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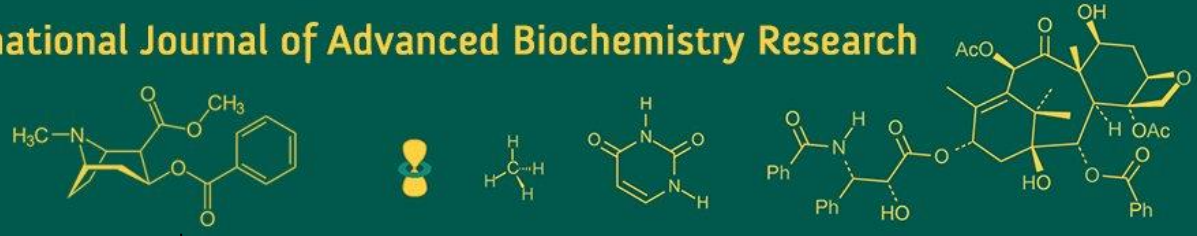

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Survey for occurrence, distribution and monitoring of buckeye rot disease of tomato in major tomato growing areas of Western Maharashtra

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Abstract
Survey is an exercise implemented for the collection of information, data and interpretation of research. Regular field survey provides crucial data on the geographic distribution and severity of the disease. The survey helps in early disease detection and also guide the implementation of both cultural and chemical control methods to minimize crop losses. Tomato crops are highly susceptible to buckeye rot, and severe outbreaks can lead to significant economic losses all over the world in every year. Survey which focuses on tomato-growing areas to monitor the incidence of buckeye rot disease, is essential for understanding how this disease affects crops. Accordingly, the field survey on buckeye rot disease of tomato in major tomato growing regions of Western Maharashtra were carried out during 2021-2022 and 2022-2023 *Kharif* crop season in three districts of Western Maharashtra *viz.*, Nashik, Pune and Ahilyanagar. During survey time GPS location of surveyed areas were captured and disease samples were collected for further lab studies.
Survey interpretation is illustrated and described in detail as below. During year 2021-22 maximum buckeye rot disease incidence was observed in Nashik district (27.60%) followed by Pune district (21.00%) while minimum in Ahilyanagar district (17.61%). Similarly in 2022-23 highest disease incidence was found same in Nashik district (26.33%) followed by Pune district (20.60%) and lowest in Ahilyanagar district (16.57%).

Keywords: Tomato, buckeye rot, survey

1. Introduction
Tomato (*Solanum lycopersicum* L.), is one of the most important "Protective food" as it has special nutritive and antioxidant properties due to the presence of lycopene and flavonoids (Sepat *et al.* 2013) [9]. It is one of the world's largest grown vegetable crop after potato and sweet potato, and it ranks 1st in canning industry. In India, tomatoes are grown on 8.09 million ha with an annual production of 19.7 million tonnes (Ashwathappa *et al.*, 2020) [2]. In Maharashtra tomatoes are grown on 42,900 ha with an annual production of 10,40,000 tonnes with an average productivity of 24.24 T ha^{-1} in 2019-2020 (Anonymous, 2020) [1].
Ripe fruits are good source of ascorbic acid, vitamin A and minerals like potassium and sodium. Unripe green tomatoes can also be breaded and fried, used to make salsa. It is very good source of income for small and marginal farmers and also contributes to the nutrition of the consumers (Singh *et al.* 2010) [11]. Tomato and its based products are used as a preventive strategy against major lifestyle diseases, such as cancer and cardiovascular diseases (Canene-Adams *et al.* 2005) [4]. Fungal diseases are of paramount importance and among various diseases of tomato, buckeye rot caused by *Phytophtora nicotianae* and is regarded as one of the most devastating tomato disease in certain regions. It is a significant soil-borne disease that affects fruit quality and yield, especially under warm and moist conditions.
Buckeye rot of unripe tomatoes is of serious concern to small and marginal farmers because it results in complete failure when fruiting coincides with the onset of rainy season (Paragannavar, 2017) [7]. The pathogen infects both leaves and fruits but is more severe on fruits, where high relative humidity coupled with warm weather conditions prevail. The pathogen infects the lower fruit touching the soil, causing water-soaked lesions with concentric rings, which can lead to considerable economic losses. Losses due to this disease have been reported between 30 and 70 percent by Rattan and Saini (1979) [8], which may rise

with the favourable conditions and severity of disease even go up to 90 percent (Sharma, 1971) [10]. Considering the importance of buckeye rot infection and their potentiality of being an epidemic pathogen, survey on occurrence of buckeye rot disease of tomato will be helpful in managing the disease. Hence, survey on occurrence of buckeye rot disease of tomato was carried out during both years 2021-22 and 2022-23.

2. Materials and Methods

2.1 Survey, collection and maintenance of material

In the course of present investigations, different tomato growing areas of Nashik, Pune and Ahilyanagar districts were periodically survey during 2021-22 and 2022-23 crop seasons to record the occurrence of buckeye rot disease of tomato.

During the course of surveys, the diseased samples *i.e.*, fruits showing buckeye rot symptoms were collected and kept in paper bags. These samples were brought to laboratory for isolation of the associated pathogen and stored in a refrigerator at 4 °C for further studies.

2.2 Disease incidence

Tomato growing areas of Nashik, Pune and Ahilyanagar districts of Maharashtra were surveyed during 2021-22 and 2022-23 crop season in order to record the incidence of buckeye rot disease at various localities. Randomly 10 plants were selected at different localities to record the data on disease incidence. The disease incidence was calculated in case of fruits using following formula:

$$\text{Disease Incidence (\%)} = \frac{\text{Number of diseased fruits per plant}}{\text{Total number of fruits per plant}} \times 100$$

3. Results and Discussion

3.1 Tehsil wise survey to monitor the incidence of buckeye rot disease in major tomato growing areas of Western Maharashtra during 2021-22 and 2022-23

To study the prevalence of the disease, periodic surveys of tomato (*Solanum lycopersicum* L.) growing areas of 38 villages from 8 tehsils were surveyed across 3 districts namely Nashik, Pune and Ahilyanagar of Western Maharashtra during 2021-22 and 2022-23 *Kharif* crop season. Data pertaining to incidence of buckeye rot disease of tomato at different locations were recorded and presented in Table 1 and Plate 1, Plate 2.

It is evident from the data Table 1, that the disease was widespread in Nashik, Pune and Ahilyanagar districts of Maharashtra. The occurrence of incidence of buckeye rot was ranged from 11.00 to 38.00 percent in 2021-22. In Nashik district, highest incidence was recorded at Kadwa Mahalungi village (38.00%) from Dindori tehsil followed by Mohadi village (34.66%) while lowest at Khadambe Khurd village (11.00%) from Rahuri tehsil from Ahilyanagar district in 2021-22. In 2022-23 highest incidence of disease was recorded at Otur village (34.66%) from Junnar tehsil of Pune district and lowest at Rahuri tehsil in Digras village (10.00%) of Ahilyanagar district. In 2022-23 occurrence of buckeye rot disease of tomato was ranged from 10.00 to 34.66 percent. The overall data revealed that the incidence of the disease was more in Nashik district than Pune and Ahilyanagar district.

3.2 District wise survey of disease incidence of buckeye rot disease of tomato in major tomato growing areas of Western Maharashtra

Disease incidence of buckeye rot disease of tomato was found varied from district to district may be due to the variations in environmental factors, cropping pattern, soil, availability of water and cultural practices as described earlier. It is seen from Table 2 that, during year 2021-22 maximum buckeye rot disease incidence was observed in Nashik district (27.60%) followed by Pune district (21.00%) while minimum in Ahilyanagar district (17.61%). Similarly in 2022-23 highest disease incidence was found same in Nashik district (26.33%) followed by Pune district (20.60%) and lowest in Ahilyanagar district (16.57%).

District wise complied average disease incidence of buckeye rot disease of tomato (Table 2) showed that, highest average disease incidence was noticed in Nashik district (26.96%) followed by Pune district (20.80%) while lowest in Ahilyanagar district (17.09%). Result from districts wise survey of tomato indicated that, buckeye rot disease of tomato was found as a major disease in tomato growing districts of Western Maharashtra in varied range due to high rainfall and high relative humidity. The representative photographs of survey study are shown in Plate 1 and 2. Geographical distribution of buckeye rot disease of tomato in major tomato growing districts of Western Maharashtra during 2021-22 and 2022-23 shown in Plate 3.

The district-wise analysis of buckeye rot disease incidence in tomatoes showed clear variability in disease pressure across regions. Nashik consistently exhibited the highest incidence rates, suggesting that this district is more prone to buckeye rot disease, potentially may be due to environmental factors, cultivation practices, or pathogen prevalence. On the other hand, Ahilyanagar experienced the lowest disease incidence, indicating better control measures or less favorable conditions for the pathogen.

These findings are in accordance with the earlier reports of buckeye rot reported in Himachal Pradesh. An incidence of 65 to 68 percent due to fruit rot disease in ripe tomato fruits was recorded by Thapa and Sharma, 1976 [12], Dodan *et al.*, 1995 [5]. Bharat and Gupta (2011) [3] noticed disease incidence up to 71 percent. Krishan (2014) [6] found disease incidence in the range of 5 to 85 percent in different genotypes of tomato from different locations of Mandi and Kangra districts of Himachal Pradesh.

Table 1: Survey on disease incidence of buckeye rot disease in tomato major growing areas of Western Maharashtra during 2021-22 and 2022-23

District	Tehsil	Village	Longitude	Latitude	Variety	Disease incidence (%) 2021-22	Disease incidence (%) 2022-23
Nashik	Nashik	Matori	73º 75' 0.77"	20 º 05'71.97"	Aryaman	29.33	27.33
		Mungsare	73º 72' 40.43"	20º 05'50.58"	Yogi 35	28.00	28.00
		Madsangvi	73º 86' 90.95"	20º 00'06.62"	Aryaman	25.33	26.66
		Shevgedarna	73º 84' 9.22"	19º 91' 2.71"	1057	27.33	24.33
		Lakhalgaon	73º 92' 66.31"	19º 98'67.16"	Sahoo	26.66	26.00
		Average				27.33	26.46
	Dindori	Dhakambe	73º 80' 47.41"	20º 11'01.36"	Omini	33.33	30.00
		Mavadi	73º 92' 12.13"	20º 31'00.62"	6288	30.66	30.00
		Niwane	73º 07' 3.18"	20º 47'58.33"	Sahoo	29.33	28.66
		Kadwa Mahalungi	73º 81' 6.84"	20º 25'51.35"	Alankar	38.00	33.33
		Mohadi	73º 82' 71.96"	20º 20'41.71"	Aryaman	34.66	31.33
		Average				33.20	30.66
	Niphad	Kasabe Sukene	74º 01' 30.32"	20º 07'84.69"	Aryaman	25.33	24.00
		Vadali Najik	74º 02' 57.89"	20º 10'92.83"	Sahoo	22.00	20.66
		Antarweli	73º 97' 56.64"	20º 19'34.98"	Aryaman	21.33	22.00
		Naitale	74º 16' 18.47"	20º 07'32.25"	Aryaman	22.66	22.66
		Pimpalas	73º 80' 03.21"	20º 0' 83.30"	Aryaman	20.00	20.00
		Average				22.26	21.86
		Average of Nashik district				27.60	26.33
Pune	Junnar	Narayngaon	73º 55' 00.02"	19º 0' 7.00"	Abhinav	20.00	21.33
		Yedgaon	73º 98' 05.45"	19º 15'48.34"	Virang	22.66	20.66
		Otur	73º 94'70.233"	19º 26'32.22"	Alankar	26.66	34.66
		Rajur	73º 8' 34.01"	19º 24' 5.83"	Virang	17.33	14.66
		Ale	74º 11'03.155"	19º 17'70.31"	Sahoo	20.66	18.00
		Average				21.46	21.86
	Ambegaon	Ghodegaon	73º 73' 01.24"	19º 11'23.25"	1057	21.33	20.66
		Mahalunge Padwal	76º 0' 4.34"	18º 57' 4.58"	6242	22.00	20.00
		Eklahare	73º 86' 0.74"	18º 0' 39.60"	Abhinav	20.66	18.66
		Kalamb	76º 0' 4.34"	18º 57' 4.58"	Sahoo	18.00	19.33
		Chandoli	73º 9' 24.10"	18º 98' 7.75"	Abhinav	20.66	18.00
		Average				20.53	19.33
		Average of Pune district				21.00	20.60
Ahilyanagar	Sangamner	Ambhore	74º 28' 18.15"	19º 47'88.25"	Atharv	20.00	18.66
		Pimparne	74º 27' 9.56"	19º 51' 7.15"	Ansal	19.33	19.33
		Kanoli	74º 30' 3.53"	19º 53'1.08"	Abhinav	18.66	20.00
		Nimaj	74º 0' 83.80"	19º 3'20.50"	Ayushman	22.00	20.66
		Pimplgaon Depa	74º 26' 68.65"	19º 45'4.27"	Ansal	21.33	19.33
		Average				20.26	19.60
	Rahuri	Malharwadi	74º 59' 7.53"	19º 38' 2.81"	Aryaman	12.00	11.33
		Digras	74º 62' 3.28"	19º 35' 2.23"	Yug	11.33	10.00
		Gadadhe Akhada	74º 52' 7.99"	19º 39' 0.16"	1057	13.33	12.00
		Khadambe Khurd	74º 6' 92.78"	19º 3' 13.59"	Aryaman	11.00	10.66
		Average				11.91	11.00
	Akole	Takali	74º 00' 3.76"	19º 55' 6.16"	6242	21.33	18.00
		Dhokri	73º 98' 4.44"	19º 56'4.41"	Virang	20.00	19.33
		Auranpur	73º 97' 5.25"	19º 53'9.67"	Abhinav	20.66	20.00
		Average				20.66	19.11
		Average of Ahilyanagar district				17.61	16.57

Table 2: District-wise average disease incidence of Buckeye Rot disease of Tomato during *Kharif* season 2021-22 and 2022-23 of Western Maharashtra

Sr. No.	District	Disease incidence (%)		Average disease incidence (%)
		2021-22	2022-23	
1.	Nashik	27.60	26.33	26.96
2.	Pune	21.00	20.60	20.80
3.	Ahilyanagar	17.61	16.57	17.09
	Pooled average disease incidence	22.07	21.16	21.62

Plate 1: Survey on incidence of buckeye rot disease of tomato in major growing areas of Western Maharashtra during 2021-22

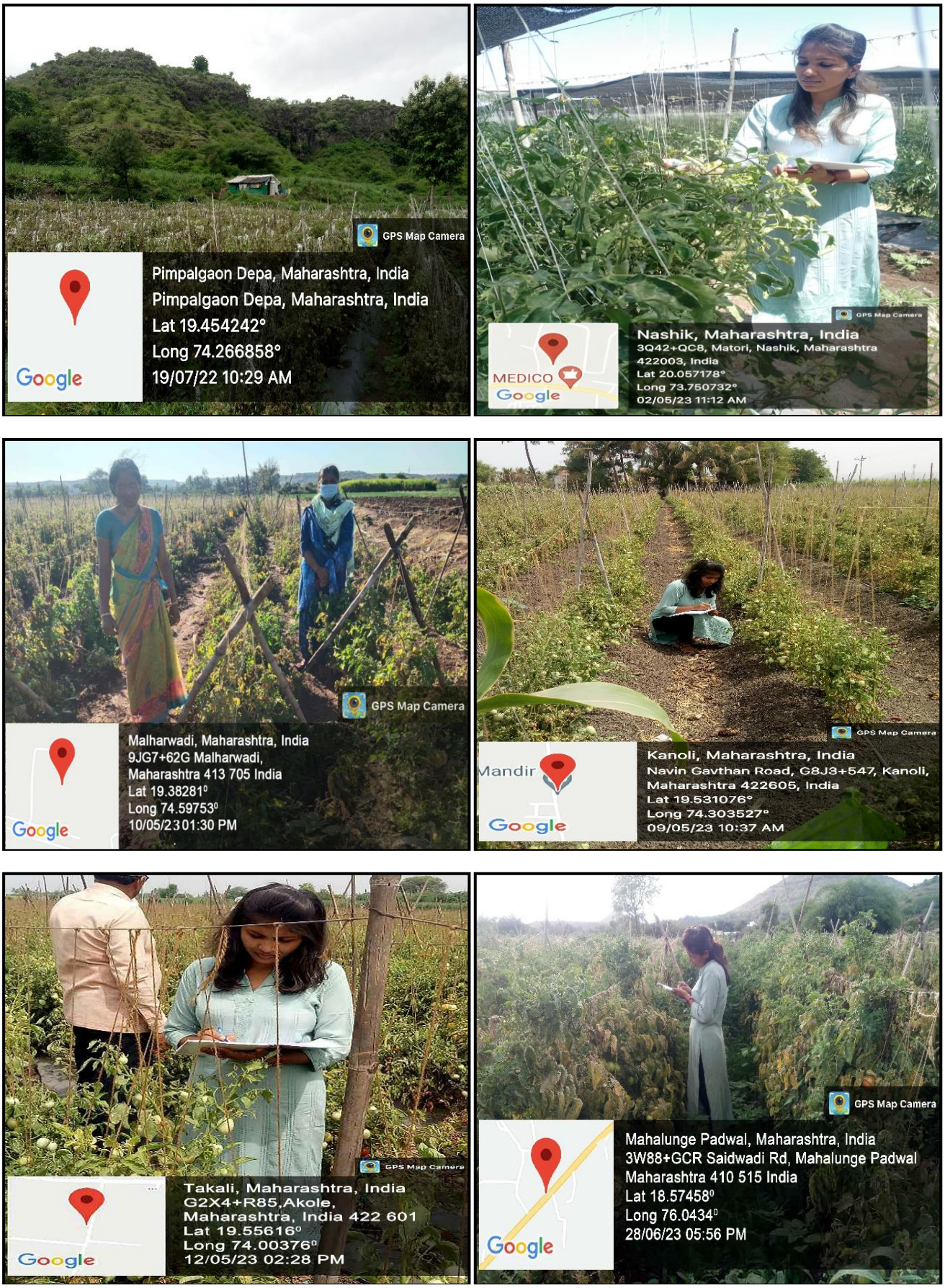

Plate 2: Survey on incidence of buckeye rot disease of tomato in major growing areas of Western Maharashtra during 2022-23

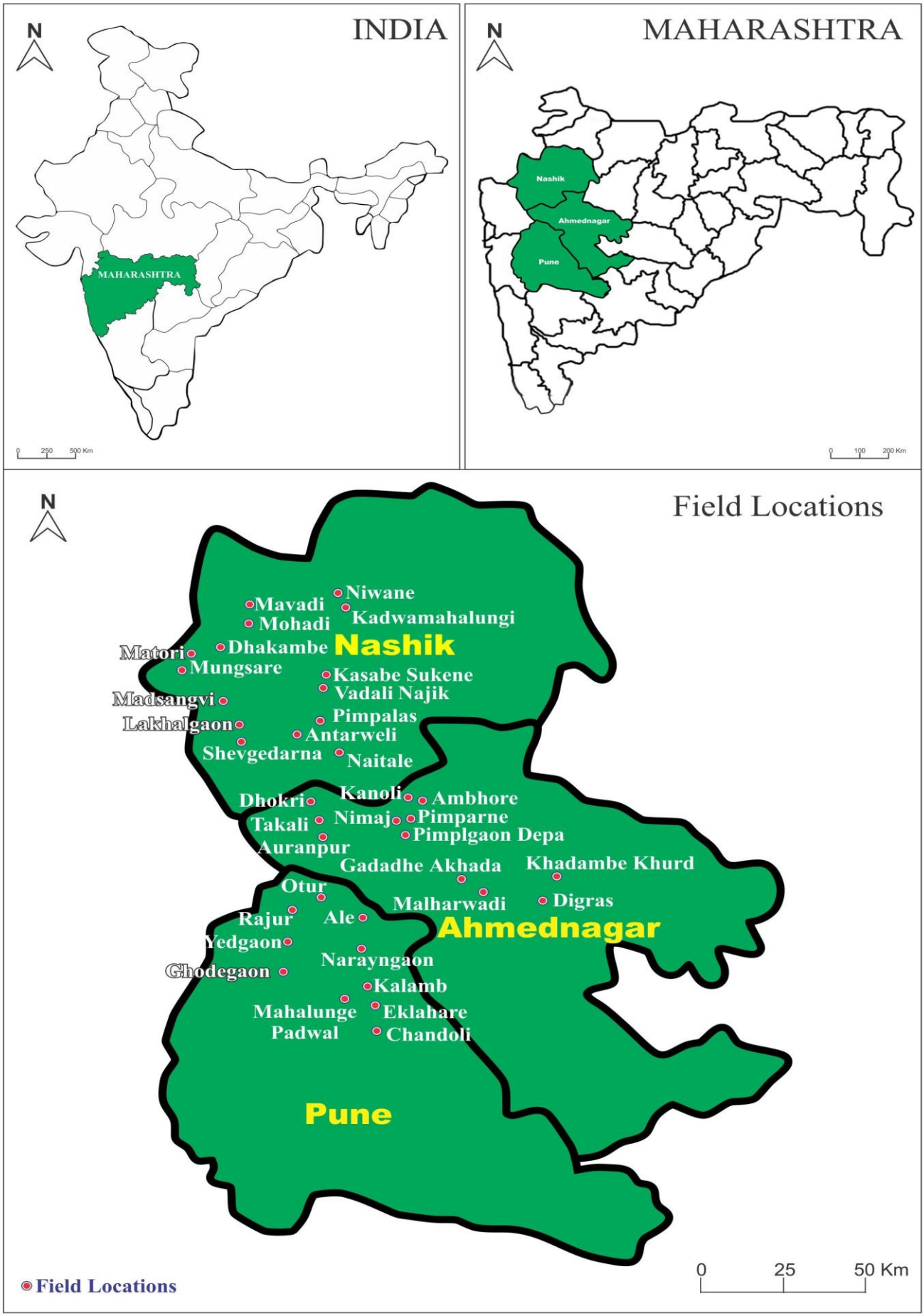

Plate 3: Map showing geographical distribution of buckeye rot disease of tomato in major tomato growing districts of Western Maharashtra during 2021-22 and 2022-23

4. Conclusion

Occurrence and distribution of Buckeye Rot disease of tomato was found in all tomato growing regions of Western Maharashtra. Nashik district is more prone to Buckeye Rot disease than other district during both years. The disease incidence was noticed more in year 2021-22 than 2022-23.

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