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Survey on fungal blights of onion incidence and evaluation of onion (*Allium cepa* L.) genotypes against *Alternaria porri* and *Stemphylium vesicarium*

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Abstract
Last year, the Ministry of Consumer Affairs dispatched 150 tonnes of onions to Jammu and Kashmir in an effort to stabilize the soaring prices of this essential commodity. The initiative aimed to release bulk quantities of onions into the local markets, thereby controlling the price surge, particularly in Jammu. Interestingly, the production of onion crops in India has witnessed a significant increase-from 65.2 tonnes per hectare in the financial year 2012 to 163.5 tonnes per hectare in 2025. However, despite this growth, the rising incidence of fungal diseases such as Stemphylium blight and purple blotch continues to negatively impact onion yields. To address this issue, a research study was conducted from 2019-2020 in Sher-e-Kashmir University of Agricultural Sciences and Technology, Jammu. The primary objective of the study was to survey the prevalence of fungal blights across different locations in Jammu and to evaluate the performance of various onion cultivars under local conditions. Several cultivars were collected from different sources and tested through field trials to determine their resistance to purple blotch and Stemphylium blight. Among the tested varieties, the Arka Kalyan germplasm showed the most promising results, demonstrating strong resistance against these fungal diseases and making it a suitable cultivar for cultivation in the region.

Keywords: Fungal blights, germplasm, *Stemphylium vesicarium*, onion

1. Introduction
From Sacred Sustenance to Ancient Soil: Since ancient times, *Allium cepa* L., a crucial bulb crop of the Allium genus within the Alliaceae family, has played a significant role in human history and culture. Onions, which are categorized as Tamsik Bhojan, have generated controversy since the Vedic period. They still have a big sociopolitical impact today, and changes in their cost and availability can affect the stability of the Indian government. Onions have been grown and eaten for ages; they are said to have originated in Central Asia. As the "Queen of the Kitchen," they are revered in India for their unique taste, spiciness, and unmatched adaptability. As evidence of their many uses, onions are important as environmentally beneficial stored grain protectants in addition to their culinary value (Jaggi, 2005) [6].

During 2017 and 2021, more than five million hectares of onion bulbs (*Allium cepa* L.) were produced annually, yielding almost 100 million metric tonnes of bulbs worldwide (FAO, 2023) [5]. With respective contributions of 22-27 million metric tonnes, China and India are the top producers (FAO, 2023) [5]. With an annual production of between 3.5 and 4.2 million metric tonnes of onion bulbs produced on roughly 52,000-61,000 hectares, the United States ranks third in terms of production. This production is valued at about one billion US dollars (FAO, 2023; USDA, 2023) [5, 15]. According to USDA (2023) [15], California, Washington, and Oregon are the top three states in the US for onion production. Onion production in the Jammu division averages 35,810.85 metric tonnes, with 1,783 hectares under cultivation (Kaushik *et al.*, 2025) [7]

About 89.11 percent water, 1.10 percent proteins, 0.10 percent lipids, 0.35 percent ash, 0.34 percent carbohydrates, 1.70 percent dietary fiber, and 4.24 percent total sugar (0.99 percent sucrose, 1.97 percent dextrose, and 1.29 percent fructose) are found in fresh onion bulbs.

They also contain 0.21 percent minerals (potassium, phosphorous, calcium, magnesium, sodium, and iron) and a substantial amount of vitamins B, C, and E (Mazmanyan, 2023; Sami *et al.*, 2021) [10, 12]. Allicin, quercetin, organosulphur compounds, antioxidants, phenolic compounds, flavonoids, and fructooligosaccharides are just a few of the many and useful phytochemicals that make up onions (Bhat, 2020; Chauhan *et al.*, 2023; Sagar *et al.*, 2022; Yan *et al.*, 2023) [3, 4, 11, 19].

Onion is susceptible to numerous pests and diseases throughout its growth period under field conditions. Diseases constitute a significant aspect of crop cultivation and research, as they have a direct impact on crop productivity. Therefore, it is essential to possess comprehensive knowledge of both biotic and abiotic factors that influence the yield and health of a particular crop. The most commercially significant biotic agents that inhibit onion yield are purple blotch (*Alternaria porri*), downy mildew (*Peronospora destructor*), and leaf blight (*Stemphylium vesicarium*). Among these, Alternaria blight is one of the most devastating diseases (Marmath *et al.*, 2013) [9].

Presently, the disease is controlled by using fungicides as foliar sprays and seed treatments (Kaushik *et al.*, 2025) [7], utilizing disease-free onion seeds or seedlings, host-resistant cultivars (Yadav *et al.*, 2017) [18], and clearing away infected debris (Shumsun *et al.*, 2014). However, because new races have emerged to counteract resistance types, using them may not be guaranteed (Kim *et al.*, 2022) [8]. Intensive field surveys on the disease pandemic are not conducted in the study areas instead of prevalence and fungicide evaluation studies, despite the fact that the disease is a significant constraint on onion production. In order to determine the current resistance germplasms and to offer information on the severity of the disease in various areas, a compressive field survey on purple blotch and stemphylium blight epidemics throughout Jammu's onion-producing regions should be helpful. Thus, the study was carried out to identify the resistant germplasms in Jammu and evaluate the distribution and severity of onion blights.

2. Materials and Methods

2.1 Survey

During 2019-2020, a roaming survey was carried out in the four tehsils of Akhnoor, Bishnah, RS Pura, and Marh in the Jammu district to ascertain the proportion of fungal blights of onion disease intensity. In each hamlet, three fields were chosen, and three plants in each field were randomly inspected and given a disease intensity score on a range of 0 to 5 (Bhangale and Joi, 1985) [2]. The following formula was used to get the percentage disease intensity (PDI) (Wheeler, 1969) [17]:

$$PDI = \frac{TNR}{TIL \times MDR} \times 100$$

Where,
TNR = Total sum of numerical rating
TIL = Total number of infected leaves observed
MDR = Maximum disease rating

Locations selected for Survey

Location (Tehsils)	Village
Akhnoor	Jourian
	Garkhal
	Rajpura
Bishnah	Deoli
	Ismailpur
	Salehar
RS Pura	Kullian
	Badyal Brahmna
	Kotli
Marh	Gajansoo
	Akalpur
	Kanachak

2.2 Screening of onion germplasm under field condition

On October 28, 2019, the seeds of several onion germplasms were planted in nursery beds after being gathered from various sources (see below).

The seeds of several onion germplasms were planted in nursery beds after being gathered from various

Source	Germplasm
Dr. Y.S. Parmar University of Horticulture and Forestry, Solan, Nauni, Himachal Pradesh	Nasik Red
Krishi Vigyan Kendra, Bajaura, Kullu, Himachal Pradesh	Palam Lohit
National Horticultural Research and Development Foundation, Nasik, Maharastra	NHRDF Red, NHRDF Red-2, NHRDF Red-3, NHRDF Red-4, Agrifound Light Red, Arka Kalyan, Arka Niketan, Agrifound Dark Red
IARI, Regional Station, Katrain, Kullu, Himachal Pradesh	Brown Spansl
Indian Agricultural Research Institute, Pusa, New Delhi	Pusa Madhui, Pusa White Round
Local	Nasik Dark Red, Hybrid Seeds

2.3 Disease Scoring

A scale of 0 to 5 was used to determine the percentage of disease severity (Bhangale and Joi, 1985) [2].

A scale of 0 to 5 was used to determine the percentage of disease severity

Rating Scale	Host response	Symptoms/percent leaf area covered
0	HR	No symptoms on leaf
1	R	Spots covering 1-10% of the leaf area
2	MR	Spots covering 11-20% of the leaf area
3	MS	Spots covering 21-40% of the leaf area
4	S	Spots covering 41-60% of the leaf area
5	HS	Spots covering more than 60%

2.4 Screening of germplasm against fungal blights of onion

Each of the fifteen genotypes utilised for this purpose was planted in four rows. As recommended by Bhangale and Joi (1985) [2], a scale 0-5 was used to quantify the severity of the disease at maturity.

3. Results

3.1 Survey

3.1.1 Purple blotch

Examining the disease intensity data (Table 1) revealed that the disease was prevalent in each of the four Tehsils that were investigated. With an overall mean of 29.55 percent,

the illness intensity on leaves ranged from 14.09 to 56.12 percent. The disease intensity in Tehsil Akhnoor varied from 24.01 to 34.84 percent, with an average of 30.63 percent. Jourian village had the greatest disease intensity (34.84%), while Rajpura had the lowest (24.01%). Conversely, in Tehsil Bishnah, Salehar village had the lowest disease intensity (14.09%), while Deoli village had the highest disease intensity (29.01%). However, with an average of 27.42 percent, the villages of Kullian and Badyal Brahmna in Tehsil RS Pura had the highest and lowest illness intensity, respectively, at 34.12% and 23.12%. In contrast, the disease intensity in Tehsil Marh varied between 28.85 and 56.12%. Gajansoo village had the lowest illness intensity (28.85%), while Kanachak village had the highest disease intensity (56.12%) on leaves. Table 1 and Figure 1 also make it clear that, among the four Tehsils, Marh had the highest illness intensity (38.09%), while Bishnah had the lowest (22.07%).

3.1.2 Stemphylium blight

The findings showed that the intensity of stemphylium blight in Akhnoor Tehsil during Rabi 2019-2020 varied between 14.15 and 16.70 percent. Rajpura had the lowest illness intensity (14.15%), whereas Garkhal had the highest (16.70%). In Tehsil Bishnah, Ismailpur had the highest illness intensity (12.55%), followed by Deoli (11.37%) and Salehar (10.64%). But in R.S. Pura, Kullian had the highest illness intensity (11.09%), followed by Badyal Brahmna (10.53%) and Kotli (9.73%). Kanachak (13.79%) had the highest illness intensity in Marh, followed by Akalpur (13.25%) and Gajansoo (11.97%).

Table 1: Onion fungal blight disease intensity as a percentage at different sites in the Jammu district

Tehsil (Location)	Village	Disease intensity (%)	
		Purple blotch	Stemphylium blight
Akhnoor	Jourian	34.84	15.42
	Garkhal	33.03	16.70
	Rajpura	24.01	14.15
	Mean ± SE	30.63 ± 0.13	15.42 ± 0.34
	Range	24.01-34.84	14.15-16.70
Bishnah	Deoli	29.01	11.37
	Ismailpur	23.10	12.55
	Salehar	14.09	10.64
	Mean ± SE	22.07 ± 0.27	11.52 ± 0.18
	Range	14.09-29.01	10.64-12.55
R.S. Pura	Kullian	34.12	11.09
	Badyal Brahmna	23.12	10.53
	Kotli	25.03	9.73
	Mean ± SE	27.42 ± 0.29	10.45 ± 0.18
	Range	23.12-34.12	9.73-11.09
Marh	Gajansoo	28.85	11.97
	Akalpur	29.30	13.25
	Kanachak	56.12	13.79
	Mean ± SE	38.09 ± 0.29	13.00 ± 0.27
	Range	28.85-56.12	11.97-13.79
	Overall mean	29.55	12.59
	Overall range	14.09-56.12	9.73-16.70

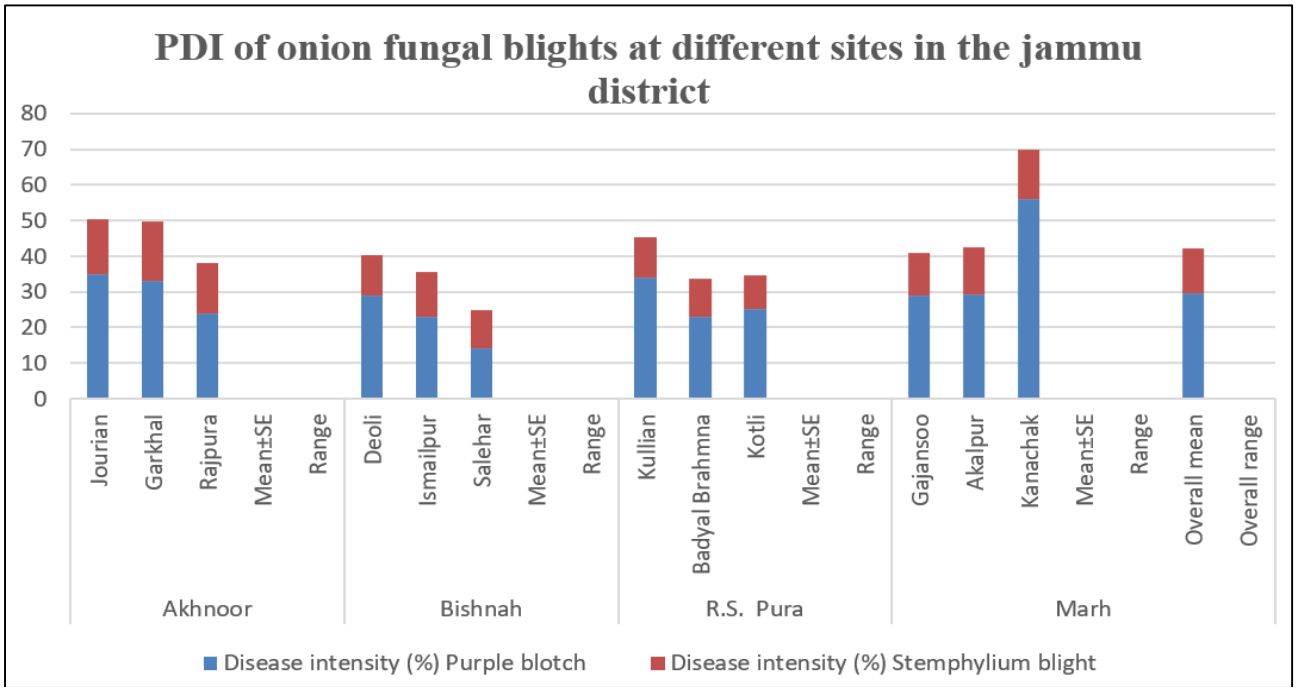

Fig 1: Percentage disease index of onion blights at multiple sites in Jammu region

3.2 Evaluation or Screening of onion cultivars against fungal blights of onion

3.2.1 Purple blotch

Table 2 revealed the maximum disease intensity of 59.55 per cent on the onion cultivar of Nasik Dark Red, followed by Brown Spansl (54.66%), Palam Lohit (49.33%), Hybrid Seeds (39.10%), NHRDF-Red (37.77%), Agrifound Dark Red (36.44%), Nasik Red (31.99%), Agrifound Light Red (29.33%), NHRDF Red-3 (27.55%), Pusa White Round (22.21%), Pusa Madhui (19.10%), Arka Niketan (17.04%), NHRDF Red-4 (16.88%), NHRDF Red-2 (13.77%) and Arka Kalyan (9.77%).

As it is evident from table 3 while categorising different cultivars after screening against purple blotch Nasik Dark Red, Brown Spansl and Palam Lohit showed susceptible reaction, while NHRDF Red-3, Agrifound Dark Red, Nasik Red, Agrifound Light Red, Pusa White Round, Hybrid seeds, NHRDF-Red were moderately susceptible and

NHRDF Red-4, NHRDF Red-2, Pusa Madhui and Arka Niketan were found moderately resistant and Arka Kalyan was the only cultivar resistant whereas, there was no any cultivar found highly resistant and highly susceptible against purple blotch of onion under field condition.

3.2.2 Stemphylium blight

In this case results revealed in table 2 showed the maximum disease intensity on Brown Spansl (37.09%) followed by Agrifound Dark Red (37.03%), NHRDF Red-3 (33.09%), Nasik Dark Red (33.04%), NHRDF Red-2 (31.81%), Nasik Red (31.33%), NHRDF Red-4 (29.63%), Arka Kalyan (27.36%), Agrifound Light Red (25.67%), NHRDF-Red (23.99%), Palam Lohit (23.61%), Arka Niketan (21.03%), Pusa Madhui (19.34%), Hybrid Seeds (15.37%) and Pusa White Round (11.23%).

It was observed that cultivar Hybrid seeds, Pusa Madhui and Pusa white round were moderately resistant, while all others found moderately susceptible. There was no cultivar showed highly resistant, resistant, susceptible and highly susceptible reaction against the stemphylium blight (Table 3).

Table 2: Screening of onion germplasm against fungal blights under field conditions

Germplasm	Purple blotch		Stemphylium blight	
	Disease intensity (%)	Disease response	Disease intensity (%)	Disease response
Nasik Dark Red	59.55	S	33.04	MS
Arka Niketan	17.04	MR	21.03	MS
Pusa White Round	22.21	MS	11.23	MR
NHRDF Red-2	13.77	MR	31.81	MS
NHRDF Red-4	16.88	MR	29.63	MS
NHRDF-Red	37.77	MS	23.99	MS
Pusa Madhui	19.10	MR	19.34	MR
Hybrid Seeds	39.10	MS	15.37	MR
Palam Lohit	49.33	S	23.61	MS
Agrifound Dark Red	36.44	MS	37.03	MS
Nasik Red	31.99	MS	31.33	MS
Agrifound Light Red	29.33	MS	25.67	MS
NHRDF Red-3	27.55	MS	33.09	MS
Arka Kalyan	9.77	R	27.36	MS
Brown Spansl	54.66	S	37.09	MS

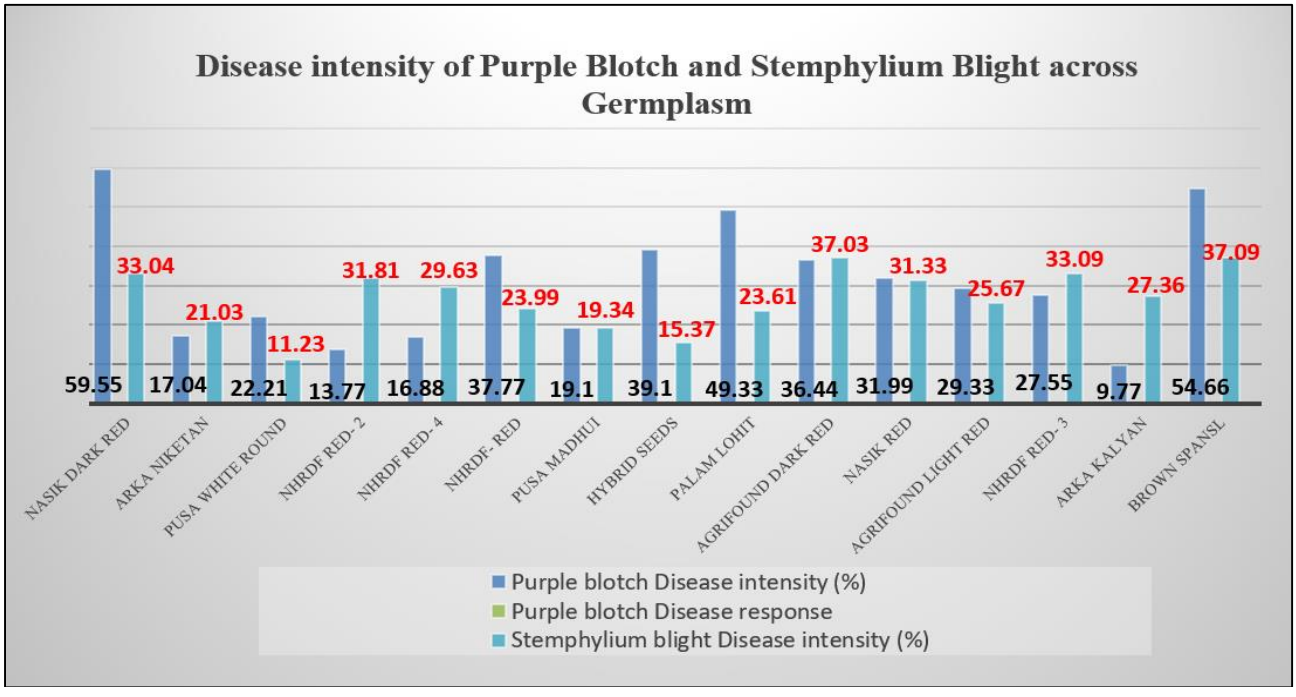

Fig 2: Percentage disease intensity of onion blights in multiple germplasms

Table 3: Categorization of different cultivars against fungal blights of onion

Reactions	Germplasm	
	Purple blotch	**Stemphylium blight**
Highly resistant	-	-
Resistant	Arka Kalyan	-
Moderately resistant	NHRDF Red-2 Arka Niketan Pusa Madhui NHRDF Red-4	Pusa Madhui Hybrid seeds Pusa White Round
Susceptible	Palam Lohit Brown Spansl Nasik Dark Red	-
Moderately susceptible	Hybrid seeds NHRDF Red-3 Agrifound Light Red Pusa White Round NHRDF-Red Agrifound Dark Red Nasik Red	Palam Lohit Arka Kalyan NHRDF Red-2 Arka Niketan Brown Spansl Nasik Dark Red NHRDF Red-3 Agrifound Dark Red Nasik Red Agrifound Light Red NHRDF-Red NHRDF Red-4
Highly susceptible	-	-

Plate a: Symptoms of purple blotch infection in onions

Plate b: Symptoms of Stemphylium blight infection in onion

4. Discussion

4.1 Survey

4.1.1 Purple blotch

In the present study, the highest disease intensity, ranging from 24.01% to 34.84%, was recorded in Tehsil Akhnoor. In contrast, the lowest disease intensity was observed in Bishnah (22.07%), followed by R.S. Pura (27.42%) and Akhnoor (30.63%). The variation in disease intensity across locations can primarily be attributed to climatic factors and the inoculum load in the area, which serves as a source of secondary infection. These findings are consistent with those of Shahnaz *et al.* (2007) [13], who reported that in Jammu district, the average intensity of purple blotch increased from 6.37% during the 7th standard week to 20.91% by the 13th standard week.

4.1.2 Stemphylium blight

The highest disease intensity (15.42%) was recorded in Akhnoor Tehsil, followed by Marh (13.00%), Bishnah (11.52%), and R.S. Pura (10.45%). The data also indicated that both diseases were occurring independently across all the surveyed locations.

4.2 Screening

4.2.1 Purple blotch

Fifteen onion germplasms were evaluated under natural epiphytotic conditions, and the severity of purple blotch and Stemphylium blight was recorded. For purple blotch, the highest disease intensity (59.55%) was observed in the cultivar Nasik Dark Red, followed by Brown Spansl (54.66%), while the lowest intensity was recorded in Arka Kalyan (9.77%). Similar results were reported by Bal *et al.* (2019) [1], who found that out of 23 genotypes, five-Akola Safed, Arka Niketan, Punjab Naroya, Arka Lalima, and Arka Kirtiman-exhibited resistance to purple blotch disease in onion.

During the course of the study, susceptible reactions were observed in Nasik Dark Red, Brown Spansl, and Palam Lohit. Meanwhile, cultivars such as NHRDF Red-3, Agrifound Dark Red, Nasik Red, Agrifound Light Red, Pusa White Round, Hybrid seeds, NHRDF Red, NHRDF Red-4, NHRDF Red-2, Pusa Madhavi, and Arka Niketan were found to be moderately resistant. Arka Kalyan was the only cultivar that exhibited resistance to purple blotch. However, Veeraghanti *et al.* (2017) [16] reported Arka Kalyan as moderately resistant to the disease.

4.2.2 Stemphylium blight

In the case of Stemphylium blight, the results revealed that the highest disease intensity was observed in Brown Spansl (37.09%), followed by Agrifound Dark Red (37.03%), NHRDF Red-3 (33.09%), Nasik Dark Red (33.04%), NHRDF Red-2 (31.81%), Nasik Red (31.33%), NHRDF Red-4 (29.63%), Arka Kalyan (27.36%), Agrifound Light Red (25.67%), NHRDF Red (23.99%), Palam Lohit (23.61%), Arka Niketan (21.03%), Pusa Madhavi (19.34%), Hybrid Seeds (15.37%), and Pusa White Round (11.23%).

5. Conclusion

During the field survey and evaluation of onion germplasms, only one cultivar—Arka Kalyan—was found to be resistant to purple blotch. However, none of the evaluated germplasms exhibited resistance to Stemphylium blight. To achieve a healthy crop with minimal disease incidence, implementing effective control measures is crucial.

The critical period for infection by purple blotch was observed to be during the mid-growth stage, typically between 60 to 90 days after transplanting (DAT), whereas Stemphylium blight showed peak susceptibility between 60 to 75 DAT. Spore formation occurs during the night, and as dew evaporates in the morning, the spores become airborne and spread to susceptible onion tissues.

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