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Fruit and vine rot of pointed gourd-etiology, epidemiology and management

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Fruit and vine rot disease of pointed gourd appears every year and causes extensive damage. It infects vines at the nodal or internodal region and the affected vines above the point of infection dries up. Water soaked lesion develops at any portion of fruit, affected tissue shrinks and turns brown. In cloudy and rainy weather, thin layer of white fungal growth covers the affected tissue of the stem and fruit. Abundant sporangia are formed on such growth. The disease also causes leaf blight under condition of continuous rainy days for a few days. Sporangiophores are undifferentiated, sympoidially branched, sporangia are ovoid or elliptical in shape, germinate by producing germ tube under humid condition or by releasing zoospores continues its growth through empty sporangium. The pathogen is identified as *Phytophthora cinnamomi.*

The pathogen survives in soil, soil solarization eliminates the fungus, but natural flood does not eliminate the fungus from soil.

In vitro study shows that 12 fungicides (copper oxychloride, copper hydroxide, shield, ziram, thiram, mancozeb, captafol, ediphenphos, propiconazole, hexaconazole, tabuconazole, metalaxyl + mancozeb) out of 34 fungicides tested, inhibit hyphal growth, sporangium formation and germination, in field condition, matalaxyl + mancozeb, copper oxychloride, mancozeb, thiram, Shield — a copper sulphate based formulations give significant control of the disease.

Key words : Fruit and vine rot, *Phytophthora cinnamomi,* soil survival, chemical control

INTRODUCTION

Pointed gourd (*Trichosanthes dioica* Roxb.) also called 'parwal' or 'patal' is an important and highly accepted cucurbitaceous vegetable crop extensively cultivated in Eastern India, particularly in Bihar, Eastern Uttar Pradesh, West Bengal, Assam and Tripura, to some extent in Orissa, Madhya Pradesh, Maharashtra and Gujarat. The area under pointed gourd cultivation is about 10,000 ha in Uttar Pradesh and 14,000 ha in North Bihar (Singh, 1989). This crop is widely accepted, and is available for nearly eight months of the year. It is called "King of gourds" because of its higher nutrient content than other cucurbits.

As the crop prefers the warm condition and major part of the growth phase passes through rainy season, it suffers from large number of diseases. So far around eight fungal, one nematode and two virus (Plumb and Mukhopadhyay, 2000) diseases have been reported. Among the diseases downy mildew (Bilgrami *et al.,* 1979 ; Khatua *et al.,* 1981b), fruit and vine rot (Khatua *et al.,* 1981a), root knot (Mukherjee and Sharma, 1973) cause major damage of the corp. In West Bengal these three diseases are prevalent (Khatua and Maiti, 2982 ; Khatua *et al.,* 1981a). Earlier studies on fungal diseases of pointed gourd are related mainly with the report on incidence of the disease.

In West Bengal fruit and vine rot of pointed gourd appears every year and causes severe damage of the corp. Destruction of the entire field is also common in the rainy season. The disease is popularly known to the farmers as '*Haja*'. Fruit rot disease of pointed gourd is reported to be caused by *Pythium aphanidermatum* (Chattopadhyay and Sengupta, 1951), *P. cucurbitacearum* (Chaudhuri, 1975), *Fusarium equiseti* (Kritagyan and Singh, 1980) and *Phytophthora cinnamomi* (Khatua *et al.*, 1981a). Detail scientific information regarding fruit and vine rot disease i.e. 'Haja' of the farmer, its causal organism and management, is not known. Present investigation includes recording of details of the symptoms of Fruit and vine rot disease of pointed gourd, identification of the causal pathogen, mode of survival of the organism and development of suitable management practices.

MATERIALS AND METHODS

Detection of Phytophthora cinnamomi from soil

Pointed gourd fruit was used as bait for colonization of *Phytophthora cinnamomi* and *Pythium aphanidermatum*, if present in field soil. A pointed gourd fruit was transversely cut towards any one end to remove 1-2 cm length and such fruit was buried in moist soil by placing the cut end in downward direction, 5-8 cm below the soil surface. Fifty fruits were randomly placed in the soil of each selected field. The soil around the fruit was kept moist by addition of water, if necessary.

The fruit underwent partial rotting towards the cut of the fruit within 3-5 days. If *Pythium, Phytophthora* and other fungi were present in soil around the fruit tissue they colonized on the cut surface, developing a thin white mycelial growth.

Colonized fruit was removed from the soil, gently washed with water to remove soil particle. Portion of colonized tissue was put in water in half-submerged condition in petridish. In next 48 hours *Pythium, Phytophthora* and / or other fungi grew in water beyond the area of fruit tissue and produced hyphae and sporangium. The identity of fungi in water was confirmed through microscopic examination (the petriplate with the fruit tissue and mycelial growth in water was directly used for microscopic examination).

Solarization on the survival of Phytophthora cinnamomi in soil

After destruction of pointed gourd crop by Fruit and vine rot disease, the affected field was cleaned ; the land was ploughed down in 2nd week of August. The land was leveled and pressed with ladder. Pointed gourd fruits were placed in the field soil, as bait for colonization of *Phytophthora* and *Pythium* sp. These two fungi colonized on the cut surfacee (bait) of prointed gourd fruit after 3-5 days and such fruits were brought to the laboratory for to study the nature of colonization.

After recording the presence of fungi, land was divided into strips of four feet wide with irrigation channel in between them. Two such stirps were covered by thick transparent polythene sheet for 3 weeks and one strip was kept as control without coverning. During the period for covering there were rain also. After 7th and 17th days, the polythene was removed ; soil of this bed was turned over with spade, leveled and again covered with polythene sheet. Light irrigation was given when necessary, with the help of a rose can to keep the soil moist. Similar practices were followed in control plot where soil surface was not covered with polythene sheet. After 3 weeks polythene was removed and pointed ground fruit was placed again in soil as bait (50 fruits per bed) in the solarized and control plot to detect *P. cinnamomi* in soil.

Bioassay of fungicides

Medium for good growth and production of the sporangium could not be developed as yet. If agar disc with mycelial growth of *Phytophthora cinnamomi* species was put over a medium containing chemotoxicant, the hyphal growth moved upward touching the upper lid of petridish. Assay of fungicide of poison food technique was difficult for this fungus. In aqueous condition this fungus grew well, produced abundant sporangia and the sporangia liberated zoospores. Proliferation of sporangium also occurred in such condition. Taking and advantage of this property bioassay of fungicide has been standardized.

Small pieces of naturally infected fruit tissue were put in a petridish containing aqueous solution/ suspension of fungicide, in half submerged condition. Five replications were maintained for each concentration of a fungicide. Suitable control was maintained using water only. The plates were kept in room temperature or in BOD at 28±1°C for

48h. Then the plates were observed under microscopes to record the extent of mycelial growth in water/fungicide solution beyond the area of fruit tissue. Simultaneously extent of sporangia formation and germination of sporangia were recorded, Presence of empty sporangia or proliferated sporangia indicated the germination of sporangia.

Assessment of fungicides in field condition

Field experiments were conducted in farmers' plot in District Nadia at three locations to study the effect of fungicides on Fruit and vine rot of pointed gourd. The crop was planted in October 2001. Stem cuttings were used as propagative materials. Individual plot size was 40 feet × 4 feet and there was irrigation channel in between two plots. Three replications were maintained for each treatment. Suitable control was maintained where no fungicide was sprayed. Farmer's practices were followed in relation to method of planting and crop management, excepting use of fungicides.

Spraying of fungicide was started at the second week of January at 10-15 days interval. Spraying could not be done at fixed interval because in the later phase fungicides were sprayed on day of harvest of fruits. Fruits were harvested in the morning hours and spraying was done just before sunset.

Spraying Contaf and Tilt were withdrawn after March. Observation on vine infection and fruit infection was separately recorded on 6.6.2002 and 26.6.2002.

RESULTS AND DISCUSSION

The disease symptoms

In West Bengal the pointed gourd crop is grown in soil bed or raised on sacffold. Sometimes the crop is maintained as ratoon corp.

In ratoon crop, drying of vines is found in early March, If there is shower at the end of February — March. On examination, oozing and drying of gummy substance is found in one or two internode(s). Such vine dries up above the point of oozing. The internodal region on the two sides of oozing point covering a length of 2-4 cm turns brown. If there is rain or cloudy weather white mycelial growth of the fungus can be seen on the brown region. On laboratory investigation the fungus is found to produce sporangia on the affected tissue.

Oozing of sticky gummy substances is common in female flower, just below the base of the petal. It is found in all fields. Such oozing does not hamper fruit develpment. Sticky and gummy substances also ooze out of fruit and stem at the point of infection.

Similar symptom i.e. drying of vines is found in newly planted crop in April or May after covering of the field bed with vines and following a heavy or light shower. Farmers popularly call it as *Dry haja* or *Sukno haja.*

In April and May a few fruits have been found to be affected. infection starts at any point of the fruit usually near the middle portion. Affected portion shrinks and dries up. If there is rain or cloudy weather or field is moist due to application of irrigation, then white mycelial growth is found on the affected portion. Sporangia may be formed on the affected tissue.

After the monsoon rain starts in June-July, the field soil remain moist. Frequent rains and cloudy conditions favour development of disease. In this situation infection spreads very fast, more and more vines and fruits are infected. Intensity of fruit infection becomes more. Affected tissue becomes water soaked and discoloured. In all cases the affected area of fruit is covered by white mycelial growth and abundant sporangia are formed on such mycelial growth. Affected portion of the stem (vine) appears water soaked with white mycelial growth and abundant sporangia. During this phase stem infection is also found mainly in the nodal region.

During rainy days oozing of sticky substances from diseased stem, leaf and fruit tissue is more common is incidence and oozing took place before appearance of mycelial growth on the surface of the diseased tissue.

If rain continues for a few consecutive days and temperature is warm or hot, infection initiates on leaves near the point of affachment of leaf lamina with petiole, causing leaf blight symptom. From there, infection spreads to vine nodes developing brown lesion on stem leading to death of vines. Young leaves and tender vines are more susceptible.

When the disease is severe in the field, leaf spot and marginal blight symptoms on mature leaves are also found.

If number of tender vines are more in number over the crop bed the disease spreads rapidly and entire crop may be damaged by this disease. Stagnation of rainwater in the field accelerates the spread of the disease.

The pathogen

If small bits of artificially inoculated and colonized fruit tissue, naturally infected fruit or stem tissue were put in a petridish in half submerged condition in water, the fungus produced profuse mycelia and sporangia in water. Sporangiophores were indeterminate undifferentiated, sympodially branched the sporangia were ovoid to elliptical measuring 45-145 µm × 20-72 µm (average 86.6 µm × 48.6 µm). Breadth of hyphae and sporangiophore varied from 3 to 6.25 µ.

Zoospores were relesed through the opening at the top of the sporangia. The interesting phenomenon was that the sporangia proliferated 1-3 times at same point. Growth of sporangiophore might continue through the empty proliferated sporangia to produce new sporangia. Empty sporangia remained attached with the sporangiophore. Sporangia also germinated directly by producing germ tube (1-2) in humid condition but in absence of free water.

The fungus produced chlamydospores which were usually intercalary formed singly or in chain. Occasionally chlamydospores were produced on the terminal end of the hyphae. They were elliptical in shape, extremely variable in size, measuring 2.4-19.2 µm × 2.4-14.4 µm (average 10.96 µm × 7.9 µm).

No oospore was detected in affected tissue or in culture medium. The fungus is identified as *Phytophthora cinnamomi* (Waterhouse, 1970 ; Zentmyer, 1980).

Host Range

In the present study pointed gourd isolate of *P. cinnamomi* infected fruits of the number of vegetables in laboratory condition (bitter gourd, ridge gourd, snake gourd, ivy gourd, cucumber, spiny gourd, tomato, capsicum, brinjal) and occasionally ridge gourd in field condition.

P. cinnamomi was known to infect large number of plants including ornamentals and shrubs and bushy plants in the nursery (Ann and Ann, 2000, Orlikowski, 1999 ; Latorre *et al.*, 1997, Caruso and Wilcox, 1990, Zentmyer, 1980). In India root rot of *Cedrus deodara* has been reported recently (Karthikeyan *et al.,* 2000 ; Singh *et al.*, 2000). Infection of cucurbit fruits by *Phytophthora* spp. was not reported earlier. Similarly infection of tomato, capsicum, brinjal by *P. cinnamomi* was recorded for the first time.

Survival of Phytophthora cinnamomi infecting pointed gourd in cultivated field soil

Phytophthora cinnamomi colonized on the cut surface of fruit tissue used as bait (Table 1). Besides *P. cinnamomi and Pythium aphenidermatum, Phytophthora nicotianae* var. *nicotianae* and other *Pythium* sp. also grew on the cut surface. Some of the fruits were colonized by *Phytophthora cinnamomi* alone or both *Phytophthora cinnamomi* and *Pythium aphanidermatum.* A good percentage of fruits were damaged by soil insects.

In all ratoon crop fields and fields where pointed gourd was grown in previous year there was incidence of fruit and vine rot disease in previous season (2001). In all such fields *Phytophthora cinnamomi* has been deteced by baiting. In seven fields where there were crops other than pointed gourd in the previous season, *Phytophthora cinnamomi* was not detected. This proved that *Phytophthora cinnamomi* was present in the field soil before incidence of the disease in crop field under study (2002) and this also proved the survival potential of *Phytophthora cinnamomi* in soil.

Table 1 : Detection of (survival) *Phytophthora cinnamomi and Pythium aphanidermatum* in soil of pointed gourd field.

Date of Placing of fruit in soil	% of insect damage	% of fruit colonized by fungi/bacteria			
		Phytophthora cinnamomi	*Pythium aphanidermatum*	Other *Pythium* sp.	Other fungi & / or bacteria
Ratoon crop					
5.4.2002	14.8	44.4	7.4	11.1	22.2
6.4.2002	Nil	7.6	46.2	11.5	34.6
19.4.2002	53.8	23.1	Nil	Nil	23.1
19.4.2002	25.0	32.2	17.8	Nil	25.0
19.4.2002	35.7	25.0	10.7	7.2	17.8
19.4.2002	11.5	15.3	34.6	15.3	23.1
19.4.2002	55.5	11.1	14.8	Nil	18.5
19.4.2002	44.4	18.5	14.8	Nil	22.2
26.4.2002	40.0	36.0	8.0	Nil	16.0
26.4.2002	28.0	24.0	16.0	8.0	24.0
In field where crops pointed gourd were cultivated in the previous seasons (other crop-pointed gourd)					
6.4.2002	20.0	Nil	20.0	8.0	52
3.5.2002	7.14	32.14	21.4	14.2	25
3.5.2002	34.4	17.24	13.7	6.8	27.5
3.5.2002	17.8	25.0	28.5	21.4	7.14
20.4.2002	24.1	27.5	10.3	13.4	24.1
20.4.2002	14.2	10.7	17.8	7.14	50.0
20.4.2002	35.7	Nil	10.7	17.8	35.7
26.4.2002	17.2	27.5	13.7	Nil	41.3
26.4.2002	17.8	21.4	14.2	10.7	35.7
26.4.2002	10.7	25.0	10.7	17.8	35.7
In fields where crops other than pointed gourd were cultivated in the previous season (Other crop-pointed groud)					
1.4.2002	Nil	7.6	38.4	Nil	53.8
1.4.2002	Nil	Nil	19.2	23.1	57.6
1.4.2002	24.0	Nil	16.0	8.0	52.0
5.4.2002	Nil	Nil	7.6	3.8	88.4
5.4.2002	Nil	Nil (11.5*)	26.9	15.3	46.15
5.4.2002	25.9	Nil (3.7*)	Nil	37.03	33.3
19.4.2002	74.1	Nil	3.7	7.4	14.8

* *Phytophthora nicotianae* var. *nicotianae*

Pythium aphanidermatum was detected from 25 field out of 27 fields. No correlation was found between presence of *P. aphenidermatum* and types of previous corp. In two fields *Phytophthora nicotianae* var. detected and it caused fruit rot of brinjal on laboratory test.

This indicated that both the fungi were soil borne survival of *P. cinnamomi* was influenced by crop rotation but crop rotation has less influence on *P. aphanidermatum*. This fungus is actually a soil inhabitant (Singh and Singh, 1984). Soil survival potential of *P. cinnamomi* is already established (Zentmyer, 1980).

Effect of flood on the survival of the pathogen in soil

During September 2000 (25.9.2000) there was a devastating flood in West Bengal, destroying crops in thousands of hectares. Three farmers' field were selected where the pointed gourd crop was under 3-5' of standing water for 10-15 days. In all the fields, the plants were rotten. In first week of November, 2000 the farmers removed the plant debris and ploughed down the lands. Attempt was taken whether *Phytophthora* sp. could be detected from the soil of three such field.

In all three, the *Phytophthora* was detected from the colonized tissue. Though majority of fruits was colonized by both *Phythium aphanidermatum* and *Phytophthora cinnamomi.* This indicated that submerged condition did not eliminate the fungus from the soil and also indicated the survival potential of the fungus (*Phytophthora cinnamomi*) in soil.

Effect of solarization on the survival of Phytophthora cinnamomi and Pythium aphanidermatum in soil

Before solarization, twenty two percent of such fruits (used as bait) were colonized by *Phytophthora cinnamomi*, 46.6 % fruit by *Pythium aphenidermatum,* 10 % fruits by both the fungi and 9.3 % by bacteria and 6.6 % fruits were damaged by insect. Percentage of fruit remained unaffected was 5.3 % (Table 2).

In solarized plots, seven days after placement of fruits in soil, a few fruits were rotted and such rotting was found to be due to bacteria. The process (baiting) was repeated again. Same results was obtained. None of the fruits were colonized by *Pythium aphanidermatum* or *P. cinnamomi* (Table 2). But in control plot rotting of fruits was found within 3-5 days and number of fruits colonized by *P. cinnamomi* and *P. aphanidermatum* was more or less similar to those recorded before solarization.

Table 2 : Percent colonization of pointed gourd fruit used as bait, by *Phytophthora cinnamomi and Pythium aphanidermatum*

Colonized by	Percent colonization before				Percent colonization after solarization			
	Plot I	Plot II	Plot III Control	Average	Plot I	Plot II	Average	Plot III Control
Phytophthora cinnamomi	20.0	24.0	22.0	22.0	Nil	Nil	Nil	18.0
Pythium aphanidermatum	42.0	48.0	50.0	46.6	Nil	Nil	Nil	48.0
P. cinnamomi & P. aphanidermatum	12.0	10.0	8.0	10.0	Nil	Nil	Nil	8.0
Bacteria	8.0	8.0	12.0	9.3	5.0	3.0	4.0	11.0
Insect damage	10.0	4.0	6.0	6.6	Nil	Nil	Nil	9.0
Not colonized by fungi or bacteria		6.0	2.0	5.3	95.0	97.3	96.0	6.0

This proved *Pythium aphanidermaum* and *P. cinnamomi* present in the soil of infested pointed gourd field were eliminated by solar heating or their population became very low to detect by baiting. Solar treatment was started a few days after removal of crop and crop debris. Possibly both the fungi were in active mycelial and asexual reproductive stage in soil and in this stage the fungi were more sensitive to solar heating.

There are reports regarding reduction of population *P. cinnamomi* from soil or control of diseases caused by *P. cinnamomi* (Juarez *et al.*, 1991 ; Pinkerton *et al.*, 2000, Zentmyer 1980) by solarization. Solarization was practiced in control of *Phytophthora* disease of vegetable — Buck eye rot of tomato (Satour *et al.*, 1991) *Phytophthora* blight of tomato (Duff and Barnaart, 1992, Chellemi *et al.*, 1994), *Phytophthora* blight of capsicum (Polizzi *et al.*, 1994). Similar results were obtained in present study. *P. cinnamomi* and *P. aphanidermatum* were eliminated by solarization from field soil after removal of severely affected pointed gourd plants.

Bioassay of fungicides against Phytophthora cinnamomi

Among the 34 fungicides tested, 15 fungicides were protective, 17 were systemic, 2 were combination products. Most of the fungicides showed adverse effect on sporangia formation and sporangial germination (Table 3). Details of findings of bio-assay study are as follows.

Foltaf and Folicure completely inhibited mycelial growth, sporangia formation and sporangial germination at concentration of 0.0625 g or ml/l. Seven fungicides namely Blitox, EmcopB, Cuman L, Vitavax, Opas, Fujione, Saaf, inhibited mycelial growth at concentration of 1g or ml/l, but seven otehr fungicides (Kocide 101, Thiram, Captan, Kitazin, Contaf, Trooper, Krilaxyl MZ) did so at concentration of 0.5g or ml/l, Hinosan and Tilt at 0.25 ml/l, Calixin, Bayleton and Shaan at concentration of 2 g or ml/1.

In Flowable sulphur, Kri Benomyl, Bavistin, Roko and Rovral, no effect was recorded in general, on mycelial growth, sporagia formation and sporangial germination at concentration under study, except Bavistin which inhibited sporangial germination at 1g/1.

It was interesting to note that mancozeb (Indofil M45), Bavistin (carbendazim) and Krilaxyl 35 (metalaxyl) did not checked mycelial growth of *Phytophthora cinnamomi* at 1.0 g/l dose, but combination product of mancozeb + metalaxyl (Krilaxyl MZ) and mancozeb + carbendazim (Saaf) inhibited growth at concentration of 0.5 g/1 and 1.0 g/1 respectively.

Effect of spraying of fungicides on Fruit and vine rot of pointed gourd

In three locations spraying of Contaf and Tilt reduced growth of vines to a large extent. The leaf size was reduced with various types of curling.

It was observed that, spraying fungicides gave significant protection of vines and fruits in all the locations (Table 4-7). No common trend in the performance of the fungicides was noted when assayed in 6.6.2002 and 26.6.2002 in respect to vine and fruit infection. In most cases Krilaxyl MZ and Foltaf performed much better compared to other fungicide.

At later stage copper fungicides Blitox, Shield gave better result compared to Thiram and Indofil M45 in protection of vines. In copper fungicides treated plot, the leaves became thick and stiff. Repeated application of copper fungicides caused chlorosis

Table 3 : Bioassay of fungicides against *Phytophthora cinnamomi* infecting pointed gourd plants in aqueous environment.

Fungicides	Active ingredient and Formulation	Standard does for spraying (g/l or ml/1)	Extent of mycelial growth * At conectration – g/l or ml/1 No growth	Poor or deformed growth	Normal growth	Inhibition of sporangia formation *At concentration–g/l or ml/l or above	Inhibition of sporangial germination
Blitox	Copper oxychloride 50% WP	4.0	1.0	0.125-0.5	0.0625	0.0625	0.0625
Kocide 101	Copper hydroxide 77%, WP	2.5	0.5-2.0	0.0625-0.25		0.0625	0.0625
Emcop A	Copper sulphate based fungicide L	1.0		0.0625-1.0		0.0625	0.0625
Emcop B	-do-	1.0	1.0	0.0625-0.5		0.0625	0.0625
Emcop L	-do-	1.0		0.125-1.0	0.0625	0.125	0.125
Sulfex	Sulphur 80% WP	2.0		1.0	0.0625-0.5	NI at 1.0	NI at 1.0
Flowable Sulphur	Sulphur 50% flowable	2.0			0.0625-1.0	NI at 1.0	NI at 1.0
Cuman L	Ziram 27% SC	3.0	1.0	0.0625-0.5		0.0625	0.0625
Thiram	Thiram 75% WS	2.0	0.5-1.0	0.125-0.25	0.0625	0.0625	0.0625
Indofil M45	Mancozeb 75% WP	2.0		0.0625-1.0	0.0625	0.125	0.125
Captan	Captan 50% WP	2.0	0.5-1.0	0.125-0.25	0.0625	0.125	0.125
Foltaf	Captafol 80% DS	1.0	0.0625-1.0			0.0625	0.0625
Kavach	Chlorothalonil, 75% WP	2.0		0.0625-1.0		0.0625	0.0625
Shaan	Dithianon 75% WP	1.0	2.0	0.0625-1.0		1.0	0.0625
Antracol	Propineb 70% WP	3.0		0.0625-1.0		0.25	0.0625
Vitavax	Carboxin 75% WP	1.0	1.0	0.125-0.5	0.0625	0.50	0.0625
Kri Benomyl	Benomyl 50% WP	1.0			1.0	Ni at 1.0	NI at 1.0
Bavistin	Carbendazim 50% WP	1.0			0.25-2.0	Ni at 2.0	1.0
Roko	Thiophanate methyl 70% WP	1.0			0.0625-1.0	Ni at 1.0	NI at 1.0
Hinosan	Ediphenphos 50% EC	1.0	0.25-1.0	0.0625-0.125		0.0625	0.0625
Kitazin	Iprobenfos 48% EC	1.0	0.5-1.0	0.25	0.0625-0.125	0.125	0.0625
Contaf	Hexaconazole 5% EC	1-2	0.5-1.0	0.125-0.25	0.0625	0.0625	0.0625
Tilt	Propiconazole 25% EC	1.0	0.25-1.0	0.125	0.0625	0.125	0.0625
Trooper	Tricyclazole 75% WP	0.75-0.8	0.5-1.0	0.125-0.5	0.0625	0.0625	0.0625
Opas	Epoxyconazole	1.5	1.0	0.125-0.5	0.0625	0.0625	0.0625
Folicure	Tabuconazole	1.5	0.0625-1.0			0.0625	0.0625
Calixin	Tridemorph 80% EC	1.0	2.0	0.0625-1.0		0.0625	0.0625
Bayleton	Triadimefon 25% WP	0.5-1	2.0	0.125-1.0		0.125	0.125
Fujione	Isoprothiolane 40% EC	1.5-2	1.0-2.0	0.25-0.5	0.0625-0.125	0.0625	0.0625
Rovral	Iprodione 50% WP	1.0			0.0625-1.0	NI at 1.0	0.5
Monceren	Pencycuron 250SC	1.5		1.0	0.0625-0.5	NI at 1.0	NI at 1.0
Krilaxyl	Metalaxyl 35% WS	1.0			0.25-1.0	1.0	1.0
Saaf	Carbendizim 12% + Mancozeb 63% WP	2.0	1.0	0.125-0.50	0.0625	0.5	0.5
Krilaxyl	Metalaxyl 8% + Mancozeb 64% WP	3.0	0.50-1.0	0.25	0.0625-0.125	0.125	0.125

NI = No inhibition

* Study conducted at concentration of fungicide 0.0625-1.0g or ml/liter except Bavistin (upto 2g/l), Calixin (upto 2 ml/1) Bayleton upto (2g/l)

along the major veins. Chlorosis was more pronounced when this group of fungicides were sprayed in day time in hot sunny days. Injury became less when the copper fungicide was sprayed towards evening hours.

In Krilaxyl MZ treated plot growth stimulation was recorded during the high temperature period.

Based on the field performance Krilaxyl MZ (metalaxyl + mancozeb) and Blitox (copper oxychloride) were selected as best fungicides and Shield (copper sulphate based fungicide), Indofil M45 (mancozeb) and Thiram came in second order.

Efficacy of copper fungicides, mancozeb, captafol, metalaxy1 + mancozeb formulations in controlling diseases of vegetables caused by different species of *Phytophthora* have been reported earlier by different scientists (Felix, 1948 ; Hunter and Buddenhagen, 1969 ; Alfaro Moreno and Vegh, 1971 ; Clerjeau, 1973 ; Das and Mohanty, 1987, Cox and Kasimani, 1990 ; Felett *et al.*, 1991, Charifi and Nazari, 1992, Sharma, 1992, Singh, 1998, Wicks *et al.*, 2000 ; Ahmed *et al.*, 2000). Shield is a newly introduced copper sulphate based protective fungicide. As it belongs to the group of copper fungicide, it also gave control of *Phytophthora* disease.

Table 4 : Effect of fungicidal spray on vine infection by Fruit and vine rot of pointed gourd (as recorded on 6.6.02)

Fungicides	Dose g or	Number of infected vine Location			% disease control Location			Average
		I	II	III	I	II	III	
Blitox	4.0g	18.0	9.7	12.0	64.5	72.2	75.4	70.7
Shield	1.5 ml	14	8.7	14.7	72.3	75.1	69.9	72.4
Thiram	2.0g	10.7	10.0	6.0	78.9	71.4	87.7	79.3
Indofil M45	2.0g	11.0	9.0	6.7	78.3	74.3	86.2	79.6
Foltaf	1.0g	2.0	1.0	2.0	96.1	97.1	95.9	96.4
Krilaxyl MZ	3.0g	1.7	1.0	1.7	96.6	97.1	96.5	96.4
Control		50.7	35.0	48.7				
C.D. at 1%		2.7	2.7	4.4				

Table 5 : Effect of fungicidal spray on fruit infection by Fruit and vine rot of pointed gourd (as recorded on 6.6.02)

Fungicides	Dose g or	Number of infected fruits Location			% disease control Location			Average
		I	II	III	I	II	III	
Blitox	4.0g	19.3	28.0	24.7	82.9	76.9	76.3	78.7
Shield	1.5ml	24.3	34.3	26.7	78.5	71.7	74.4	74.9
Thiram	2.0g	13.0	14.3	11.3	88.5	88.2	89.2	88.6
Indofil M45	2.0g	14.0	8.7	7.3	87.6	92.8	93.0	91.1
Foltaf	1.0g	1.2	1.2	0.7	98.9	99.0	99.3	99.1
Krilaxyl MZ	3.0g	1.2	1.2	0.7	98.9	99.0	99.3	99.1
Control		113.0	121.3	104.3				
C.D. at 1%		4.7	6.4	5.8				

Table 6 : Effect of fungicidal spray on infection by Fruit and vine rot of pointed gourd (as recorded on 26.6.2002)

Fungicides	Dose g or	Number of infected fruits Location			% disease control Location			Average
		I	II	III	I	II	III	
Blitox	4.0g	32.7	26.3	42.7	84.2	74.4	76.4	78.3
Shield	1.5ml	36.7	30.7	38.3	82.3	71.2	78.8	77.4
Thiram	2.0g	103.0	72.0	68.0	50.2	32.5	62.4	48.4
Indofil M45	2.0g	68.3	70.0	101.7	67.1	34.4	43.8	48.4
Foltaf	1.0g	31.3	10.0	26.0	84.9	90.6	85.6	87.0
Krilaxyl MZ	3.0g	4.7	29.0	24.7	97.7	92.8	86.4	85.6
Control		207.3	106.7	181.0				
C.D. at 1%		14.1	13.8	7.1				

Table 7 : Effect of fungicidal spray on fruit infection by Fruit and vine rot of pointed gourd (as recorded on 26.6.2002)

Fungicides	Dose g or	Number of infected fruits Location			% disease control Location			Average
		I	II	III	I	II	III	
Blitox	4.0g	40.7	79.9	41.0	89.4	78.3	89.7	85.8
Shield	1.5ml	103.3	118.0	95.0	73.2	67.3	76.3	72.5
Thiram	2.0g	167.7	252.0	236.0	59.5	29.9	41.0	43.5
Indofil M45	2.0g	202.0	200.0	235.0	47.6	43.5	41.2	44.1
Foltaf	1.0g	29.0	39.7	46.7	92.4	89.2	88.3	89.9
Krilaxyl MZ	3.0g	59.3	38.0	43.7	84.6	89.7	89.9	88.1
Control		385.7	367.7	400.3				
C.D. at 1%		19.4	21.8	23.7				

Growth enhancement of pointed gourd by Krilaxyl MZ has been observed in the experimental plots at three locations. Kenerly *et al.* (1984) reported growth stimulation by metalaxyl. In addition to inhibitory activity of Krilaxyl MZ, metalaxyl component has the property of stimulation of host defense against pathogen (Lazarovitis and Ward, 1982 ; Coffey and Young, 1984).

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