SpatialDistributionandDiseaseIncidenceofGuavaWiltVillageSurvey Across Prayagraj and Kaushambi, Uttar Pradesh, India

Abstract

A comprehensive roving survey was conducted in the Prayagraj and Kaushambi districts of UttarPradesh,India,bothprominentguava-producingregions.Thesurvey,whichincluded30 villages,revealedwidespreadguavawiltwithincidenceratesrangingfrom19.04%to37.93%, averaging30.19%acrosstheregion.Threeformsofwiltthesearequick,slow,andpartialwere identified. Kaushambi district had a higher incidence rate (31.56%) compared to Prayagraj district (28.82%). Indarapur village in Kaushambi recorded the highest wilt incidence (37.93%). The survey also found that 66.67% of farmers lacked formal training in guava cultivation,contributingtopoordiseasemanagement.Guavawiltwasmost prevalentinolder orchards(10+years)and primarilyaffectedtheAllahabadSafedavariety,whichhadthehighest wilt incidence (33.64%). In contrast, the Pant Prabhat variety exhibited the lowest wilt incidence(22.95%).Thecausalpathogen,*Fusariumoxysporum*f.sp.*psidii*,wasisolatedfrom diseasedplants.Threefungalisolatesdisplayedvariationsincolonymorphology,growth,and sporulation.Microconidiawerenon-septateandkidney-shaped,whilemacroconidiawerethin-walled and typically 2-3 septate. Two isolates also produced chlamydospores. This study highlights the need for enhanced farmer training and the potential for cultivating wilt-tolerant varieties to mitigate the spread of the disease in the region.

KeyWords:*AgriculturalPractices,Fusariumoxysporum*f.sp.*psidii,GuavaVarieties,Guava Wilt Disease Incidence, Kaushambi, Prayagraj, Wilt Management.*

1. Introduction:

Guava (*Psidium guajava* L.) is a significant fruit crop in tropical and subtropical regions, including widespread cultivation across India (Misra, 2006). Originally from Mexico, Central America, the Caribbean, and northern South America (Amusa *et al*., 2005), it belongs to the Myrtaceae family and has a chromosome number of 2n=22 (Singh, 2001). In India, guava is grownextensively,with UttarPradeshbeing theleadingproducer,contributing22.93%ofthe nation's output (Tractor Junction, 2023). Despite its nutritional significance these are rich in vitamins A and C, dietary fiber, potassium, and antioxidants, guava cultivation faces a significant challenge from guava wilt disease (Parvez *et al*., 2018; Mitra *et al*., 1996). Guava wilt is the most destructive disease affecting this crop, primarily caused by soil-borne pathogens such as *Fusarium oxysporum* f. sp. *psidii* (Prasad *et al*., 1952). First reported in Taiwan in 1926 and later in India in 1935 from Allahabad (Singh and Lal, 1953), guava wilt hasbecomeapersistentissue,particularlyinmajorguava-producingregionslikeUttarPradesh. The disease is characterized by symptoms such as wilting leaves, chlorosis, poor fruit development, and root decay, ultimately leading to tree death (Singh *et al*., 2021). Several factors, including soil type, climate, and cultural practices, influence disease development (Hakim *et al*., 2021). Managing guava wilt is challenging due to its complex etiology and its association with multiple pathogens, including *Fusarium* species, *Macrophomina*, and *Rhizoctonia*(Srivastava*etal*.,2021).Theaimofthestudywasevaluatingthecurrentscenario of the

wilt incidence in Indias most guava producing region. Also how to amplify the productionanddecreasethewiltincidencebyusingthesomebasicpracticeslikeusingresistant varieties of the guava wilt.

2. Materialsand methods:

A comprehensive survey was conducted in Prayagraj, Uttar Pradesh, from October 2023 to February 2024 to evaluate guava wilt prevalence. This study targeted key guava-growing blocksinPrayagrajandKaushambidistricts,coveringtenblocksintotal,fivefromeachdistrict (Table1).Threevillages fromeachblockwereselectedforin-depthinvestigation.Farmersof these villages were interviewed with open-ended questionnaires, and discussions were held with local farmers, experts, and gram panchayat officials. This approach provided a detailed overview of guava cultivation practices and the impact of guava wilt. The survey explored factors such asorchardsize,guavavarieties, orchardage,and challengeslikepest anddisease problems. It also assessed whether farmers had received any formal training or guidance on guava cultivation and disease management. Disease prevalence was calculated using the formula from Madden and Hughes (1995).

$$\text{Plant Disease Incidence (PDI)} = \frac{\text{Number of Infected Plants}}{\text{Total Number of Plants Observed}} \times 100$$

To identify the causative pathogens, guava plant root samples with wilt symptoms were collected from each orchard.Theinfected rootsegments (2-3 mm) were sterilized using 0.1% sodiumhypochloritesolutionfor10-20seconds,thenwashedinsterilizeddistilledwater.These segments were placed on Potato Dextrose Agar (PDA) medium and incubated at 25 ± 2˚C. Pathogen identification was based on the cultural and morphological characteristics of the fungi, observed on the media, following keys from Nelson *et al*. (1983). Microscopic examination of fungal structures was performed using micrometry. This approach effectively reveals the extent of guava wilt and the involved pathogens, providing essential insights for developing targeted management strategies.

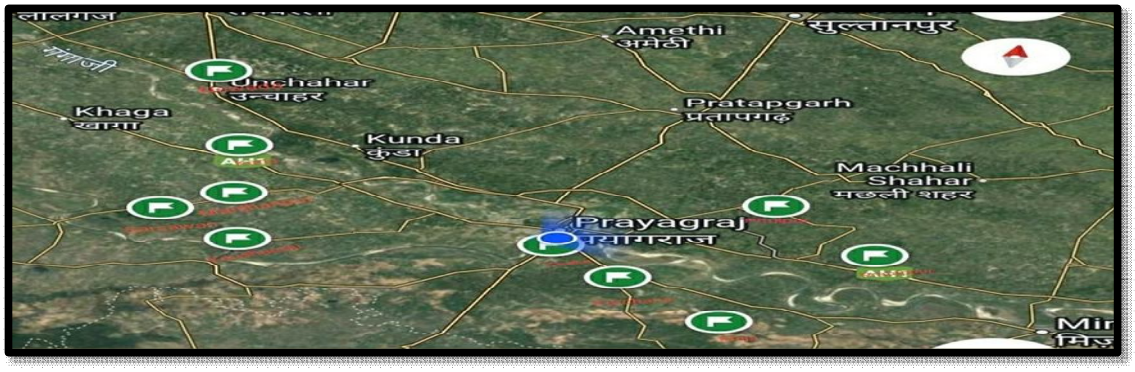


Plate 1 Blocks in the Prayagraj and Kaushambi district where surveyed for recorded wilt incidence

3. Results:

Asurveyof30villagesinPrayagrajandKaushambidistrictsfoundguavawiltwithanaverage incidenceof30.19%,rangingfrom19.04%to37.93%.Kaushambihadahigherrate(31.56%) than Prayagraj (28.82%). Indarapur village had the highest incidence at 37.93%. Wilt predominantlyaffectedolderorchards(10+years)andtheAllahabadSafedavariety(33.64%) more than Pant Prabhat (22.95%). *Fusarium oxysporum* f. sp. *psidii* was the pathogen identified, showing varied morphology and sporulation. The findings highlight the need for improved farmer training and wilt-resistant guava varietie.

3.1 Recordedwiltincidence indistrictPrayagraj:

InPrayagrajdistrict,guavawiltwasmostsevereinChakablock,withanincidenceof32.10%, followed by Phulpurblock at 29.44%. Among villages, Mohabatganj Uparharhad thehighest diseaserateat34.95%,andDhanuhawasclosebehindat34.31%.Thelowestincidenceinthe district was in Karchana block at 28.09%, with Birna village in Phulpur block showing the lowestrateof19.04%.InPhulpurblock,Shudhanipurhadthehighestwiltincidenceat30.95%, followed by Baraepur at 30.39%, and Birna at 19.04%. In Karchana block, Chakiya recorded thehighestrateat29.89%,withMahoriandPuraniat27.27%and27.11%,respectively.Meja blockhadKardahawiththehighestincidenceat31.42%,followedbyPatariaat28.68%and

Sukath at 26.66%. In Pratappur block, Manipur had the highest incidence at 29.03%, with Balarampur at 28.09% and Chak Todar at 27.51%.

3.2 Recordedwiltincidence indistrict Kaushambi:

In Kaushambi district, guava wilt was most severe in Kaushambi block, where it affected 34.06%oftheplants.Newadablockhadaslightlylowerincidenceat31.81%.Thevillagewith the highest guava wilt was Indarapur in Kaushambi block, with 37.93%. Other villages with highwiltratesincludedBaruliainKadablock(33.96%)andUndiinSarsawanblock(33.85%). The lowest wilt incidence was in Kada block, at 29.18%, with Aladinpur village having the lowest rate at 26.23%. In Newada block, Tarana village had the highest rate at 33.66%, while Fareedpur had the lowest at 29.52%. In Sarsawan block, Undi had the highest rate at 33.85%, followed by Bhobhi at 33.61%, and Gahani at 26.98%. In Kada block, the highest incidence was in Barulia village at 33.96%, with Chak Saini at 27.35% and Aladinpur at 26.23%. In Manjhanpur block, Mokimpur had the highest rate at 32.67%, with Pathara-kalan and Pachamba at 30.85% and 30.33%.

Thesurveyof30villagesintwodistrictsrevealedthatmostfarmerswereeitherinexperienced or untrained in guava cultivation, with 66.67% in this category. In Prayagraj district, 20% of farmershadformaltraining,whileinKaushambidistrict,only13.33%weretrained.Thesurvey alsoshoweddifferencesinorchardsizesandagesbetweenthedistricts.OrchardsinKaushambi are generally larger, averaging 1.20 acres, compared to 1.01 acres in Prayagraj. Orchards in Kaushambiarealsoabitolder,withanaverageageof13.52years,comparedto13.26yearsin Prayagraj. Some areas, like Karchana in Prayagraj and Newada in Kaushambi, have particularly old orchards, indicating these farms are more established.

Thevariationsinorchardsizesandagesacrossdifferentblocksandvillageswithineachdistrict highlight differences in agricultural practices, resource availability, and training levels. On average,orchardsinKaushambidistrictareslightlylarger(1.20acres)thanthoseinPrayagraj (1.01 acres).Additionally, the average orchard age in Kaushambi (14 years) is higher than in Prayagraj (13.26 years). Notably, some blocks like Karchana in Prayagraj (15.66 years) and Newada in Kaushambi (15.33 years) have older orchards, indicating more established cultivation practices.

The survey of 30 orchards found thatAllahabad Safeda (36.20%) and Banarasi (19.76%) are the most widely cultivated guava varieties, followed by Allahabad Surkha (16.35%), Lalit (12.67%), L-49 (7.51%), Chittidar (3.74%), and Pant Prabhat (3.74%). Allahabad Safeda exhibitedthehighestincidenceofwiltat33.64%,withBanarasiclosebehindat30.27%.L-49 had a wilt incidence of 30.20%, followed by Chittidar (28.68%) and Allahabad Surkha (27.76%).TheLalitvarietyhadalowerincidenceofwilt(25.66%),whilePantPrabhathadthe lowest at 22.95%.

Table: -1. Recorded guava wilt disease incidence in Prayagraj and Kaushambi district [Each districthad 5 blocks, and 3 villagesfromeach blockwereselected forthe survey.]

District	Block	Village	Wilt disease incidence (%)	Block Average (%)	District Average (%)	Grand Average (%)
Prayagraj	Chaka	Dhanuha	34.31%	32.10%	28.82%	30.19%
		Chaka	27.05%			
		Mohabatganj uparhar	34.95%			
	Meja	Kardaha	31.42%	28.92%		
		Sukath	26.66%			
		Pataria	28.68%			
	Karchana	Mahori	27.27%	28.09%		
		Purani	27.11%			
		Chakiya	29.89%			
	Pratappur	ChakTodar	27.51%	28.21%		
		Manipur	29.03%			
		Balrampur	28.09%			
	Phulpur	Baraepur	30.39%	26.79%		
		Shudhanipur	30.95%			
		Birna	19.04%			
Kaushambi	Kaushambi	Bindaw	32.89%	34.06%	31.56%	
		Indarapur	37.93%			
		Dugauli	31.37%			
	Newada	Fareedpur	29.52%	31.81%		
		Makhupur	32.25%			
		Tarna	33.66%			
	Sarsawan	Undi	33.85%	31.48%		
		Bhobhi	33.61%			
		Gahani	26.98%			
	Kada	Aladinpur	26.23%	29.18%		
		Barulia	33.96%			
		ChakSaini	27.35%			
	Manjhanpur	Mokimpur	32.67%	31.28%		
		Pachamba	30.33%			
		Pathara-kalan	30.85%			

Table:-2.Numberoftheformaltraininghaveandnotamong30orchards

District	Sumofnumberof respondents	Sumoftrained farmers	Sumofamature amaturefarmers
Prayagraj	15	6 (20%)	9

Kaushambi	15	4 (13.33)	11

Table:-3.Listoftheareaandageoftheorchardsofallsurveyedplaces

District	Block	Village	Ageofthe orchards (Years)	Averageageof the orchards (Years)	Totalareaof the orchards (Acre)	Avaerage age of theorchard(Acre)
Prayagraj	Chaka	Dhanuha	13	15	1	1.33
		Chaka	17		2	
		Mohabatganj uparhar	15		1	
	Meja	Kardaha	12	11.66	0.5	0.75
		Sukath	15		0.5	
		Pataria	8		1.25	
	Karchana	Mahori	16	15.66	1.5	1
		Purani	14		0.5	
		Chakiya	17		1	
	Pratappur	ChakTodar	19	14	1.5	1.08
		Manipur	13		0.5	
		Balrampur	10		1.25	
	Phulpur	Baraepur	13	10	1	0.91
		Shudhanipur	10		1.25	
		Birna	7		0.5	
Kaushambi	Kaushambi	Bindaw	16	13.66	1.5	1.16
		Indarapur	13		1.5	
		Dugauli	12		0.5	
	Newada	Fareedpur	19	15.33	1	0.83
		Makhupur	17		0.5	
		Tarna	10		1	
	Sarsawan	Undi	15	11.33	1.25	1
		Bhobhi	11		1.25	
		Gahani	8		0.5	
	Kada	Aladinpur	19	14.66	1	1.16
		Barulia	12		0.5	
		ChakSaini	13		2	
	Manjhanpur	Mokimpur	17	12.66	2	1.33
		Pachamba	12		1	
		Pathara-kalan	9		1	

Table:-4.Listofthefrequencyandwiltdiseaseincidence%onspecificvarietiesofthe guava

Guavavarieties	Frequency (%)	Wiltincidence(%)
AllahabadSafeda	36.2	33.64
Banarasi	19.76	30.27
L-49	7.51	30.2
Chittidar	3.74	28.68
AllahabadSurkha	16.35	27.76
Lalit	12.67	25.66
PantPrabhat	3.74	22.95

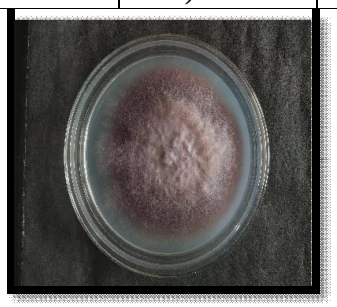
In this present study, the fungus responsible for guava wilt was identified as *Fusarium oxysporum* f. sp. *psidii* based on morphological features described by Nelson *et al*. (1983). Three isolates were purified, displaying distinct colony colors, growth patterns, and morphology.After seven days on PDAmedium, colony diameters ranged from 45 to 75 mm, with mycelia colors varying from white to light brown, occasionally showing pink or purple hues.

Theisolatesproducedabundantmicroconidia(6.8–14.5µminlength,2.28–4.65µminwidth), whichwereovaltokidney-shapedandnon-septate.Macroconidia(21.94–37.75µminlength, 5.68–6.83 µm in width) were thin-walled, falcate to nearly straight, typically with 2–3 septa, andhadpointedends.Twoisolatesalsoproducedchlamydospores(5.75–9.4µm),whichwere thick-walled, terminal or intercalary, and globose, forming either singly or in clusters.

Table:-5.Morphologicalcharactersoftheisolatepathogens

Source of Isolates	IsolateNo.	Microconidia length/breath (µm)	Macro-conidia length/breath(µm)	Colonycolour	Chlamy dospore (+/-)
Chaka, U.P.,Allahabad Safeda	**Fop 1** (Plates 4.6, 4.7, 4.12, 4.15 and 4.17)	6.80-8.30/2.28	21.9428.97/5.68	The fungal colony shows a dark purplish center, fading to lighterpurpleandthen to whitish at the edges.	+
Phulpur, U.P., AllahabadSafeda	**Fop 2** (Plates 4.8,4.9,4. 13, 4.14 and 4.18)	7.54-9.71/3.12	24.16-31.45/5.98	The fungal colonytransitionsfrom a white center to alight brown or tan withafuzzytexture, fadingtoatranslucent edge.	+

Kaushambi, U.P., Banarasi	**Fop 3** (Plates 4.10, 4.11, 4.13 and 4.16)	9.53-14.5/4.65	30.1437.75/6.83	Predominantly white, withaslightlydenser, creamy white center,exhibitinga fluffy texture throughout.	-



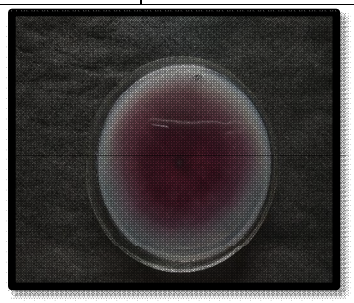
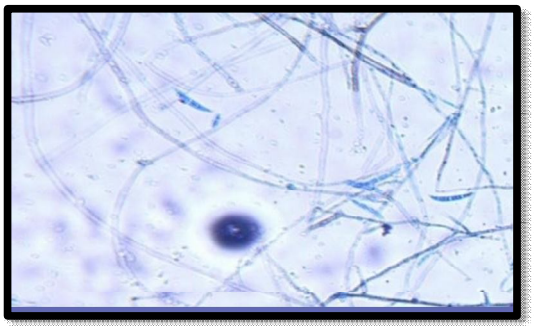


Plate2and3: Colony morphologyof isolateFop 1

Plate4 Colony morphology of isolateFop 2

Plate5 Colony morphology

Plate6 and 7 Colony morphologyof isolate Fop3 isolateFop



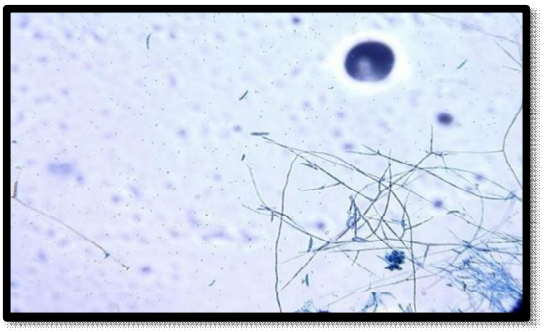


Plate8 Phialides(10x)

Plate9 Macroconidiawithmycelium (10x)

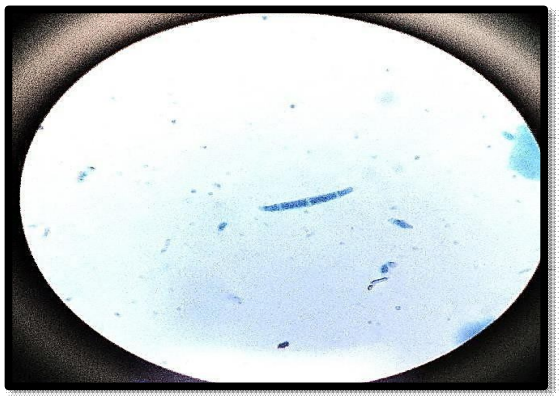


Plate10 Macroconidia(3Septate) (40x)

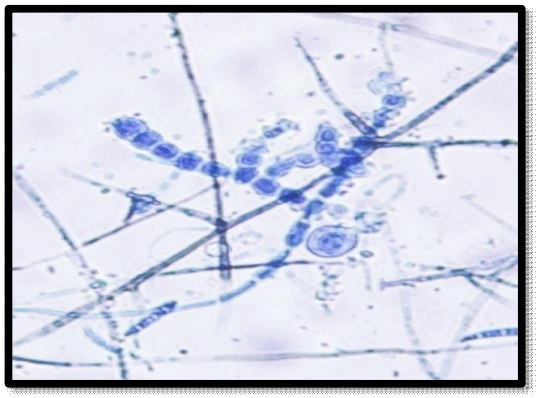


Plate11 Chlamydosporeinchainform(40x)

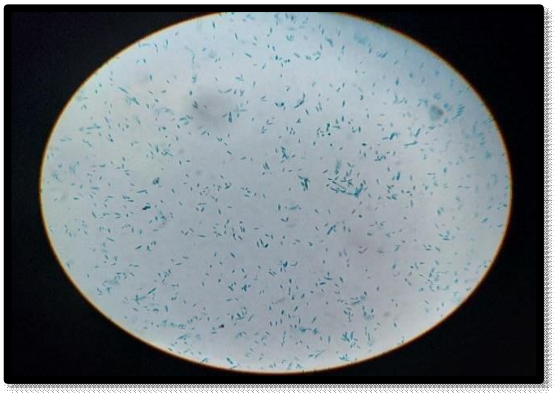


Plate12 Micro-conidia(10x)

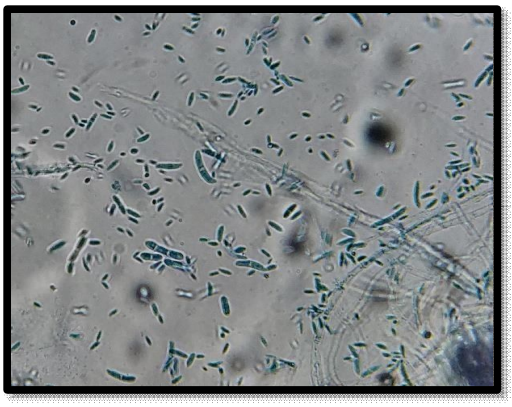


Plate13 Micro-conidiaandMacroconidia (10x)

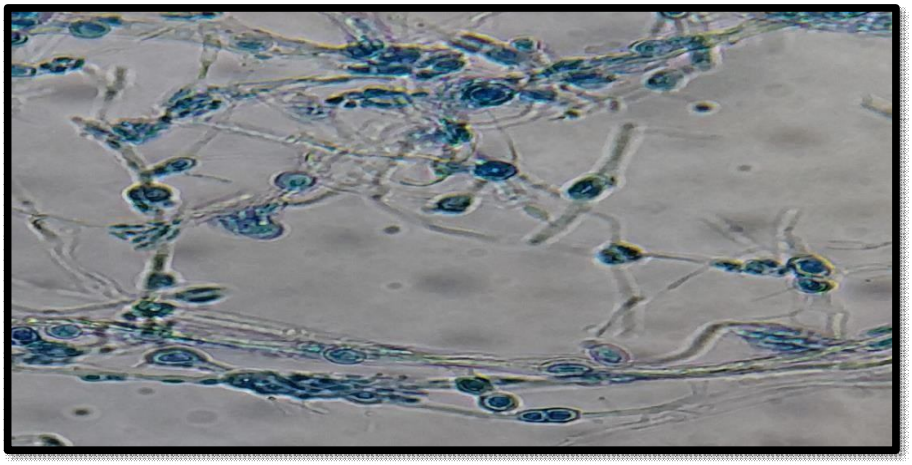


Plate14 Twocelledandintercalarychlamydospores(40x)

4. Discussion:

Survey conducted across 30 villages in the Prayagraj and Kaushambi districts revealed an average guava wilt incidence of 30.19%, ranging from 19.04% to 37.93%.The incidence was higher in Kaushambi (31.56%) compared to Prayagraj (28.82%), with Indarapur village in Kaushambirecordingthehighestincidenceat37.93%.Olderorchards(over10years)andthe AllahabadSafedavariety(33.64%)weremostaffected,whilethePantPrabhatvarietyhadthe lowest wilt incidence (22.95%).The pathogen responsible, *Fusarium oxysporum* f. sp. *psidii*, was identified through morphological analysis, which showed variations in colony color, growth, and sporulation. Misra and Shukla, 2002 estimated 5%-60% loss in Lucknow area.

In Prayagraj, the most severe incidence was in Chaka block (32.10%), with Mohabatganj Uparharhavingthehighestvillage-levelincidenceat34.95%.InKaushambi,Kaushambiblock had the highest overall wilt incidence (34.06%), with Indarapur village topping the list at 37.93%. Kaushambi district orchards were larger (1.20 acres) and slightly older (13.52 years) than those in Prayagraj (1.01 acres, 13.26 years), reflecting different cultivation practices and resource availability.

Thesurveyalsohighlightedthatmostfarmerslackedformaltraining,withonly20%offarmers in Prayagraj and 13.33% in Kaushambi receiving training in guava cultivation. The most commonlycultivatedguavavarietieswereAllahabadSafeda(36.20%)andBanarasi(19.76%). AllahabadSafedahadthehighestwiltincidence(33.64%),followedbyBanarasi(30.27%)and L-49 (30.20%). Round varieties are more prone to infection, while the L-49 variety demonstrates some resistance to wilt disease (Singh *et al*., 1977).

Theidentificationof*Fusariumoxysporum*f.sp.*psidii*wasconfirmedbasedonmorphological traitsdescribedbyNelson*etal*.(1983).Threeisolatesdisplayeddistinctcolonycharacteristics, and their microconidia measured 6.8–14.5 µm in length and 2.28 to 4.65 µm in width. Macroconidia ranged from 21.94 to 37.75 µm in length, with 2-3 septa. Two isolates also produced chlamydospores, ranging from 5.75 to 9.4 µm in size, either singly or in clusters. Thesefindingsstresstheneedforbetterfarmereducationandthedevelopmentofwilt-resistant guava varieties.

5. Conclusion:

In conclusion, the survey revealed that the majority of orchard owners lacked formal training inguavacultivationandwerenotplantingwilt-resistantvarieties,whichhaslikelycontributed to the widespread occurrence of guava wilt in the region. Most of the orchards surveyed consisted of older trees, predominantly the Allahabad Safeda variety, with a significant proportion of trees being over 10 years old. These older plants were found to be more susceptible to the disease, highlighting the need for targeted interventions, including farmer education on proper cultivation practices and the adoption of resistant guava varieties, to mitigate the impact of guava wilt and ensure sustainable production.

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