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Management of Foliar and Soil Borne Diseases in Long Pepper using Bioagents and Organics

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ABSTRACT

Long pepper (*Piper longum* L.) is an important medicinal plant used in *Ayurvedic* system of medicine since ancient time and diseases are an important biological constraint in limiting the production and productivity of it hence a field experiment was conducted to evaluate the foliar and soil borne diseases of Long pepper (cv. Vishwam) using several combinations of bioagents and organics. The result revealed that soil treatment with *T. viride* @3 g/m^2 with 20t FYM/ha + Neem Cake @ 2t/ha was found superior in managing the leaf blight/rot disease where as spraying of Tebuconazole + Trifloxystrobin @ 0.1% was appeared to be the best in case of leaf spot and stem rot diseases. As far as dry catkin yield is concerned, soil treatment with *T. viride* @3 g/m^2 with 20t FYM/ha + Neem Cake @ 2t/ha recorded highest yield of 445.4 Kg/ha.

Key words: *Long pepper, Diseases, Bioagents, Organics, Dry catkin,*

Introduction

Long pepper or pipali (*Piper longum* L.) belonging to the family *Piperaceae* is an important medicinal plant used in *Ayurvedic* system of medicine for more than 300 classical formulations along with many modern formulations. In addition to being used as a medicinal plant, it is also used as a spice in India. Spikes of long pepper contain piperine, piplartine, piperlongumine and piperlonguminine whereas roots show the presence of piperine, piplartine, piperlongumine, piperlonguminine triacontane, dihydrostigmasterol and glycosides. Piperine constitutes a major alkaloid of spikes/fruits/catkins but in case of roots piperlongumine and piperlonguminine are the dominating constituents. Pungent roots are particularly useful as heating, stomachic, laxative, anthelmintic, carminative, it improves the appetite, useful in bronchitis, abdominal pain, diseases of spleen, tumours. Ripe catkins are also used in treating bronchitis, fevers, asthma, leucoderma, tumours, urinary discharges, piles diseases spleen related disorders, jaundice, inflammation, leprosy and tuberculosis. However, majorly the dried unripe spikes/catkins/fruits and dried roots of the plant are being used as valuable drug for the treatments of various ailments particularly for the diseases related to respiratory tract *viz.* cough, bronchitis, asthma, chest congestion etc. (Viswanathan 1995; Kumari, 2014; Kendre, 2016).

In India, it is cultivated as commercial crop in West Bengal, Assam, Meghalaya, Maharashtra, Odisha, Andhra Pradesh, Uttar Pradesh, Tami Nadu and Kerala (Basak and Mohapatra, 2015). As far as status of long pepper in Odisha is concerned, the State is not able to fulfil its domestic consumption of long pepper (1331 quintals) and it has to procure a significant amount (530 quintals) of its requirement from outside of the State (Swain and Kumar, 2018). Availability of long pepper can be sporadically seen in various agroclimatic zones of Odisha, however, long pepper vines are mostly available in Keonjhar, Khurda, Phulbani and Mayurbhanj districts (Basak and Mohapatra, 2015). State Medicinal Plants Board (SMPB) of Odisha has identified long pepper as one of the medicinal plants whose cultivation can be associated and integrated with horticulture crops in different agroclimatic zones of Odisha. Under National Mission on Medicinal Plants (NMMP), long pepper has been one of the prioritized medicinal plants by the Government of Odisha for its promotion. Because of this intervention by the government, acreage under long pepper is on increasing trend (Swain and Kumar, 2018). However, the biotic and abiotic constraints are major limiting factors in achieving the yield potential of any crop. Diseases are an important biological constraint limiting the production and productivity of long pepper. A number of diseases have been reported to affect the cultivation of long pepper at global and national levels. In India long pepper has been affected by leaf spot and blight caused by *Colletotrichum gloesporioides*, *Cercospora* sp., (Kurian and Shankar, 2007; Kumari *et al.*, 2018) leaf spot and rot by *Botrayodiplodia theobromae* and *Fusarium pallidoroseum* (Kumari and Jha, 2014) and root rot complex by *Fusarium solani*, *Rhizoctonia bataticola*, *Pythium* spp. and *Phytophthora parasitica* (Kendre, 2016; Kendre *et al.*, 2017). Keeping these points in mind, the present investigation was carried out in order to find out the better management practice for the diseases of Long pepper using bioagents and organics.

Materials and Methods

A field experiment was conducted during *Kharif* 2017-18 to 2019-20 in the experimental farm of All India Coordinated Research Project (AICRP) on Medicinal and Aromatic Plants and Betelvine at Horticultural Research Station, Baramunda Farm, of Odisha University of Agriculture and Technology (OUAT), Bhubaneswar. The trial was laid out in Randomized Block Design with nine treatments and three replications. The variety, Vishwam was selected for the study and planting was done during second fortnight of September at a spacing of 60 cm and 60 cm between rows and plants respectively. Long pepper vines were randomly observed at regular intervals and per cent diseases index (PDI) for foliar diseases and stem rot was calculated. Five diseased vines were randomly selected from each plot and five diseased leaves in case of foliar diseases were chosen from each selected vine. Based upon the per cent of the leaf area affected by the disease, the chosen leaves were assigned a numerical rating following 1-9 numerical rating scale given by McKinney (1923). In case of stem rot, PDI was calculated in five randomly selected vines. PDIs for five randomly selected vines were averaged to give the PDI of stem rot in a particular plot. In case of root rot, only percentage incidence of the disease was calculated. The details of numerical rating scale and formula for calculating PDI are mentioned below:

McKinney formula for PDI calculation

$$\text{Per cent disease index} = \frac{\text{Summation of all disease ratings}}{\text{Total number of ratings x Maximum disease grade}} \times 100$$

For root rot, disease incidence was calculated by following formula:

$$\text{Disease incidence} = \frac{\text{Number of infected vines}}{\text{Total number of vines}} \times 100$$

The yield was recorded from each plot and converted to in kg/ha. The data were subjected to statistical analysis after using suitable transformations

Table 1. Treatment details

Treatment	Details
T_1	Soil treatment with *T. viride* @3 g/m^2 with 20 t FYM/ha + Neem Cake @ 2 t/ha
T_2	Soil treatment with *P. fluorescens* @3 g/m^2 + 20 t FYM/ha + Neem Cake @ 2 t/ha
T_3	Soil treatment with *T. viride* @3 g/m^2 + *P. fluorescens* @3 g/m^2 with 20 t FYM/ha + Neem Cake @ 2 t/ha
T_4	Neem seed kernel extract (NSKE) spray @ 0.3%
T_5	Spraying *P. fluorescens* @10 g/lit
T_6	Spraying *P. fluorescens* @10 g/lit + Neem seed kernel extract (NSKE) spray @ 0.3%
T_7	Spraying Tebuconazole + Trifloxystrobin @ 0.1%
T_8	Soil treatment with 20 t FYM/ha + Neem Cake @ 2 t/ha
T_9	Control

Table 2. Numerical rating Scale used for calculating PDI

% Foliage affected	Grade
No Infection	1
0.1 to 5	2
6 to 10	3
11 to 15	4
15 to 20	5
21 to 30	6
31 to 50	7
51 to 75	8
Above 75	9

such as angular transformations for percent disease incidence.

Results

The result revealed that soil treatment with *T. viride* @3 g/m^2 with 20t FYM/ha + Neem Cake @ 2t/ha controlled the leaf blight/rot disease maximum followed by spraying of Tebuconazole + Trifloxystrobin @ 0.1%. In comparison to untreated plot, soil treatment with *T. viride* @3 g/m^2 with 20t FYM/ha + Neem Cake @ 2t/ha controls the disease to the tune of 58% whereas Soil treatment with *P. fluorescens* @3 g/m^2 + 20 t FYM/ha + Neem Cake @ 2 t/ha manages the disease to the tune of 43.3% only. In case of leaf spot and stem rot diseases, spraying of Tebuconazole + Trifloxystrobin @ 0.1% was found superior followed by soil treatment with *T. viride* @3 g/m^2 with 20t FYM/ha + Neem Cake @ 2t/ha. However, all treatments were significant in controlling the disease.

As far as dry catkin yield of long pepper is concerned, soil treatment with *T. viride* @3 g/m^2 with 20t FYM/ha + Neem Cake @ 2t/ha resulted maximum yield (445.4 Kg/ha) followed by Soil treatment with *T. viride* @3 g/m^2 + *P. fluorescens* @3 g/m^2 with 20 t FYM/ha + Neem Cake @ 2 t/ha (438.9 Kg/ha). However, treatments T_1, T_2 and T_3 were found at par with each other.

Table 3. Effects of different treatments on the severity of three major diseases of long pepper

Treatment	PDI (leaf blight/rot)				% Disease	PDI (leaf spot)				% Disease	PDI (Stem rot)				% Disease
	2018-19	2019-20	2020-21	Pooled mean	control	2018-19	2019-20	2020-21	Pooled mean	control	2018-19	2019-20	2020-21	Pooled mean	control
T_1	20.5	18.20	16.3	18.3	58.2	15.3	17.93	17.2	16.8	60.0	18.8	7.96	11.5	12.7	
	(26.7)	(25.2)	(23.6)	(25.1)		(23.0)	(25.0)	(24.4)	(24.1)		(25.4)	(16.3)	(19.7)	(20.4)	61.0
T_2	31.8	21.53	21.2	24.8	43.3	18.4	22.42	19.3	20.0	52.3	27.4	11.65	20.3	19.7	
	(34.2)	(27.6)	(27.3)	(29.7)		(25.4)	(28.2)	(25.9)	(26.5)		(31.4)	(19.9)	(26.7)	(26.0)	39.5
T_3	28.4	20.50	12.6	20.5	53.1	16.3	20.91	22.4	19.8	52.8	22.0	8.80	17.2	16.0	
	(32.1)	(26.9)	(20.6)	(26.5)		(23.7)	(27.2)	(28.1)	(26.3)		(27.8)	(17.2)	(24.4)	(23.1)	50.9
T_4	39.6	28.16	36.3	34.6	21.0	18.6	29.60	31.1	26.4	37.1	26.7	16.56	30.4	24.5	24.8
	(37.1)	(32.0)	(36.9)	(35.3)		(25.5)	(32.9)	(33.8)	(30.7)		(31.0)	(23.9)	(33.2)	(29.3)	
T_5	38.8	25.72	39.2	34.5	21.2	18.8	24.86	32.1	25.2	40.0	25.2	17.16	28.4	23.5	27.9
	(38.5)	(30.4)	(38.7)	(35.8)		(25.7)	(29.8)	(34.4)	(29.9)		(30.0)	(24.4)	(32.1)	(28.8)	
T_6	34.7	24.38	31.4	30.1	31.2	17.1	26.90	27.5	23.8	43.3	26.1	13.52	25.3	21.6	33.7
	(36.0)	(29.5)	(34.0)	(33.1)		(24.4)	(31.2)	(31.5)	(29.0)		(30.5)	(21.5)	(30.1)	(27.3)	
T_7	26.7	17.40	14.3	19.4	55.7	14.4	15.64	11.5	13.8	67.1	12.1	7.33	8.6	9.34	71.3
	(31.0)	(24.6)	(21.9)	(25.8)		(22.3)	(23.2)	(19.6)	(21.7)		(20.2)	(15.6)	(16.9)	(17.5)	
T_8	39.0	26.38	33.4	32.9	24.8	18.1	26.77	34.1	26.3	37.3	26.4	14.00	25.2	21.8	33.1
	(38.5)	(30.8)	(35.2)	(34.8)		(25.1)	(31.1)	(35.5)	(30.5)		(30.7)	(21.9)	(30.0)	(27.5)	
Control	48.1	34.24	49.1	43.8	—	43.4	39.47	43.3	42.0	—	36.1	27.46	34.5	32.6	—
	(43.8)	(35.7)	(44.4)	(41.3)		(41.2)	(38.8)	(41.4)	(40.4)		(36.9)	(31.5)	(35.9)	(34.7)	
SEm±	1.994	1.24	2.046	1.660		2.891	1.01	1.709	1.462		2.290	0.69	1.777	1.079	
CD (0.05)	5.97	3.73	6.13	4.97		8.66	3.05	5.12	4.38		6.86	2.08	5.32	3.23	

*Figures in parentheses are angular transformed values

Discussion

In case of management of leaf blight/rot disease it was observed that three treatments i.e. T_1, T_3 and T_7 were at par with each other indicating that the differences in their management efficiencies among three of them were non-significant. It can be noted here that treatment T_2 having the same composition except the presence of *Pseudomonas fluorescens* instead of *Trichoderma viride* was less effective. It indicates that *Pseudomonas fluorescens* is not as effective against the disease as *Trichoderma viride*. It was interesting to note that all treatments comprising of organics (FYM, Neem cake) and bioagents (*T.viride* or *P. fluorescens* or a combination of both) gave significantly higher yield compared to other treatments. Further, it can be observed that soil treatment with 20 t FYM/ha + Neem Cake @ 2 t/ha which differs from treatments T_1, T_2 and T_3 only by the absence of bioagents resulted lower yield (387.4 Kg/ha). Thus, it can be said that in the present study, addition of bioagents in organics particularly *T. viride* gives higher yield of dry catkins. Another interesting point was that spraying of Tebuconazole + Trifloxystrobin @ 0.1% was found to be the best treatment in case of leaf spot disease and stem rot disease and second best treatment (but at par with the best treatment, i.e. T_1) in case of leaf blight/rot disease. But the yield of dry catkins was much lesser (333.2 Kg/ha). Thus, the present investigation indicates that spraying of Tebuconazole + Trifloxystrobin @ 0.1% can control the diseases effectively but the control in diseases cannot be translated into increase in dry catkin yield of long pepper. The reason behind this could be that organics and bioagents are applied in soil during planting itself so they have a multitude of positive effects on vines resulting in higher yield unlike treatment T_7 that was sprayed as and when there appeared the diseases, particularly during monsoon season. However, our findings are in line with the findings of Kendre (2016) who proved the effectiveness of Neem Cake and *T. viride* in controlling foliar and root rot disease and increasing the yield of long pepper. Our findings are also in concurrence with earlier observations i.e. organics enhance soil suppressiveness which reduces the soil borne diseases. Additionally, they also improve soil quality leading to positive effects on crop productivity and plant health (Bonilla *et al.*, 2012). The mode of action of bioagents is already proven that they act by production of antipathogenic metabolites and stimulating the growth of beneficial microorganism (Agrios, 2005; Kumari, 2014).

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