**Prevalent Diseases of Cucumber (*Cucumis sativus* L.) and Its Management Through Integrated Approaches**

**ABSTRACT**

**Aim:** To evaluate different integrated disease management module 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:** It includes the management strategies through an integrated approach for the management of prevalent diseases of cucumber like collar rot, downy mildew and cucumber mosaic virus using strategies such as growing border crop, use of reflective mulches, soil application and spray of 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:** These findings provide valuable insights for the farmers who are facing lot of problem due to attack of different disease in cucumber crop during *summer* season, can grow their crop by adopting the technologies. The treatments combination also recorded maximum fruit yield (107.2 q/ha) with highest economic return (Rs. 1,58,668) with maximum B:C ratio of 3.5. This integrated approach is safe and ecologically sound and seems to be a healthy tactic for disease management.

***Keywords:*** *cucumber, diseases, management, integrated approaches, yield, BC ratio*

1. **INTRODUCTION**

Cucumber (*Cucumis sativus* L.) is an important commercial vegetable which is also used as salad belongs to the family Cucurbitaceae, commercially grown throughout the country. It is considered as fourth most important vegetable crop after tomato, cabbage and onion in Asia (Tatlioglu, 1993). Cucumber is widely cultivated in China, Camerron, Russian Federation and Turkey (Amin *et al*, 2018). Mainly three types of cucumber (i.e., slicing, pickling and seedless) are cultivated across the world. It is mainly grown in the summer season and is popular for its soft and tender juicy fruit. The fruit consist of more than 90% of water (Loy, 1990; Maynard, 2001). It is also considered as an important fruit from the medicinal point of view as it provides cooling effect to human body when consumed. People also use it on skin and face for relaxation when physically stressed. It is also considered as helpful fruit to prevent and cure jaundice and constipation. Seeds of this fruits contains essential oil which is helpful for brain development and body smoothness (Bhagwat *et al.,* 2018). It aids in weight loss and rehydration (Shetty and Wehner, 2002) as it contains low calories (16 calories per cup) and more fiber on the skin (Bhagwat *et al.,* 2018). Therefore, it is also known as versatile food for its countless number of health benefits (Ngouajio *et al.,* 2006). In India, it is mainly grown as a summer warm season vegetable crop and area under cucumber cultivation is 1,30,000 ha with a production of 15,50,000 tonnes 3. It comprises of 117 genera and 825 species and is cultivated in warmer parts of the world (Nagamani *et al.,* 2019). In India approximately 112 open pollinated varieties of several cucurbits have been recommended for cultivation at national and state level. The vulnerability of this crop to several biotic and abiotic stresses accounts for its low yield potential and in turn the high cost of production. *Alternaria* blight, powdery mildew, downy mildew and cucumber mosaic diseases are the major foliar diseases which are responsible for yield loss and quality parameters in cucumber. In recent years, hybrid varieties of cucumber have drastically changed the productivity pattern, cultivation practices and production area. Genetic improvement and application of modern technologies in cultivation practices along with management of different biotic stresses through integrated approach are key factors for achieving maximum yield. Our main goal of research was to improve productivity by managing of prevalent diseases of cucumber like collar rot, downy mildew and cucumber mosaic virus using integrated disease management strategies such as growing border crop, use of reflective mulches, soil application and spray of fungicides and insecticides.

1. **MATERIALS AND METHODS**

**2.1 Experimental Site and plants growing**

The experiment was conducted in a randomized block design with four replications under All India Coordinated Research Project on Vegetable Crops at Central Research Station OUAT, Bhubaneswar (East and SE Coastal Plain Zone, 20015’N latitude and 85052’ E longitude) during the summe*r* season of three consecutive years of 2015-16, 2016-17 and 2017-18. Seeds of cucumber variety Kumuda were sown in the well-prepared plots of 5.0 x2.5 m in size following pit sowing with 100 x 50 cm spacing. All recommended agronomic cultural practices were followed in the main field previously surrounded with 2 rows of maize sown 30 days before sowing of cucumber seeds. Plots were divided into seven treatment combinations following Randomized Block Design with three replications.

2.2 Treatment combinations

**T0 - Common to all treatments**: Border crop with maize in main field and use of silver mulch sheet

**T1 -** To + seed treatment with seed pro @ 25g/kg and soil drenching of seed pro@5% at true leaf stage after germination followed by 5-6 spray of seed pro@ 1% at 10 days interval in rotation with Neem oil @ 0.2% alternatively after 15 days of drenching

**T2 -** T0 + Seed treatment with carbendazim 12% + mancozeb 63% @ 3g/kg and drenching of captan 70% + hexaconazole 5%WP @0.1% at 1st true leaf stage after germination followed by 5-6 spraying of seed pro @ 1% at 10 days interval in rotation with Neem oil @ 0.2% alternatively after 15 days of drenching

**T3 -** T0+ seed treatment with seed pro @25g/kg and soil drenching of seed pro @ 5% at 1st true leaf stage after germination followed by spraying of captan 70% + hexaconazole 5%WP @0.1% followed by spraying of Imidacloprid 17.8 SL@ 7.5 ml/15L + Neem oil @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+ Neem oil @0.2% followed by Fosetyl Al @ 0.1% at 10 days interval

**T4** **-** T0+ seed treatment with seed pro @25g/kg and soil drenching of seed pro @ 5% at 1st true leaf stage after germination followed by spraying of Imidacloprid 17.8 SL@ 7.5 ml/15L + Neem oil @0.2% followed by Tebuconazole 50%+ Trifloxystrobin 25% @ 1g/l followed by Fosetyl Al @ 0.1% followed by Tebuconazole 50%+ Trifloxystrobin 25% @ 1g/l 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

**T5 -** T0+ Seed treatment with carbendazim 12% + mancozeb 63% @ 3g/kg and drenching of captan 70% + hexaconazole 5%WP @0.1% at 15 days after germinationfollowed by spraying of Tebuconazole 50%+ Trifloxystrobin 25% @ 1g/l followed by spraying of Imidacloprid 17.8 SL@7.5 ml/15 L+ Neem oil @0.2% followed by Fosetyl Al @ 0.1% followed by Tebuconazole 50%+ Trifloxystrobin 25% @ 1g/l 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

**T6 -** T0+ Seed treatment with carbendazim 12% + mancozeb 63% @ 3g/kg and drenching of captan 70% + hexaconazole 5%WP @0.1% at 15 days after germinationfollowed 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

**T7** **-** Control

**2.3 Experimental data recording**

The incidence of different diseases like collar rot and CMV, were recorded from all the individual plot percent disease incidence was calculate by using following formula.

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

Whereas, percent severity of downy mildew disease was recorded by selecting 10 plants from each treatment and disease severity was assessed from 30 days after sowing (DAS) up to 90 DAS at 15 days intervals by using 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).

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

2.4 Economic analysis

The cost benefit ratio (B:C) over the control was worked out separately considering different treatment combination on the basis of existing prices of inputs, hired labour wages (Rs.213.5/- per man days), market price of tomato fruit (Rs.2000/- per quintal) during the time of this study

Marketable fruits (excluding disease and insect damage fruits) of the periodical harvests from the individual plot were counted and weighed to express marketable fruit yield per plot (kg) and then it was converted to marketable fruit yield (quintal) in hectare.

1. **RESULTS AND DISSCUSION**

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

Attempts were made to develop integrated management strategies, an experiment was conducted under All India Coordinated Research Project on Vegetable Crops at Horticulture Research Station OUAT, Bhubaneswar (East and SE Coastal Plain Zone, 20015’N latitude and 85052’ E longitude) involving physical, biological and chemical module has been formulated to manage the cucumber diseases during three consecutive years from 2015-16, 2016-17 and 2017-18 during the summer season. Disease incidence/ severity different diseases were recorded as mentioned in the materials and method and fruit yield was calculated from cumulative harvest. The results of percent disease incidence/ severity of different diseases of cucumber are presented in Table. 1 and Figure. 1. The present investigation revealed that in general all the treatment combinations had not only substantial positive effects on the reduction of percent disease incidence / severity over control (Table. 2 and Figure. 2), but also increases the net income as well as B:C ratio.

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 germinationfollowed 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. Severity of downy mildew during the course of study was significantly reduced in treatment combinations (T6) involving integrated management practices as compared to control. The minimum disease severity (**17.8**%) and the maximum disease reduction (**69.2**%) were recorded in treatment (T6) involving integrated management practices combined with application of fungicides and insecticides (T6). 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. Neem oil derived from *Azadirachta indica* controls downy mildew disease of cucurbits (Utobo *et al*., 2015). The above above fungicides were effective against downy mildew of cucumber as described by (Ghosh *et al*., 2014; Shankar *et al*., 2014 and Lebeda *et al*., 2019).

1. **CONCLUSION**

Therefore, it can be concluded from the present investigation that that the different diseases of tomato are the major hindrance for cucumber cultivation particularly in the Coastal zone of Odisha, could effectively be reduced in a sustainable manner through integration of physical, biological and chemical management practices. Further, it was revealed from the present study that the treatments were statistically equally effective in respect of reducing disease incidence by lowering the disease incidence/ intensity over the control. So, cucumber growers who are facing problem from different diseases can easily grow their crop by adopting the technologies involving **barrier crop, economic use of chemicals.** Because this integrated disease management practice (T6) gave maximum net return (Rs. **1,53,832**/-) with highest B:C ratio (**3.5**).

**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**