Assessment on the Prevalence of Wilt of Lentil inDifferent Districts of Uttar Pradesh

Abstract

A comprehensive field survey was carried out to evaluate the incidence of wilt of lentil during the *rabi* seasons of 2018-19 and 2019-20 across various farmer's fields in different districts of western Uttar Pradesh. The pooled data of two years (2018-19 and 2019-20) revealed a significant variation in wilt incidence among the surveyed districts. The disease incidence ranged from 9.37 to 38.47 per cent with an overall average of 23.74%. The disease was present in each village across the ten districts surveyed, but significantly maximum disease incidence (38.47%) was recorded in Aligarh followed by Bulandshahr (34.83%), thereby exhibiting significant differences from each other. However, minimum per cent incidence was observed in district Muzaffarnagar (9.37%) followed by Saharanpur (11.86%) and Bijnor (14.56%).

Keywords: Fusarium wilt, disease incidence, lentil, survey, Uttar Pradesh

Introduction

Lentil (*Lens culinaris* Medik.) is an important pulse crop next to chickpea recognized for its high nutritional value. It is cultivated in subtropical and warm temperate regions and at high altitudes in the tropics. It is particularly well-suited for rainfed conditions and capable of standing in drought conditions.Its seeds contain carbohydrates (55.3%), protein (283%), fiber (8.5%), ash (5.3%), total lipids (2.1%), and various minerals like potassium, phosphorus, iron, and zinc (Khart*et al*., 2023). It also facilitates atmospheric nitrogen fixation, and the ability to confiscate carbon ensures enriched nutrient status and soil fertility which aids in sustainable production (Sayyeda and Singh, 2023). Globally it is cultivated on an area of 5.53mha with production and productivity of 6.65 mtand 1209.4 kg/ha, respectively (FAOSTAT, 2022). In India this crop is grown on an area of 1.42 mha with a production of 1.28 mt annually and an average yield of 904 kg/ha (Agricultural Statistic at a Glance, 2022).

India reports over ten important diseases affecting lentil crops, which not only reduce yield but also degrade seed quality. Among them, Fusarium wilt caused by *Fusarium oxysporum* f. sp. *lentis* is one of the most destructive disease, which significantly impact lentil production and productivity by reducing crop stand in the field.This disease has been reported in major lentil-growing regions worldwide.The disease was first reported in Hungary

(Fleischmann, 1937) and subsequently reportedin many other countries including India (Padwick, 1941). In India, Fusarium wilt hampers lentil production in states such as Uttar Pradesh, Madhya Pradesh, Himachal Pradesh, Bihar, Rajasthan,Haryana,West Bengal, Assam, and Punjab (Chaudhary *et al*., 2009).

The disease manifests at two growth stages of the crop i.e., the seedling stage (early wilt) or the reproductive stage (late wilt) (Khare, 1981; Stoilova and Chavdarov, 2006).Symptoms include stunting, epinasty, chlorosis, necrosis, significant reduction of the root system, internal vascular discoloration of the lower stem, shedding, and wilting (Tosi and Cappelli, 2001; Agrios, 2005). It often occurs with other root rot pathogens like *Rhizoctonia solani*, *R.bataticola*, *S. rolfsii*, etc., forming a complex that leads to substantial loss of lentil seedlings.Various researchers have reported wilt incidence ranging from 50-78% in different fields (Khare *et al*., 1979; Agrawal *et al*., 1993). The disease can cause 5-10% yield loss in India and may lead to complete crop failure under favourable conditions (Das *et al*., 2017, Sayyeda and Singh, 2023). Ahmad (2010) noted that the extent of yield loss due to this disease depends on the crop variety, growth stage, and prevailing environmental conditions. In a survey, Sharma *et al*. (2016) also observed that none of the surveyed locations was found free from the incidence of lentil wilt in Madhya Pradesh.

The review of this disease impelled the present study to examine and appraise the incidence of lentil wilt in the ten districts of western Uttar Pradesh. This study has compiled comprehensive information on disease incidence, which will aid in developing effective management solutions for this devastating pathogen and alerting the farmers about the imminent risk to their crops.

Materials and Methods

To assess the prevalence of wilt disease in lentil, a comprehensive field survey was conducted during the *rabi* seasons (2018-19 and 2019-20) at farmer's fields in ten districts of western Uttar Pradesh (Table 1, Fig 1). The observation was made from December to Februaryof each cropping season, spanning from the pre-flowering to pod formation/maturity stage. A total of two hundred fifty diverse fields were monitored across the identified districts.Surveys were conducted in five villages per district, with five fields per village. In each farmer's field, a 1m x 1m area was marked at five selected spots for observation.

Plants exhibitingdistinct symptoms of the wilt were taken into consideration. These disease samples were collected and brought to the laboratory for detailed analysis. Additionally, soil texture was also recorded in identified districts.

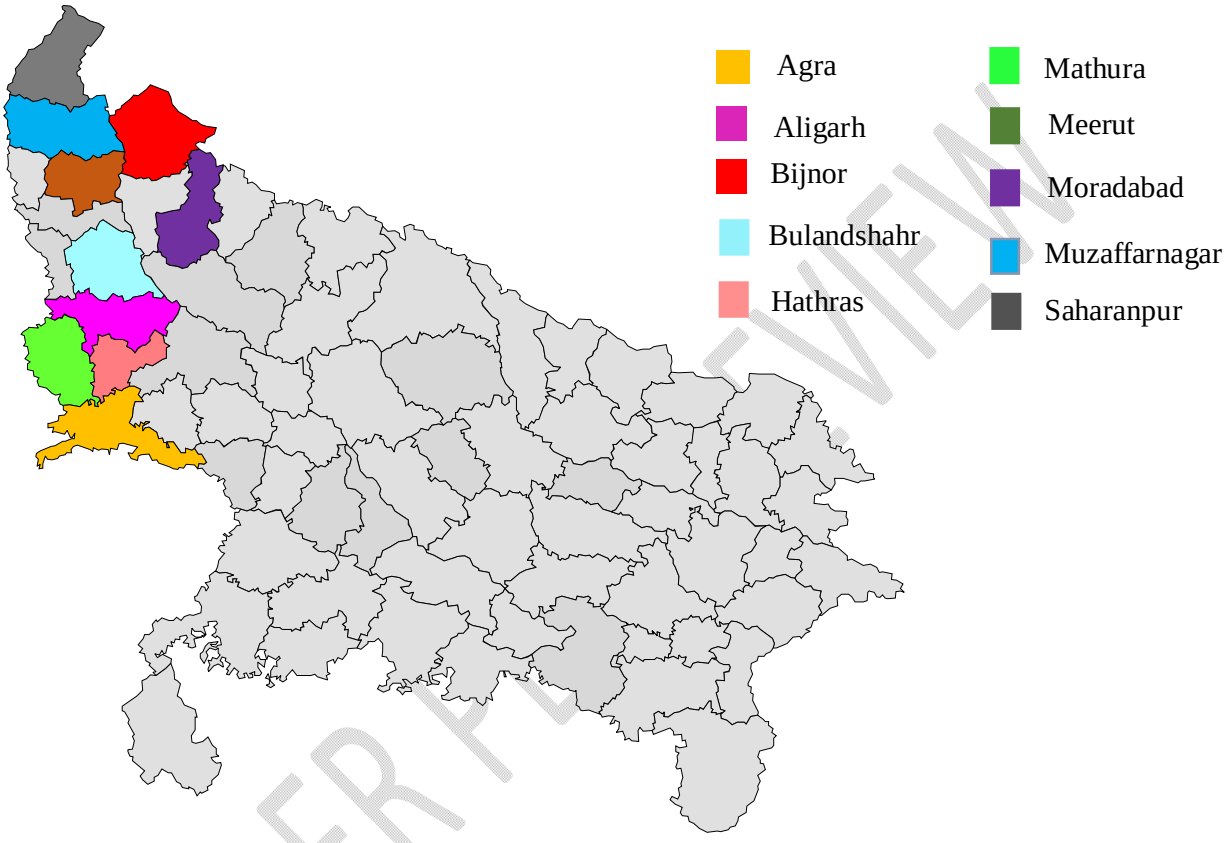

Fig 1. Ten districts of Uttar Pradesh surveyed for collection of samples and monitoring of wilt prevalence

Data recordings

$$\text{Disease incidence (\%)} = \frac{\text{Total number of infected plants}}{\text{Total number of plants}} \times 100$$

Statistical analysis

All data were subjected to analysis of variance (ANOVA) for their normalization. Other complemental calculations were done “R” and MS Word 2019.

Results and Discussion

Table 1. Incidence of wilt on lentil in different villages of ten districts of Uttar Pradesh during rabi seasons of 2018-19 and 2019-20

Districts	Villages	Cordinates	Soil texture	Disease incidence (%)

The incidence of wilt disease in lentil significantly varied in all ten districts of western Uttar Pradesh. In the surveyed districts, the disease incidence ranged from 9.37 to 38.47 per cent with an overall average of 23.74%.

The disease was present in eachvillage of ten districts; however, significantly maximum disease incidence (38.47%) was recorded in district Aligarh followed by Bulandshahr (34.83%), thereby exhibiting significant differences from each other (Table 1). The minimum per cent incidence was observed in district Muzaffarnagar (9.37%) and it was found to be significantly at par with that recorded in Saharanpur (11.86%) and Bijnor (14.56%) (Table 1).

The pooled data of two years revealed a significant variation in incidence ofwiltacross different villages in the surveyed districts. The maximum incidence (42.96%) was recorded in village Barhauliof district Aligarh, and the minimum (7.05%) was in Wahalna village of districtMuzaffarnagar (Table 1).

Regarding soil texture across the villages in the ten districts, it was found that soil of all surveyed field of different districts exhibited variation in their soil texture. Sandy soil texture was found in Agra and Aligarh; loamy soil was observed in Bulandshahr, Hathras, Mathura, Meerut and Moradabad. However, clayey loam texture was recorded in Bijnor, Muzaffarnagar and Saharanpur (Table 1). Maximum disease incidence (38.45%) was found in sandy texture of soil in Aligarh. Minimum incidence (9.37%) was observed in clayey loam soil of Muzaffarnagar district.

The present study clearly indicates that the prevalence of wilt in lentil varied significantly in ten different districts of western Uttar Pradesh during both survey years (2018-19 and 2019-20).Maximum incidence was recorded in Aligarh followed by Bulandshahr, Agra, Mathura and Moradabad.While, minimum incidence wasnoted in Muzaffarnagar. This trend was further supported with the record of maximum incidence of the disease in the village Barhauli of Aligarh and minimum in Wahalna village of Muzaffarnagar.

		Longitude (E)	Latitude (N)		2018-19	2019-20	Mean
Agra	Hazipur Khera	77°59'58.7	27°18'25.3	Sandy soil	36.20^{abc}	35.96^{a-f}	36.08
	Malupur	78°01'35.5	27°17'55.5	Sandy soil	28.11^{a-j}	32.13^{b-f}	30.12
	Nekpur	78°02'37.4	27°17'30.5	Sandy soil	34.45^{a-e}	37.50^{a-e}	35.97
	Poiya	78°02'29.8	27°16'17.1	Sandy soil	30.57^{a-h}	33.08^{a-f}	31.82
	Ujrai	78°01'58.9	27°17'25.0	Sandy soil	26.61^{a-k}	29.98^{b-g}	28.29
				Mean	**31.18**	**33.73**	**32.45**
Aligarh	AlampurSubkara	78°03'13.8	27°56'29.6	Sandy soil	39.23^{ab}	39.54^{ab}	39.38
	Asgarabad	78°14'07.6	28°04'17.2	Sandy soil	35.54^{a-d}	38.07^{a-d}	36.80
	Barhauli	78°14'23.5	28°04'12.7	Sandy soil	40.33^{a}	45.59^{a}	42.96
	Siya Khas	78°03'33.6	27°57'59.0	Sandy soil	38.15^{ab}	39.13^{abc}	38.64
	Tejpur	78°07'44.7	28°03'15.9	Sandy soil	31.50^{a-g}	37.66^{a-e}	34.58
				Mean	**36.95**	**39.99**	**38.45**
Bijnor	Abdipur Kishna	78°23'52.0	29°25'58.9	Clayey loam	18.72^{f-o}	17.05^{h-p}	17.88
	Inampur	78°25'15.4	29°26'36.0	Clayey loam	13.88^{j-o}	14.81^{j-p}	14.34
	Jalalpur Bhunga	78°24'18.7	29°26'29.9	Clayey loam	12.70^{k-o}	11.72^{op}	12.21
	Malakpur Abdulla	78°24'52.3	29°27'12.5	Clayey loam	20.64^{e-o}	18.60^{g-p}	19.62
	Palri	78°23'50.5	29°26'09.5	Clayey loam	09.92^{no}	07.64^{p}	08.78
				Mean	**15.17**	**13.96**	**14.56**
Bulandshahr	Akbapur	77°49'01.1	28°25'25.8	Loamy soil	36.12^{abc}	37.34^{a-e}	36.73
	Bahalimpur	77°50'53.5	28°22'42.8	Loamy soil	27.87^{a-j}	29.57^{b-h}	28.72
	Dhamrawali	77°50'17.3	28°22'42.8	Loamy soil	37.39^{ab}	34.91^{a-f}	36.33
	Pandrawal	78°11'43.7	28°07'03.3	Loamy soil	38.69^{ab}	39.61^{ab}	39.14
	Viraura	78°12'31.4	28°06'33.1	Loamy soil	32.57^{a-f}	34.32a-f	33.44
				Mean	**34.52**	**35.15**	**34.83**
Hathras	Ajroi	78°04'53.7	27°40'51.3	Loamy soil	18.21^{f-o}	11.09^{op}	14.65
	Bijahari	78°04'33.8	27°41'21.1	Loamy soil	24.88^{b-m}	24.90^{e-n}	24.89
	BilkhauraKhund	78°05'11.7	27°44'07.0	Loamy soil	21.50^{c-o}	17.64^{g-p}	19.57
	Jagipur	78°04'18.9	27°38'52.1	Loamy soil	13.69^{j-o}	9.81^{p}	11.75
	Ruheri	78°03'35.1	27°38'15.8	Loamy soil	15.93^{h-o}	16.45^{i-p}	16.19
				Mean	**18.84**	**15.97**	**17.40**
Mathura	Birbal	77°50'57.3	27°34'41.8	Loamy soil	20.67^{d-o}	26.36^{c-m}	23.51
	Birhana	77°49'52.8	27°34'11.3	Loamy soil	24.34^{b-n}	28.71^{b-i}	26.52
	Pirsua	77°49'13.1	27°33'53.4	Loamy soil	32.38^{a-g}	35.16^{a-f}	33.77
	Shivli	77°50'14.7	27°34'22.5	Loamy soil	28.00^{a-j}	32.41^{b-f}	30.20
	Tirwaya	77°48'07.1	27°33'32.4	Loamy soil	35.42^{a-e}	38.38^{a-d}	36.90
				Mean	**28.16**	**32.20**	**30.18**
Meerut	AllipurJijmana	77°45'28.8	28°54'04.8	Loamy soil	25.94^{a-l}	27.61^{b-j}	26.77
	Gagaul	77°42'52.5	28°53'54.6	Loamy soil	17.95^{f-o}	16.51^{i-p}	17.23
	Mamepur	77°44'14.0	29°01'38.3	Loamy soil	14.19^{i-o}	12.05^{nop}	13.12
	Nalpur	77°45'10.4	28°48'50.9	Loamy soil	20.60^{e-o}	25.84^{d-m}	23.22
	Peepli Khera	77°45'31.5	28°52'52.4	Loamy soil	28.82^{a-i}	33.58^{a-f}	31.20

				Mean	**21.50**	**23.11**	**22.30**
Moradabad	Didaura	78°39'16.0	28°59'45.2	Loamy soil	21.42^{c-o}	23.27^{f-o}	22.34
	Bhainsla	78°42'52.4	28°50'47.0	Loamy soil	17.53^{g-o}	14.20^{l-p}	15.86
	Kasampur	78°37'51.2	29°04'10.1	Loamy soil	31.37^{a-g}	27.35^{b-k}	29.36
	Ladawali	78°41'57.8	28°56'20.6	Loamy soil	25.46^{a-l}	26.78^{b-l}	26.11
	Salawa	78°41'32.0	28°57'17.5	Loamy soil	36.18^{abc}	36.87^{a-e}	36.52
				Mean	**26.39**	**25.69**	**26.04**
Muzaffarnagar	Baghra	77°34'16.5	29°28'20.7	Clayey loam	10.08^{mno}	15.26^{j-p}	12.67
	Bahadapur	77°41'46.2	29°23'38.7	Clayey loam	07.51^{o}	07.34^{p}	07.41
	Bibipur	77°43'14.2	29°25'54.0	Clayey loam	08.32^{o}	09.37^{p}	08.84
	Sandhawali	77°42'36.5	29°25'23.2	Clayey loam	09.35^{o}	12.41^{nop}	10.91
	Wahalna	77°41'29.8	29°25'21.1	Clayey loam	07.26^{o}	06.84^{p}	07.05
				Mean	**08.50**	**10.24**	**09.37**
Saharanpur	Ghalauli	77°40'14.7	29°36'39.8	Clayey loam	14.74^{i-o}	17.30^{g-p}	16.02
	Gunarsa	77°40'28.0	29°38'56.0	Clayey loam	12.72^{k-o}	14.47^{k-p}	13.59
	Gunarsi	77°40'18.6	29°39'58.9	Clayey loam	08.31^{o}	07.56^{p}	07.93
	Isharpur	77°40'00.5	29°40'11.9	Clayey loam	09.41^{o}	09.45^{p}	09.43
	Jal Kheri	77°40'59.4	29°36'59.4	Clayey loam	11.19^{l-o}	13.56^{m-p}	12.37
				Mean	**11.27**	**12.46**	**11.86**
				Grand mean	**23.25**	**24.25**	**23.75**
				L.S.D.(P≤0.05)	**7.06**	**6.12**	**-**
				SE(m)±	**3.66**	**3.18**	**-**

*Each value is an average of five replicates. Values within a column followed by different alphabets are significant and some alphabets are non-significant according to Tukey's Test at P≤0.05

The similar results were also found by Prasad *et al*. (2021)who conducted a survey in different districts of Uttar Pradesh during the winter season of 2019-20 and 2020-21. They found the highest disease incidence at flowering (18.95%) and podding stages (14.27%) in Kanpur district for 2019-20, with the lowest incidence at flowering (11.50%) and podding (10.86%) in Ayodhya district.In 2020-21, the highest incidence at flowering was in Sitapur (15.18%), and at podding in Kanpur (15.75%), while the lowest was again in Ayodhya, at flowering (11.73%) and podding (9.86%).

In another study, Shrivastava and Dhakad (2021) also reported the maximum average disease incidence in Sehore district (17.87%) and the minimum in Sagar district (13.07%) of Madhya Pradesh.The variation in wilt incidence across different locations may be attributed to factors such as varied agro-climatic conditions, cropping patterns, inappropriate cultural practices (e.g., close spacing, frequent irrigations, sowing dates, heavy fertilization), inoculum levels and common management practices affecting disease development.Additionally, the pathogen, which is both seed- and soil-borne, thrives in warm

weather,acidic, and sandy soils, which may explain the higher wilt incidence in Aligarh.The survey also revealed that many fields were planted solely with lentil, which could increase pathogen populations and exacerbate the disease (Das *et al.,* 2022).Favourable environmental conditions, soil texture, and the use of susceptible varieties also likely contributed to the increased incidence of the disease in these areas.

Conclusion

The prevalence of wilt in lentil varied significantly across different locations in western Uttar Pradesh. Maximum incidence was observed in district Aligarh followed by Bulandshahr, Agra, Mathura, Moradabad, Meerut, Hathras, Bijnor, Saharanpur and Muzaffarnagar. This variation could be attributed to the prevailing environmental conditions and incessant cultivation of susceptible varieties by the farmers in these locations over the years. The study emphasizes the need to identify new sources of resistance under field conditions and promote the use of resistant cultivars to combat this disease.

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