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Integrated Management of Root Rot Disease of Papaya (*Carica papaya* L.) caused by *Fusarium solani*

RAHUL KUMAR* AND SK SINGH

Deptt. of Plant Pathology, Rajendra Agricultural University, Pusa, Samastipur, Bihar, India

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ABSTRACT

Present study the most effective fungicides, plant extract, organic cake and bio-agent were evaluated in different combinations under field conditions for the management of papaya root rot disease. It was observed that there was 81.5% disease incidence in control while the lowest disease incidence (29.60%) was recorded in treatment (T_{13}) (Comprising disease free seedling + mustard cake (10%)+ wild garlic (10%) + dipping of seedlings in thiophanate methyl (0.1%) 30 min.+ soil drenching with thiophanate methyl (0.1%) solution three times (1st at time of transplanting, second at 3rd MAT and third at 5th month after transplanting)+ Soil application of *Trichoderma viride* @ 50g/plant three times (i.e. 1st at time of transplanting, second at 3rd MAT and third at 5th MAT)+ soil application of *Pseudomonas florescence* @ 50g/plant three times (i.e. 1st at time of transplanting, second at 3rd MAT and third at 5th MAT). This was followed by treatment T_6 (37.0%), T_9 (40.7%) and T_5 (44.4%). The effect of different treatments on yield was also studied and the highest fruit yield (1064.67 kg/plot) was obtained from the treatment T_{13} followed by treatment T_9 (848.67 kg/plot) and T_5 (810.00 kg/plot) over the control T_1 (209.00 kg/plot).

Keywords: Integrated Disease Management Papaya *Fusarium solani*

INTRODUCTION

Papaya (*Carica papaya* Linn.) has long been known as a wonder fruit of the tropics and grown primarily for its delicious test and for extraction of its digestive constituent papain. It gives one of the highest productions of fruits per hectare and an income next to banana. The present area under papaya cultivation is about 70 thousand ha and production is around 1.5 million tonnes (Deshmukh and Hardaha, 2014). Root rot of papaya caused by *Phytophthora nicotianae* was reported for the first time by Roberts and Trujillo in 1998 and subsequently Rodriguez *et al*. (2001) reported root rot of papaya incited by *P. aphanidermatum* from Tabasco, Mexico and the United States. A new disease - Root rot of papaya was encountered at Pusa and other places of Bihar as a threat to papaya cultivation throughout the plant growth stage during the year 2012-13 and 2013-14 showing up to 100% incidence and resulted in gradual collapse of entire papaya plantations. However in the recent past root rot of papaya, a new emerging disease caused by *Fusarium solani* (Singh and Kumar, 2015), posing a serious threat to papaya cultivation in agro-ecological conditions of Bihar, which causing up to 95 per cent crop damage. Due to its devastating nature, there is an urgent need to focus on remedies for its management. Therefore, selection of the appropriate variety, determining suitable sowing date and optimum plant density are very important factors for increasing the quality and yield of papaya. Good Agronomic Practices (GAP) may be treated as an efficient and eco-friendly tool for sustainable management of plant diseases under changing climate scenario (Singh *et al*., 2015). Knowledge of the occurrence and distribution of the disease of papaya and environmental variables that affect the disease is lacking especially in agro-ecology situation of Bihar. Hence, the present study was under taken to determine the development of IDM modules against the disease. Integration of different treatments, including seedling dip, with carbendazim, addition of vermi-compost, drenching with fungicide (carbendazim+ mancozeb), and application of *Trichoderma viride* was found to be effective in managing the disease, in comparison to individual treatments (Madhavi and Bhattiprolu, 2011).

MATERIALS AND METHODS

Among fungicides, plant extract, organic cake and bioagents tested under *in vitro* conditions the most effective and compactable ones were evaluated in different combination for management of root rot of papaya as per method given below. A field trial was conducted as per lay out at Horticultural Research Farm, RAU, Pusa during 2014-15 to study the effect of integration of mustard cake, wild garlic, carbendazim, thiophanate methyl, *Trichoderma viride* and *Pseudomonas florescence* in papaya root rot management. The field was ploughed thrice and finally prepared for transplanting of papaya. Varieties Pusa Dwarf was transplanted in month of March-April at plant spacing 1.5 x 1.5m. The treatments were replicated thrice. All the package and practices were followed. The per cent root rot incidence and yield (kg/plant) were recorded at time of harvesting. A detailed statistical analysis (one way ANOVA) was performed to test the level of significance.

Details of treatments

T_1- Disease free seedlings (DFS) (Control), **T_2**-DFS+ mustard

*Present address: Senior Research Fellow ICAR-RCER Patna, Bihar, India
***Corresponding Author Email:** rahul.tiwari072@gmail.com

cake (10%)+wild garlic(10%), **T_{3}**- DFS+ mustard cake(10%)+wild garlic(10%)+ Soil application of *Trichoderma viride* @ 50g/plant three times 1st at time of transplanting ,second at 3rd MAT and third at 5th MAT, **T_{4}**-DFS+ mustard cake(10%)+wild garlic(10%)+ Soil application of *Pseudomonas florescence* @ 50g/plant three times 1st at time of transplanting ,second at 3rd MAT and third at 5th MAT, **T_{5}**-DFS+ mustard cake(10%)+wild garlic(10%)+ Soil application of *Trichoderma viride* @ 50g/plant three times 1st at time of transplanting ,second at 3rd MAT and third at 5th MAT+ Soil application of *Pseudomonas florescence* @ 50g/plant three times 1st at time of transplanting ,second at 3rd MAT and third at 5th MAT, **T_{6}**-DFS+ mustard cake(10%)+wild garlic(10%)+ dipping of seedlings in Carbendazim (0.2%) 30 min.+ soil drenching with Carbendazim (0.2%) solution three times, 1st at time of transplanting ,second at 3rd MAT and third at 5th MAT, **T_{7}**-DFS+ mustard cake(10%)+wild garlic(10%)+dipping of seedlings in Thiophanate methyl (0.1%) 30 min.+ soil drenching with Thiophanate methyl (0.1%) solution three times, 1st at time of transplanting, second at 3rd MAT and third at 5th month after transplanting, **T_{8}**- DFS+ mustard cake(10%)+wild garlic(10%)+ dipping of seedlings in Carbendazim (0.2%) 30 min.+ soil drenching with Carbendazim (0.2%) solution three times, 1st at time of transplanting ,second at 3rd MAT and third at 5th MAT+ Soil application of *Trichoderma viride* @ 50g/plant three times 1st at time of transplanting ,second at 3rd MAT and third at 5th MAT, **T_{9}**- DFS+ mustard cake(10%)+wild garlic(10%)+dipping of seedlings in Thiophanate methyl (0.1%) 30 min.+ soil drenching with Thiophanate methyl (0.1%) solution three times, 1st at time of transplanting, second at 3rd MAT and third at 5th month after transplanting+ Soil application of *Trichoderma viride* @ 50g/plant three times 1st at time of transplanting ,second at 3rd MAT and third at 5th MAT, **T_{10}**-DFS+ mustard cake(10%)+wild garlic(10%)+ dipping of seedlings in Carbendazim (0.2%) 30 min.+ soil drenching with Carbendazim (0.2%) solution three times, 1st at time of transplanting ,second at 3rd MAT and third at 5th MAT+ Soil application of *Pseudomonas florescence* @ 50g/plant three times 1st at time of transplanting ,second at 3rd MAT and third at 5th MAT, **T_{11}**- DFS+ mustard cake(10%)+wild garlic(10%)+dipping of seedlings in Thiophanate methyl (0.1%) 30 min.+ soil drenching with Thiophanate methyl (0.1%) solution three times, 1st at time of transplanting, second at 3rd MAT and third at 5th month after transplanting+ Soil application of *Pseudomonas florescence* @ 50g/plant three times 1st at time of transplanting ,second at 3rd MAT and third at 5th MAT, **T_{12}**- DFS+ mustard cake(10%)+wild garlic(10%)+ dipping of seedlings in Carbendazim (0.2%) 30 min.+ soil drenching with Carbendazim (0.2%) solution three times, 1st at time of transplanting ,second at 3rd MAT and third at 5th MAT+ Soil application of *Trichoderma viride* @ 50g/plant three times 1st at time of transplanting ,second at 3rd MAT and third at 5th MAT+ Soil application of *Pseudomonas florescence* @ 50g/plant three times 1st at time of transplanting ,second at 3rd MAT and third at 5th MAT, **T_{13}**- DFS+ mustard cake(10%)+wild garlic(10%)+dipping of seedlings in Thiophanate methyl (0.1%) 30 min.+ soil drenching with Thiophanate methyl (0.1%) solution three times, 1st at time of transplanting, second at 3rd MAT and third at 5th month after transplanting+ Soil application of *Trichoderma viride* @ 50g/plant three times 1st at time of transplanting ,second at 3rd MAT and third at 5th MAT+ Soil application of *Pseudomonas florescence* @ 50g/plant three times 1st at time of transplanting ,second at 3rd MAT and third at 5th MAT. Per cent root rot incidence due to *Fusarium solani* and yield per plot were calculated at time of harvested.

Fig.1: In-vitro screening of bio-agent against *Fusarium solani* causing root rot of papaya

RESULTS AND DISCUSSION

During the present study the most effective fungicides, plant extract, organic cake and bio-agent were evaluated in different combinations under field conditions for the management of papaya root rot disease. The effect of different treatments on root rot of papaya was presented in Fig. 2 and 3.

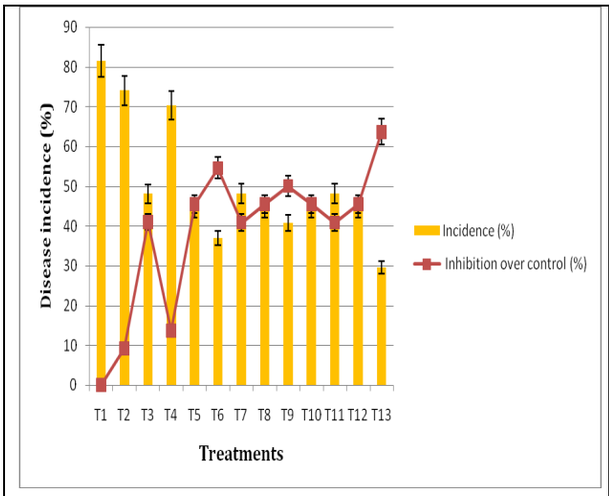

Fig.2: Effect of different treatments on incidence of root rot of papaya and inhibition of the disease over control

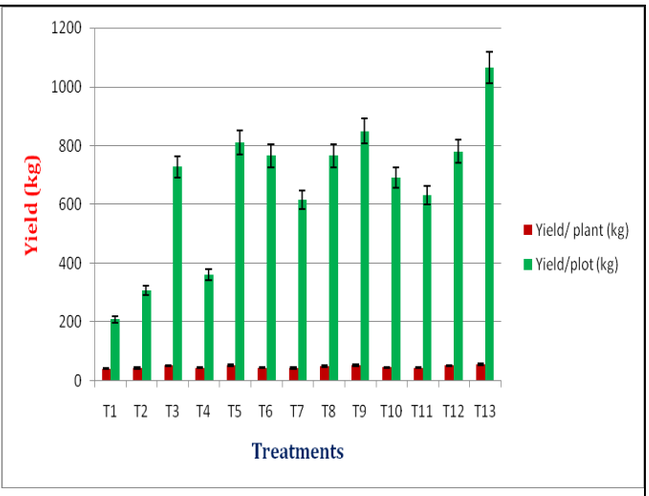

Fig.3: Effect of different treatments on yield of papaya

The most effective fungicides, plant extract, organic cake and bio-agent under *in vitro* study were applied under field conditions for the management of papaya root rot as per treatments detailed in material and methods. In-vitro screening of bio-agent against *Fusarium solani* causing root rot of papaya has been done and presented in Fig. 1.

Per cent age of root rot due to *Fusarium solani* was calculated at the time of harvesting. The crop was harvested at maturity and yield per plot was recorded. The effect of different treatments on root rot of papaya was presented in Table 1. It is clear from the table that the treatments differed significantly in suppression of root rot of papaya. It was observed that there was 81.5 per cent disease incidence in while the lowest disease incidence (29.60%) was recorded in treatment T_{13} i.e. DFS+ mustard cake(10%)+wild garlic (10%)+dipping of seedlings in Thiophanate methyl (0.1%) 30 min.+ soil drenching with Thiophanate methyl (0.1%) solution three times (1st at time of transplanting, second at 3rd MAT and third at 5th month after transplanting)+ Soil application of *Trichoderma viride* @ 50g/plant three times (i.e. 1st at time of transplanting ,second at 3rd MAT and third at 5th MAT)+ Soil application of *Pseudomonas florescence* @ 50g/plant three times (i.e. 1st at time of transplanting ,second at 3rd MAT and third at 5th MAT). It was followed by treatment T_6 (37.0%), T_9 (40.7%) and T_5 (44.4%).

Earlier several workers have integrated studied management of root rot/wilt incited by *Fusarium solani* and other pathogen in various crops. Madhavi *et al.,* 2006 reported that the effectiveness of carbendazim tolerant mutants of *Trichoderma viride* and *P. fluorescens* increased when used as soil and seed application treatments and also when combined with soil drenching with chemicals which resulted in zero per cent wilt incidence in chilli. Madhavi and Bhattiprolu (2011) reported complete reduction of the pathogen with the help of soil solarization alone or with low dosages of a fungicide, biocide and biological control agent. Dabbas *et al.* (2012) conducted an experiment to manage wilt of brinjal due to (*Fusarium solani*) with thirteen treatments of green manuring, seedling treatments, soil drenching with chemicals and bio-agents. The seedling treatment with carbendazim solution (0.25%) for thirty minutes combined with soil drenching by carbendazim solution @ (0.25%) three times at 15 days interval, starting at the age 25 days of crop after transplanting was found best, which gave low (6.70%) disease intensity and optimum fruit yield (91.11 kg) in 5 m x 3 m plot of crop and highest C: B ratio 1:2.84. The effect of different treatments on yield against diseases has been shown in Table 1. The highest fruit yield (1064.67 kg/plot) was obtained from the treatment T_{13} followed by treatment T_9 (848.67 kg/plot) and T_5 (810.00 kg/plot) over the control T_1 (209.00 kg/plot). The treatment T_2 was least effective in disease suppression (9.2% inhibition) and registered the lowest yield (44 kg/plant) among all the treatment but found superior to the control.

CONCLUSION

The most effective treatment for the management of disease was integration of disease free seedling + mustard cake (10%)+wild garlic (10%)+dipping of seedlings in thiophanate

Table 1: Effect of different treatments on incidence of root rot of papaya

Treatments	*Incidence (%)	Inhibition over Control (%)	Yield/ plant (kg)	Yield/plot (kg)
T_1	81.5	-	42	209.00
T_2	74.0	9.2	44	308.00
T_3	48.1	41.0	52	728.00
T_4	70.3	13.7	45	360.67
T_5	44.4	45.5	54	810.00
T_6	37.0	54.6	45	765.67
T_7	48.2	40.9	44	616.33
T_8	44.4	45.5	51	765.00
T_9	40.7	50.1	53	848.67
T_{10}	44.4	45.5	46	690.33
T_{11}	48.2	40.9	45	630.33
T_{12}	44.4	45.5	52	780.00
T_{13}	29.6	63.7	56	1064.67
LSD (P=0.05)	4.3			90.18
S. Em. (±)	1.5			30.71
C.V. (%)	5.1			7.91

*Mean of three replications

methyl (0.1%) for 30 min. + soil drenching with thiophanate methyl (0.1%) solution three times, 1st at time of transplanting, second at 3rd month after transplanting (MAT) and third at 5th MAT+ soil application of *Trichoderma viride* @50g/plant three times 1st at time of transplanting, second at 3rd MAT and third at 5th MAT+ soil application of *Pseudomonas florescence* @ 50g/plant three times 1st at time of transplanting ,second at 3rd MAT and third at 5th MAT.

REFERENCES

Dabbas M R, Rajiv, Prakash, H. G. and Pallavi .2012. Integrated management of *fusarium* wilt of brinjal. *International Journal of Agricultural Sciences*. **8**(1): 111-3.

Deshmukh G and Hardaha MK. 2014. Effect of irrigation and fertigation scheduling under drip irrigation in papaya. *Journal of AgriSearch* **1**(4): 216-20.

Madhavi GB and Bhattiprolu S L. 2011. Evaluation of fungicides, soil amendment practices and bioagents against *Fusarium solani* causal agent of wilt disease in chilli. *Journal of Horticultural Sciences* **6**(2): 141-4.

Madhavi M, Kumar CPC, Reddy DRR and Singh TVK. 2006 . Integrated management of wilt of chilli incited by *Fusarium solani*. *Indian Journal of Plant Protection*.**34** (2): 225-8.

Roberts PD and Trujillo E. 1998. First report of *Phytophthora nicotianae* causing leaf blight, fruit rot, and root rot of papaya in American Samoa. *Plant Disease* **82** (6): 712.

Rodriguez AG, Fernandez PSP, Geraldo VJA and Landa HL. 2001. *Pythium aphanidermatum* causing collar rot on papaya in Baja California Sur, Mexico. *Plant Disease* **85**(4): 444.

Singh SK and Kumar R. 2015. Etiology, symptomatology and molecular characterization of papaya root rot – A new and serious threat. *Indian Phytopath*. **68 (3)**: 348-9.

Singh AK, Singh D, Singh A, Sangle UR and Gade RM .2012.Good Agronomic Practices (GAP) - An efficient and eco-friendly tool for sustainable management of plant diseases under changing climate scenario. *J. of Plant Disease Sci.* 7 (1):1-8

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