

International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
ISSN Online: 2617-4707
IJABR 2024; SP-8(8): 1212-1217
www.biochemjournal.com
Received: 06-06-2024
Accepted: 09-07-2024

RS Gayake
PG Scholar, Plant Pathology
Section, College of Agriculture,
Nagpur, Dr. PDKV, Akola,
Maharashtra, India

Dr. MJ Patil
Plant Pathology Section,
College of Agriculture, Nagpur,
Dr. PDKV, Akola,
Maharashtra, India

Dr. RW Ingle
Plant Pathology Section,
College of Agriculture, Nagpur,
Dr. PDKV, Akola,
Maharashtra, India

Dr. Seema A Thakare
Horticulture Section, College of
Agriculture, Nagpur, Dr.
PDKV, Akola, Maharashtra,
India

PN Rakhonde
Plant Pathology Section,
Anand Niketan College of
Agriculture, Warora, Dr.
PDKV, Akola, Maharashtra,
India

AR Shinde
PG Scholar, Plant Pathology
Section, College of Agriculture,
Nagpur, Dr. PDKV, Akola,
Maharashtra, India

RS Gite
PG Scholar, Plant Pathology
Section, College of Agriculture,
Nagpur, Dr. PDKV, Akola,
Maharashtra, India

Shejal V Khadse
PG Scholar, Plant Pathology
Section, College of Agriculture,
Nagpur, Dr. PDKV, Akola,
Maharashtra, India

Corresponding Author:
RS Gayake
PG Scholar, Plant Pathology
Section, College of Agriculture,
Nagpur, Dr. PDKV, Akola,
Maharashtra, India

Efficacy of fungicides against powdery mildew of cucumber (*Cucumis sativus* L.)

RS Gayake, Dr. MJ Patil, Dr. RW Ingle, Dr. Seema A Thakare, PN Rakhonde, AR Shinde, RS Gite and Shejal V Khadse

DOI: <https://doi.org/10.33545/26174693.2024.v8.i8Sp.2012>

Abstract

Erysiphe cichoraciarum DC. is the pathogen causing the powdery mildew disease that affects cucumber, which is a significant fungal disease that causes significant yield losses. With the following objectives in mind: effectiveness of fungicides in field conditions, effect of fungicides on conidial germination inhibition of powdery mildew, correlation of weather parameters with percent disease intensity, yield of cucumber per plot, and B:C ratio at the Department of Plant Pathology, College of Agriculture, Nagpur (MS), the current study was conducted to evaluate the intensity of the disease and develop appropriate management practices under field conditions during Rabi season 2023. According to the disease management study, all six fungicides were tested in the field against powdery mildew of cucumber and significantly reduced the disease's intensity compared to the unsprayed control. Three sprays of Azoxystrobin 23% SC (0.1%) were found to be the most effective fungicidal treatment, followed by Propiconazole 25% EC (0.1%) and Fluxapyroxad 250 g/l + Pyraclostrobin 250 g/l SC (0.1%), with minimum mean percent disease intensity recording 19.01, 22.22, and 27.89 percent disease intensity, respectively, with fruit (80.00 q/ha), (70.00 q/ha), and (67.65 q/ha), respectively. Six fungicides were tested by doubling the concentration under *in-vitro* conditions at room temperature against *Erysiphe cichoracearum* for inhibition of conidial germination, and the results showed that all the fungicides inhibited conidial germination 100 Percent, except the treatment metrafenone 500 g/SC (0.08%), which showed conidial germination inhibition (66.73%).

Keywords: *Erysiphe cichoraciarum* DC, cucumber, Azoxystrobin 23% SC

1. Introduction

A member of the Cucurbitaceae family, cucumber (*Cucumis sativus* L.) is one of the earliest vegetable crops to be produced. Vegetables like cucumber are widely grown. The plant is a creeping vine that produces cucumiform blossoms, which can be eaten raw or cooked. Pickling, seedless, and slicing are the three main types of cucumbers. Fruits are good for people suffering from constipation, jaundice, and indigestion (Anonymous, 2014) [2]. The primary objective of cucurbitaceous vegetable research in India is to generate biotic and abiotic-resistant varieties and hybrids with excellent qualities in order to increase productivity on a sustainable basis (Rai *et al.*, 2008) [15].

Powdery mildew is an important disease of cucurbits, particularly cucumber, which is highly susceptible to this disease and suffers heavy losses in all localities of Maharashtra State, wherever it is grown. In the Maharashtra districts of Aurangabad and Jalana, the incidence of disease was found to range from 20.10% to 47.28% on various cultivars. (S. M. Wahul, 2018) [18, 19].

Cucumber powdery mildew disease is attributed to two fungal species, *Sphaerotheca fuliginea* (Schlttl.) Pollaci and *Erysiphe cichoracearum* (DC.), which belong to two different genera in the same family, *Erysiphaceae*. Yield loss due to powdery and downy mildew diseases was estimated to be 50–70 percent. Though there are many cultural practices employed, such as crop rotation and fall ploughing, and also the use of fungicides, crop loss was reported to be 50–70 percent. The severity and disease development in cucurbits have led to severe yield losses; hence, a detailed study to assess the efficacy of systemic fungicides and combi fungicides under *in-vitro* and *in-vivo* conditions is very important.

2. Materials and Methods

2.1 Fungicides

The following fungicides which is effective against powdery mildew of cucumber were used with their recommended doses. The fungicides require for the present investigation were provided by Department of Plant Pathology, College of Agriculture, Nagpur (MS).

S. No.	Fungicides	Conc. %
1.	Fluxapyroxad 250 g/l + Pyraclostrobin 250 g/l SC	0.1
2.	Metrafenone 500 g/SC	0.04
3.	Azoxystrobin 23% SC	0.1
4.	Azoxystrobin 4.8% w/W + Chlorothalonil 40% w/W	0.1
5.	Carbendazim 50% WP	0.1
6.	Propiconazole 25% EC	0.1
7.	Water	-

2.2 Experimental details

2.2.1. Experimental site

The present investigation was carried out at Horticulture field of the College of Agriculture, Nagpur, and laboratory work was conducted at the laboratory of the Plant Pathology section during the rabi season 2023 at the College of Agriculture, Nagpur (MS).

2.2.2 Layout and plan

The field experiments were conducted in Randomized Block Design (RBD) with seven treatments and three replications and laboratory experiment was also conducted with Randomized Block Design (RBD) with seven treatments and three replications.

2.2.3 Detail of layout

1.	Name of crop	Cucumber
2.	Botanical Name	<i>Cucumis sativus</i> L.
3.	Variety	Cindrella
4.	Experimental design	Randomized Block Design
5.	Treatments	7
6.	Replications	3
7.	Spacing	60 x 60 cm.
8.	Date of Sowing	15 September 2023
9.	Date of termination	25 December 2023

2.3 Fungicidal spraying schedule

The aqueous solution of required concentration of various treatments was prepared in water just before spraying. Three sprays of each solution were given, first spray was given on 10 November 2023 second on 25 November 2023 and third on 10 December 2023 during rabi season 2023. The spray was done with the help of knapsack sprayer with hollow cone nozzle. During spraying of fungicide complete coverage of plant surface was ensured and the spray drifts of different treatments were avoided by taking appropriate precautions. Crop were sprayed thrice with each fungicide at their recommended doses. The details of fungicides are given in Table 1. First spraying was done at the onset of disease symptoms and repeated after 15 days interval. Control plots was sprayed with same volume of water.

Disease severity was recorded before the beginning of first spray and subsequent observations were recorded before each spray i.e. After 15 days and final observation was taken 15 days after last spray and finally disease intensity was

recorded. Fruit yield (kg/plot) was also recorded and finally converted in to ql/ha. Data was statistically analysed using appropriate statistical method.

In each plot five cucumber plants were randomly selected and for measuring disease intensity, lower, middle and upper crop canopy observed and evaluated individually using 0-9 rating scale based on leaf area covered by pustules as mentioned below.

Rating scale used for disease intensity (Mayee and Datar, 1986) ^[12]

Rating scale	Description
0.	No symptoms on leaf.
1.	Powdery mildew pustules small, scattered covering 1% or less of leaf area.
3.	Powdery mildew pustules more in number covering 1-10% of leaf area.
5.	Typical powdery mildew pustules covering 11-25% of leaf area.
7.	Typical powdery mildew pustules covering 26-50% of leaf area.
9.	Typical powdery mildew pustules covering 51% or more of leaf area.



Plate 1: Disease scoring scale for powdery mildew of cucumber

Further these scales were converted to percent disease intensity using following formula. (Mc Kinney, 1923) ^[11]

$$PDI = \frac{\text{Sum of observed numerical rating}}{\text{Number of leaves x plant observed}} \times \frac{100}{\text{Maximum rating}}$$

Further, percent disease control (PDC) was worked out by applying the following formula.

$$PDC = \frac{PDI \text{ in control plot} - PDI \text{ in treatment plot}}{PDI \text{ in control plot}} \times 100$$

2.4 Effect of fungicides on inhibition of conidial germination of *E. cichoracearum* In-vitro

The efficacy of six fungicides at double concentrations (0.2%) was tested against *E. cichoracearum* by spore germination technique. Required concentration of each fungicide was prepared in distilled water. Two drops of fungicide solution were taken on clean cavity slide. Powdery mildew spores were suspended using camel hair brush in fungicide solution on the cavity slide. Each concentration was replicated thrice in a separate cavity slide. Control treatment was maintained by putting conidia with distilled water.

These cavity slides were kept in the Petri plates lined with moist blotting paper and were incubated at room

temperature (28 ± 1 °C) for 24 hours. After 24 hours, observations were taken at 40 X microscopic fields for each cavity slide, the total number of spores and germinated spores in each microscopic field were recorded and percent germination and percent germination inhibition was calculated.

Percent germination was calculated by counting number of conidia germinated against total number of conidia observed microscopic field at magnification of 40 X by using the formula mentioned below.

$$\text{Percent germination (PG)} = \frac{A}{B} \times 100$$

Where,

PG = Percent germination

A = Number of conidia germinated

B = Number of conidia observed

The average of three cavities (three replications) was found out and the percent inhibition of spore germination was calculated with the following formula.

$$\text{Percent inhibition of spore germination} = \frac{C - T}{C} \times 100$$

Where,

C - Germination of conidia in control

T - Germination of conidia in treatment

2.5 Correlation of weather parameters with Percent Disease Intensity (PDI)

The epidemiological work had been studied in the field of Horticulture, College of Agriculture Nagpur. Five plants from variety Cindrella were selected randomly and were labelled to study the intensity of powdery mildew disease on leaves. Observations were recorded at 7 days interval of meteorological week by using 0-9 scale (Mayee and Datar, 1986) [12]. The data of these weather parameters was collected from Agro Meteorological Division of College of Agriculture Nagpur.

The disease development was correlated with weather

parameters viz., rainfall, maximum and minimum temperature, relative humidity during morning and evening on cucumber crop.

3. Results and Discussion

3.1 Evaluation of fungicides against conidial germination of *Erysiphe cichoracearum* In-vitro

Six systemic fungicides were tested under in-vitro conditions at room temperature against *E. cichoracearum* for inhibition of conidial germination and the results are presented in Table 1. No conidial germination was observed in azoxystrobin 23% (0.2%), carbendazim (0.2%), propiconazole (0.2%), azoxystrobin 4.8% w/W + chlorothalonil 40% w/W (0.2%), fluxapyroxad 250 g/l + pyraclostrobin 250 g/l SC (0.2%). The treatment metrafenone 500 g/SC (0.08%) were showed germination (12.97) percent. The maximum conidial germination was observed in control (39.36) percent. Maximum conidial germination inhibition (100%) was observed in azoxystrobin (0.2%), carbendazim (0.2%), propiconazole (0.2%), azoxystrobin 4.8% w/W + chlorothalonil 40% w/W (0.2%), fluxapyroxad 250 g/l + pyraclostrobin 250 g/l SC (0.2%). The treatments of metrafenone 500 g/SC (0.08%) showed conidial germination inhibition (66.73) percent.

3.2 Average effect of fungicidal spraying on Percent disease intensity of powdery mildew and percent disease control

The results of the average percent disease intensity and percent disease control after each spraying have been summarized in table 2. and final effect of different treatment on percent disease control in relation to percent disease intensity is represented graphically in fig. 2.

From the table 2 it was indicated that, all the treatments were significantly superior over untreated control in reducing the disease intensity of powdery mildew of cucumber.

The minimum Percent disease intensity (PDI) was noticed in treatment azoxystrobin 23% (0.1%) which was highly significant among all the treatments. The next best treatment was propiconazole (0.1%) which is also superior to remaining treatments recording (19.01) and (22.22) percent disease intensity respectively.

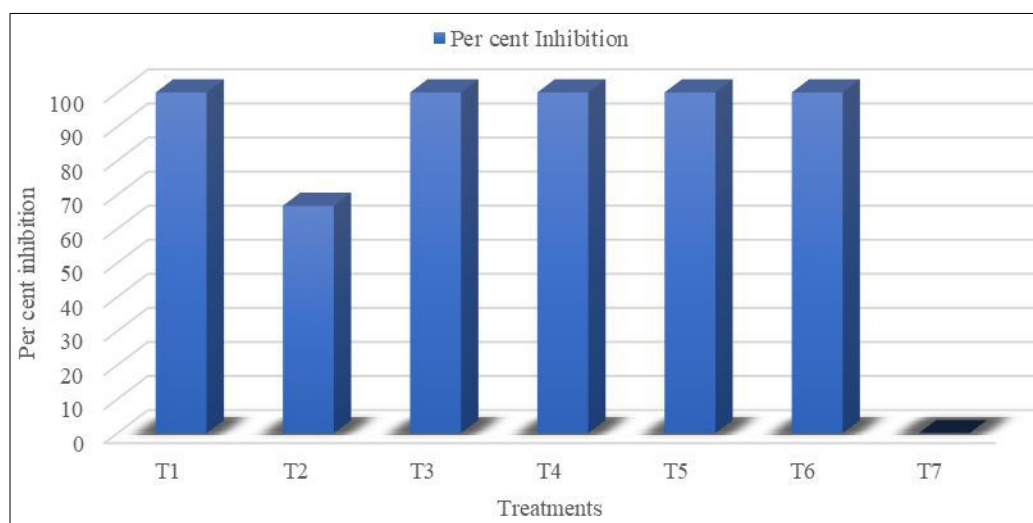


Fig 1: Effect of fungicides on Percent inhibition of conidial germination of *Erysiphe cichoracearum* In-vitro

Table 1: Effect of fungicides on Percent inhibition of conidial germination of *Erysiphe cichoracearum* In-vitro

Tr. No.	Treatment	Conc. (%)	<i>Erysiphe cichoracearum</i>	
			Percent germination	Percent germination inhibition
T ₁	Fluxapyroxad 250 g/l + Pyraclostrobin 250 g/l SC	0.2	0.0	100.0
T ₂	Metrafenone 500 g/SC	0.08	12.97	66.73
T ₃	Azoxystrobin 23% SC	0.2	0.0	100.0
T ₄	Azoxystrobin 4.8% w/W + Chlorothalonil 40% w/W	0.2	0.00	100.0
T ₅	Carbendazim 50% WP	0.2	0.0	100.0
T ₆	Propiconazole 25% EC	0.2	0.0	100.0
T ₇	Control	-	39.26	-
'F' Test			Sig.	Sig.
SE(m)±			0.85	2.14
C.D at 5%			2.61	6.60

The other promising treatments were fluxapyroxad 250 g/l + pyraclostrobin 250 g/l SC (0.1%) and azoxystrobin 4.8% w/W + chlorothalonil 40% w/W (0.1%) recording (27.89) and (28.93) percent disease intensity respectively.

The next promising treatments were carbendazim 50% WP (0.1%) and metrafenone 500 g/SC (0.04%) exhibiting (34.11) and (36.91) percent disease intensity respectively.

Maximum Percent disease control (PDC) was observed in treatment azoxystrobin 23% (0.1%) followed by

propiconazole (0.1%) and fluxapyroxad 250 g/l + pyraclostrobin 250 g/l SC (0.1%) recording (67.72), (62.42) and (52.66) percent respectively.

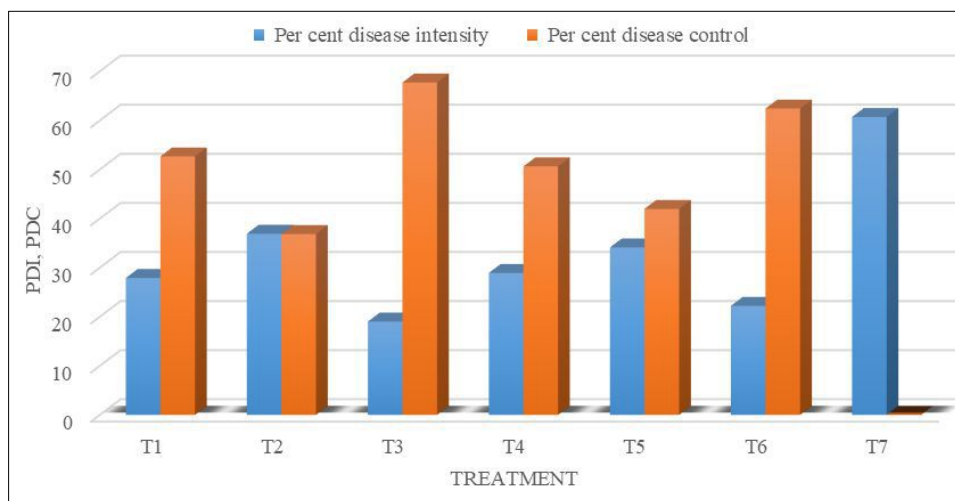
From The table 5 it was also indicated that among the fungicides evaluated, three sprays of azoxystrobin 23% (0.1%) resulted in maximum fruit yield (80.00 ql/ha) which was followed by propiconazole (0.1%) (70.00 ql/ha) and fluxapyroxad 250 g/l + pyraclostrobin 250 g/l SC (0.1%) (67.65 ql/ha) respectively.

Table 2: Average effect of fungicidal spraying on Percent disease intensity of powdery mildew and percent disease control

Tr. No.	Treatment Details	Conc. (%)	(PDI) after spray			Mean (PDI)	(PDC) after spray			Mean (PDC)	Yield ql/ha
			First	Second	Third		First	Second	Third		
T ₁	Fluxapyroxad 250 g/l + Pyraclostrobin 250 g/l SC	0.1	23.58** (29.01)*	28.64 (32.32)	31.46 (34.11)	27.89 (31.81)	46.18	51.56	60.24	52.66	67.65
T ₂	Metrafenone 500 g/SC	0.04	33.08 (35.17)	37.03 (37.47)	40.61 (39.58)	36.91 (37.41)	24.50	37.37	48.67	36.85	50.00
T ₃	Azoxystrobin 23% SC	0.1	16.17 (23.62)	19.38 (26.05)	21.48 (27.57)	19.01 (25.75)	63.09	67.22	72.85	67.72	80.00
T ₄	Azoxystrobin 4.8% w/W + Chlorothalonil 40% w/W	0.1	25.30 (30.15)	29.63 (32.96)	31.85 (34.32)	28.93 (32.48)	42.26	49.89	59.74	50.63	66.00
T ₅	Carbendazim 50% WP	0.1	29.13 (32.64)	35.30 (36.44)	37.90 (37.98)	34.11 (35.69)	33.52	40.30	52.10	41.97	57.50
T ₆	Propiconazole 25% EC	0.1	18.51 (25.44)	22.59 (28.35)	25.55 (30.34)	22.22 (28.04)	57.75	61.79	67.71	62.42	70.00
T ₇	Control	-	43.82 (41.44)	59.13 (50.26)	79.13 (62.28)	60.69 (51.33)	0	0	0	0.00	40.00
'F' Test			Sig.	Sig.	Sig.	Sig.					
SE(m)±			1.20	1.11	1.48	1.80	-	-	-	-	
C.D at 5%			3.71	3.42	4.55	5.54	-	-	-	-	

* Figures in the parentheses are arc sine transformed value

** Figures in the parentheses are average of three replications

**Fig 2:** Average effect of fungicidal spraying on percent disease intensity and percent disease control

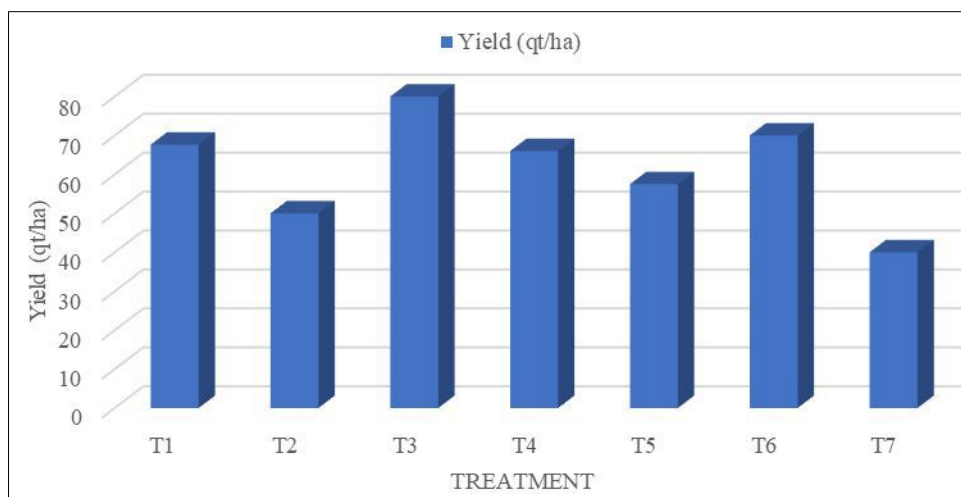


Fig 3: Average yield of cucumber per plot

3.3 Correlation of weather parameters with Percent disease intensity of powdery mildew of cucumber during rabi season 2023

The data were analysed by statistically and presented in Table 3. Concluded that the powdery mildew was appeared in 44th (MW) and it was spread upto 51th (MW). Highest intensity of powdery mildew was noticed in 51th (MW) exhibiting 79.13 percent disease intensity.

Maximum temperature (-0.729) had showed highly significant and negative correlation with powdery mildew, while minimum temperature (-0.603) showed highly non-significant and negative correlation with percent disease intensity of powdery mildew. Whereas Relative humidity during morning (0.351) and evening (0.346) and also rainfall (0.152) had shown moderately non-significant and positive correlation with percent disease intensity of powdery mildew of cucumber.

Table 3: Correlation of weather parameters with Percent disease intensity of cucumber powdery mildew disease during rabi season 2023

Meteorological weeks	PDI	Max. Temp. (°C)	Min. Temp. (°C)	RH I (%) mor.	RH II (%) eve.	Rainfall (mm)
44	3.33	30.9	16.3	68	48	0.0
45	9.00	31.5	15.1	81	63	0.0
46	20.37	31.7	16.3	78	62	0.0
47	43.82	31.5	19.1	81	63	0.0
48	52.96	31.3	13.3	87	60	20.2
49	59.13	30.7	14.1	74	57	0.0
50	70.37	29.3	14.1	79	61	0.0
51	79.13	28.3	10.1	79	61	0.0
“T” Test		Sig.	NS	NS	NS	NS
“r” value		-0.729	-0.603	0.351	0.346	0.152

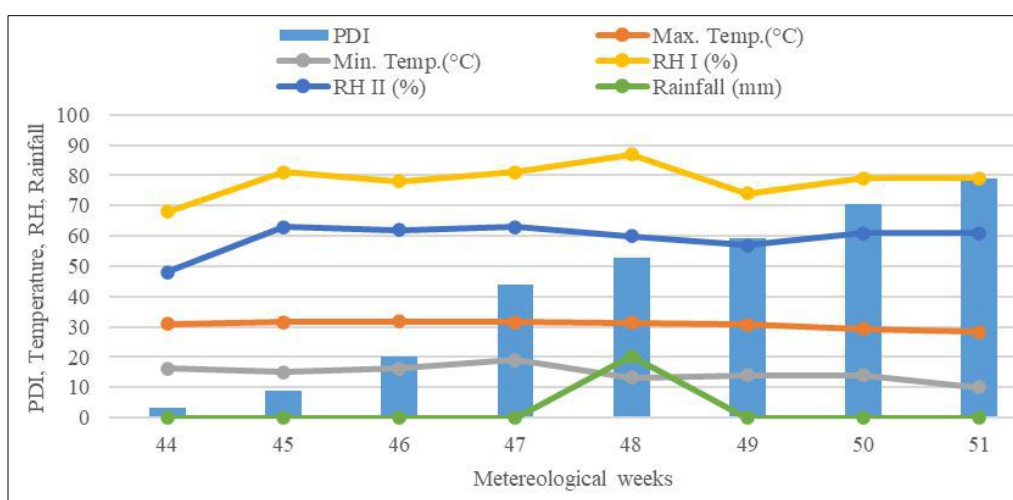


Fig 4: Correlation of weather parameters with Percent disease intensity of powdery mildew of cucumber during rabi season 2023

4. Conclusion

It is concluded from the present study evident that all the fungicides were effective in reducing disease intensity over control. Among the foliar spray of fungicides azoxystrobin

23% (0.1%) was most effective than other fungicides in reducing the percent disease intensity of powdery mildew and increasing yield followed by propiconazole (0.1%).

Azoxystrobin (0.2%), carbendazim (0.2%), propiconazole (0.2%), Azoxystrobin 4.8% w/W + Chlorothalonil 40% w/W (0.2%), Fluxapyroxad 250 g/l + Pyraclostrobin 250 g/l SC (0.2%) were found effective and recorded significantly highest inhibition of conidial germination (100) percent of *Erysiphe cichoraciarum*.

Weather parameters like temperature and relative humidity plays an important role in development of the powdery mildew of cucumber.

5. Acknowledgements

I am thankful to the Head of the Plant Pathology section, College of Agriculture, Nagpur for providing all the necessary facilities for conducting the research work.

6. Reference

- Anand T, Chandrashekar AP, Kuttalam SP, Senthiraj G, Raghuchander T, Samiyappan R. Effectiveness of azoxystrobin in the control of *Erysiphe cichoracearum* and *Pseudoperonospora cubensis* on cucumber. Journal of Plant Protection Research. 2008;48(2):147-158.
- Anonymous. Nutritional Value; c2014. Available from: <http://ndb.nal.usda.gov>.
- Ashtaputre SA, Kulkarni S, Rao MS, Shivaprasad M. Management of powdery mildew of chilli using triazoles. Journal of Plant Diseases and Sciences. 2007;2(2):132-134.
- Ashwini R, Amaresh YS, Kulkarni S, Yenjerappa ST, Patil SG, Hanchinal SG. *In-vitro* evaluation of various fungicides against spore germination inhibition of *Erysiphe cichoracearum* DC. in bhendi. Biological Forum – An International Journal. 2021;13(2):367-373.
- Basavaraj K, Amaresh YS, Sunkad Gururaj, Aswathanarayana DS, Hurali S. Prevalence of powdery mildew in cucumber growing areas in North Eastern Karnataka, India. International Journal of Pure and Applied Biosciences. 2018;7(1):420-424.
- Betadesh, Amaresh YS, Yenjerappa ST, Ajithkumar K, Pampanna Y. Efficacy of systemic and combi product fungicides and bioagents against powdery mildew of Ber. The Pharma Innovation Journal. 2023;12(1):1124-1129.
- Bheemaraya A, Jamadar MM, Huilgol S. Correlation between weather parameters and sunflower powdery mildew caused by *Erysiphe cichoracearum* DC. International Journal of Current Microbiology and Applied Sciences. 2018;7(9):3503-3509.
- Brahmane PR, Deokar CD, Khaire PB, Deshmukh HV. Effect of foliar sprays of fungicides on powdery mildew severity and fruit yield of cucumber during Kharif season. Journal of Pharmacognosy and Phytochemistry. 2020;9(6):1990-1994.
- Dhutraj DN. Efficacy of fungicides and bioagents against powdery mildew of okra. Journal of Plant Diseases and Sciences. 2011;6(2):170-172.
- Jahagirdar S, Venkatesh H, Jamadar MM. Influence of antecedent weather variables on powdery mildew of grapes in Northern Karnataka. Paper presented at: National Seminar on Agrometeorological Research for Sustainable Agricultural Production; c2001 Sep. Anand, India.
- Kinney MC. A new system of grading plant diseases. Journal of Agricultural Research. 1923;26:195-218.
- Mayee CD, Datar VV. *Phytopathometry*. Technical Bulletin-1 (Special Bulletin-3). Marathwada Agricultural University, Parbhani, Maharashtra, India; c1986. p. 29.
- Naik KS, Nagaraja A. Chemical control of powdery mildew of okra. Agricultural Science Digest. 2003;23(4):305-306.
- Navale MD, Suryawanshi AP, Markad HN. In-vivo efficacy of fungicides against ridge gourd powdery mildew (*Erysiphe cichoracearum* DC.). The Pharma Innovation Journal. 2022;11(9):31-36.
- Rai M, Singh M, Pandey S, Pandey K, Singh J, Kumar S, Singh B. A decade of accomplishments. Indian Institute of Vegetable Research, Varanasi; c2008. p. 1-37.
- Bademiyya SI, Ashtapure S. Integrated management strategies in chilli powdery mildew. International Journal of Chemical Studies. 2020;8(4):899-902.
- Shivanna E, Arun Sataraddi, Janagoudar BS, Patil MB. Efficacy of fungicides for the management of powdery mildew, *Erysiphe cichoracearum*, of okra. Indian Journal of Plant Protection. 2006;34(1):85-88.
- Wahul SM, Jagtap GP, Rewale KA, Bhosale RP. *In-vitro* evaluation of various fungicides against *Erysiphe cichoracearum* in polyhouse. International Journal of Current Microbiology and Applied Sciences. 2018;7(10):1611-1617.
- Wahul SM, Jagtap GP, Rewale KA, Bhosale RP. Survey on powdery mildew of cucumber in Aurangabad and Jalna districts, India. International Journal of Current Microbiology and Applied Sciences. 2018;7(10):1618-1624.
- Yarwood CE, Sidky S, Cohen M, Santilli V. Temperature relations of powdery mildews. *Hilgardia*. 1978;22:603-622.