**Integrated Management Strategies for Prevalent Diseases of Cucumber (*Cucumis sativus* L.) under Odisha Condition**

**ABSTRACT**

**Aim:** To evaluate different integrated disease management modules against major diseases of cucumber (*Cucumis sativus* L.).

**Study design:** The experiment was laid out in a randomized complete block design (RBD) with 3 replications and 7 treatments including control.

**Place and duration of Study:** All India Coordinated Research Project on Vegetable Crops, Odisha University of Agriculture and Technology, Bhubaneswar during summe*r* season of three consecutive years of 2015-16, 2016-17 and 2017-18.”

**Methodology:** Included in this integrated approach are methods for controlling common cucumber diseases like downy mildew, cucumber mosaic virus and collar rot. These methods include growing border crops, using reflective mulches, applying soil amendments and spraying fungicides and insecticides.

**Results:** “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 Agri mulch sheet, Seed treatment with carbendazim 12% + mancozeb 63% @ 3g/kg and drenching of captan 70% + hexaconazole 5%WP @0.1% at 15 days after germination followed by by spraying of Imidacloprid 17.8 SL@7.5 ml/15 L+ Neem oil @ 0.2% followed by captan 70% + hexaconazole 5%WP @0.1% 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+ Neem oil @0.2% followed by Fosetyl Al @ 0.1% at 10 days interval was substantially reduced *per cent* incidence/intensity of different disease like collar rot (74.5%), downy mildew severity (69.2%) and mosaic incidence (65.2%) as compared to control.”

**Conclusion:** The results give light on how farmers, who are experiencing a lot of trouble this summer owing to the onslaught of several diseases on cucumber crops, might increase yields by using these technologies. In addition to achieving a maximum B:C ratio of 3.5, the treatment combination also achieved the greatest economic return (Rs. 1,58,668) and fruit production (107.2 q/ha). As far as disease control strategies go, this integrated strategy seems to be both safe and environmentally sound.

***Keywords:*** *Cucumber diseases, integrated management modues, yield estimation, B:C ratio calculation*

1. **INTRODUCTION**

The cucumber, scientifically known as Cucumis sativus L., is a widely cultivated commercial vegetable that is also popular in salads. It is a member of the Cucurbitaceae family. After cucumbers, cabbage and onions, it is ranked as Asia's fourth most significant vegetable crop (Primescholars, 2024). China, Cameroon, the Russian Federation and Turkey are major producers of cucumbers (Amin et al., 2018). Around the globe, people mostly grow three varieties of cucumbers: slicing, pickled and seedless. The summer is prime time for its cultivation because of the abundance of delicious, luscious fruit it produces. More than 90% of the fruit contains water (Loy, 1990; Maynard, 2001). Because of the cooling impact it has on the human body, it is also thought of as a medicinally significant fruit. People also use it on their faces and skin as a way to relax when they're physically tense. Some people also find that this fruit helps with jaundice and constipation. According to Bhagwat et al. (2018), the essential oil found in the seeds of this fruit promotes brain growth and overall body smoothness. Its low calorie content (16 calories per cup) and increased skin fiber content make it an effective weight reduction and rehydration aid (Shetty and Wehner, 2002; Bhagwat et al., 2018). Because of its many uses and several health advantages, it is often called versatile food (Ngouajio et al., 2006). Anonymous (2024) reports that 1,30,000 hectares (ha) of cucumbers are cultivated in India, with a total annual yield of 15,50,000 metric tons. The 117 genera and 825 species that make up this group are grown in regions with warmer climates (Nagamani et al., 2019). According to Munshi et al. (2017), the Indian government has approved the growing of over 112 open-pollinated cultivars of several cucurbits. This crop's limited yield potential and high production cost are caused by its sensitivity to several biotic and abiotic stressors. Foliar diseases such as Alternaria blight, powdery mildew, downy mildew and cucumber mosaic are the main culprits for the decline in cucumber production and quality. Hybrid cucumber cultivars have recently altered the pattern of productivity, cultivation techniques and production area in a dramatic way. Maximizing production requires an integrated strategy that includes genetic improvement, the use of contemporary technology in farming methods and the control of various biotic stressors. The primary objective of our research was to enhance crop yields by mitigating common cucumber diseases such as downy mildew, cucumber mosaic virus and collar rot through the implementation of integrated disease management strategies. These strategies include border crop cultivation, reflective mulch application, soil application and insecticide and fungicide spraying.

1. **MATERIALS AND METHODS**

**2.1 Experimental Site and plants growing**

Under the auspices of the All India Coordinated Research Project on Vegetable Crops, an experiment was carried out in the summer of 2015–16, 2016–17 and 2017–18 at Central Research Station OUAT, Bhubaneswar (East and SE Coastal Plain Zone, 20015’N latitude and 85052’ E longitude) using a randomized block design with four replications. After thorough preparation, cucumber seeds of the Kumuda type were scattered evenly in 100 x 50 cm-spaced pits in 5.0 × 2.5 m plots. In the primary field, which had two rows of maize planted 30 days prior to cucumber seeding, all advised agronomic cultural activities were carried out. Through the use of a Randomized Block Design with three replications, the plots were separated into seven treatment combinations.

“2.2 Treatment combinations

chart 1: Treatment combinations

| **Treatments** | **Treatment Description** |
| --- | --- |
| **T0** | Common to all treatments: Border crop with maize in main field and use of silver mulch sheet. |
| **T1** | T0 + Seed treatment with Seed Pro @ 25 g/kg and soil drenching of Seed Pro @ 5% at true leaf stage after germination, followed by 5–6 sprays of Seed Pro @ 1% at 10-day intervals in rotation with Neem oil @ 0.2%, alternated every 15 days after drenching. |
| **T2** | T0 + Seed treatment with Carbendazim 12% + Mancozeb 63% @ 3 g/kg and drenching with Captan 70% + Hexaconazole 5% WP @ 0.1% at 1st true leaf stage, followed by 5–6 sprays of Seed Pro @ 1% at 10-day intervals in rotation with Neem oil @ 0.2% alternately after 15 days of drenching. |
| **T3** | T0 + Seed treatment with Seed Pro @ 25 g/kg and soil drenching of Seed Pro @ 5% at 1st true leaf stage, followed by spraying of: (1) Captan 70% + Hexaconazole 5% WP @ 0.1%, (2) Imidacloprid 17.8 SL @ 7.5 ml/15 L + Neem oil @ 0.2%, (3) Fosetyl-Al @ 0.1%, (4) Captan + Hexaconazole, (5) Imidacloprid + Neem oil, (6) Fosetyl-Al at 10-day intervals. |
| **T4** | T0 + Seed treatment with Seed Pro @ 25 g/kg and soil drenching of Seed Pro @ 5% at 1st true leaf stage, followed by spraying of: (1) Imidacloprid + Neem oil, (2) Tebuconazole 50% + Trifloxystrobin 25% @ 1 g/L, (3) Fosetyl-Al @ 0.1%, (4) Tebuconazole + Trifloxystrobin, (5) Imidacloprid + Neem oil, (6) Fosetyl-Al at 10-day intervals. |
| **T5** | T0 + Seed treatment with Carbendazim 12% + Mancozeb 63% @ 3 g/kg and drenching with Captan 70% + Hexaconazole 5% WP @ 0.1% at 15 days after germination, followed by spraying of: (1) Tebuconazole + Trifloxystrobin, (2) Imidacloprid + Neem oil, (3) Fosetyl-Al, (4) Tebuconazole + Trifloxystrobin, (5) Imidacloprid + Neem oil, (6) Fosetyl-Al at 10-day intervals. |
| **T6** | T0 + Seed treatment with Carbendazim 12% + Mancozeb 63% @ 3 g/kg and drenching with Captan 70% + Hexaconazole 5% WP @ 0.1% at 15 days after germination, followed by spraying of: (1) Imidacloprid + Neem oil, (2) Captan + Hexaconazole, (3) Fosetyl-Al, (4) Captan + Hexaconazole, (5) Imidacloprid + Neem oil, (6) Fosetyl-Al at 10-day intervals. |
| **T7** | Absolute control (no treatment).” |

**2.3 Experimental data recording**

When we documented the occurrence of illnesses such collar rot and CMV from each individual plot, we used the following calculation to compute the percentage of incidents.

 PI$=\frac{Number of infected plants/plot}{Total no of plants observed/plot} X 100$

In contrast, ten plants from each treatment were used to record the percent severity of downy mildew disease. The disease severity was evaluated from 30 days after sowing (DAS) to 90 DAS at 15-day intervals using a 0-9 scale (Yangn et al., 2007), where 0 represents a healthy leaf, 1 represents 1%-5%, 3 = 6%- 10%, 5 = 11%- 25%, 7 = 26%-55% and 9 = 56%-100% of infected leaf content. This is how Wheeler (1969) determined the percent disease index (PDI).

 PDI$=\frac{Sum of individual ratings }{Total number of plants evaluated disease scale } X 100$

* 1. Economic analysis

Using the current input costs, hired labor salaries (Rs.213.5/- per man days) and market price of cucumber (Rs.2000/- per quintal) at the period of this research, the cost benefit ratio (B:C) above the control was calculated separately considering various treatment combinations.

 The marketable fruits, which do not include fruits affected by diseases or insects, were measured and weighed from each harvest period to determine the marketable fruit yield per plot in kilograms. This yield was then translated to marketable fruit yield per hectare in quintals.

1. **RESULTS AND DISSCUSION**

**3.1 Effect of treatments on disease incidence/ severity**

In an effort to find better ways to control cucumber diseases, researchers at the Horticulture Research Station OUAT in Bhubaneswar (East and SE Coastal Plain Zone, 20015'N latitude and 85052' E longitude) ran an experiment in the summers of 2015–16, 2016–17 and 2017–18 as part of the All India Coordinated Research Project on Vegetable Crops. The experiment included a physical, biological and chemical module. Fruit production was determined from the cumulative harvest and the occurrence and severity of various illnesses were documented in accordance with the materials and methods. A number of cucumber illnesses are detailed in Table 1 and Figure 1, along with the percentage occurrence and severity of each. Table 2 and Figure 2 show that all therapy combinations significantly reduced illness incidence and severity compared to the control group and the current analysis also found that net income and the B:C ratio increased.

 “Three years pooled data revealed that minimum incidence of collar rot (12.7%) and CMV (14.3%) with maximum reduction 74.5 and 65.2% respectively were found in treatment combination comprising T0+ Seed treatment with carbendazim 12% + mancozeb 63% @ 3g/kg and drenching of captan 70% + hexaconazole 5%WP @0.1% at 15 days after germination followed by by spraying of Imidacloprid 17.8 SL@7.5 ml/15 L+ Neem oil @0.2% followed by captan 70% + hexaconazole 5%WP @0.1% 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+ Neem oil @0.2% followed by Fosetyl Al @ 0.1% at 10 days interval. There was a statistically significant decrease in downy mildew severity in treatment combinations (T6) that included integrated management methods compared to the control group. Treatment 6 (T6), which included integrated management methods in addition to the use of fungicides and insecticides, resulted in the lowest disease severity (17.8%) and the highest disease reduction (69.2%). The present study is aligned 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.” According to Utobo et al. (2015), cucurbits may be protected against downy mildew by using neem oil that is extracted from Azadirachta indica. According to studies conducted by Ghosh et al. (2014), Shankar et al. (2014) and Lebeda et al. (2019), the aforementioned fungicides successfully combated cucumber downy mildew.

1. **CONCLUSION**

Thus, it is clear from this study that physical, biological and chemical management practices could be used together to tackle the various diseases that plague cucumber crops, especially in Odisha's coastal zones. This would allow for their sustainable reduction. In addition, the current investigation showed that no difference was statistically significant between the therapies and the control group when it came to decreasing illness incidence or intensity. Cucumber farmers who are struggling with a variety of illnesses may rest easy knowing that technological advancements like barrier crops and smart pesticide usage can help them create a better harvest. Since this integrated illness management technique (T6) yielded the greatest net return (Rs. 1,53,832/-) with the highest B:C ratio (3.5), it is highly recommended.

**DISCLAIMER (ARTIFICIAL INTELLIGENCE)**

Author(s) hereby declares that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT etc.) and text-to-image generators have been used during writing or editing of the manuscript.

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**Table 1. Effect of different treatments on IDM packages for cucurbit diseases (Pooled 2015-16 to 2017-18)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Treatments** | **% Collar rot Incidence** | **% Downy Mildew Severity** | **% CMV incidence** |
|  | **2015-16** | **2016-17** | **2017-18** | **Pooled****Mean** | **Percent Disease Reduction** | **2015-16** | **2016-17** | **2017-18** | **Pooled****Mean** | **Percent Disease Reduction** | **2015-16** | **2016-17** | **2017-18** | **Pooled****Mean** | **Percent Disease Reduction** |
| T1 | 17.8(22.87) | 31.8(34.19) | 37.0(37.35) | **28.9****(31.47)** | 42.0 | 23.9(29.0) | 43.3(41.14) | 28.4(32.11) | **31.9****(34.08)** | 44.7 | 35.3(36.12) | 32.6(34.53) | 24.0(29..12) | **30.6****(33.25)** | **25.5** |
| T2 | 8.7(17.15) | 17.0(23.70) | 19.7(25.98) | **15.1****(22.27)** | 69.7 | 21.4(27.35) | 37.3(37.48) | 19.3(25.77) | **26.0****(30.2)** | 54.9 | 22.3(28.02) | 17.4(24.37) | 19.3(25.77) | **19.7****(26.05)** | **52.1** |
| T3 | 27.2(31.42) | 39.1(38.58) | 35.1(36.23) | **33.8****(35.41)** | 32.1 | 25.9(30.50) | 41.6(40.17) | 35.3(36.37) | **34.3****(35.68)** | 40.6 | 40.7(39.63) | 29.8(32.90) | 26.3(30.70) | **32.3****(34.41)** | **21.4** |
| T4 | 29.8(33.02) | 38.8(38.44) | 40.4(39.44) | **36.3****(36.96)** | 27.1 | 19.8(26.28) | 42.33(40.65) | 34.7(35.98) | **32.3****(34.30)** | 44.0 | 17.0(24.12) | 22.7(28.34) | 19.4(25.86) | **19.7****(26.10)** | **52.1** |
| T5 | 12.4(20.42) | 13.9(21.76) | 19.6(25.59) | **15.3****(22.59)** | 69.3 | 26.9(31.22) | 17.7(24.14) | 18.7(25.22) | **21.1****(26.86)** | 63.4 | 38.7(38.44) | 11.4(16.26) | 13.3(21.09) | **21.1****(25.26)** | **48.7** |
| T6 | **6.9(****12.37)** | 16.2(19.45) | **15.1****(22.70)** | **12.7****(18.17)** | **74.5** | **18.1****(25.09)** | 18.6(25.57) | 16.7(23.94) | **17.8****(24.9)** | **69.2** | **15.8****(23.41)** | 15.9(23.08) | **11.3****(18.65)** | **14.3****(21.71)** | **65.2** |
| T7 | 46.7(42.73) | 50.0(45.0) | 52.8(46.59) | **49.8****(44.77)** | - | 52.2(46.29) | 59.0(50.32) | 62.0(52.10) | **57.7****(49.57)** | - | 42.0(40.24) | 40.0(39.59) | 41.3(39.98) | **41.1****(39.93)** | **-** |
| CD(0.05) | 8.48 | 16.71 | 14.21 | **13.13** | - | 6.99 | 12.10 | 11.51 | **10.2** | - | 8.49 | 12.34 | 10.28 | **10.37** | **-** |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Treatments** |  **Fruit Yield ( q/ha )** | **Cost of cultivation ( Rs. /ha)** | **Gross Income ( Rs./ha)** | **B:C ratio** |
|  | **2015-16** | **2016-17** | **2017-18** | **Pooled****Mean** | **2015-16** | **2016-17** | **2017-18** | **Pooled****Mean** | **2015-16** | **2016-17** | **2017-18** | **Pooled****Mean** | **2015-16** | **2016-17** | **2017-18** | **Pooled****Mean** |
| T1 | 82.2 | 77.8 | 81.2 | 80.4 | 57700.00 | 60435.00 | 62248.00 | 60127.70 | 164400.00 | 155600.00 | 162400.00 | 160800.00 | 2.8 | 2.5 | 2.6 | 2.6 |
| T2 | 91.2 | 91.7 | 88.8 | 90.6 | 55805.00 | 58440.00 | 60193.00 | 58146.00 | 182540.00 | 183400.00 | 177600.00 | 181180.00 | 3.3 | 3.1 | 3.0 | 3.1 |
| T3 | 77.5 | 89.3 | 87.5 | 84.8 | 58610.00 | 61245.00 | 63082.00 | 60979.00 | 155060.00 | 178600.00 | 175000.00 | 169553.00 | 2.6 | 2.9 | 2.8 | 2.8 |
| T4 | 103.6 | 81.3 | 79.5 | 88.1 | 64810.00 | 67445.00 | 69468.00 | 67241.00 | 207340.00 | 162600.00 | 159000.00 | 176313.00 | 3.2 | 2.4 | 2.3 | 2.6 |
| T5 | 87.2 | 112.3 | 106.8 | 102.1 | 64470.00 | 67105.00 | 69118.00 | 66897.00 | 174200.00 | 223400.00 | 213600.00 | 203733.00 | 2.7 | 3.3 | 3.1 | 3.0 |
| T6 | 106.4 | 104.6 | 110.7 | 107.2 | 58270.00 | 60905.00 | 62732.00 | 60635.00 | 212800.00 | 209200.00 | 221400.00 | 214467.00 | 3.6 | 3.4 | 3.5 | 3.5 |
| T7 | 60.9 | 56.2 | 61.0 | 59.4 | 52700.00 | 55335.00 | 56995.00 | 55010 | 121800.00 | 112400.00 | 122000.00 | 118733.00 | 2.2 | 2.0 | 2.1 | 2.1 |
| CD(0.05) | 10.05 | 10.10 | 15.73 | 11.96 | - | - | - | - | - | - | - | - | - | - |  | - |

**Table 2. Fruit yield of cucumber (q/ha) and economics as influenced by different treatments (Pooled 2015-16 to 2017-18)**

**Fig. 1 Effect of different IDM on incidence/severity of different diseases of cucumber**

**Fig. 2 Effect of different IDM on Net Income**