International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(3): 5129-5131

Received: 16-03-2019
Accepted: 18-04-2019

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Survey for incidence and intensity of Nagpur mandarin gummosis and root rot

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Abstract
Rapid roving field survey was conducted in the month of October, 2016 to know the incidence and intensity of Nagpur mandarin gummosis in Warund and Morshi tahsils of Amravati district. The peak period of disease progress for incidence and intensity of gummosis was recorded in month of October to November. The disease incidence and intensity of citrus gummosis was in the range from 25.00 to 50.00% and 6.94 to 29.16%, respectively in all the location surveyed. The incidence and intensity of citrus gummosis was maximum in Nimbhi (50.00%) and Bhaipur (29.16%) of Morshi tahsil whereas minimum incidence and intensity of gummosis was recorded in Lehgaon which was (25.00%) and Lakhara (6.94%), Similarly to rapid roving field survey was conducted in the month of September 2016 to know the incidence and intensity of Nagpur mandarin root rot diseases in Warud and Morshi tahsils of Amaravati district. The peak period of disease progress for incidence and intensity of root rot was recorded in month of August to November. The disease incidence and intensity of Nagpur mandarin root rot was in the range from 29.00 to 50.00% and 7.40 to 17.51%, respectively in all the location surveyed. The Nagpur mandarin root rot incidence and intensity was maximum in Nagziri (50.00%) and Jamgaon (17.51%) of Morshi tahsil whereas minimum disease incidence and intensity was recorded in Yawali which was (29.00%) and Khadka (7.40%).

Keywords: Survey, incidence, intensity, Nagpur mandarin gummosis, root rot

Introduction
The genus citrus, one of the most important groups of fruit crops worldwide, belongs to the family Rutaceae comprising 140 genera and 1300 species distributed throughout the world. Nagpur mandarin occupies an important place in the horticulture wealth and economy of India as the third largest fruit industry after banana and mango. India ranks sixth in the production of citrus fruit in the world. Citrus fruits originated in the tropical and subtropical regions of South East Asia particularly in India and China. In 2013-14, total area under citrus in India was 1078 thousand ha production and productivity was 11147 thousand metric tonnes and 10.3 million tonnes/ha, respectively. In Maharashtra, total area was 379.0 thousand ha, with a production and productivity of 6887.4 thousands metric and 18.2 million tonnes /ha (Annonymus, 2014) [1]. Nagpur mandarin decline has been a wide spread problem in central India and *Phytophthora* disease has been identified as the major cause of decline. *Phytophthora* spp. causing severe losses to citrus plants from nursery level to various stages of plant growth in the form of root rot, collar rot, crown rot, gummosis and brown rot in orchards, damping off and root rot in seed beds and nurseries appear to be the major cause of citrus decline. The survey of citrus nursery in central India revealed 24% mortality of nursery plants due to root rot and collar rot diseases in virgin areas, (Naqvi 1999; Gade and Armarkar, 2011) [5].

Phytophthora root rot and gummosis is the most important soil borne diseases of Nagpur mandarin causing mortality, slow decline and yield loss of mature trees. All citrus orchards in central India and other citrus cultivation belts of India are infected by *Phytophthora* diseases. More than 20 per cent seedling mortality has been reported in central India due to *Phytophthora* spp. in Madhya Pradesh adjoining to Vidarbha region of Maharashtra, India, 20-50% Nagpur mandarin plants were found to be affected resulting in severe decline due to *P. parasitica, P. citrophthora* along with *P. palmivora*. In Andhra Pradesh also, 20-100% acid lime plantation was severely affected with *P. parasitica* along with *P. citropthora* and *P. palmivora*. In kinnow growing areas of Punjab state,10-80% plants of *C. sinensis* and 10-100% plants of kinnow mandarin (12-25 years old) showed symptoms of diseases caused by *P. parasitica, P. citrophthora* and *P. palmivora* due to excessive flood irrigation (Savita *et al*., 2012) [7].

Materials and Methods

Survey of Warud and Morshi tahisil Nagpur mandarin orchards was conducted where prominent citrus area is covered. An intensive rapid roving field survey contributes to assess the distribution and incidence of plant pathogens prevalent in particular areas to check the variation occur within pathogen. Such surveys collect data at a single point in time; it is difficult to measure changes in the plant population unless two or more surveys are done at different points in time. Such repetition is often expensive and time-consuming, making frequent periodic surveys impractical.

The intensity of root rot of citrus was recorded on the basis of levels of visible symptoms that showed dulling, yellowing, browning of leaves with some eventually dropping off and drying of branches. The modified disease rating scale was used for recording observations (Gade *et al*., 2006) [3].

Table 1: Disease rating scale for root rots of Nagpur mandarin

Scale	Remark
0	No yellowing
1	Yellowing of leaves and leaf fall (1-10%)
3	Yellowing of leaves and leaf fall (11-25%)
5	Yellowing of leaves and leaf fall (26-50%)
7	Above 50% Yellowing of leaves and leaf fall
9	Drying of branches

Gummosis of Nagpur mandarin

The trees showing oozing of gum at bud joint and one meter above the ground level on the trunk where observed for calculating disease intensity of citrus gummosis. Observations on gumming were recorded on the basis of gradation as follows,

Table 2: Disease rating scale for gummosis of Nagpur mandarin

Scale	Remark
0	Healthy
1	Oozing and lesion developed up to 1 cm^2 area
3	Oozing lesion developed above 1 cm^2 up to 2.5 cm^2 area
5	Oozing lesion developed above 2.5 cm^2 up to 5 cm^2 area
7	Oozing lesion developed above 5 cm^2
9	Splitting of bark

To record the observations, the infected lesion was superficially scrapped with knife sterilized with sodium hypochlorite 4 per cent solution. Transparent tracing paper was kept over the lesion and area of infection was traced on tracing paper. This tracing was then kept over graph paper to calculate total area of infection. The disease intensity of both diseases was recorded by selecting twenty four plants from each plot. Percent disease intensity (PDI) was calculated by following formula, (Gade *et al*., 2006) [3].

$$\text{Per cent Disease Intensity} = \frac{\text{Summation of all numerical ratings}}{\text{Total number of tree examined X maximum ratings}} \times 100$$

Per cent disease incidence of root rot and gummosis of Nagpur mandarin was calculated by following formula, (Jagtap *et al*., 2012) [4].

$$\text{Per cent Disease Incidence} = \frac{\text{Number of infected plants}}{\text{Total number of plants}} \times 100$$

Survey for incidence and intensity of root rot and gummosis of Nagpur mandarin

Rapid roving survey

A rapid roving field survey was conducted to know the incidence and intensity of Nagpur mandarin gummosis and root rot diseases in Warud and Morshi tahsils of Amaravati district conducted in places like Tiwasakhed, Khadka, Magona, Bargaon Benoda, Nagziri, Malkapur, Jarud, Malkhed, Palsona from Warud whereas places *viz.*, Nimbhi, Dapori, Morjha, Yawali, Hiwarkhed, Umarkhed, Mengoli, Lakhara, Lehgaon, Jamgaon, Bhaipur and Ghodegaon surveyed from Morshi tahsil. The observations on disease intensity were recorded according to the disease rating scale developed with numerical rating 0-9. Also, observations on disease incidence was calculated by formula given under section 3.2.2.2.

A fixed plot survey of Nagpur mandarin orchards of Warud tahsil of Amravati district was carried out during the year 2016 and 2017. Five different plots *viz.*, Nagziri (two plots), Goregaon (single plot), Bargaon (single plot) and Benoda (single plot) were selected and designated as A, B, C, D and E, respectively. During the study monthly observations on incidence and intensity of diseases of Root rot and Gummosis were taken and soil samples were collected from Nagpur mandarin orchards. Soil samples were collected from the depth of 5 cm to 30 cm of rhizosphere for assessment of Phytophthora propagule and to check biological status in per gram of soil. From each plot, 24 plants were selected randomly for the observations on incidence and intensity of Root rot and Gummosis (Jagtap *et al*, 2012) [4]. The details of the experiment is furnished as follows,

The details of the experiment is furnished as follows,

Field	Plot-A (Nagziri)	Plot-B (Nagziri)	Plot-C (Goregaon)	Plot-D (Bargaon)	Plot-E (Benoda)
Farmer name	Ramesh Jichkar	Ramesh Jichkar	Sanjay Dharad	Rajendra Karale	Suresh Baramase
Irrigation	Drip irrigation	Drip irrigation	Drip irrigation	Check basin	Flood irrigation
Rootstock	Rangpur lime	Rangpur lime	Jambheri	Jambheri	Jambheri
Age of tree (Yr)	16	16	10	15	13

Rapid roving field survey was conducted to know the incidence and intensity of Nagpur mandarin gummosis in Warud and Morshi tahsils of Amravati district. Citrus growing fields of above mentioned areas were surveyed as explained in material and methods and the data generated is presented in Table 3.

Results and Discussion

The disease incidence and intensity of citrus gummosis was in the range from 25.00 to 50.00% and 6.94 to 29.16%, respectively in all the location surveyed. The incidence and intensity of citrus gummosis was maximum in Nimbhi (50.00%) and Bhaipur (29.16%) of Morshi tahsil whereas minimum incidence and intensity of gummosis was recorded in Lehgaon which was (25.00%) and Lakhara (6.94%), respectively.

The results of the present findings are in accordance to Jagtap *et al*, (2012) [4] who did roving survey to assess the disease incidence and intensity of citrus gummosis and noticed highest disease incidence in Nanded district (63.38%)

followed by Jalna (58.00%). Whereas maximum per cent severity in Limbgaon village in Nanded district (34.50%) followed by Bahirgaon village in Jalna district (33.20%).

Table 3: Survey for incidence and intensity of Nagpur mandarin gummosis in Warud and Morshi tahsil (During October)

Sr. No.	Location	Incidence (%)	Intensity (%)
	Warud tahsil		
1	Tiwasakhed	41.66	7.16
2	Khadka	45.83	18.97
3	Magona	33.33	7.40
4	Bargaon	41.66	13.88
5	Benoda	37.50	15.27
6	Nagziri	37.50	18.05
7	Malkapur	41.66	12.95
8	Jarud	45.83	20.83
9	Malkhed	41.66	18.51
10	Palsona	29.16	10.64
	Morshi tahsil		
11	Nimbhi	50.00	20.83
12	Dapori	37.50	15.27
13	Morjha	29.16	18.64
14	Yawali	37.50	13.64
15	Hiwarkhed	41.60	13.71
16	Umarkhed	41.83	15.73
17	Mengoli	37.50	13.42
18	Lakhara	33.33	6.94
19	Lehgaon	25.00	9.71
20	Jamgaon	29.00	16.02
21	Bhaipur	33.33	29.16
22	Ghodegaon	45.83	12.49

Table 4: Survey for incidence and intensity of Nagpur mandarin root rot in Warud and Morshi tahsil (During September)

Sr. No.	Location	Incidence (%)	Intensity (%)
	Warud tahsil		
1	Tiwasakhed	37.50	9.25
2	Jarud	45.83	9.71
3	Malkapur	37.50	10.25
4	Bargaon	41.50	8.25
5	Khadka	33.33	7.40
6	Nagziri	50.00	8.79
7	Palsona	37.50	12.03
8	Benoda	41.66	12.49
9	Magona	45.83	15.24
10	Malkhed	37.50	9.25
	Morshi tahsil		
11	Nimbhi	41.16	10.72
12	Dapori	29.16	9.71
13	Morjha	33.33	8.33
14	Yawali	29.00	11.56
15	Hiwarkhed	29.16	11.56
16	Umarkhed	41.66	11.10
17	Mengoli	41.66	15.27
18	Lakhara	33.33	12.95
19	Lehgaon	33.33	12.92
20	Jamgaon	29.16	17.51
21	Bhaipur	29.16	8.79
22	Ghodegaon	37.50	10.64

Survey for incidence and intensity of Nagpur mandarin root rot in Warud and Morshi tahsil

Rapid roving field survey was conducted to know the incidence and intensity of Nagpur mandarin root rot in Warud and Morshi tahsils of Amravati district and the data generated is depicted in Table 4.

The disease incidence and intensity of Nagpur mandarin root rot was in the range from 29.00 to 50.00% and 7.40 to 17.51%, respectively in all the location surveyed. The Nagpur mandarin root rot incidence and intensity was maximum in Nagziri (50.00%) and Jamgaon (17.51%) of Morshi tahsil whereas minimum disease incidence and intensity was recorded in Yawali which was (29.00%) and Khadka (7.40%), respectively. This is in conformity with the findings of Naqvi (2006) [6] and Gade (2012) [3].

Present findings are in line with Fateh *et al*. (2017) who conducted surveys to observe disease incidence, severity and percent disease index of citrus decline in six tehsils of district Sargodha. Maximum mean disease incidence was recorded in tehsil Sargodha (94.06%) followed by tehsil Shahpur (93.33%) while it was the minimum in tehsil Sillanwali (35.73%). Similarly, mean disease severity was found to be the maximum in tehsil Sargodha (1.47) followed by tehsil Bhalwal and was the minimum in Sillanwali (0.64). As regards disease index, it was recorded to the maximum in tehsil Sargodha (29.41%) followed by tehsil Shahpur (26.75%). On the other hand, minimum disease index was again observed in tehsil Sillanwali (10.36%).

Acknowledgments

The authors are thankful to the Information Technology Research Academy (ITRA), Ministry of Information Technology, GOI, New Delhi for providing fellowship and funding to conduct this research work. We are also thankful to Indian Institute of Technology (IIT) Bombay for providing sensor based data on environmental factors of all four experimental plots.

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