

Original Research Article

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Management of Prevalent Diseases of Cucumber (*Cucumis sativus*) through Integrated Approach

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ABSTRACT

Keywords

Cucumber, Downy mildew, Damping-off, Fosetyl-Al, Trifloxystrobin, mancozeb, Mulch.

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A wide range of pathogens (fungi, bacteria, and viruses) affect the productivity of cucumber crop, which renders its production uneconomical. Therefore, an integrated approach was developed for the management of prevalent diseases of cucumber like damping-off and downy mildew using strategies such as growing border crop, use of reflective mulches, soil application and spray of fungicides and insecticides. The results of the experiments showed that treatment comprising raising of two rows of maize as border crop in the main field 15 days before cucumber seed sowing along with sliver agrimulch sheet, seed treatment with Carbendazim 12% + Mancozeb 63% WP @ 3g/kg and drenching of Captan 70% + Hexaconazole 5% WP @ 0.1 % 15 days after germination followed by sequential spraying of Tebuconazole 50% + Trifloxystrobin 25% WP @ 1g/L, Imidacloprid 17.8SL @ 7.5ml/15L + Neemoil 0.2 %, Fosetyl-Al @ 0.1 %, Tebuconazole 50% + Trifloxystrobin 25% @ 1g/L, Imidacloprid 17.8SL @ 7.5ml/15L + Neemoil 0.2 % and Fosetyl-Al @ 0.1 % at 10 days interval till fruit formation was found significantly superior over all other treatment in terms of per cent incidence of damping-off (2.67%), downy mildew PDI (6.51) and fruit yield (126.80 q/ha) with better cost-benefit ratio (1:1.71). This integrated approach is safe and ecologically sound and seems to be a healthy tactic for disease management.

Introduction

Cucumber (*Cucumis sativus*) is a widely cultivated plant in the gourd family, Cucurbitaceae. It is one of the most important cucurbitaceous crops cultivated throughout the world and in India due to its anti-oxidant and anti-inflammatory properties. Cucumber is commonly attacked by a wide range of diseases. Among those reported as causing substantial losses are powdery mildew,

downy mildew, anthracnose, fusarium wilt, soil borne diseases and viral diseases such as mosaic, bud necrosis, leaf curl and leaf distortion virus.

Cucumber is more susceptible to downy mildew than other cucurbits (Ojiambo *et al.*, 2010). Downy mildew of cucumber caused by the oomycetes *Pseudoperonospora cubensis* (Berk & Curt.) Rostov is one of the most economically important and widespread plant

pathogens in India and all over the world (Paltian and Cohen, 1980; Lehmann, 1991; Tsai *et al.*, 1992; Lebeda and Cohen, 2011). Downy mildew of cucumber causes serious losses under favourable environmental conditions. In many regions with high humidity, the disease is the main limiting factor for cucumber production (Shetty and Wehner, 1997). Characteristic symptoms are angular, chlorotic lesions on the foliage. These lesions appear angular because they are bound by leaf veins. During humid conditions, the underside of the leaf reveals grey-brown to purplish-black 'down'. Eventually, leaves turn necrotic and curl upwards (Miriam *et al.*, 2004; Chand *et al.*, 2014).

Powdery mildew of cucumber is caused by the fungi *Erysiphe cichoracearum* DC and *Sphaerotheca fuliginea* (Schlecht. ex Fr.) Poll. Typical symptoms include white powdery growth on the upper surfaces of leaves and the stems of infected plants. Infected areas are often stunted and distorted and may drop prematurely from the plant. Fruits are usually not directly affected, but their size and growth may be stunted (Singhand Sahore, 2002; Morsy *et al.*, 2009; Chand *et al.*, 2014).

Several fungi or fungus-like microorganisms including *Pythium* sp., *Fusarium* sp., and *Rhizoctonia* sp., which live in soil and attack seedlings of cucumber. Seedlings are attacked before or after emergence, resulting in gaps and uneven stands. Young plants suddenly wilt and topple over. Water-soaked lesions are apparent on stems at the soil line for only a short time before the seedling dies. Chemical seed treatments still represent a major practice in agriculture to manage damping-off diseases (Babadoost and Islam, 2003; Dorrance *et al.*, 2009; Lamichhane *et al.*, 2017).

Several common viruses can affect cucumber, including *Cucumber mosaic virus*, *Pumpkin*

mosaic virus and *Watermelon mosaic virus*. Infected plants may be stunted or have leaves that are mottled, crinkled, or a light green colour. Fruits may be irregular in shape, mottled or warty. Various insects transmit these viruses (Zitikaite, 2002; Chand *et al.*, 2014).

Many plant pathogens survive in the soil and can survive during off season in soil debris. Mulch such as polythene mulch will help prevent both soils from splashing onto plants and fruit from touching the bare ground. Cucumber benefits from a mulch layer to help prevent diseases such as damping-off and downy mildew (Reuveni and Raviv, 1997).

There is a great need to carry out farmer level research pointing to develop a holistic disease management approach to manage the major diseases of cucumber. The present studies were therefore undertaken to develop effective and eco-friendly management practices such as growing border crop, use of polythene mulch, soil application as well as spray of fungicides and insecticides against prevalent diseases of cucumber.

Materials and Methods

The experiment was conducted at All India Coordinated Research Project (Vegetable Crops), Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India during the year 2017-18 in *Kharif* seasons using cucumber cv. Pune Khira for the management of prevalent diseases of cucumber. The soil of the experimental field was black cotton soil. The experiment was laid out in a randomized block design with three replications consisting of seven treatment combinations as shown below. Seeds were sown in the plots of 5x2.5 m in size following pit sowing with a distance of 100x50 cm spacing. All recommended agronomic cultural practices were followed.

The per cent disease incidence of damping-off was calculated using following formula.

$$\text{Disease incidence (\%)} = \frac{\text{Number of diseased plants}}{\text{Total number of plants observed}} \times 100$$

The downy mildew disease was quantified using disease grading 0-9 scale (Yangn *et al.*, 2007) where, 0 = Healthy Leaf, 1 = 1%- 5%, 3 = 6%- 10%, 5 = 11%- 25%, 7 = 26%-55%, and 9 = 56% -100% of infected leaf. The percent disease index (PDI) was calculated as given below (Wheeler, 1969).

$$\text{PDI} = \frac{\text{Sum of all numerical ratings}}{\text{Total No of samples} \times \text{Maximum rating scale}} \times 100$$

For this purpose, five plants were selected randomly from each plot and observations were taken from downy mildew infected leaves and statistically analysed. Plot wise cucumber fruit yield (recorded at each picking) were cumulated and converted into quintal/hectare and statistically analysed.

Results and Discussion

Reduction in disease incidence

Data presented in Table 1 revealed that significantly lowest damping-off incidence was recorded in treatment T5 (raising of two rows of maize as border crop in the main field 15 days before cucumber seed sowing along with sliver agrimulch sheet; seed treatment with Carbendazim 12% + Mancozeb 63 % WP @ 3g/kg and drenching of Captan 70% + Hexaconazole 5% WP @ 0.1 % 15 days after germination followed by sequential spraying of Tebuconazole 50% + Trifloxystrobin 25% WP @ 1g/l, Imidacloprid 17.8SL @ 7.5ml/15L + Neemoil 0.2 %, Fosetyl-Al@0.1 %, Tebuconazole 50% + Trifloxystrobin 25% @ 1g/l, Imidacloprid 17.8SL @ 7.5ml/15L+ Neemoil 0.2 % and Fosetyl-Al @ 0.1 %) (2.67 %) followed by treatment T4 (7.43 %).

This was followed by treatment T3 (12.33 %) and T6 (12.41 %) were at par with each other. Treatment T1 (17.31 %) and T2 (17.90 %) were also at par with each other. However, the highest incidence of damping-off (22.01 %) was recorded in control.

Significantly lowest PDI of downy mildew was recorded in treatment T5 (raising of two rows of maize as border crop in the main field 15 days before cucumber seed sowing along with sliver agrimulch sheet; seed treatment with Carbendazim 12% + Mancozeb 63% WP @3g/kg and drenching of Captan 70% + Hexaconazole 5% WP@0.1 % 15 days after germination followed by sequential spraying of Tebuconazole 50% + Trifloxystrobin 25% WP @ 1g/l, Imidacloprid 17.8SL @7.5ml/15L + Neemoil 0.2 %, Fosetyl-Al @ 0.1 %, Tebuconazole 50% + Trifloxystrobin 25% @ 1g/l, Imidacloprid 17.8SL @ 7.5ml/15L + Neemoil 0.2 % and Fosetyl-Al @ 0.1 %) (6.51) followed by treatment T4 (13.11) and T3 (16.91) which were at par with each other. However, the highest PDI of downy mildew (36.00) was recorded in control.

Yield and economics

Data presented in Table 1 revealed that among all the treatments T5 (raising of two rows of maize as border crop in the main field 15 days before cucumber seed sowing along with sliver agrimulch sheet; seed treatment with Carbendazim 12% + Mancozeb 63% WP @ 3g/kg and drenching of Captan 70% + Hexaconazole 5% WP @ 0.1 % 15 days after germination followed by sequential spraying of Tebuconazole 50% + Trifloxystrobin 25% WP @ 1g/l, Imidacloprid 17.8SL @ 7.5ml/15L + Neemoil 0.2 %, Fosetyl-Al @ 0.1 %, Tebuconazole 50% + Trifloxystrobin 25% @ 1g/l, Imidacloprid 17.8SL @ 7.5ml/15L + Neemoil 0.2% and Fosetyl-Al @ 0.1%) recorded the highest fruit yield of

126.80 q/ha which was statistically significant overall other treatments. This was followed by T4 (105.52 q/ha) and T3 (104.80 q/ha) whereas Control recorded the lowest fruit yield (54.80 q/ha).

The data presented in Table 2 showed that the highest cost-benefit ratio (1:1.71) was achieved with the treatment T5 (raising of two rows of maize as border crop in the main field 15 days before cucumber seed sowing along with sliver agrimulch sheet; seed treatment with Carbendazim 12% + Mancozeb 63% WP

@ 3g/kg and drenching of Captan70% + Hexaconazole 5% WP @ 0.1% 15 days after germination followed by sequential spraying of Tebuconazole 50% + Trifloxystrobin 25% WP @ 1g/l, Imidacloprid 17.8SL @ 7.5ml/15L + Neemoil 0.2 %, Fosetyl-Al @ 0.1 %, Tebuconazole 50% + Trifloxystrobin 25% @ 1g/l, Imidacloprid 17.8SL @ 7.5ml/15L + Neemoil 0.2 % and Fosetyl-Al @ 0.1 %). This was followed by treatment T3 (1:1.63), T4 (1:1.47), T1 (1:1.40), T2 (1:1.36) and T6 (1: 1.34).

Details of various treatments used for the integrated management of diseases

Details of treatment	
T0	Common to all treatments: Growing of two rows of maize as border crops and use of agrisilver mulch sheet.
T1	Seed treatment with Seed Pro @ 25 g/kg and soil drenching of Seed Pro @ 5% at 1 st true leaf stage after germination followed by 5 spray of Seed Pro (1%) at 10 day interval in rotation with Neem oil (0.2%) alternatively after 15 days after drenching.
T2	Seed treatment with Carbendazim 12% + Mancozeb 63% @ 3g/kg and drenching of Captan 70 % + Hexaconazole 5% WP @ 0.1% at 1 st true leaf stage after germination followed by 5-6 spraying of Seed Pro (1%) at 10 day interval in rotation with Neem oil (0.2%) alternatively after 15 days after drenching.
T3	T0 + Seed treatment with Seed Pro @ 25 g/kg and soil drenching of Seed Pro @ 5% 1 st true leaf stage after germination followed by spraying of Captan 70 % + Hexaconazole 5% WP @ 0.1% followed by spraying of (Imidacloprid 17.8SL @ 7.5ml/15L + Neemoil 0.2%) followed by Fosetyl-Al @ 0.1% followed by Captan 70 % + Hexaconazole 5% WP @ 0.1% followed by spraying of Imidacloprid 17.8 SL @ 7.5 ml/15 L + Neemoil 0.2% followed by Fosetyl-Al @ 0.1% at 10 days interval.
T4	Seed treatment with Seed Pro @ 25 g/kg and soil drenching of Seed Pro @ 5% at 1 st true leaf stage after germination followed by spray of (Imidacloprid 17.8 SL @ 7.5 ml/ 15 L + Neem oil 0.2%) followed by spray of Tebuconazole 50% + Trifloxystrobin 25% @ 1g/l followed by Fosetyl-Al @ 0.1%, followed by spray of Tebuconazole 50% + Trifloxystrobin 25% @ 1g/l followed by spray of (Imidacloprid 17.8 SL @ 7.5 ml/15 L + Neem oil 0.2%) followed by Fosetyl-Al @ 0.1% at 10 days interval.
T5	Seed treatment with Carbendazim 12% + Mancozeb 63% @ 3 g/kg and drenching of Captan 70 % + Hexaconazole 5% WP @ 0.1% 15 days after germination followed by spraying of Tebuconazole 50% + Trifloxystrobin 25% @ 1g/l + spray with (Imidacloprid 17.8 SL @ 7.5 ml/15 L + Neem oil 0.2%) followed by Fosetyl-Al @ 0.1% followed by spraying of Tebuconazole 50% + Trifloxystrobin 25% @ 1g/l + spray with (Imidacloprid 17.8 SL @ 7.5 ml/15 L + Neem oil 0.2%) followed by Fosetyl-Al @ 0.1% at 10 days interval.
T6	Seed treatment with Carbendazim 12% + Mancozeb 63% @ 3 g/kg and drenching of Captan 70 % + Hexaconazole 5% WP @ 0.1% 15 days after germination followed by spray with (Imidacloprid 17.8 SL @ 7.5 ml/ 15 L + Neem oil 0.2%) %) followed by spraying of Captan 70 % + Hexaconazole 5% WP @ 0.1% followed by Fosetyl- Al @ 0.1 % followed by spraying of Captan 70 % + Hexaconazole 5% WP @ 0.1% + spray with (Imidacloprid 17.8 SL @ 7.5 ml/15 L + Neem oil 0.2%) %) followed by Fosetyl- Al @ 0.1% at 30 days after drenching
T7	Control

Table.1 Effect of integrated management treatment on the incidence of diseases and fruit yield (q/ha)

Treatments	Incidence of diseases		Yield (q/ha)
	Damping-off (%)	Downy mildew (PDI)	
T1	17.31 (24.57)*	27.30 (31.48)	82.56
T2	17.90 (25.01)	28.03 (31.94)	81.20
T3	12.33 (20.56)	16.91 (24.25)	104.80
T4	7.43 (15.80)	13.11 (21.19)	105.52
T5	2.67 (9.11)	6.51 (14.61)	126.80
T6	12.41 (20.60)	20.64 (27.02)	83.76
T7	22.01 (27.97)	36.00 (36.84)	54.80
SEm ±	0.93	1.22	5.28
CD at 5%	2.86	3.81	16.48
* Figures in parenthesis are angular transformations			

Table.2 Cost-benefit ratio as affected by integrated management treatments

Treatments	Total cost of treatment (Rs./ha)	Yield (q/ha)	Cost of production (Rs/ha)	Gross Income (Rs/ha)	Net profit (Rs./ha)	Cost Benefit Ratio
T1	3493	82.56	59351	83200	23849	1:1.40
T2	4447	81.20	60215	81910	21695	1:1.36
T3	7053	104.80	64451	105210	40759	1:1.63
T4	14916	105.52	72404	106490	34086	1:1.47
T5	15879	126.80	74853	127720	52867	1:1.71
T6	7732	83.76	63722	85090	21368	1:1.34
T7	-	54.80	54370	58080	3710	1:1.07

The present study is confirmatory with the result of (Kumar *et al.*, 2018; Bagri *et al.*, 2019) who reported that cucumber seed treatment with Carbendazim 12% + Mancozeb 63% @ 3 g/kg and drenching of Captan 70 % + Hexaconazole 5% WP @ 0.1% 15 days after germination followed by spraying of Tebuconazole 50% + Trifloxystrobin 25% @ 1g/l + spray with

Imidacloprid 17.8 SL @ 7.5 ml/15 L + Neem oil 0.2% followed by Fosetyl-Al @ 0.1% followed by spraying of Tebuconazole 50% + Trifloxystrobin 25% @ 1g/l + spray with Imidacloprid 17.8 SL @ 7.5 ml/15 L + Neem oil 0.2% followed by Fosetyl-Al @ 0.1% was effective against diseases of cucumber. Neem oil derived from *Azadirachta indica* controls downy mildew disease of cucurbits (Meister,

1999; Utobo *et al.*, 2015). Many workers also reported that above fungicide were effective against downy mildew of cucumber (Kagadi *et al.*, 2002; Gupta and Thind, 2006; Chaudhry *et al.*, 2009; Ojiambo *et al.*, 2010; Ghosh *et al.*, 2014; Shankar *et al.*, 2014; Ihsan *et al.*, 2015; Lebeda *et al.*, 2019).

In conclusion it may be concluded that, raising of two rows of maize as border crop in the main field 15 days before cucumber seed sowing along with sliver agrimulch sheet, seed treatment with Carbendazim 12% + Mancozeb 63% WP @ 3g/kg and drenching of Captan 70% + Hexaconazole 5% WP @ 0.1 % 15 days after germination followed by sequential spraying of Tebuconazole 50% + Trifloxystrobin 25% WP @ 1g/L, Imidacloprid 17.8SL @ 7.5ml/15L+ Neemoil0.2 %, Fosetyl-Al @ 0.1 %, Tebuconazole 50% + Trifloxystrobin25% @ 1g/L, Imidacloprid 17.8SL @ 7.5ml/15L + Neemoil 0.2 % and Fosetyl-Al @ 0.1 % at 10 days interval till fruit formation effectively manage damping-off and downy mildew of cucumber.

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