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Verification of Effective Fungicides for the Control of Basil (*Ocimum basilicum*) Downy Mildew in Field Condition

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ABSTRACT

Sweet basil (Ocimum basilicum) is seriously infected by downy mildew which is caused by Peronospora belbahrii and affects the leaves, branches, and stems of basil. It is a widespread and serious disease of both greenhouse and field grown basil and can lead to 100 percent crop loss. The present study was undertaken to verify effective fungicides for the control of basil downy mildew. A total of six treatments with the untreated control were investigated in field conditions. The experiment was arranged in randomized complete block design with three replications. Fungicides were sprayed after disease occurrence at 7 days interval for four rounds. Data was recorded on disease severity, disease control, plant height and essential oil content. Among the fungicide treatments, Matco (DC=78.1%), DORAOSL (DC=70.3%) and Fengozeb (DC=69.97%) were effective fungicides against basil downy mildew in field condition.

Key words: *Ocimum basilicum; Fungicides; Basil downy mildew; Disease control*

Introduction

Sweet basil (*Ocimum basilicum*) is a sun-loving annual aromatic Species and medicinal plant belongs to the family Lamiaceae. The name basil is derived from Greek word, basileus which means “king”, because of the royal fragrance of this herb [1].

Basil is herbaceous species, native to warm regions of Asia, Africa and India, but it is grown commercially all over the Mediterranean region and in California. According to Kumar, basil was taken from India to Europe through the Middle East in the sixteenth century, and subsequently to America in the seventeenth century [2]. The main centers of diversity of this genus are Africa, South America (Brazil) and Asia. It grows mainly in France, Italy, Bulgaria, Hungary, South America, Comoros Islands, Thailand, India, Haiti and Guatemala.

Basil is used as fragrance ingredients in perfumes, hairdressings, dental cream and mouth washes. The leaves can be used in fresh or dried as spice. Essential oils extracted from fresh leaves and flowers can be used as aroma additives in food, pharmaceuticals and cosmetics [3]. Essential oil of basil has antibacterial, insecticidal and medicinal properties [4]. Traditionally, sweet basil has been used as a medicinal plant in the treatment of headaches, coughs, diarrhea, constipation, warts, worms and kidney malfunction [5].

A herb and a source of essential oils extracted by steam distillation from the leaves and the flowering tops which are used to flavor foods, in dental and oral products, and in fragrances. In addition to its culinary use basil is also used in perfumes, soaps, shampoos and dental preparation.

Downy mildew of basil, caused by Peronospora belbahrii, is a widespread and serious disease of both greenhouse and field grown basil. It is spread by wind, seed and infected plant material [6]. Unlike many other downy mildews, this one is active not only under cool conditions, but also warmer conditions in late spring and summer [7]. Basil downy mildew is caused by Peronospora belbahrii and can lead to 100 percent crop loss [8]. Based on previous study results downy mildew has been found the abundant disease of sweet basil at Wondo Genet Agricultural Research Center, Ethiopia.

Symptoms of basil downy mildew can mimic nutrient deficiency. Affected plants may show chlorosis (yellowing) on lower leaves, which is common in plants with nitrogen deficiency. Chlorosis caused by nutrient deficiency is not vein-bound, but chlorosis caused by downy mildew is. This is especially true when the plant disease is more advanced. In very humid conditions, the yellowed areas can quickly become necrotic.

Downy mildew is a widespread and serious disease of both greenhouse and field grown basil. It is spread by wind, seed and infected plant material. Unlike many other downy mildews, this one is active not only under cool conditions, but also warmer conditions in late spring and summer. The pathogen is Peronospora belbahrii, which is host specific to basil.

Objective

To verify effective fungicide for the control of downy mildew on Basil (*Ocimum basilicum*).

Materials and Methods

Description of the Study Area

The experiment was conducted at Wondo Genet Agricultural Research Center experimental field. The site is located at 7° 192′ N latitude and 38° 382′ E longitudes with an altitude of 1780 m above sea level. The site receives a mean annual rainfall of 1000 mm with minimum and maximum temperatures of 10°C and 30°C, respectively. The soil textural class is clay loam with an average pH of 7.2.

A plot size of 3m × 3m with 40 cm × 60 cm spacing between plants and rows will be used, respectively. Spacing between plots and blocks will be 1.5 m and 2 m, respectively to minimize the spread of the disease by wind. Healthy planting materials will be planted.

Experimental Design and Treatment Application

The experiment was laid out in randomized complete block design (RCBD) with three replications. A total of six (5 chemicals) treatments were used, namely Sabozeb 80% WP, Dorao SL, Matco, Infinito SC 687.5, Fengozeb and untreated control. The fungicides were sprayed at the recommended rate (Table 1).

Data to be Collected

Disease intensities were taken after 4 weeks of fungicides application using a 1-4 rating scale, where 1= very little leaf damage, 2= little leaf damage, 3= medium leaf damage and 4= all leaf areas infected.

Percentage data on disease incidence and disease control were calculated using the following formula:

$$\text{Disease Intensity} = \frac{\text{Total number of leaves rated x maximum disease grade}}{\text{Sum of all numerical rating}} \times 100$$

PDC= DC-DT/DC, where PDC is Percent disease control, DC is disease control, DT is disease treated.

Other agronomic data such as plant height, essential oil content and essential oil yield were recorded.

Statistical Analysis

The collected data were analyzed using analysis of variance using SAS software version 9.3. Treatment means were separated using LSD at P= 0.05.

PDC= DC-DT/DC, where PDC is Percent disease control, DC is disease control, DT is disease treated.

Other agronomic data such as fresh leaf weight, dry weight and gel weight were recorded.

Table 1: Fungicides and recommended rate used in the study.

No.	Treatments trade name	Common ame	Rate
1	Sabozeb 80% WP	Mancozeb	-
2	Dorao SL	-	-
3	Matco	Metalaxyl 8% + mancozeb 64%WP	-
4	Infinito SC 687.5	Propamocarb hydrochloride 625g/l + fluopicolide 62.5 g/l	1.2 - 1.6 L/ha
5	Fungozeb 80 WP	Sancozeb	2-3kg/ha
6	Untreated control	-	-

Statistical Analysis

The collected data were analyzed using analysis of variance using SAS software version 9.2. Treatment means were separated using least significant difference (LSD at P= 0.05).

Result and Discussion

Pathological Observation

Disease incidence before fungicides application: Significantly different disease incidence were observed among the different treatments before fungicides application (Table 2). The downy mildew incidence was higher a week after week before fungicides application. The disease incidence increased from week to week before fungicide spray in each treatment plots.

Disease incidence and Disease control after fungicides application: The result revealed that all the fungicides significantly controlled the downy mildew disease as compared to the control plot (Table 3). Minimum disease incidence was observed by the spraying of Matco (2.33%), Fengozeb (3.33%) and DORAO SL (3.33%). The highest disease incidence (11.3%) was observed on the control plot.

All the fungicides significantly controlled the disease as compared to the control plot. The highest disease control was recorded by Matco (78.1%) followed by DORAOSL (70.3%) and Fengozeb (69.97%).

Biometric Parameters

Plant height: Significantly different plant height was observed among the different treatments (Table 4). Plant height was higher on the treated plots than the untreated control plot. The average highest plant height was recorded on DORAO SL treated plot followed by Fengozeb treated plot.

Table 2: Downy mildew disease incidence before fungicide application on Basil plant.

No.	Treatments	Disease incidence before application	
		Week 1	Week 2
1	Sabozeb 80% WP	3.00 a	7.33 ab
2	Dorao SL	2.60 ab	9.00 b
3	Matco	2.93 ab	8.00 ab
4	Infinito SC 687.5	2.53 ab	7.66 ab
5	Fengozeb	2.80 ab	6.66 c
6	Untreated control	2.33 b	10.66 a
	LSD (0.05)	0.62	5.39
	CV %	12.75	36.05

Table 3: Efficacy of fungicides on disease control of downy mildew after application.

No.	Treatments	DI	DC
1	Sabozeb 80% WP	6.00 b	46.27 b
2	DORAO SL	3.33 b	70.33 ab
3	Matco	**2.33 b**	**78.10 a**
4	INFINITO SC 687.5	6.00 b	48.50 b
5	Fengozeb	3.33 b	69.97 ab
6	Untreated control	**11.33 a**	**0.00 c**
	LSD (0.05)	4.09	24.55
	CV (%)	41.72	25.85

Table 4: Efficacy of different fungicides on biometric parameters of Basil plant.

No.	Treatments	PH	EOC
1	Sabozeb 80% WP	0.53 a	1.29 a
2	DORAO SL	**0.57 a**	1.17 ab
3	Matco	0.53 a	**1.21 a**
4	INFINITO SC 687.5	0.51 ab	0.79 b
5	Fengozeb	0.54 a	0.91 ab
6	Untreated control	0.32 b	1.14 ab
	CV (%)	22.92	20.92
	LSD (0.05)	0.21	0.41

Essential oil content: Essential oil content was higher in Sabozeb 80% WP, Matco and DORAO SL treated plots than the other treatments. However, lower essential oil content was recorded on INFINITO SC 687.5 and Fengozeb treated plots than the untreated control. This is may be the effectiveness of this fungicides are as equal as the untreated control plot.

Discussion

The major purpose of the present study was to verify effective fungicides for the control of basil downy mildew disease.

In our study, five fungicides such as Sabozeb 80% WP, DORAO SL, Matco, INFINITO SC 687.5, and Fengozeb were applied with recommended dose in field condition. According to the result the highest disease control was recorded by Matco (DC=78.1%) followed by DORAOSL (DC=70.3%) and Fengozeb (DC=69.97%). Minimum disease incidence was recorded by applying Matco (2.33%), DORAOSL (3.33) and Fengozeb (3.33) compared with control (11.33%). Plots treated with DORAO SL observed more plant height while Sabozeb 80% WP and Matco recorded more essential oil content as compared to control and other fungicides.

Wyenandt CA reported that the best control of 98% was achieved with preventive fungicide application, before symptoms occurred, on a weekly schedule [9]. Mefenoxam (metalaxyl-M) plus copper has been the most widely used and effective product against P. belbahrii, since its registration on basil in Italy in 2004 [10].

Basil downy mildew can develop systematic infection in young basil plants. Systematically infected plants remained stunted and produce no seed. Seed treatments and at seedling fungicides may have the potential for the good start of basil production [9,11]. Mefenoxam can be applied at seedling into the soil in field growing basil [9].

As the systemic fungicides are prone to the resistance development, ingredients with different modes of action are needed [12]. The cultivation of resistant sweet basil cultivars also can be efficient control strategy.

Conclusion

The present study illustrated that the tested fungicides were effective for managing downy mildew disease on basil plant. Among the tested fungicide treatments, Matco (78.1%), DORAOSL (70.3%) and Fengozeb (69.97%) significantly controlled the downy mildew disease on basil plant compared to the untreated control. The rest two fungicides were not effective due to certain fungicides can only protect plants from basil downy mildew.

Therefore, Matco and DORAOSL are effective for the management of basil downy mildew disease and have the potential to be a vital component of integrated pest management for downy mildew diseases of basil plant. Chemical pesticides should be used as the last alternative options than the other control methods. Thus, further study should test the promising effective fungicides as one component of integrated pest management and provide effective and safer basil downy mildew management.

Recommendations

Downy mildew disease resistant basil varieties should be used. Cultural control methods such as use of drip irrigation, increase row width, remove diseased plants by monitoring seedlings and transplants. Fungicide sprays should begin before infection occurs in order to be effective.

Extreme periods of rainy, wet weather should be taken into consideration which may result in no control of fungicide combination. It should be applied at label recommended intervals and every 7 days for effective disease reduction.

Declarations

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Conflict of Interests

The authors have not declared any conflict of interest.

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