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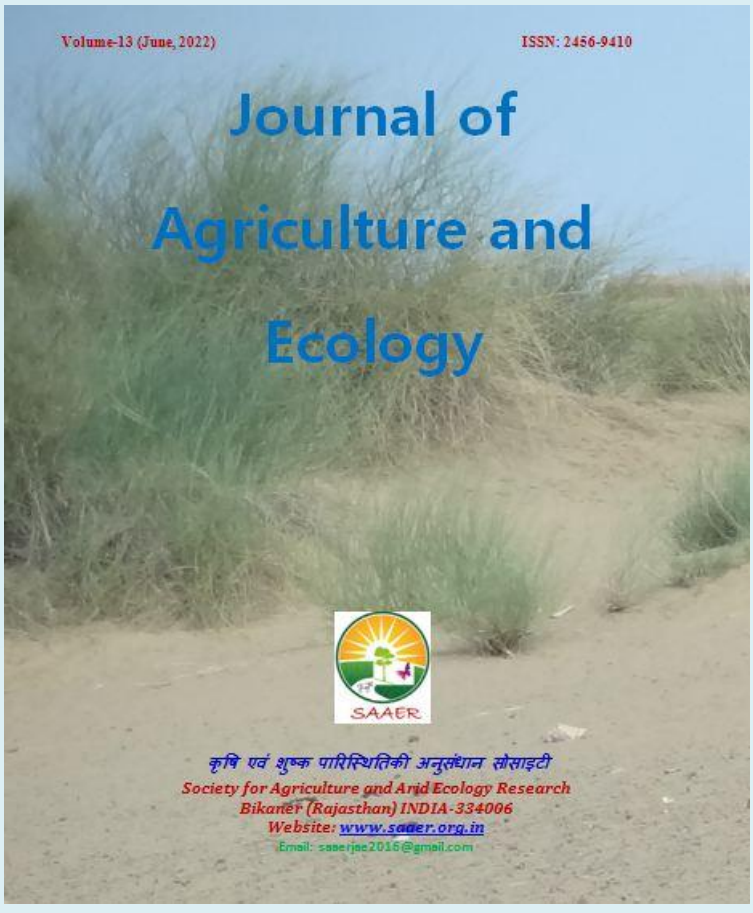

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Screening of onion species against white rot disease caused by *Sclerotium rolfsii* Sacc. in Manipur

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Abstract

White rot of onion caused by *Sclerotium rolfsii* has devastated onion cultivations at various small scale onion growing locations in Manipur. The maximum white rot disease incidence was observed during the month of April in all the onion species and the minimum disease incidence was observed during February month. The disease symptoms were not apparent during the first three months after planting. The symptoms of white rot became evident during second week of February with yellowing of leaves starting from tips and gradually progressing downwards. The disease became most obvious during last week of March to first week of April when the basal part of onion stem starts rotting and drooping and the plant wilts and collapse. The bulbs of infected plants are decayed and accompanied by the signs of the pathogen including white mycelium and sclerotia.

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Introduction

Onion, *Allium cepa* L. is an important vegetable crop which is used both for spice and medicinal purposes. It is under the family *Amaryllidaceae.* It is being cited as queen of the kitchen (Selvaraj 1976; Fahima et al. 2019; Sethupathi & Paramasivan 2019). White rot is one of the important fungal diseases of onion in Manipur. It has shattered onion cultivation at various onion growing places in Manipur. It is one of the most destructive fungal diseases causing heavy losses reducing potential yield of onion to a considerable degree (Amin et al. 2014). White rot disease caused by *Sclerotium cepivorum* Berk. is very destructive to *Allium* crops including onion, leek, Welsh onion, shallot and garlic and the fungus attack the plant at any crop stages and often manifests after harvest as bulb rot and often disseminates on diseased bulbs or seedlings (Walker 1924). White rot on shallot, garlic and onion results in death of the roots and semi watery decay of the scale which is associated with superficial growth of white fluffly mycelium of the fungus (Tims 1948). It affects *Allium* crops throughout the world (Entwistle 1990). Foliage symptoms

are not obvious until the fungus invades the bulb of the plant resulting in semi watery decay of the bulb followed successively by yellowing of leaves, dieback and wilting. Bulb becomes watery soft and the fungus is visible superficial white fluffy mycelium with accompanied by sclerotia. The diseased plant can be easily pulled off from the ground (Sammour et al. 2011).

In Manipur, white rot of onion is caused by *Sclerotium rolfsii* Sacc. The fungus has a broad host range affecting more than 500 plant species including both crops of economical importance as well as weeds (Aycock 1966). White rot of onion caused by *S. rolfsii* has also been reported from other parts of India including Luknow and Rajasthan (Mukherji & Tewari 1969; Mathur & Sharma 2002; Konjengbam & Devi 2020). The fungus survives in a broad range of environment and thrives best on acidic soil. The fungus produces sclerotia as overwintering structures which is also a primary source of inoculums. The fungus also survives as mycelium in infected plant tissues and plant debris. The temperature and moisture are two important parameters that influenced the survival of *S. rolfsii* under field condition (Beute & Rodriguez-Kabana 1981).
Sclerotia are dispersed by rain, irrigation water, wind, vegetative propagating materials, infested soil and contaminated tools (Kator et al. 2015). Germination of sclerotia are stimulated by the presence of volatile organic compounds generated from decaying plant parts and by the host (Punja 1985). White rot has wrecked onion cultivation in Manipur as the disease become obvious late in the growing season near the harvesting period and by then the bulbs were deeply affected and accompanied with white cottony mycelial growth as well as sclerotia of the fungus. Moreover, specific and thorough information about the disease is not available at present. Therefore, the research investigations were carried out to evaluate the commonly cultivalted onion species in Manipur against white rot caused by *Sclerotium rolfsii* Sacc.

Materials and Methods

Isolation and identification of the pathogen

The diseased onion bulbs which were cultivated in the experimental site in the previous crop season were collected. White fluffy mycelium from the basal plate of the bulbs were inoculated on potato dextrose agar medium (PDA) and were incubated at 28 ± 1^0C for 4 days. The pathogen was purified by hyphal tip cut method and re-isolated on PDA and maintained throughout the research period for identification by comparison with relevant monographs.

Planting materials

Commonly cultivated onion species were collected for screening against white rot. Seeds of two varieties of common or bulb onion , *Allium cepa* L. namely, Prema and Nasik Red N-53 were purchased from market. Bulbs of one local cultivar of common onion (small bulb size), multiplier or potato onion, *Allium cepa* L. var. *aggregatum*, spring or bunching onion , *Allium fistulosum* L. and shallot, *Allium cepa* L. var. *ascalonicum* were also collected from small scale commercial onion growers.

Assessment of onion species against white rot under field condition

The present investigation was carried out at College of Agriculture, Central Agricultural University, Imphal, India. The climate of Imphal is sub-tropical. The soil of the experimental site is clayey in texture and acidic with p^H ranging from 5.6 to 5.8. The experiment was undertaken

using randomized block design with three replications in a plot size measuring 2m x 1.5m with spacing of 10cm X 10cm. A single plot accommodates 266 plants. Seeds were used for raising Prema and Nasik Red and 45 days old seedlings were transplanted for screening on second week of December. Bulbs were used for propagation in case of common onion local cultivar, multiplier onion, spring onion and shallot for screening against white rot and were planted on the same day at which seedlings of both Prema and Nasik Red were transplanted. The onions were raised uniformly by adopting required cultural practices under natural epiphytotic condition where the field was already infested with the pathogen. The crops were observed for disease intensity from February to April just before harvesting.

Percent disease intensity was calculated by using the following formula.

Per cent disease incidence

$$= \frac{\text{Total number of diseased plants}}{\text{Total number of healthy plants}} \text{ X } 100$$

Results and Discussions

The isolated fungus was identified as *Sclerotium rolfsii* Saccardo on the basis of morphological characteristics and taxonomic keys available in the literatures (Saccardo 1913; Mordue 1974). The highest white rot disease incidence was observed in spring onion (62.61% and 63.22%), followed successively by shallot (61.50% and 63.03%) and multiplier onion (59.88% and 60.66%) during 2014-15 and 2015-16 respectively. The lowest white rot incidence was observed in Prema (48.43% and 50.14%) followed successively by Nasik Red (52.52% and 54.88%) and local cultivar (53.19 and 54.98%). The minimum disease incidence was observed during February (43.35%). The maximum disease incidence was observed during the month of April (72.13%) in all onion species screened against white rot. The disease developed swiftly as the temperature rises and become warmer in March and April. The white rot disease incidence in all the onion species tested increased more rapidly in April after the onset of rainfall.

Table 1. Meteriological data of the cropping season

Month	Rainfall (mm)	Mean relative humidity(%		Mean air temperature (^{o}C)		Mean daily bright sunshine (hours)
		Morning	Evening	Maximum	Minimum	
November	0.0	85.2	53.8	28.0	11.6	8.0
December	0.0	89.3	56.4	23.5	6.3	6.9
January	1.5	87.2	51.0	22.7	7.5	7.5
February	0.6	85.6	43.7	24.7	6.6	6.8
March	0.7	77.7	42.5	28.5	11.0	7.0
April	7.1	86.6	63.2	26.4	16.0	3.5

*Weather data from ICAR, Imphal, Manipur

Table 2. Meteorological data of the cropping season

Month	Rainfall (mm)	Mean relative humidity (%)		Mean air temperature (°C)		Mean daily bright sunshine (hours)
		Morning	Evening	Maximum	Minimum	
November	0.4	89.3	55.6	25.6	11.4	7.7
December	0.0	90.8	55.4	21.7	5.8	5.3
January	0.3	91.1	47.8	22.1	4.6	6.6
February	1.2	88.2	48.5	25.1	9.6	6.1
March	2.2	88.1	48.6	27.6	12.6	6.7
April	7.2	85.7	65.1	28.4	17.1	5.8

*Weather data from ICAR, Imphal, Manipur

The diseases symptoms became obvious in second week of February on all the species screened against white rot. The initial symptoms were yellowing and drying of leaves from the tips which subsequently progressed downwards resulting in blighting (Mathur & Sharma 2002). The disease symptoms started becoming apparent in last week of March. The disease symptoms became most severe in April after rainfall. The leave sheath and basal part of the stem starts rotting and the plants collapsed, drooped down, and the infected bulbs became soft watery and decayed. These symptoms are further accompanied by the signs of the pathogen which includes fungal white mycelial growth along with sclerotia scattered on the rotted bulbs and basal part of the stem (Mukherji and Tewari, 1969). Utkhede and Rahe (1978) reported that all the 64 cultivars of common and bunching onions screened against white rot were not immune and were affected with the disease. Utkhede and Rahe (1980) also reported occurrence of significant differences in susceptibility to *S. cepivorum* Berk. in all the onion cultivars tested for resistance to white rot. Utkhede and Rahe (1984) reported that differences in infection of white rot occurred while screening five seed lots along with the self and open pollinated progenies of the cultivar Ailsa Craig. Hovius and Goldman (2004) reported that eight long day breeding lines and hybrids of onion screened against white rot both under field and greenhouse conditions were all affected by the disease and the disease incidence of white rot ranges between 0.3% and 100% under field condition and 0.4% and 54.7% under greenhouse condition in all the onion lines and hybrid tested. El-Nagar et al. (2013) reported that *S. rolfsii* showed high degree of virulence on onion.

Table 3. Disease intensity of white rot on onion species

Serial number	Varieties/ Cultivars	Per cent disease incidence			Mean
		February	March	April	
1	Prema	38.00	47.50	59.80	48.43
2	Nasik Red	40.20	53.35	64.00	52.52
3	Local cultivar	39.67	54.77	65.14	53.19
4	Multiplier	40.15	61.25	78.25	59.88
5	Spring	44.97	63.00	79.85	62.61
6	Shallot	41.54	62.95	80.00	61.50

Mean		34.93	48.97	60.99
SE(d)		5.51		
CD(5%)		12.01		

Table 4. Disease intensity of white rot on onion species

Serial number	Varieties/ Cultivars	Per cent disease incidence			Mean
		February	March	April	
1	Prema	40.00	50.30	60.10	50.13
2	Nasik Red	43.35	55.15	66.15	54.88
3	Local cultivar	42.50	55.75	66.70	54.98
4	Multiplier	44.15	60.78	77.05	60.66
5	Spring	45.90	62.68	81.05	63.22
6	Shallot	44.25	63.05	81.78	63.03
Mean		43.35	57.95	72.13	
SE(d)		5.21			
CD (5%)		11.36			

Punja (1985) reported that warm temperatures and wet conditions favours mycelial growth as well as sclerotia production and germination of *S. rolfsii* which in turn enhanced disease development leading to increase in disease incidence. Crowe and Hall (1980) reported that disease development is more rapid with increasing temperature within the range of 6-24ºC in combination with damp soil. Mukherji and Tewari (1969) reported that white rot of onion caused by *S. rolfsii* became severe in Lucknow and neighbouring areas after rainfall. Pawar & Chavan (2015) disclosed that southern blight and decayed of onion bulb caused by *S. rolfsii* progressed rapidly in Maharastra due to increase in relative humidity and decrease in temperature caused by unseasonal heavy rainfall and hailstorm. During the research period, it was also observed that healthy looking harvested onion bulbs kept in storage room develops white rot which indicates the capability of *S. rolfsii* to survive and developed on harvested infected host tissues. Hence, the further research work is considered very crucial to understand the survival of the pathogen concerned.

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