

Original Research Article

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Determination of the Effective Dose of Fungicide Mixtures against *Pseudoperonospora cubensis* causing Downy Mildew in Cucumber (*Cucumis sativus* L.)

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A B S T R A C T

Downy mildew is a common and serious disease in cucumber (*Cucumis sativus* L.), caused by the obligate fungus- *Pseudoperonospora cubensi*. The downy mildew disease causes abundant reduction in both quality and quantity of cucumber in countries around the world. In the present study, different doses of fungicide mixtures were used to determine the most effective dose for the management of the disease under the field conditions. The Experiment was conducted during the year of 2017-18 and 2018-19 at the University farm. The use of seven fungicide mixtures against the downy mildew pathogen were applied T1-T7 with T8 as control. The Average minimum Disease severity was found in 1st year T3 (2.221) and T2 (2.246) followed by T6 (2.982), T1 (3.709), T5 (3.773), T4 (4.499) and T7 (4.931). The average maximum disease severity was found in T8 (7.888). Similarly, the Average minimum disease severity was found in 2nd year T3 (2.184) and T2 (2.301) followed by T6 (3.079), T1 (3.684), T5 (3.824), T4 (4.628) and T7 (5.014). The maximum disease severity average was found in T8 (8.091). Thus, our studies concluded that these fungicide mixtures were effective in lowering the disease severity under the field conditions if used with recommendations.

Keywords

Cucumber, Downy
mildew,
Peronosporomycetes,
Dimethomorph

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Introduction

Cucumber (*Cucumis sativus* L.) is from Asiatic origin (De Candolle 1883). China is the world leader in cucumber production, accounting for approximately 62 per cent of the total production, followed by Turkey,

Iran, Russian Federation and USA (Anonymous 2010). In India, a number of major and minor cucurbits are cultivated, which share about 5.6 per cent of the total vegetable production (Rai *et al.*, 2008). Downy mildew of cucumber was first recorded Berkeley and Curtis in 1868. It is a

common threatening disease in cucumber (*Cucumis sativus* L.), caused by the fungus *Pseudoperonospora cubensis* (Palti and Cohen, 1980). The downy mildew pathogen is very severe and aggressive when favorable environment such as fog and rains, which may lead to kill the whole plant (Motes and Cuperus, 1995). The downy mildew disease causes abundant reduction in both quality and quantity of cucumber in countries across the world. Different pathogens and rates of infection are dependent on many factors, including wind patterns, temperature, humidity, varietal resistance, and plant health etc. Downy mildew, caused by *Pseudoperonospora cubensis*, is an important disease of all these crops, especially in areas with high humidity and rainfall. In most years the disease is an annual, late-season problem on cucumber. Since, it is impossible to control plant pathogens using cultural, mechanical, crop rotation practices, thus for quick and effective control of plant diseases we use chemicals.

Materials and Methods

A local cucumber variety “seven star” was grown during Rabi, 2017-18 and 2018-19 and the experimental was laid out in Randomized Block Design (RBD) with eight Treatment and three replications, row to row distance 60 cm and area of each sub plot 3×4 Sq mt at the University instructional farm, Jaguli, BCKV. The sprays were given on 51, 65, 83 DAS. The disease severity data was recorded pre and post sprays of fungicide in different doses with eight treatments and three replications

for the bioefficacy studies with a spacing of 60x40 cm² and six treatments for the phytotoxicity studies in ascertaining the impact on downy mildew disease. All the agronomical practices were followed as per the standard package of practices recommendations. Assessment of the disease severity was done by scoring methods as given below and expressed as Per cent Disease Index (PDI) (Table 1).

Methodology

All the eight treatments were applied into three replications at the appearance of disease symptoms with three sprayings starting before the appearance of the disease symptom. All the agronomical practices were followed as and when required. Sprays were done by using knapsack sprayer with hollow cone nozzle with spray volume of 750 L/ha. The first spray was given after the onset of the disease and thereafter three sprays were given at 15 days interval and the severity of the disease was recorded before every spray and at 7 days after 1st, 2nd and 3rd spray on randomly selecting 30 plants per plot, following 0-9 scale (Table 2). Downy mildew resistance was evaluated as necrosis, chlorosis, sporulation, and stunting. Ratings were done on a 0 to 9 scale as described by Jenkins and Wehner (1983), with 0 indicating no damage, and 9 indicating that the plant was dead.

Percent disease Index was calculated using the following formula:

$$\text{PDI} = \frac{\text{Sum of all disease Ratings}}{\text{Total no of leaves/bunches assessed}} \times \frac{100}{\text{X Maximum Disease grade}}$$

Phytotoxic studies of fungicidal mixtures on tomato

For phytotoxicity effects of different fungicidal mixtures at the recommended doses of @1500, 2000, 2500 and 3000 with along with the standard check treatments. All the field experimental conditions were kept constant. The phytotoxicity observations were measured on leaf injury, wilting, vein clearing, necrosis, epinasty & hyponasty were recorded on ten randomly selected plants before spray, 3, 7 and 15 days after 1st spray. The level of phytotoxicity was estimated by visual assessment on below mentioned scale of 0-10.

Results and Discussion

The application of different fungicidal dose sprays reduced downy mildew disease severity in cucumber. During the 1st year, the Average minimum disease severity was found in T3 (2.221) and T2 (2.246) followed by T6 (2.982), T1 (3.709), T5 (3.773), T4 (4.499) and T7 (4.931) and the maximum disease severity average was found in T8 (7.888). Among these fungicide T3 (Metiram44% + Dimethomorph 9% WG) is most effected

fungicide against downy mildew pathogen of cucumber, Han-cheng *et al.*, (2009) reported that Dimethomorph is a fungicide with highly activity against peronosporomycetes plant pathogens. The percent of fungicide dose reduce disease gradually increased as like T2 (Metiram44% + Dimethomorph 9% WG). Proper dose of fungicide is the main strategy for management. A similar pattern in downy mildew disease severity was observed during the 2nd year trial, the Average minimum Disease severity was found in T3 (2.184) and T2 (2.301) followed by T6 (3.079), T1 (3.684), T5 (3.824), T4 (4.628) and T7 (5.041). The maximum disease severity average was found in T8 (8.091). (Fig 1)

Among these fungicide T3 (Metiram44% + Dimethomorph 9% WG) is most effective fungicide against downy mildew pathogen of cucumber, Han-cheng *et al.*, (2009) reported that Dimethomorph is a fungicide with high activity against peronosporomycetes plant pathogens. The percent of fungicide dose reduce disease gradually increased as like T2 (Metiram44% + Dimethomorph 9% WG). Proper dose of fungicide is the main strategy for management.

Table.1 Applied fungicidal mixtures with treatment details

Treatment	Chemical composition	Formation (gm/ha)	Water Volume(L/ha)
T1	Metiram44% + Dimethomorph 9% WG	1500	500 Lit
T2	Metiram44% + Dimethomorph 9% WG	2000	500
T3	Metiram44% + Dimethomorph 9% WG	2500	500
T4	Metiram 70% WG	2500	750
T5	Dimethomorph 70% WP	500	750
T6	Cymoxanil 8 % + Mancozeb 64% WP	1500	500-600
T7	Metiram44% + Dimethomorph 9% WG	5000	500
T8	Control		

Table.2 Subjective rating scale for field assessment of downy mildew in cucumber

Subjective Rating Scale	Description of symptoms* for sporulation	Leaf necrosis and chlorosis and Plant stunting
0	No Symptoms	No Symptoms
1	1-8 % sporulation	Trace
2	8-14 % sporulation	Trace
3	14-25% sporulation	Slight
4	25-40% sporulation	Slight
5	40-60% sporulation	Moderate
6	60-75% sporulation	Moderate
7	75-87% sporulation	Severe
8	87-100% sporulation	Severe
9	Plant Disease	Plant dead

*Sporulation was rated on underside of foliage and was approximate area of leaf covered

Table.3 Scale for phytotoxicity

Score	Phytotoxicity (%)
0	No phytotoxicity
1	1-10
2	11-20
3	21-30
4	31-40
5	41-50
6	51-60
7	61-70
8	71-80
9	81-90
10	91-100

Fig.1 The PDI in different treatments with fungicide mixture during the year 2017-18 and 2018-19

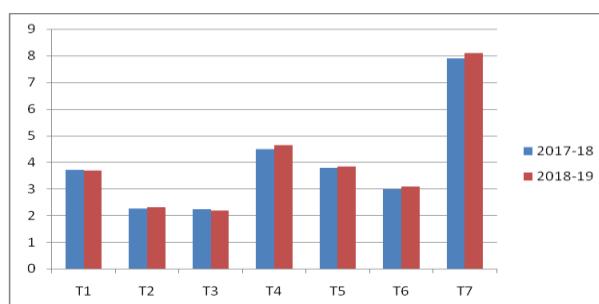
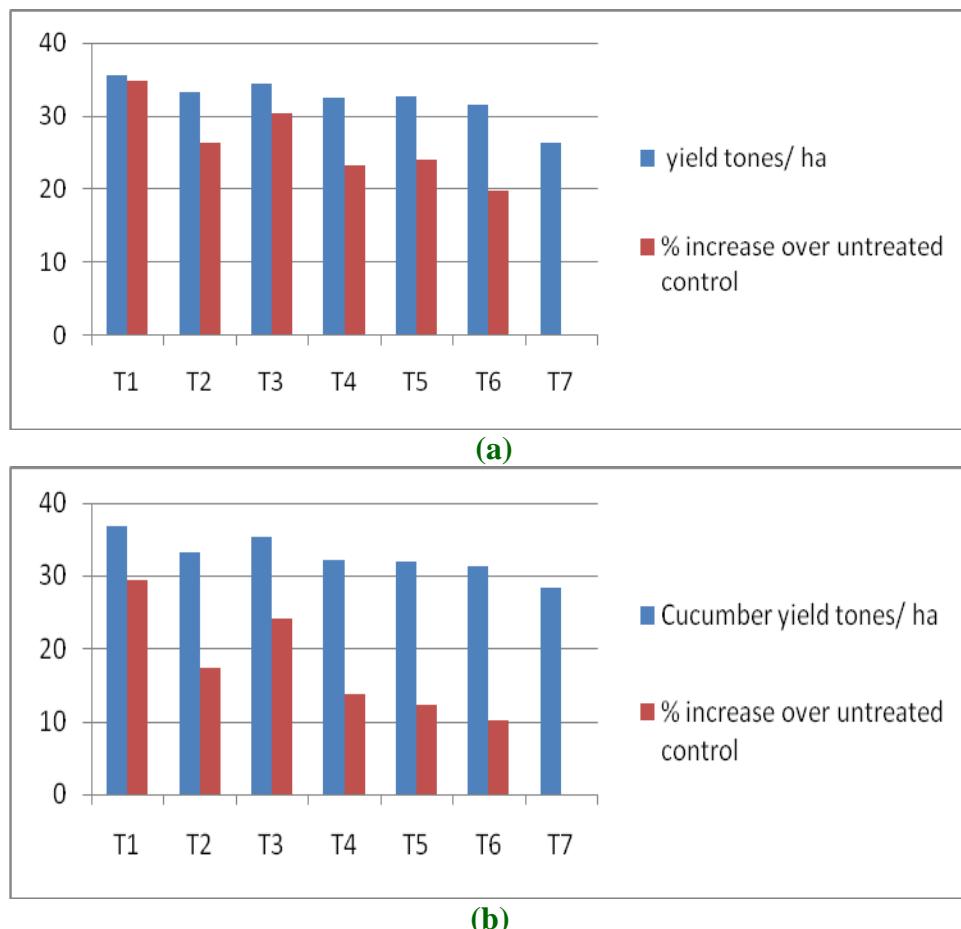


Fig 2: Observations on effect of yield in various fungicide mixture treatments during the year 2017-18 and 2018-19, (a) & (b) respectively



Effect on the yield

All the fungicidal treatments showed a positive impact on the increase in the fruit yield. During the 1st year, maximum fruit yield of 35.56 tonnes/ha was recorded in Metiram 44%+ Dimethomorph 9% WG @ 1500g/ha. which was followed by its higher dose of 2500g/ha (34.38 tonnes/ha) as compared to the control (26.38 tonnes/ha) (Fig. 2). Similarly, during the 2nd year, Maximum fruit yield of 36.75 tonnes/ha was recorded in Metiram 44%+ Dimethomorph 9% WG @ 1500g/ha which was followed by its higher dose of 2500g/ha (35.25 tonnes/ha) as compared to control (28.36).

Phytotoxicity studies

For the phytotoxicity studies, various parameter, viz., leaf injury, wilting, Vein clearing, necrosis, hyponasty and epinasty was studied with three doses of Metiram44% + Dimethomorph 9% WG @ 2500 and 5000 g a.i./ha, with Control treatment during the experiments conducted in respective years. No phytotoxicity was observed in all the treatments (Table 3).

Summary and conclusions are as follows:

The results of the trial confirmed that spraying of the fungicide mixtures Metiram44% + Dimethomorph 9% WG @

2500 gave significantly superior control of downy mildew of cucumber with comparison to other treatments with increased fruit yield. Hence, it may be recommended for the management of downy mildew of Cucumber.

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