

Occurrence and characterization of *Curvularia lunata* causing Leaf Blight of Sarpagandha (*Rauwolfia serpentina*) in West Bengal, India

SANJOG CHHETRI¹, SIDDARTH SINGH², SOUMIK MUKHERJEE², GOUTAM MONDAL³,
MAIMOM SONIYA DEVI⁴ AND RAKESH YONZONE^{5*}

¹Department of Plant Pathology, School of Agriculture, ITM University, Sithouli,
Gwalior- 474001, Madhya Pradesh

²Department of Plant Pathology, Bidhan Chandra Krishi Viswavidyalaya,
Mohanpur, Nadia- 741252, West Bengal

³AICRP on Medicinal & Aromatic Plant and Betelvine, Directorate of Research,
Bidhan Chandra Krishi Viswavidyalaya, Mohanpur- 741252, West Bengal

⁴Department of Plant Protection, College of Horticulture,
Central Agriculture University (Imphal), Birmiook-737134, Sikkim

⁵College of Agriculture (Extended Campus), Uttarbanga Krishi Vishwavidyalaya,
Majhian, Dakshin Dinajpur-733133, West Bengal

Received : 02.02.2026

Accepted : 01.03.2026

Published : 30.03.2026

Rauwolfia serpentina (L.) Benth. Ex Kurz., commonly known as Sarpagandha is one of the important medicinal plants. Its main economic part is the root which contains many important alkaloids mostly used as a remedy for curing hypertension, insomnia, mental agitation, gastrointestinal disorders and many other diseases. Leaf blight caused by *Curvularia lunata* (Wakker) Boedijn was observed on *Rauwolfia serpentina* in the Medicinal & Aromatic Plants Garden of the All India Coordinated Research Project on Medicinal & Aromatic Plants and Betelvine at C-Block Farm, Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal, India, during 2016–2018. The symptoms appeared as dark brown, mud-coloured irregular lesions generally appeared from the edge of the infected leaves. In severe form the whole leaf got blighted and fallen off. Morphological characteristics indicated the conidia aseptate (generally, two to five celled), smooth-walled, olivaceous brown, relatively fusiform, cylindrical, or slightly curved, 1-4-septate, mostly 3 septa and 4 cells with one of the central cells / third cells being larger and darker. The size of the conidia ranged from 15.66 μ m to 28.38 μ m in length and from 6.02 μ m to 10.84 μ m in width. Pathogenicity was confirmed through detached leaf assays fulfilling Koch's postulates. Field observations showed that disease severity peaked during July (61.3% PDI), coinciding with high rainfall and relative humidity. Correlation and regression analyses revealed rainfall as the most influential factor governing disease development, explaining 78% ($R^2=0.78$) of variation in severity, which increased to 87% ($R^2=0.87$) when combined with maximum temperature. This study represents the first detailed report on occurrence and characterization of *C. lunata* causing leaf blight of Sarpagandha and highlights the strong influence of weather variables on disease progression.

Keywords : *Curvularia lunata*, disease severity, Leaf blight disease, *Rauwolfia serpentina*,

INTRODUCTION

Rauwolfia serpentina (L.) Benth. Ex Kurz., commonly known as Sarpagandha (Indian snakeroot) is an evergreen, woody, glabrous and perennial shrub that belongs to family Apocynaceae and occurs in habitats of tropical and subtropical regions, mainly in the Indian

subcontinent and South-East Asian countries (Singh *et al.* 2009; Mukherjee *et al.* 2019). Generally, it grows in the region with an annual rainfall of 200 to 250 cm and upto 1000 m altitude. It contains many important alkaloids, like ajmalicine, ajmaline, isoajmaline, rauwolfinine, reserpine, serpentine, rescinnamine, tetraphyllicine, yohimbine, and 3 epi-yohimbine used as a remedy for curing hypertension, insomnia, mental agitation, gastrointestinal disorders, excitement, epilepsy, traumas, anxiety, schizophrenia,

*Correspondence : rakesh@ubk.ac.in

sedative insomnia and insanity (Singh *et al.* 2017; Dubey *et al.* 2026). Due to its high economic importance as a drug, promising collections can be exploited for large-scale cultivation for their pharmacologically important constituents (Raina *et al.* 2013).

Despite its multifaced medicinal role specially in Ayurvedic and pharmacological industries and having huge demand in global market it is often effected by numbers of fungal pathogens viz., leaf blight and bud rot caused by *Alternaria tenuis* and *A. alternata*, (Shivanna *et al.* 2014), die back caused by *Colletotrichum dematium* (Mondal *et al.* 2018; Avan, 2021), leaf blotch caused by *Cercosporaserpitinae* (Mondal *et al.* 2018), Cercospora leaf spot caused by *Cercosporarauvolfiae*, *C. serpitinae* (Mondal *et al.* 2018; Avan, 2021); Target leaf spot caused by (Mondal *et al.* 2018); Anthracnose caused by *Colletotrichum gloeosporoides* (Ghosh and Banerjee, 2015), root rot caused by *Macrophomina phaseolina* (Mondal *et al.* 2018), leaf spot caused by *Curvularia lunata* (Varadarajan, 1967), inflorescence and fruit rot caused by *Rhizopus stolonifer* (Shukla *et al.* 2006), leaf spot and blight caused by *Rhizoctonia solani* and mosaic virus (Supyaniet *et al.* 2014), etc.

In recent years, *Curvularia* sp. has caused major diseases in many crops, causing economic losses worldwide (Adaangadiet *et al.* 2018; Adomako *et al.* 2025; Guo *et al.* 2025; Solórzano and Malvick, 2026). Despite the economic importance of *Rauvolfia serpentina*, information regarding leaf blight disease caused by *Curvularia lunata* under West Bengal conditions is limited. A clear understanding of the pathogen, its symptoms and its relationship with environmental factors is essential for developing effective disease management strategies. Therefore, the present study was undertaken to investigate the symptomatology, morphological characteristics, pathogenicity of the causal organism and to analyse the influence of weather parameters on disease development under field conditions.

MATERIALS AND METHODS

Collections of disease samples

Infected leaf samples were collected from the field of the Medicinal & Aromatic Plants Garden of All

India Coordinated Project on Medicinal & Aromatic Plants and Betelvine at C- Block Farm, Bidhan Chandra Krishi Viswavidyalaya, Nadia, and West Bengal. Disease symptoms were studied visually on the standing plants in the field and with the help of a stereomicroscope [Zeiss Stereo (Model-Discovery V8) in the laboratory. Photographs were captured using an AxioCam ERc5s camera attached to a Carl Zeiss microscope and analyzed using Axio Vision LE Rel. 4.3 software.

Isolation and purification of pathogen

The fungus, *C. lunata*, was isolated from the infected leaf tissue showing blighted appearance and small infected portions of 2 × 2 mm, including both diseased and healthy portions were sterilized with 0.1% mercuric chloride solution for 30 seconds to 1 minute, rinsed with a series of sterilized distilled water and placed directly onto the medium containing water agar (2%) followed by incubation for 2-3 days and further mycelial growth was subcultured on potato dextrose agar media at 28°C ± 1°C. The fungus was subsequently purified by single spore isolation, and the culture was maintained on Potato Dextrose Agar slants at 4°C for further studies and these cultures were renewed at 20 days intervals to keep the fungus in an active growing stage. Morphological observations of the pathogen and its asexual structures were made using a Zeiss light microscope (Axio Scope A1). Measurements were recorded using Axio Vision LE Rel. 4.3 image analysis software.

Pathogenicity test

To prove pathogenicity, detached leaf assays were performed by inoculating mycelial plugs following a modified method described by Cai *et al.* (2009) and Hyde *et al.* (2009). The leaves were first surface sterilized with 0.1% mercuric chloride for 15 seconds followed by three washes with sterilized water. After sterilization, the leaves were inoculated with a 5 mm disc from a fresh pure culture (seven days old) of *C. lunata*, and a pinprick was made on the leaf surface using the wound inoculation method. These inoculated leaves were kept in desiccators (280 mm plate size), sealed with grease, and incubated at 27°C ± 1°C. To maintain the humidity, a sterilized moist

cotton ball was placed on the inoculated portion. Symptoms were monitored regularly after inoculation. Control sarpagandha leaves were treated with agar plug (5 mm).

Disease development in relation to weather variables

The fixed plot survey was conducted in the Medicinal & Aromatic Plants Garden of the All India Coordinated Project on Medicinal & Aromatic Plants and Betelvine at C-Block Farm, Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal. The details of the meteorological parameters were collected from the Agro-Met Field Unit, Dept. of Agricultural Meteorology and Physics, BCKV, Kalyani-741235, Nadia, West Bengal (Table 1).

Ten plants were selected and disease severity % (PDI) was calculated using a 0-5 scale given by Bhat *et al.* (2013) as follows: 0 = no infection; 1 = 0.1%–10%; 2 = 10.1%–25%; 3 = 25.1%–50%; 4 = 50.1%–75%; 5 = more than 75% of the leaf area infected. Scoring was done at 15 days interval. For calculating PDI, following formula was used:

$$\text{PDI} = \frac{\text{Sum of all numerical ratings}}{\text{Total number of leaves observed} \times \text{maximum rating}} \times 100$$

Statistical analysis

Correlations were calculated between variables (Disease severity) Y and weather factors such as: Tmax (maximum temperature, °C), Tmin (minimum temperature, °C), RHmax (maximum relative humidity, %), RHmin (minimum relative humidity, %), RF (rainfall, mm), DP (dew point, °C), BSSH (bright sunshine hours, hours) and WS (wind speed, km h⁻¹). The stepwise multiple regression analysis was done by using the formula:

$$v = A + b_1x_1 + e$$

Where, v = predicted severity

A = intercept

b_i = regression co-efficient for x_i (i = 1 ton)

x_i = independent variables (i = 1 to n)

e = random error.

RESULTS AND DISCUSSION

Symptomatology

The disease symptoms caused by *Curvularia lunata* showed dark brown, mud-coloured irregular lesions generally appeared from the edge of the infected leaves (Fig. 1 a-c). The necrotic lesions were with a definite margin and surrounded by yellowish hallow. The necrotic zone gradually enlarges in size and the adjacent lesions may coalesce with each other. In severe form, the whole leaf got blighted and fallen off. Under the stereoscopic microscope, the presence of short conidiophore arising from the blighted portion of the leaves was observed (Fig. 1 d-e). A similar type of leaf blight symptoms caused by *C. lunata* has also been reported from Thailand on the host, Mulberry (Bussaban *et al.* 2017).

Morphology of *Curvularia lunata*

Macroscopic features of the pathogen were brown to black colour, hairy, velvety or woolly texture and loosely arranged and rapidly growing colonies on potato dextrose agar medium (Fig. 2 a). Conidiophores were straight to erect, unbranched, septate, simple or geniculate growth pattern, varied in colour ranging from pale to dark brown, flexuous in the apical part with flat and dark brown scars (Fig. 2 e-h). Conidia were formed apically through a pore (poroconidia) in sympodially, elongating, geniculated conidiophores. Conidia were multicelled (generally, two to five celled), smooth-walled, olivaceous brown with end cells somewhat paler. They were relatively fusiform, cylindrical, or slightly curved, 1-4-septate, mostly 3 septa and 4 cells with one of the central cells / third cells being larger and darker. The size of the conidia ranged from 15.66 μm to 28.38 μm (Mean: 20.95 μm ± 2.83) in length and from 6.02 μm to 10.84 μm (Mean: 8.82 μm ± 1.01) in width. Based on morphological characters of the fungus closely resembled those described as *Curvularia lunata*.

It has been reported leaf spot disease of *Rauvolfia serpentina* caused by *Curvularia lunata*. He observed that the initial lesions gradually expanded into irregular to circular patches. With disease progression, most of the leaf lamina turned yellow,

Table 1: Influence of meteorological parameters on seasonal development of leaf blight disease (PDI) of Sarpagandha caused by *Curvularia lunata* under field conditions during 2017–18.

Date	Tmax	Tmin	Rainfall	RHmax	RHmin	Dew point	BSSH	Wind Speed	Severity (%)
29.06.17	34.02	26.61	9.24	93.33	75.67	27.38	5.13	0.89	55.6
14.07.17	32.31	26.46	13.31	97.87	85.6	27.54	2.41	0.53	58.8
29.07.17	31.17	26.06	15.88	95.93	84.67	26.84	2.78	0.49	61.3
13.08.17	33.11	26.5	11.79	94.07	80.87	28.03	3.32	0.55	59.4
28.08.17	32.63	26.14	7.65	95.53	84	27.4	4.82	0.18	51.7
12.09.17	34.25	26.53	5.03	95.07	76.93	27.72	5.17	0.36	46.2
27.09.17	34.35	26.76	5.13	96	73.4	27.63	5.72	0.33	38.2
12.10.17	32.31	25.24	9.58	97.88	81.53	26.96	4.43	0.65	35.1
27.10.17	32.27	24.61	7.78	97.4	72.2	25.59	6.07	0.37	26.2
11.11.17	31.03	20.16	0	94.4	58.4	21.35	8.53	0.28	18.1
26.11.17	28.19	17.83	2.41	93.27	62.53	19.05	6.26	0.26	0
11.12.17	26.55	14.82	1.03	91.4	60.13	17.11	5.46	0.21	0
26.12.17	25.71	14.19	0	93.8	60.73	16.74	6.57	0.23	0
10.01.18	23.97	9.51	0	92.93	51.2	12.66	7.4	0.35	0
25.01.18	24.41	8.67	0	91.27	49.4	12.49	5.89	0.24	12.5
08.02.18	28.2	12.31	0	89.79	44.07	14.31	6.82	0.26	13.2

Tmax = Maximum temperature, Tmin = Minimum temperature, RHmax = Maximum relative humidity, RHmin = Minimum relative humidity, BSSH = Bright sunshine hours

Table 2: Multiple Regression Equation indicating the relationship of meteorological factors with leaf blight disease PDI (Y) caused by *C. lunata*

Model No.	Multiple Regression Equation	R ²
1.	PDI (Y)= 7.94 +3.93Rainfall	0.78
2.	PDI (Y)= -68.17 +2.69Rainfall +2.74Tmax	0.87

bearing numerous scattered spots and patches. Severe infection ultimately led to premature defoliation, leaving behind dried stems and inflorescences with partially developed fruits. Other authors have also obtained similar results when examining species infecting other plants, for example rice (Kusai *et al.* 2016) characterized *C. lunata* colonies in PDA (potato-dextrose-agar medium) with the cottony appearance and blackish-grey colouration. These authors also found that the conidia had three transverse septa, with a more voluminous median cell, pronounced curvature and dark hilum at one end with average dimensions of 20.62 $\mu\text{m} \times 8.58 \mu\text{m}$. A similar report of the morphology of *Curvularia lunata* isolated from *Sorghum bicolor* is found with a curve to

pyriform conidia with large central cells and the size of conidia ranging from 7.3 μm to 21.26 μm (Akram *et al.* 2014).

Effect of meteorological factors on disease progression

Disease severity (%) varied considerably during the cropping season (Table 1). The maximum PDI (61.3%) was recorded during the fourth week of July (29.07.17), when moderate temperature (Tmax 31.17 °C; Tmin 26.06 °C), high relative humidity (RHmax 95.93%; RHmin 84.67%), and rainfall (15.88 mm) prevailed. Thereafter, disease severity gradually declined from August to October. High dew point (26.84 °C) and reduced bright sunshine hours (2.78 h) during this period further favoured pathogen establishment. A slight increase in PDI was recorded during late January and early February.

Correlation analysis revealed that disease severity % (PDI) was positively and significantly associated with rainfall, maximum temperature, relative humidity, and dew point, indicating that



Fig 1: Symptoms of leaf blight on Sarpagandha caused by *Curvularia lunata* (a) Infected plant in the field, (b) Infected leaf and (c-e) stereo microscopic views of leaf blight.



Fig. 2: Morphology of *Curvularialunata*. (a) Growth on PDA (b&c) conidia (d) formation of conidium and (e-h) conidia on conidiophores.

moisture-related weather parameters played a crucial role in disease development (Fig. 3).

Stepwise multiple regression analysis identified rainfall as the most influential subset of weather variables affecting disease severity. In the first regression model (Table 2), the positive effect of rainfall alone explained 78% of the variation in PDI ($R^2=0.78$), indicating its dominant role in disease progression. In the final model, the positive effect of maximum temperature, along with rainfall

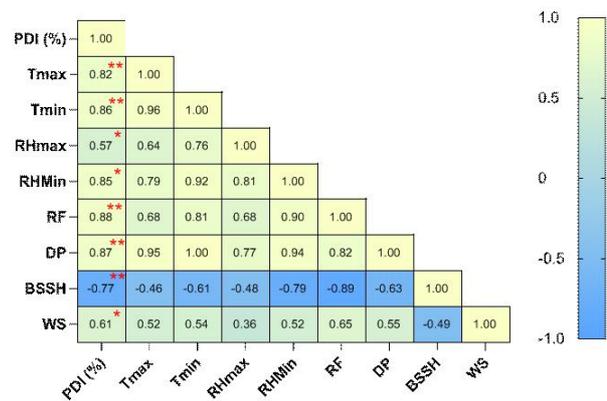


Fig 3: Correlation coefficients (r) between leaf blight disease severity (PDI) of Sarpagandha caused by *Curvularia lunata* and weather parameters under field conditions during 2017–18 PDI= Percent disease index, Tmax = Maximum temperature, Tmin = Minimum temperature, RHmax = Maximum relative humidity, RHmin = Minimum relative humidity, RF=Rainfall, DP=Dew Point, BSSH = Bright Sunshine hours, and WS=Wind speed *5% significant level, ** 1% significant level.

further improved the explanatory power of the model, accounting for 87% of the total variation in disease severity ($R^2=0.87$). This indicates that rainfall provides favourable moisture conditions for infection, whereas the maximum temperature contributes to warmer conditions conducive to disease development. The exclusion of other meteorological variables from the final regression model may be attributed to their strong interdependence with rainfall and temperature.

Overall, the results demonstrate that disease severity was primarily governed by rainfall, with temperature acting as an additional contributing factor under field conditions. The peak disease severity observed during July may be attributed to favourable weather conditions, particularly high relative humidity (e"80%), rainfall (4–20 mm/week,) and temperature (27–28°C) as the most critical weather factors for the development and infection rate of brown spot disease caused by *Curvularia oryzae* (Sopialena *et al.* 2025).

The gradual decline in disease severity during the subsequent months can be explained by decreasing temperature and moisture availability. The absence of disease during winter months indicates unfavourable climatic conditions for

pathogen activity. These findings are in agreement with those of earlier reports by Njokuocha *et al.* (2016), who recorded the highest number of fungal spores during the rainy season.

CONCLUSION

The present study confirmed *Curvularia lunata* as the causal agent of leaf blight disease of *Rauvolfia serpentina* based on characteristic symptoms, morphological features, and pathogenicity tests under field conditions in West Bengal, India. Disease severity showed marked seasonal variation and was strongly influenced by weather variables, with maximum incidence recorded during periods of high rainfall, elevated relative humidity, and moderate temperature. Correlation and regression analyses identified rainfall as the most critical factor governing disease development. The findings emphasize the significant role of weather parameters in disease epidemiology and provide a basis for developing weather-based forecasting and timely management strategies for leaf blight of Sarpagandha.

ACKNOWLEDGEMENT

The authors are thankful to the All India Coordinated Research Project on Medicinal and Aromatic Plants and Betelvine (AICRP), Directorate of Research, Bidhan Chandra Krishi Viswavidyalaya, for providing financial support, laboratory facilities and field facilities for the research.

DECLARATION

Conflict of Interest. Authors declare no conflict of interest.

REFERENCES

- Adaangadi, K.C., Harlapur, S., Chakrasali, S., Hadimani B.R. 2018. Studies on evaluation of fungicides against *Curvularia lunata* in maize. *Int. J. Agric. Sci.* **14**: 224-228.
- Adomako, J., Larbi-Koranteng, S., Bukari, T.A., Danso, Y. 2025. Pathogenic variability among *Curvularia* species causing brown leaf spot disease of rice. *J. Plant Pathol.* **107**: 243-249.
- Akram, W., Anjum, T., Ahmad, A., Moeen, R. 2014. First report of *Curvularia lunata* causing leaf spots on *Sorghum bicolor* from Pakistan. *Plant Dis.* **98**: 1007.
- Avan, M. 2021. Important fungal diseases in medicinal and aromatic plants and their control. *Turk. J. Agri. Eng. Res.* **2**: 239-259.
- Bhat, H.A., Ahmad, K., Ahanger, R.A., Qazi, N.A., Dar, N.A., Ganie, S.A. 2013. Status and symptomatology of *Alternaria* leaf blight of gerbera in Kashmir valley. *Afr. J. Agric. Res.* **8**: 819-823.
- Bussaban, B., Kodchasee, P., Apinyanuwat, S., Kosawang, C., Jonglaekha, N. 2017. First report of *Curvularia lunata* causing leaf blight on mulberry in Thailand. *Plant Dis.* **101**: 1951.
- Cai, L., Hyde, K.D., Taylor, P.W.J., Weir B., Waller, J., Abang, M.M., Zhang J.Z. 2022. A polyphasic approach for studying *Colletotrichum*. *Fungal Divers.* **39**: 183-204.
- Chandra, V. 1975. Leaf blotch disease of *Rauvolfia serpentina*. *Sci. Cult.* **23**: 99.
- Dubey, A., Patel, V. K., Sahu, V. K., Dash, S. L., Mishra, A. 2026. *Rauvolfia serpentina*: Phytochemistry, Mechanisms of Action, and Clinical Implications—A Comprehensive Review. *Inter. J. Pharm. Res. Technol.* **16**: 184-197.
- Ghosh, S.K., Banerjee, S. 2015. Anthracnose disease of *Rauvolfia serpentina* in West Bengal. *Curr. Res.* **7**: 19916-19920.
- Guo, Z.J., Amenyogbe, M.K., Chen, S.Q., Rashad, Y.M., Deng, J.X., Luo H. 2025. Morphological and phylogenetic analyses reveal two novel species of *Curvularia*. *MycKeys.* **120**: 139-156.
- Hyde, K.D., Cai, L., McKenzie, E.H.C., Yang, Y.L., Zhang, J.Z., Prihastuti, H. 2009. *Colletotrichum*: a catalogue of confusion. *Fungal Divers.* **39**: 1-17.
- Kusai, N.A., Azmi, M.M.Z., Zulkifly, S., Yusof, M.T., Nor, A.I. 2016. Morphological and molecular characterization of *Curvularia*. *Rend. Fis. Acc. Lincei.* **27**: 205-214.
- Mondal, G., Dasgupta, B., Sharma, R. 2018. Diseases of medicinal and aromatic plants and their management. In: *Recent approaches for management of plant diseases* (Eds. S. Das, S. Dutta, B.N. Chakraborty and D. Singh), Indian Phytopathological Society, pp. 251–283.
- Mukherjee, E., Gantait, S., Kundu, S. 2019. Biotechnological interventions on the genus *Rauvolfia*. *Appl. Microbiol. Biotechnol.* **103**: 7325-7354.
- Njokuocha, R.C., Agwu, C.O., Okezie, C.E. 2017. Effects of weather conditions on airborne fungal spores. *Grana.* **56**: 263-272.
- Raina, A.P., Gupta V., Sivaraj, N., Dutta, M. 2013. *Andrographis paniculata* (Burm. f.) Wall. Ex Nees (kalmegh), a traditional hepatoprotective drug from India. *Genet. Resour. Crop Evol.* **60**: 1181–1189. <https://doi.org/10.1007/s10722-012-9953-0>
- Shivanna, M. B., Parashurama, T. R., Achar, K. S., Vasanthakumari, M. M. 2014. Fungal foliar diseases in *Withania somnifera* and its effect on secondary metabolites. *Plant Biosyst.* **148**: 07-916. <https://doi.org/10.1080/11263504.2013.845266>
- Shukla, R. S., Alam, M., Sattar, A., Khaliq, A., Singh, H. N. 2006. First report of *Rhizopus stolonifer* causing inflorescence and fruit rot of *Rauvolfia serpentina* in India. *EPPO Bull.* **36**: 11-13.
- Singh, P., Singh, A., Shukla, A.K., Singh, L., Pande, V., Nailwal, T.K. 2009. In vitro regeneration of *Rauvolfia serpentina*. *Life Sci. J.* **6**: 74-79.
- Singh, M. 2017. Evaluating the therapeutic efficiency and drug targeting ability of alkaloids present in *Rauvolfia serpentina*. *Int. J. Green Pharm.* **11**: 132-142.
- Solórzano, J.E., Malvick, D. 2026. First report of *Curvularia lunata* on corn. *Plant Dis.* <https://doi.org/10.1094/PDIS-11-25-2254-PDN>
- Sopialena, S., Sahid, A., Suryadi, A., Aditya, N. 2025. The Effect of Climate on The Development of Brown Spot Disease (*Curvularia oryzae*) in Rice Plants. In *BIO Web of Conferences EDP Sciences*. Vol. 206, p. 06006.
- Supyani, A., Aulia, A., Widono, S., Mulyani, S. 2014. Viral infection of *Rauvolfia serpentina*. *Biomirror* **5**: 8-11.