

Original Research Article

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Integrated Management of Bulb Rot (*Fusarium proliferatum*) of Garlic (*Allium sativum* L.)

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ABSTRACT

Garlic (*Allium sativum* L.) is the second most widely used *Allium* next to onion belonging to the family Amaryllidaceae. Garlic crop is affected by several fungal, bacterial and viral diseases, of which, bulb rot is caused by *Fusarium proliferatum*. Damage caused by this pathogen can cause 45% yield losses. The research was carried out for the management of bulb rot using organic amendments. Five organic amendments and a fungicide (treated check) were evaluated for their efficacy under *in vitro* and *in vivo* against bulb rot of garlic incited by *Fusarium proliferatum*, Carbendazim @ 0.1% as treated control was effective in the inhibition of mycelial growth (100%) of *F. proliferatum* followed by T3(Neem cake-46.98%), T5(Mustard cake-44.72%), T1(Vermicompost-37.68%), T2(FYM-34.29%), T4(Poultry manure-28.89%). The organic amendments and a fungicide (treated check) were tested against bulb rot under field conditions during *Rabi* 2017-2018. Among all the treatments, soil drenching with carbendazim @ 2g/lit (Treated check) was found most effective in the reduction of disease incidence followed by Neem cake, Vermicompost, FYM, Mustard cake and Poultry manure as compared to untreated check. The maximum yield was recorded in (FYM-51q/ha). The maximum number of cloves and bulb weight was recorded in FYM and bulb size was maximum in vermicompost.

Keywords

Fungicide, *Fusarium proliferatum*, garlic, neem cake, organic amendments

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Introduction

Garlic (*Allium sativum* L.) is the second most important bulb vegetable after onion and it is grown worldwide in all temperate to sub-tropical areas as an important spice and medicinal plant (Rabinowitch and Currah, 2002). The origin of garlic is in Central Asia, but cultivated all over the world, in India, Spain, France, Egypt, Bulgaria, Hungary,

USA, Mexico and Brazil. Garlic is one of the important bulb crops grown and used as a spice or condiment throughout India. It is also important foreign exchange earner for India.

Garlic has higher nutritive value as compared to other bulbous crops. It is a rich source of carbohydrates (29%), proteins (6.3%), minerals (0.3%) and essential oils (0.1-0.4 %) and also contains fat, vitamin C and sulphur

(Memane *et al.*, 2008). In addition to this garlic has several medicinal values. It has antibacterial, antifungal, antiviral and antiprotozoal properties. It is beneficial to cardiovascular and immune system and has antioxidant and anticancer properties (Harris *et al.*, 2001).

In India about 35-40% losses estimated to be lost as post-harvest losses during handling and storage. *Fusarium* spp. is widely distributed in the world and is among soil-borne fungi that attack garlic and onion. Damage caused by this pathogen can produce 45% less yield (Schwartz and Mohan, 1995).

Materials and Methods

The experiment was conducted in the research laboratory and Department of Plant Pathology and Central Research Farm, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad. The experiment was laid out Randomize Block Design with three replications. Organic amendments were used to minimize the disease. Local variety of garlic was selected for the experiment.

Neem cake (500 kg/ha), Mustard cake (500 kg/ha), FYM (10t/ha), Vermicompost (5t/ha), Poultry manure (5t/ha) and Carbendazim (2gm/lit) as treated check were used to minimize the disease. Observations were recorded on Disease incidence (%) at 60, 75 and 90 DAS, plant height and number of leaves at 60, 75 and 90 DAS, bulb size, number of cloves, bulb weight at harvest and Yield (q/ha).

Disease incidence (%) was calculated by the following formula,

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

Poisoned food technique

The extracts of different organic amendments viz., Neem cake, Mustard cake, FYM, Poultry manure, Vermicompost, were prepared by suspending 30 g of each organic material in 150 ml sterile distilled water in flask and left for 25 days. The flasks were shaken on alternate day for thorough mixing and dissolution of the content.

After 25 days, the flasks were thoroughly shaken and content were filtered through double layered muslin cloth and autoclaved at 15lbs pressure for 20 minutes. The sterile extracts were used for testing their inhibitory effect on *Fusarium proliferatum* *in vitro* by poisoned food technique. The autoclaved extracts were individually added in previously sterilized melted and cooled potato dextrose agar medium @ 10 per cent v/v at the time of pouring in Petri plates and mixed thoroughly.

All the plates were incubated at room temperature at (27 + 2°C) after placing the 5 mm disc of actively growing 10 days old pure culture of *Fusarium proliferatum*. Four repetitions were kept for each treatment. Medium without organic extract served as control. The radial growth of the test organism and pathogen was measured after 10 days and the per cent inhibition was calculated as per the following formulae suggested (Yelmame *et al.*, 2010).

The percent inhibition of mycelia growth over control was derived by the following formula:

$$\text{Growth inhibition (\%)} = \frac{dc - dt}{dc} \times 100$$

where,

dc- diameter of colony in control.

dt- diameter of colony in treatment (Amadioha, 2003).

Results and Discussion

In-vivo efficacy of organic amendments

It is evident from the data that all the organic amendment tested reduced bulb rot incidence of garlic significantly over control. Neem cake was found significantly superior over all other treatments resulted maximum disease control, T₃(Neem cake-19.84%) followed by T₁(Vermicompost-20.92%), T₂(FYM-22.54%), T₅(Mustard cake-22.97%) and T₄(Poultry manure-27.92%). The probable reason for such findings may be the suppressive ability of neem organic amendment in inhibiting growth of soil borne pathogens has been demonstrated to be through competition, antibiosis or due to increase of soil microbial populations. The similar finding is report by Goudar and Kulkarni (1998), where they noticed minimum disease incidence using neem cake, Kimaru, *et al.*, (2004), who conducted both in the laboratory and greenhouse conditions to

investigate the effects of Neem Kernel cake powder (NKCP) on growth, sporulation and pathogenicity of tomato wilt caused by *Fusarium oxysporum* f. sp. *lycopersici* and in both the condition Neem cake was found significantly effective.

The maximum yield was found in T₂(FYM-51q/ha), followed by T₁(Vermicompost-47.66), T₃(Neem cake-40), T₄(Poultry manure-39.16), and T₅(Mustard cake-32.5) and T₆(Carbendazim-23.5) as compared with untreated T₀(Control-20.42) The maximum number of cloves and bulb weight was found in FYM, were bulb size was found in vermicompost. Amendment of organic matter in soil or horticultural container medium with either compost or vermicompost is essential to improve the soil physical, chemical and biological properties which subsequently enhance plant growth substantially. The enhanced nutrient uptake by plants, action of the HA fractions, and PGRs. (Brinchi *et al.*, 2010).

Table.1 Effect of organic amendments on bulb rot (*Fusarium proliferatum*) of garlic

| Treatments | | Percentage of Disease incidence | | | Avg. Dia. of pathogen (cm) | | | Mycelia growth inhibition (%) over control at 120 hrs |
|----------------|----------------|---------------------------------|-------|-------|----------------------------|------|-------|---|
| | | 30 DAS | 60DAS | 90DAS | 24hr | 72hr | 120hr | |
| T ₀ | Control | 19.05 | 27.49 | 36.12 | 2.45 | 4.9 | 7.96 | 0.00 |
| T ₁ | Vermicompost | 10.25 | 14.72 | 20.92 | 1.26 | 2.15 | 4.96 | 37.68 |
| T ₂ | F.Y.M. | 11.65 | 15.83 | 22.54 | 1.35 | 2.55 | 5.23 | 34.29 |
| T ₃ | Neem cake | 8.02 | 14.60 | 19.84 | 1.05 | 1.95 | 4.22 | 46.98 |
| T ₄ | Poultry manure | 13.16 | 19.39 | 27.92 | 1.48 | 3.05 | 5.66 | 28.89 |
| T ₅ | Mustard cake | 11.67 | 17.55 | 22.97 | 1.15 | 2.05 | 4.40 | 44.72 |
| T ₆ | Carbendazim | 6.27 | 12.88 | 13.26 | 0.00 | 0.00 | 0.00 | 100 |
| C.D.(5%) | | 3.45 | 2.67 | 4.66 | 0.40 | | | |
| S. Ed (±) | | 1.77 | 1.06 | 3.23 | 0.02 | | | |

Table.2 Effect of organic amendments on growth parameters of garlic

| Treatments | | Bulb weight | Bulb size | Number of cloves | Yield (q/ha) |
|----------------|------------------|-------------|--------------|------------------|--------------|
| T ₀ | Control | 19.03 | 2.23 | 11.92 | 20.42 |
| T ₁ | Vermicompost | 28.42 | 3.76 | 21.13 | 47.66 |
| T ₂ | F.Y.M. | 31.10 | 3.66 | 22.40 | 51 |
| T ₃ | Neem cake | 24.59 | 3.13 | 19.73 | 40 |
| T ₄ | Poultry manure | 22.37 | 3.06 | 19.13 | 39.16 |
| T ₅ | Mustard cake | 22.10 | 2.86 | 18.13 | 32.5 |
| T ₆ | Carbendazim | 19.65 | 2.63 | 15.86 | 23.5 |
| | C.D.(5%) | 2.18 | 0.18 | 0.78 | |
| | S. Ed (±) | 1.78 | 0.005 | 0.09 | |

In-vitro efficacy of organic amendments

All the organic amendments significantly inhibit the mycelia growth of *F. proliferatum*. Maximum inhibition of mycelial growth of *F. proliferatum* was observed in T₃ (Neem cake-46.98%) followed by T₅(Mustard cake-44.72%), T₁ (Vermicompost-37.68%), T₂ (FYM-34.29%), T₄ (poultry manure-28.89%). Our observations are conformity to Yelmame *et al.*, (2010), were tested the extracts of different organics of Neem cake, Mustard cake, FYM, Groundnut cake, Poultry manure, Press mud, Castor cake and coconut cake against *Fusarium solani* caused wilt of chilli in *in vitro*.

Minimum growth of pathogen was recorded in the extracts of Neem cake showing excellent inhibitory effect (59.8%) followed by Mustard cake (52.61%). Nikam *et al.*, (2007), tested various oilseed cakes viz., Groundnut cake, Cotton seed cake, Neem cake and Castor seed cake. Amongst four oil cakes tested Groundnut cake is proved to be effective against *F. oxysporum* f.sp. *ciceri* followed by Neem cake and Castor cake.

From present study, it was concluded that neem cake@ 500kg and FYM @10t/ha were found as best treatment to minimize bulb rot

disease of garlic where as in lab experiment neem cake and mustard cake were found to be most effective. Since chemicals have many hazardous effects on the environment as well as on the person who handles it while application in the field and consumers using the product, used of organic amendments in field condition would be considered as better, as it is beneficial and eco-friendly. Since, one year data is not sufficient to conclude concurrent result, further experimentations are required to confirm the results.

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