseolina and tuber rot caused Sclerotium rolfsii act as a threat to cultivation with incidence ranging from 8 to 23 % and 8.5 to 25 % in Ambilikai, Mulanur, Kallimandhayam , Dharapurum and Nallamaplaaym villages. In these areas, the crop also suffers loss due to leaf blight caused by Alternaria alternata up to 14.6 PDI Recently,symptoms with chlorotic striations in leaves, stunted growth and reduced flower set with malformed pods were observed due to incidence virus in G.superba . The drought resistant crop Cassia angustifolia also suffers severe yield loss due to Macrophomina root rot and Alternaria leaf blight. Recently, phytoplasmal incidence was now noticed in Solanum trilobatum with incidence up to 9% as in Catharanthus roseus (20 % incidence). The Solanum nigrum also suffers yield loss due to Alternaria leaf blight (11.5 PDI) and rust incidence (12.5PDI). The aromatic crop Cympopogon martini is also affected by rust caused by Puccinia nakanishiki up to 9.8 PDI. Leaf blight caused by Helminthosporium sp. is prevalent in Chrysopogon zizanoides and C.martini with incidence up to 9.5 PDI. Other diseases of minor medicinal and aromatic crops are also discussed.

Keywords: *Medicinal plants, Diseases, Incidence, Root rot, Leaf blight*

INTRODUCTION

Globally there is a great demand for Medicinal and Aromatic crops in the international market for health products, pharmaceuticals, food supplements, cosmetics etc. The international market of medicinal plants is expected to reach USD 35.4 billion by 2020 with a compound annual growth rate of 6.6% from 2015 to 2020 as mentioned in BCC research report (Yadav, 2019).

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The varied agroclimatic conditions of India offer scope for cultivation of wide range of medicinal plants that made it as one major exporter of crude drugs mainly to six developed countries *viz.* USA, Germany, France, Switzerland, U.K. and Japan that shares 75-80 per cent of the total export market (Chatterjee, 2002). Nearly 90% of the medicinal plants used by local communities in India are sourced from the wild. Among these about 335 medicinal plant species are recognised as threatened at the regional, national and global levels (Shankar, 2019). *Coleus forskohlii* Briq. is cultivated in more than 1000 hectares across Salem, Attur, Kallakurichi, Thiruvannamalai, Trichy and Vellore regions (Rajamani et al., 1999) and the seeds are exported for forskohlin content. In the last decade due to changing climate scenario lot of pests and diseases found infecting the agricultural and horticultural crops have moved to the medicinal and aromatic crops also. Those diseases which were of minor importance in the recent past has now become a threat to cultivation of medicinal crops in India. The medicinal and aromatic crops *viz.*, *Gloriosa superba, Coleus forskohlii, Cassia angustifolia, Vetiver zizanoides, Andrographis paniculata, Catharanthus roseus, Ocimum sanctum,Solanum nigrum* is cultivated by farmers in Tamil Nadu. Apart from this based on the consumers need and demands of the local markets the medicinal crops such as *Aloe vera, Solanum trilobatum, Plumbago zeylanica, Aegle marmelos, Gymnema sylvestre, Cymbopogon flexuosus, Cymbopogon martini* and *Phyllanthus niruri* are being cultivated locally by farmers themselves and finds usage in preparation of plant based medicines as home remedies against many human ailments like common flu, cold, fever, acidity problems, sinusitis and as immunity builder. Perusal of literature shows very few reports of diseases in medicinal crops like *Gloriosa superba, Coleus forskohlii* and *Cassia angustifolia*. In the recent days, many foliar diseases caused by *Alternaria, Curvularia, Colletotrichum*, stem rot and root rot caused by *Fusarium* sp. in *Gloriosa superba* and fungal nematode root rot complex prevalent in *Coleus forskohlii* which is left unnoticed.

Perusal of literature showed reports of diseases of few crops (Singh et al., 2016; Marimuthu et al., 2018). However, there is no pertinent information of progression of diseases in the past one decade due to climate change and changing cultivation patterns. Farmers are facing threat to cultivation of *Gloriosa superba, Coleus forskohlii, Cassia angustifolia* mainly due to the complex soil borne diseases and emerging new diseases and experience severe yield loss as they are not aware of the spread of the pathogen. Hence, a study was planned with a view to document and monitor the incidence of all the diseases affecting the major medicinal and aromatic crops cultivated in Tamil Nadu during the period from April,2018 to March 2019 so as to establish a scenario of disease prevalence in Tamil Nadu.

MATERIALS AND METHODS

A roving survey was carried out on the occurrence of diseases of important medicinal and aromatic plants during the period from April, 2018-March, 2019 at famer field. About 4-5 fields were covered in a district which include two or three villages where the medicinal crops are cultivated on commercial scale. Simultaneously, the diseases occurring in medicinal plants at the medicinal plant garden of Department of Medicinal and Aromatic Crops, Tamil Nadu Agricultural University, Coimbatore was documented and the diseases incidence was recorded. For foliar diseases, the 0 to 9 scale was followed and the diseases incidence was expressed as Per cent disease Index (PDI) (Pawlec et al., 2006). The soil borne disease like root rot and wilt were expressed as percentage (%) of infected plants.

RESULTS AND DISCUSSION

Data provided in Table 1 gives picture on the incidence of various diseases affecting economically important medicinal crops. The varying disease incidence and the field

observations are discussed in detail for the benefit of the researchers and farming community (Plate 1).The observations showed that at Tiruchengode in about 3-4 fields of *Coleus forskohlii* Briq. (under drip irrigation) exhibited severe root rot incidence caused by *Macrophomina phaseolina* up to 35 per cent along with 2 per cent infestation by root rot and root knot nematode complex. The plants were at 45 days stage where there was extensive spread of the disease in patches. Initially infected plants were identified as wilted and pale green whereas severely infected plants showed complete wilting with yellow leaves and the decayed roots were totally black in colour with fungal invasion .The plants could be easily pulled with infected roots remaining in soil. Few plants (2 per cent) exhibited root rot and part of the roots were with knots showing symptoms of root rot nematode *Meloidogyne* infestation. Similarly, *Macrophomina* root rot with 20%, 16.5 % and 5 % was observed at plants (40 days) in Perundurai, Nambiyur and Coimbatore. But in Attur, Nambiyur and Tiruvannamalai areas, the collar rot (*Fusarium chlamydosporum*) along with root knot nematode infestation was recorded to be ranging from 12-25 per cent under irrigated conditions. Here the plants exhibited wilting symptoms and the collar region was fully decayed and the plants were found to be collapsed and could be pulled out. The roots when given longitudinal split showed pinkish discolouartion .Reports of the *Macrophomina* root rot (Kamalakannan et al., 2006) of *C. forskohlii* with 50 % yield loss (Meena, 2016) has been mentioned by few researchers as in our study. Also the root knot infestation by *Meloidogyne* spp has been reported to cause 86 % yield loss in association with *M.phaseolina* infection (Bhandari et al, 2007,Senthamarai et al., 2006 and 2008) but in our study only 2 % infestation was noticed in combination with root rot. Apart from this leaf spot due to *Corynespora cassicola* with pale brown to dark brown spots which causes necrosis of leaves have been reported (Fernandes and Barreto,2003) as in our study recorded at Perundurai with 10.5 PDI. But another leaf spot caused by *Botryodiplodia theobromae* (Rakshapal Singh et al., 2011) was not noticed in our survey.

From the observations it is discussed here that farmers need to take utmost care to contain the disease spread by spotting one or two plants with symptoms of root rot / collar rot incidence at initial stages itself from 30 days after planting since there after the disease management becomes complicated as the crop canopy covers the entire field and it is not easy to apply the biocontrol agents or fungicides.

The *Gloriosa superba* L. (Glory lily) crop is well known for its medicinal importance due to the presence of alkaloid colchicine used in the treatment of gout (Padmapriya et al., 2016). This crop suffers from soil borne diseases *viz., Macrophomina* root rot, tuber rot caused by *Sclerotium rolfsii* and leaf blight diseases caused by *Alternaria alternata* and *Colletotrichum gloeosporioides* in Tirupur and Dindugul districts where this crop is cultivated on a large scale. Root rot caused by *Macrophomina phaseolina* incidence has been recorded from 8.5 to 25 % in Mulanur, Ambilikai and Dharapurum areas but lower disease incidence only up to 5.5 % was recorded in Sirumugai. The crop is affected with this disease by exhibiting symptoms of sudden drying of the plant and the plant gets detached from the root portion. Tubers from infected plants when observed revealed decaying with black fungal invasion on the tubers. The tuber rot caused by *Sclerotium rolfsii* is another interesting pathogen that attack the plants at collar region as seen with whitish mycelial strands over the soil and the pathogen moves deep in to the soil and colonises the tuber and produces about 50 to 100 sclerotia per tuber. The disease spread is fast in the field with wilting and yellowing of leaves and finally the plant collapses as observed in Nallampalayam, Dharapurum, Kallimandhayam and Mulanur with incidence ranging from 8 to 23 per cent. Both the *Macrophomina* root rot and *Sclerotium* tuber rot is soil borne and tuber borne under storage. Tuber rot is more prevalent in red loamy soils compared to other soils.

The leaf blight in *G. superba* is caused by two pathogens that can be well differentiated by the symptoms. *Alternaria* leaf blight produces blackish lesions on the leaves that enlarges and causes severe blighting of leaves with incidence ranging from 12.5 to 14.6 as recorded in the areas surveyed. Leaf blight due to *Colletotrichum gloeosporioides* was observed with 18.5 PDI only in Dharapurum with typical oval shaped spots that enlarges and covers the entire leaf with production of prominent acervuli at the whitish centre of the blighted areas. These foliar pathogens *Alternaria* and *Colletotrichum* harbouring the weed plants nearby *Gloriosa* fields would be the reason for their incidence under favourable conditions of high humidity (70 %) and rainfall during flowering periods. Similar symptoms and the incidence due to *A. alternata* was reported by Maiti et al. (2007). Further it is noticed that the *Altenaria* blight caused drying of flowers and later the pods on infected plants showed large blighted lesions causing necrosis of outer surface of pods. Though few pods were infected, the infection did not progress in to the seeds. During the peak periods of high humidity coupled with warm weather immediately one after planting tubers (month of September) few plants exhibited stunted growth coupled with striations son the leaves resembling stripe virus symptoms (2 to 15 %) at Coimbatore, Mulanur and Dharapurum. Those plants were found to be harboured by aphids which would have migrated from weed plants. There was no tuber transmission of virus; however it is suspected that insects aid as vector for spread of the virus. Infected plants produced 25 % less flowers and malformed and twisted pods than normal healthy plant. Studies should be further concentrated on the virus vector relationship to take up management practices.

The *Cassia angustifolia* L. (Senna) well known for presence of sennosides are used as laxatives (Jnanesha et al., 2018). The crop suffers from root rot incidence up to 10 % in Coimbatore, Thirumanaglam, Virudhunagar and Pannikundu especially during periods of rain immedaitely after a dry spell. Also the leaf blight caused by *Alternaria alternata* is another problem that cause severe defoliation of leaves (10.6 to 12.5 PDI) during October to December coinciding with rainfall and low temperature. Similar severe yield reduction even up to 30 per cent were reported (Patel and Pillai, 1979 ; Maiti et al., 2007).Similarly *Andrographis paniculata* (Kalmegh) Burm. F Nees known for the alkaloid andrographolide is used against stomach pains, fever, respiratory diseases and as antidote for poisonous stings (Jarukamjorn, 2010) was found to be a new host for root rot pathogen *Macrophomina phaseolina* which recorded 30 per cent root rot incidence at Coimbatore. Sudden drying of the plants leads to death of the plants within 10 days of incidence with noticeable decaying and splitting of roots.The pathogen was isolated and further inoculation of pathogen under pot culture study proved Kochs postulates and reproduced similar symptoms of root rot.

Catharanthus roseus (Perwiwinkle) has cytotoxic dimeric alkaloids vinblastine and vincristine widely used for cancer chemotherapy (Van der Heijden, 2004) is affected by phytoplasmal disease (Singh et al., 2007). In our study also chlorosis and bunching of leaves, shortened internodes and phylloid flowers due to phytoplasma infection (20 %) was noticed at Coimbatore. Similarly the *Solanum trilobatum* L. crop also encountered phytoplasmal infection (9%) at Coimbatore with crowding, reduction in size of leaves similar to the symptoms described by Thiribhuvanamala et al. (2018) *Alternaria* spp. caused leaf blighting in *S. trilobatum* and *Solanum nigrum* L. (Black night shade) with incidence of 10.8 to 11.0 PDI. Rust disease with light yellow spots on upper surface with light orange to brown pustules on lower leaf surface was noticed during September months at coimbatore with disease incidence of 12.5 PDI which coincided with high humidity (70 %) and warm weather (36 to 38°C). The aromatic crop *Cymbopogon martini* recorded leaf blight incidence due to *Helminthosporium* sp. with disease incidence of 10.3 PDI. Also severe rust incidence (*Puccinia nakanishiki*) with 12.5 PDI was recorded in *C. martini* coinciding with high humidity and warm

weather during August to September months. *Chrysopogon zizanoides* (vetiver) also recorded leaf blight due to *Helminthosporium* sp. with disease incidence of 9.0 PDI.

Other minor diseases mainly the foliar diseases caused by *Alternaria, Colletotrichum, Cercospora* sp., and powdery mildew were recorded at Coimbatore conditions in *Aegle mamelos, Aloe vera,Cissu squadrangularis, Coleus aromaticus, Gymmnema sylvestre, Lipia nodiflora, Plubago zeylanica, Phyllanthus niruri, Psoralea corylifolia, Rosemarinus officinalis, Salacia oblonga* (Table 2).

Table 1: Survey and documentation of major diseases in medicinal and aromatic crops (April 2018-March 2019)

S.No	Name of the Crop	Disease/ Pathogen	Place	GPS coordinates	District	Incidence (%) or PDI
1.	*Coleus forskohlii*	Root rot *M.phaseolina*	Tiruchengode	11.3884°N 77.9707°E	Namakkal	12- 35%
		Root rot (*M.phaseolina*) and nematode complex (*Meloidogyne incognita*)				2 %
		Root rot *M.phaseolina*	Perundurai	11.2590°N 77.5460°E	Erode	20.5%
			Nambiyur	11.3614°N 77.3501°E	Erode	16.5 %
		Collar rot *Fusarium chlamydosporium*	Nambiyur	11.3614°N 77.3501°E	Erode	17- 20%
		Collar rot *Fusarium chlamydosporium* sp.and root knot nematode complex	Attur	11.5965°N 78.6033 °E	Salem	12-25%
			Tiruvannamalai	12.2336°N 79.0668°E	Tiruvannamalai	
		Root rot *M.phaseolina*	Coimbatore	11.0123°N 76.9355°E	Coimbatore	5%
		Leaf spot *Corynespora cassicola*	Perundurai	11.2590°N 77.5460°E	Erode	10.5 PDI
2	*Gloriosa superba*	Root rot *M.phaseolina*	Mulanur	10.7947°N 77.7111°E	Tirupur	10.5%
			Ambilikai	10.5475°N 77.7257°E	Dindugul	8.5%
			Dharapuram	10.7273°N 77.6710° E	Tirupur	25 %
			Sirumugai	11.3216°N 77.0089°E	Coimbatore	5.5%
		Tuber rot *Sclerotium rolfsii*	Nallampalayam	10.7342°N 77.6288° E	Tirupur	18 %
			Dharapurum	10.7273°N 77.6710°E	Tirupur	8-23%
			Kallimandhayam	10.5912°N 77.6864°E	Dindugul	16 %
			Mulanur	10.7947°N 77.7111°E	Tirupur	9.5%
			Ambilikai	10.5475°N 77.7257°E	Dindugul	15.5 %
		Leaf blight *Alternaria alternata*	Dharapuram	10.7273°N 77.6710°E	Tirupur	14.6 PDI
			Nallampalayam	10.7342°N 77.6288°E	Tirupur	12.7 PDI
			Kallimandhayam	10.5912° N 77.6864° E	Dindugul	14.5 PDI
			Coimbatore	11.0123°N 76.9355°E	Coimbatore	12.5 PDI
			Sirumugai	11.3216°N 77.0089°E	Coimbatore	13.8 PDI
		Flower blight *Alternaria alternata*	Coimbatore	11.0123°N 76.9355°E	Coimbatore	4 %
			Sirumugai	11.3216°N, 77.0089° E	Coimbatore	8.5 %

			Dharapurum	10.7273°N 77.6710°E	Tirupur	7.5 %
		Virus - Glory lily stripe virus	Coimbatore	11.0123°N 76.9355°E	Coimbatore	2%
			Mulanur	10.7947°N 77.7111° E	Tirupur	2%
			Dharapuram	10.7273°N 77.6710°E	Tirupur	15%
		Leaf blight *Colletotrichum gloeosporioides*	Dharapuram	10.7273°N 77.6710°E	Tirupur	18.5 PDI
3.	*Cassia angustifolia*	Root rot *M.phaseolina*	Coimbatore	11.0123°N 76.9355°E	Coimbatore	10 %
			Thirumangalam	9.8216° N 77.9891°E	Madurai	4.5%
			Virudhunagar	9.5680°N 77.9624°E	Virudhunagar	8.5%
			Pannikundu	9.8588° N 77.9082°E	Madurai	5.0 %
		Leaf blight *(Alternaria alternata)*	Thirumangalam	9.8216°N, 77.9891°E	Madurai	10.6 PDI
			Pannikundu	9.8588°N 7.9082°E	Madurai	11.3 PDI
			Virudhunagar	9.5680°N 77.9624°E	Virudhunagar	12.5 PDI
4.	*Andrographis paniculata*	Root rot (*M.phaseolina)*	Coimbatore	11.0123°N 76.9355°E	Coimbatore	30 %
5.	*Catharanthus roseus*	*Phytoplasma*	Coimbatore	11.0123°N 76.9355°E	Coimbatore	20%
6.	*Solanum trilobatum*	*Phytoplasma*	Coimbatore	11.0123°N 76.9355°E	Coimbatore	9 %
		Leaf blight (*Alternaria solani*)	Coimbatore	11.0123°N 76.9355°E	Coimbatore	10.8 PDI
7.	*Solanum nigrum*	Leaf blight (*Alternaria solani*)	Coimbatore	11.0123°N 76.9355°E	Coimbatore	11.0 PDI
		Rust (*Puccinia* sp.)	Coimbatore	11.0123°N 76.9355°E	Coimbatore	12.5 PDI
8.	*Cymbopogon martinii*	Leaf blight (*Helminthosporium* sp.)	Coimbatore	11.0123°N 76.9355°E	Coimbatore	10.3 PDI
		Rust (*Puccinia nakanishiikii*)				9.8 PDI
9	*Chrysopogan zizanoides*	Leaf blight (*Helminthosporium* sp.)	Coimbatore	11.0123°N 76.9355°E	Coimbatore	9.0 PDI

Other diseases of minor importance documented at medicinal plants garden

S.No.	Name of the Crop	Disease	Description
1.	*Aegle marmelos*	Powdery mildew (*Erysiphe* sp.)	White powdery growth occurs on the upper surface of the leaves.
2.	*Aloe vera*	Basal rot (*Fusarium* sp.)	Rottening at the base of the stem and leaves.
		Leaf spot (*Colletotrichum gloeosporioides*)	Irregular brown spots appear on the leaves with dark margin and light coloured centre.
3.	*Cissus quadrangularis*	Leaf spot (*Alternaria alternata*)	Dark brown oval spots appear on the leaves.
4.	*Coleus aromaticus*	Leaf spot (*Cercospora* sp.)	Small, circular brown spots appear on the leaves.
5.	*Gymnema sylvestre*	Leaf spot (*Colletotrichum gloeosporioides*)	Brown oval spots with dark margin and light coloured centre appear on the leaves.
6.	*Lipia nodiflora*	Leaf spot (*Alternaria alternata)*	Small dark brown spots with concentric ring and yellow halo.
8.	*Plumbago zeylanica*	Leaf spot (*Colletotrichum gloeosporioides*)	Irregular brown spots appear on the leaves with dark margin and light coloured centre.
		Root rot (*Macrophomina phaseolina*)	Drying of twigs from the base. The field gives scorched appearance.

		Root knot nematode (*Meloidogyne incognita*)	Rotting of roots with presence of large sized galls or knots on the roots.
9	*Phyllanthus niruri*	Powdery mildew (*Oidium* sp.)	Whitish powdery patches on leaves and stem
9.	*Psoralea corylifolia*	Powdery mildew (*Erysiphe* sp.)	White powdery growth occurs on the upper surface of the leaves.
10.	*Rosemarinus officinalis*	*Phytophthora* root rot	Drying of plants with root disintegration
11.	*Salacia oblonga*	Seedling blight/ Twig blight (*Colletotrichum gloeosporioides*)	Blighting of growing tips downwards, necrosis on stems and drying of plants

Plate 1: Symptoms of major diseases of medicinal and aromatic crops

Root rot of *coleus forskohlii*

Coleus roots with blackish discolouration

Coleus root rot & Root knot nematode

***Corynespora* leaf spot of Coleus**

***Alternaria* leaf blight of Glory lily**

***Alternaria* pod blight of Glory lily**

Root rot infected Glory Lily plants

Root rot infected tubers of Glorylily

Tuber rot infected tubers in field

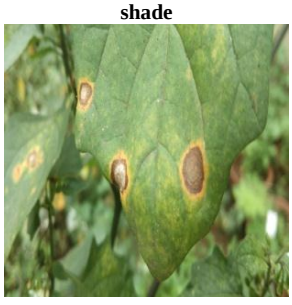
Virus disease of Glory Lily

Root rot of Senna

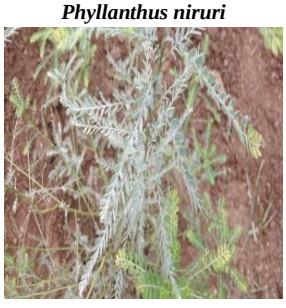
Phytoplasma disease of Perwinkle

Phytoplasma disease of *Solanum trilobatum*

***Alternaria* disease of Black night shade**



Powdery mildew of *Phyllanthus niruri*



Rust disease of *Cympopogon martini*

CONCLUSION

It is pertinent from the studies that the medicinal crops, *Gloriosa superba*, *Coleus forskohlii* and *Cassia angustifolia* is affected due to root rot caused by *Macrophomina phaseolina*. The tuber rot caused by *Sclerotium rolfsii* is another threat to Glory lily cultivation. The *Coleus forskohlii* crop is prone to root rot, collar rot and nematode infestation that leads to drastic yield reduction. The leaf blight caused by *Alternaria* and *Colletotrichum* also plays major role in defoliation of leaves that contribute to yield loss. These pathogens would thrive on weeds as alternate hosts so the the weeds around the crops have to be noticed and remove. The emerging virus and phytoplasma problems in *Catharanthus roseus*, *Solanum trilobatum*, *G. superba* has to be taken due care and further studies should be directed towards studying the virus vector relations ship . The farmers have to be given due awareness on the type of symptoms and the spread and survival of the pathogen to mitigate the disease incidence and yield loss. Certainly this study will throw light on the disease scenario of medicinal plants under Tamil Nadu conditions that help to monitor the diseases to avoid higher incidences and to take up integrated management practices to sustain the quality yield of medicinal crops.

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