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**Plant Pathology**

# Evaluation of Plaster of Paris and Some Fungicides for Management of Foot rot of *Amorphophallus campanulatus* Blume Caused by *Sclerotium rolfsii* Sacc.

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**Abstract**

Incidence of Foot rot disease of Elephant foot yam [*Amorphophallus campanulatus* Blume, syn: *A. paeoniifolius* (Dennst.) Nicolson] caused by *Sclerotium rolfsii* Sacc. is common in West Bengal. Occasionally it causes severe damage of the crop. When Plaster of Paris used on the diseased tissue in standing crop, it showed strong adverse effect on mycelial growth and survival of sclerotia. White mycelia and sclerotia produced on disease tissue lost their viability. Plant with small lesion grew normally indicating that the disease was checked without causing any phytotoxic effect. Plaster of Paris of commercial grade ($CaSO_4.½ H_2O$), available in synthetic bag in hardware shop. In laboratory test on viability of sclerotia, Plaster of Paris showed similar adverse effect. Eight fungicides (Indofil M-45, Bavistin, Blitox, Vitavax Power, Kavach, Curzet, Krilaxyl MZ) used in this test reduced sclerotial germination. Vitavax Power (Carboxin 37.5% + Thiram 37.5% WP) totally inhibited sclerotial germination. Kavach (Chlorothalonil 75%) and Krilaxyl MZ (Metalaxyl 8% + Mancozeb 64%) reduced germination upto 95%. Application of Plaster of Paris at three different doses at the base of the plant (2.0, 5.0 and 10.0 grams/plant) did not cause any phytotoxic symptoms like necrosis, epinasty, hyponasty, wilting, leaf tip injury, leaf surface injury, vein clearing, rotting at collar region on six different crops i.e. elephant foot yam, groundnut, brinjal, chilli, basella and radish. Hence, it may be incorporated in Integrated Disease Management (IDM) programme.

**Highlights**

- Plaster of Paris of commercial grade and some fungicides were evaluated against *Sclerotium rolfsii* causing Foot rot of elephant foot yam.
- Plaster of Paris showed strong adverse effect on mycelial growth and survival of sclerotia under field condition without producing phytotoxicity.
- In laboratory test, Plaster of Paris and Vitavax Power totally inhibited sclerotial germination.
- Low cost Plaster of Paris is available in powder form for plastering/interior decoration of buildings can be incorporated in Integrated Disease Management programme

**Keywords:** Foot rot, elephant foot yam, Plaster of Paris, *Sclerotium rolfsii*

Elephant foot yam (*Amorphophallus campanulatus* Blume, syn: *A. paeoniifolius* (Dennst.) Nicolson, 2n =28; Family: Araceae) is an important vegetable as well as cash crop in West Bengal. It is cultivated in all most all the districts of West Bengal. Total area under cultivation of the crop is approximately 11730 ha with a production of 163560 metric

tons in the state. The crop is severely affected by Foot rot disease caused by *Sclerotium rolfsii* Sacc. (Khatua and Maiti, 1982). The disease frequently occurs in betelvine also and caused severe damage to the crop in West Bengal (Maiti *et al*., 1986). Incidence of the disease is common where ever these crops are grown. The pathogen is a soil borne polyphagous fungal parasite, distributed in tropical and sub-tropical regions of the world, where high or warm temperature prevails. It attacks more than 500 species of plants in about 100 families including vegetable crops, cereal crops, forage plants, flowers, fruits and plantation crops, weeds etc. (Aycock, 1966; Keyser and Ferreira, 1988; Stephen and Rebecca, 1992; Mustafee, 2004; Madhavi and Bhattiprolu, 2011). Suitable measure for its management is lacking. Singh *et al.* (2013) reported that *Trichoderma viride* could be used for the integrated management of the diseases caused by soilborne plant pathogens. Scope for use of Plaster of Paris ($CaSO_4$.½ $H_2O$) in management of the diseases caused by *S. rolfsii* in sub-humid lateritic red and undulating agro-climatic region of West Bengal was exploited in this study. Plaster of Paris is extensively used in ceramic industry for preparation of models and moulds. It is also used as key raw material in the manufacture of toys and statues, chalk crayons, gypsum plaster boards, and decorative picture frames besides wide range of applications in the interior decoration of buildings and other establishments (Anonymous, 2011). Some fungicides were included in this study to get suitable alternative and comparison.

## Materials and Methods

### Effect of Plaster of Paris and fungicides on S. rolfsii

Plaster of Paris (commercial grade, Rs. 900/-per quintal) was collected from local hardware shop. Plaster of Paris is available in powder form on synthetic bag for plastering/ interior decoration of buildings. In addition to Plaster of Paris, seven fungicide namely Indofil M-45, Bavistin, Blitox, Vitavax Power, Kavach, Curzet, Krilaxyl MZ was used in this experiment for comparison. To evaluate the effect of

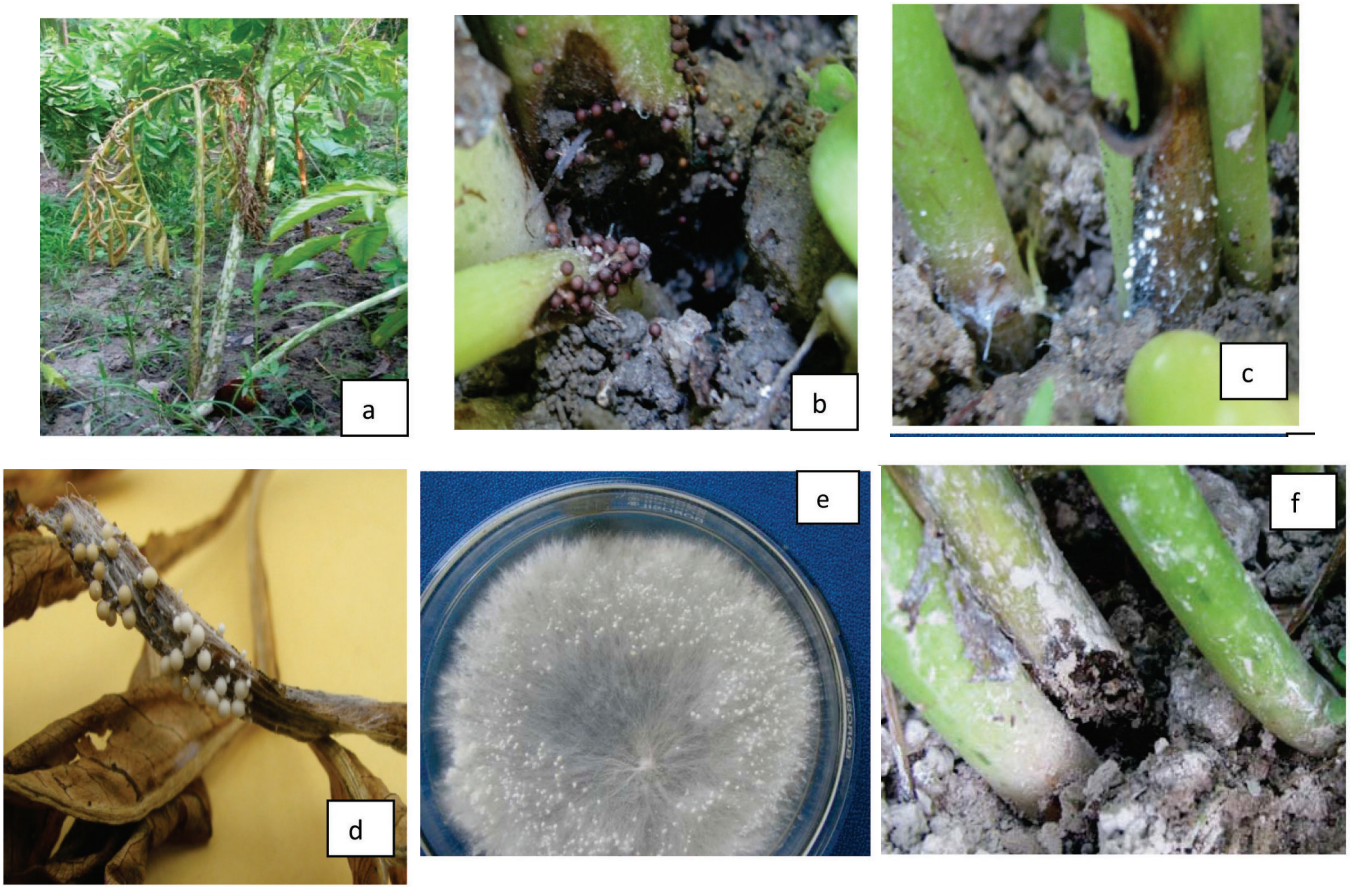


**Fig. 1:** *S. rolfsii* infected Elephant foot yam a) Infected plants showing symptoms b) c & d Sclerotia adhered with infected plant e) Growth of the fungus on PDA medium f) Infected plants treated with Plaster of Paris

 

different chemicals on sclerotial germination, *S. rolfsii* infected elephant foot yam plants with adhered sclerotia (Plate 1a, 1b, 1c, 1d) were directly collected from the infested field. The infected portion of the stem was cut into 2.0 inch pieces. Each of such pieces contained white mycelial growth on the surface and sclerotia on it. These small pieces of elephant foot yam plants were then placed on petriplates. Chemials were applied separately by dusting over the cut piece directly. There were three replications for each treatment. The treated petriplates were then incubated at 28±1ºC in BOD incubator. After 5 days of incubation 20 sclerotia from each replication of each treatment were taken randomly and shifted separately to the petriplate containing fresh PDA medium, and incubated in BOD incubator. Data of sclerotial germination were recorded at an interval of 2 days up to 10 days. The experiment was carried out in completely randomized design with three replicates. Data thus obtained were subjected to analysis of variance.

**Effect of Plaster of Paris on S. rolfsii in standing crop**

Plaster of Paris was applied directly over the infected portion of elephant foot yam plant (approximately 3 inches in length around the collar region, Plate 1f) where mycelium and sclerotia of the fungus were adhered. Plaster of Paris was dusted on ten such plants @ 2.5g/plant. Untreated control was also kept for each case to compare with the treated plants. Ten days after treatment, the treated and untreated experimental plants parts were brought to the laboratory for isolation of the fungus. The sclerotia from treated and untreated plants transferred to antibiotic (chloramphenicol) amended PDA medium aseptically to record the viability of sclerotia (Plate e). Similarly, infected stem tissue from all the plants were transferred separately into the medium in petriplates to record mycelial growth of the fungi. The petriplates were incubated at 28±1ºC in BOD incubator. Observations were taken at 10 days of incubation on the germination of sclerotia and mycelial growth from infected tissue.

***Determination of phytotoxicity of Plaster of Paris***

To know the phytotoxic effect of Plaster of Paris, six crops i.e. elephant foot yam, groundnut, brinjal, chilli, basella and radish were chosen. Experiment was conducted in PSB Agricultural Farm, Birbhum during the period of 2011-12. Plaster of Paris was applied around the collar region of plants in three different doses (2.0, 5.0 and 10.0 grams/ plant). Untreated control was also maintained. There were four treatments including control with four replications. There was five plants/replication. Observations were recorded at an interval of five days up to 15 days. Phytotoxic effect in terms of symptoms such as leaf chlorosis, leaf tip burning, leaf necrosis, leaf epinasty, leaf hyponasty, vein clearing, rosetting, rotting at collar region and wilting were critically observed. The extent of phytotoxicity was recorded based on the standard scale (0 - 10 scale) prescribed by Central Insecticide Board and Registration Committee (Sunitha and Jagginavar, 2010).

**Results and Discussion**

**Effect of Plaster of Paris on different growth stages of *S. rolfsii***

Plaster of Paris is basically calcium sulphate with half molecule of water of crystallization ($CaSO_4.½ H_2O$) and hygroscopic characteristics is obtained by duly calcined the raw material i.e. Gypsum ($CaSO_4.2H_2O$) (Anonymous, 2011). It possesses outstanding property of setting and subsequent hardening when mixed with water.

Prominent adverse effect of Plaster of Paris (@ 2.5g/ infected area/plant) on two different growth stages of *S. rolfsii* (mycelial stage and sclerotial stage) was recorded in the experiment. Plaster of Paris was applied directly as powder form over the infected area of elephant foot yam plant and observation was taken at 10 days after application. The whitish mycelial mat from collar region of all the treated plants was found disappeared. Further formation of sclerotia was stopped. The existing sclerotia became deformed and dried. The sclerotia and small bits of treated infected plant tissue were transferred to PDA medium for mycelial growth and sclerotial germination but no further growth were recorded at 10 days after inoculation. Whereas, in case of untreated infected plants growth of thick whitish mycelial mat was formed with huge numbers of sclerotia. Each of the sclerotium was germinated, and growth of the fungus was recorded from all of the untreated infected plant bits (Table 1).

Among the forty numbers of sclerotia treated by respective chemicals separately twenty of each chemical treated sclerotia were transferred aseptically to the PDA medium after 5days to know their efficacy.

 

**Table 2:** Effect of Plaster of Paris and other chemicals on germination of sclerotia at 10 days after incubation

| Plaster of Paris & fungicides | Dose in g (applied on diseased tissue) | No. of sclerotia/ replication in PDA medium | Sclerotial germination (%) |
|---|---|---|---|
| Plaster of Paris (Local hardwire shop) | 2.5 | 20 | 0.00[a](0.00) |
| Indofil M-45 (Mancozeb 75% WP, Indofil Industries Ltd.) | 2.5 | 20 | 15.00[c](9.88) |
| Bavistin (Carbendazim 50% WP, BASF) | 1.0 | 20 | 40.00[e](16.36) |
| Blitox (Copper oxy chloride 50% WP, Rallis India Ltd.) | 4.0 | 20 | 70.00[f](21.96) |
| Vitavax Power (Carboxin 37.5% + Thiram 37.5% WP, Dhanuka Agritech Limited) | 2.0 | 20 | 0.00[a](0.00) |
| Kavach (Chlorothalonil 75% WP, *Syngenta* India Ltd.) | 2.0 | 20 | 5.00[b](5.73) |
| Curzet (Cymoxanil 8% + Mancozeb 64% WP, DoPont) | 2.5 | 20 | 25.00[d](12.87) |
| Krilaxyl MZ (Metalaxyl 8% + Mancozeb 64% WP, Krishi Rasayan Pvt. Ltd.) | 2.5 | 20 | 5.00[b](5.73) |
| Untreated control | - | 20 | 98.33[g](26.32) |
| SEm (±) | | | 0.58 |
| CD (p<0.01) | | | 2.36 |
| C.V. | | | 9.14 |

Data in parentheses indicate angular transformed value.In a column, means followed by same letter are not significantly different by DMRT (p<0.01).

### *Effect of Plaster of Paris and other chemicals on germination of sclerotia*

Efficacy of eight chemicals was tested on sclerotial germination in laboratory condition. Twenty sclerotia from each replication of each chemical treatment were transferred aseptically to the PDA medium 5days after treatment to know the effect of the individual chemical. Ten days after incubation it was found that no sclerotia were germinated in the treatment where Plaster of Paris and Vitavax Power were applied. Plaster of Paris and Vitavax Power were statistically at par with each other but proved superior to the other chemicals. All the chemicals performed significantly better than untreated control where 98.33 per cent sclerotia were germinated. Kavach and Krilaxyl MZ were recorded second best treatment. In these treatments, only 5 per cent sclerotia were germinated. Blitox was less effective against the fungus as 70% sclerotial germination was recorded. Other treatments such as Indofil M-45 (15%) also proved efficacious followed by curzet (25%) and Bavistin (40%) (Table 2).

Viswakarma and Basu (1982) reported effectiveness of Vitavax (Carboxin) against the root disease of *Cicer arietinum* caused by *S. rolfsii*. Adverse effect of thiram against *S. rolfsii* was recorded by Palaiah (2002) and benodanil by Maiti *et al.* (1986) observed sensitivity of Thiram and other chemicals to various isolates of. Earlier reports regarding role of gypsum for disease management is very much interesting. Gypsum decreased disease

Table 1. Effect of Plaster of Paris in field and laboratory condition against S. rolfsii

| Field condition | | | | Laboratory condition | | | |
|---|---|---|---|---|---|---|---|
| Mycelial stage | | Sclerotial stage | | Sclerotial germination | | Growth of S. rolfsii | |
| Treated plant | Untreated plant | Treated plant | Untreated plant | Sclerotia from treated plant | Sclerotia from un- treated plant | Infected small bits of treated plant | Infected small bits of un- treated plant |
| Mycelial mat at collar region found disappeared | Thick mycelial mat were observed with huge numbers of sclerotia. Rotting at the collar region was recorded. | Mycelium mat were disappeared, rotting stopped, and recorded no further formation of sclerotia. Sclerotia were found dry and deformed. The infected plants become healthy. | Thick mycelial mat with abundant sclerotia were observed. Complete rotting of the pseudostem was recorded and infected pseudostems were died. | None of the sclerotia were germinated. | Huge mycelial growth was observed from each sclerotia. | No mycelial or sclerotial growth was recorded. | Huge mycelial growth and formation of sclerotia were recorded. |

 

development caused by *Pythium* spp. up to 50% in peanut compared to untreated control (James Grichar *et al.*, 2002). Garren and Jackson (1973) reported that high levels of Ca may control the pathogen that causes southern blight or that added Ca may increase resistance or productivity of the host plant. Sugimoto *et al.* (2008) observed the effects of several calcium compounds on *Phytophthora* stem rot of soybean. He reported that the calcium compound Ca(COOH) –A was the most effective in suppressing the disease incidence.

Use of Plaster of Paris is not tested earlier for management soil borne disease caused by *S. rolfsii*. Fungicides tested here are costly. On the other hand, Plaster of Paris is comparatively cheap and may be recommended to the farmer for management of the disease of economically important crops.

### *Visual phytotoxicity of Plaster of Paris on different crops*

It was found from the experiment that application of Plaster of Paris at three different doses did not cause any phytotoxic symptoms like necrosis, epinasty, hyponasty, wilting, leaf tip injury, leaf surface injury, vein clearing, rotting at collar region on six different crops i.e. elephant foot yam, groundnut, brinjal, chilli, basella and radish. This can be concluded from the study that Plaster of Paris can safely be used for disease management programme.

## Conclusion

Though, gypsum (Calcium sulphate dihydrate, $CaSO_4.2H_2O$) and Plaster of Paris (Calcium sulphate hemihydrates, $CaSO_4.½\ H_2O$) are very closely related chemicals, performance of the Plaster of Paris appeared to be better as it showed lethal action against this pathogen. Plaster of Paris is easily available and can be a useful chemical in disease (caused by *Sclerotium rolfsii*) management programme of crops where there is relatively wide spacing between pants. This chemical can also be utilized for management of foot rot of betelvine caused by *S. rolfsii*.

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