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Efficacy of Different Fungicides for the Management of Downy Mildew of Cucumber Grown Under Low Plastic Tunnel

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ABSTRACT

Downy mildew caused by Pseudoperonospora cubensis (Berk. and Curt.) Rostow has become a serious problem in successful cultivation of cucumber grown under low plastic tunnel in Punjab. Study on effect of sowing dates on development of cucumber downy mildew during 2008-09 and 2009-10 crop season revealed that mean disease severity of 48.70 per cent was recorded on cucumber cultivar Poinsett when the crop was sown on 15th December. The disease severity increased with delay in date of sowing and it was recorded as 73.30 per cent when sown on 30th January. Relative rate of disease progress (r) and area under disease progress curve (AUDPC) were also observed at these sowing dates. Eleven different fungicides were used for the management of cucumber downy mildew. Minimum disease severity was recorded by spraying metalaxyl + mancozeb (9.59 %), metalaxyl M + mancozeb (11.02 %), azoxystrobin (13.37 %) , Curzate M-8 (cymoxanil + mancozeb) (18.99 %), dimethomorph) (20.66 %), mancozeb (24.85 %), fluopicolide + propamocarb (24.88 %), Mandipropamid (26.21 %), propineb) (26.48 %), metiram (28.05 %), copper hydroxide (29.86 %). Fruit yield was significantly higher in treated plots with fungides Ridomil MZ and Ridomil Gold as compared to other fungicides and untreated control.

Key words: *Cucumber, Downy mildew, Fungicides, Plastic low tunnel, Yield*

INTRODUCTION

The cucumber (*Cucumis sativus* L.) is cultivated on large scale in open field but the use of low plastic tunnels has gained popularity in recent years in Punjab (India). Several diseases have been reported to attack cucumber crop in field as well as in green house. Downy mildew of cucumber (*Pseudoperenospora cubensis*) causes serious losses under favourable environmental conditions. In many regions and in tunnels with high humidity, disease is the main limiting factor for cucumber production[24] and Keinath[10]. Downy mildew on cucumber appears as characteristic small, slightly chlorotic to bright yellow areas on the upper surface of leaves which, later turn necrotic and brown. Lesions are angular in shape bounded by leaf veins.

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Sporangiophores appear on lower leaf surface producing brown or colourless zoosporangia through the stomata and cause necrosis of larger leaf areas and finally the death of entire leaf[12]. Elizabeth *et al.*[7] while studying the symptom expression on various cucurbits *viz.* cucumber (*Cucumis sativus*), muskmelon (*Cucumis melo*), ridge gourd (*Luffa acutangula*) and spongegourd (*Luffa aegyptiaca*) initially observed development of pale green areas, separated by islands of darker green, progressively these spots turn yellow and become well-defined angular in shape often restricted by veins on upper surface with purplish downy growth on lower side, subsequently resulting in death of entire leaf. Bains[4] categorized symptom expression depicted by leaves of various cucurbitaceous crops in response to downy mildew diseases caused by *Pseudoperonospora cubensis* into four groups with respect to lesion colour, shape, size, coalescing, necrosis and extent of sporulation. The four categories are as follows: Category-I: Isolated faded green to faint yellow lesions with no sporulation and no necrosis; Category-II: Conspicuous visible spots of restricted size, with water soaked corky lesions on the underside; Category-III: Conspicuous lesions due to their colour, i.e. yellow to tan yellow, enlarged spots, frequently coalescing and becoming necrotic. Category-IV: Necrotic lesions without any sporulation. Singh and Thind[18], Hausbeck *et al.*[9] studied downy mildew disease on various cucurbitaceous crops and found symptoms confined only to leaves with yellow water-soaked irregular areas on upper surface. On further advancement, these lesions were covered on lower side by violet greyish to brownish growth of sporangiophores and sporangia. Subsequently, these areas enlarged, coalesced and became necrotic.

In Punjab state cucurbits are grown in an area of about 13.41 thousand hactares with an annual production of 200.24 thousand tones[1]. Among various cucurbits grown 10 per cent area is under cucumber cultivation. Cucumber cultivars grown in Punjab state are Punjab Naveen, Malini and Poinsett. For the past few years, early cultivation of cucumber is being practiced using low plastic (polyethylene) tunnel for getting early harvest in some districts of the Punjab state *viz.* Amritsar, Kapurthala, Nawan Shehar, Sangrur and Bathinda. The crop is raised under low plastic tunnel (100 gauge thick polyethylene sheet) supported by flexible iron ring 1½ high in the middle. Plastic low tunnels provide the best way for off-season cultivation of cucurbitaceous vegetables during winter season by modifying the microclimate around the plants. Low tunnels also offer several other advantages like protection of the crop from frost, hails, and crop advancement from 30-40 days over their normal season of cultivation. This technology is gaining a big leap forward in several northern states where low temperature during winter season is a severe constraint for cultivation of entire group of cucurbits. This technology has been developed for off-season cultivation of major cucurbits for taking full advantage of the prevailing high market prices of the offseason produce. The technology is highly suitable for those areas where temperature during winter season is going down (>10 o C) for a period of 30-40 days (December- January months) and it is not possible to grow these vegetables in open fields.

Low tunnel cultivation of cucumber has resulted into early appearance of downy mildew, which has become quite serious affecting normal production of crop yields. Downy mildew used to appear in 2nd week of April on muskmelon and other cucurbits grown in open fields in the Punjab state but due to early planting of cucumber under low tunnel system it has started appearing by end of February or early March.

Keeping in view the importance of downy mildew of cucumbers grown under low plastic tunnel and lack of available information for this region, studies were conducted during 2008-09 and 2009-10 crop season to understand disease occurrence and work out its management options.

MATERIALS AND METHODS

Preparation of beds

The beds of 2.50 m width were prepared in the month of December. Before sowing the seeds, flexible iron rods of 2 meter length shaped into arches/hoops were fixed at a distance of 2 meters so as to have height of 60 cm. The paired rows on the beds were then covered. The hoops were covered with transparent plastic sheet of 100 guage thickness. The sheets were burried on both sides of the beds.

Sowing dates

Seeds of cucumber cultivar Poinsett was sown on 15th December, 30th December, 15th and 30th January on 2.5 m wide beds. The beds were covered with low tunnel of transparent plastic sheet, as mentioned above. Downy mildew development was recorded as soon it appeared and weekly observations on disease severity were recorded on a standard 0-5 rating scale[21]. The rate of disease progress (r) and area under disease progress curve (AUDPC) were calculated as per Vander Plank[23] as follows :

Rate of disease progress (r) =2.3/t2-t1 log 10 x2(1- x1)/x1(1-x2)

where, r = Apparent rate of infection and X1 and X 2 = Per cent disease index at time t1 and t2,

t2 -t1 = Time interval in days between two consecutive observations

$$\text{Area under disease progress curve (AUDPC)} = \sum_{i=1}^{k} \tfrac{1}{2}(si + si-1)$$

where s1 = disease severity at end of week i and k = number of successive evaluations of disease severity.

Fungicides evaluation

Field trials on the control of downy mildew of cucumber cv. Poinsett were carried out at the experimental farm area of PAU, Ludhiana and consisted of 12 treatments laid out in RBD replicated three times. The fungicides used in the study were Ridomil MZ, Ridomil Gold, Amistar 25 SC, Curzate M-8, Acrobat, Indofil M-45, Infinito, Mandipropamid, Antracol, Polyram and Kocide at the dose rates mentioned in Table 1. Plot size for each treatment was kept as 5 x 2 m. All the cultural practices were followed as per package and practices recommended by PAU. Spraying on the crop was started just after the appearance of the disease symptoms. Spray interval between two applications was kept 7 days for contact fungicides and 10 days for systemic fungicide and in all 4 and 3 sprays were give, respectively. Observations on disease severity were recorded after 10 days of last spray. Per cent disease control was calculated based on arc sine transformed values. Cucumber yield was also recorded in each treatment.

RESULTS AND DISCUSSIONS

Effect of sowing dates on disease development

The results (Table 2) revealed that all the sowing dates significantly affected the disease severity and fruit yield. The mean disease severity was significantly less 48.70 per cent in crop sown on 15th December than that in crop sown on 30th December 51.30 per cent, 15th January 66.10 per cent and 30th January 73.30 per cent on cucumber cv. Poinsett . Maximum fruit yield (average of two years) 17.50 kg/plot was recorded in the crop sown on 15th December followed by 30th December 13.25 kg/plot, 15th January 11.50 kg/plot and 30th January 8.0 kg/ plot, respectively. Maximum mean rate of disease progress 0.074 was recorded in the crop sown on 30th January and minimum 0.061 sown on 15th December (Table 2). Likewise, mean AUDPC (area under disease progress curve) was also recorded minimum 251.73 in the crop sown on 15th December and maximum 334.73 sown on 30th January (Table 2). In the present studies, it was noticed that inside tunnel temperature of 24-27 ^{o} C and relative humidity 90-95 per cent favoured downy mildew development which coincides well with the findings of Sharma *et al*.[20], William *et al*.[25] who also reported high humidity and temperature of 25-30 ^{o}C, favourable for disease development. When the

crop is sown on 30th January, flowering and fruit set stage appears in March. During this period, temperature and relative humidity conditions become favourable inside the tunnel. Hence, this crop suffers more from downy mildew attack compared to early sown (15th December) crop. Not many reports have been found in literature on cultivation of cucumber in low tunnel technology. However, effect of date of sowing on disease development has been studied in many other host-pathogen interactions[11,20].

Performance of fungicides for control of downy mildew

The results (Table 3) revealed that all the test fungicides significantly controlled the disease as compared to check during both the years. Pooled data for both the years showed that minimum disease severity (9.59 %) was recorded with Ridomil MZ application followed by Ridomil Gold (11.02 %), Amistar 25 SC (13.37 %), Curzate M-8 (18.99 %), Acrobat (20.66 %), Indofil M-45 (24.85 %), Infinito (24.88 %), Mandipropamid (26.21 %), Antracol (26.48 %), Polyram (28.05 %) and Kocide (29.86 %) as compared to 79.48% in untreated check. Maximum fruit yield (17.65 kg/plot) was also recorded in Ridomil MZ treatment followed by Ridomil Gold (15.68 kg/plot), Amistar 25 SC (15.32 kg/plot), Curzate M-8 (15.21 kg/plot), Acrobat (13.32 kg/plot), Indofil M-45 (13.24 kg/plot), Infinito (12.41 kg/plot), Mandipropamid (10.26 kg/ plot), Antracol (10.25 kg/plot), Polyram (9.87 kg/ plot) and Kocide (8.98 kg/plot) as compared to check (7.54 kg/plot). The present findings are in conformity to the findings of Samoucha and Cohen[16] , Mahi , Robak[14] and Sharma *et al.*[17], Han-cheng *et al.*[8] and Anthony and Virginia[2] who also reported that Ridomil MZ is highly effective against cucumber downy mildew. Apaydin[3] reported that Indofil M-45 @ 0.3 % and Ridomil MZ @ 0.25 % gave effective control of the disease. Chaudhary *et al.*[6] also reported that Ridomil MZ @ 0.2 % and Dithane M-45 @ 0.4 % were effective against cucumber downy mildew. Ridomil MZ, Ridomil Gold and Amistar treatments were significantly at par with each other and can be exploited for the management of this disease. Threerthragiri *et al.*[22] reported that azoxystrobin provideseffective control of downy mildew diseases. Mondal *et al.*[13] also reported that Ridomil MZ. Copper oxychloride and indofil M-45 recorded better and gave good protection against downy mildew in pointed gourd.

Table 1: Detail of treatments employed in the experiment

Name of Fungicides		
Trade Name and formulation	**Chemical name**	**Dose per litre of water**
Amistar 25 SC	Azoxystrobin	1 .0 gm
Curzate M-8	cymoxanil + mancozeb	2.5 gm
Acrobat	Dimethomorph	2.5 gm
Infinito	fluopicolide + propamocarb	2.5 gm
Ridomil Gold	metalaxyl M + mancozeb	2.5 gm
Ridomil MZ	metalaxyl + mancozeb	2.5 gm
Mandipropamid	Mandipropamid	2.5 gm
Antracol	propineb	2.5 gm
Indofil M-45	mancozeb	3.0 gm
Kocide 3000	copper hydroxide	2.5 gm
Polyram	metiram	2.5 gm

Table 2: Effect of date of sowing on development of downy mildew, area under disease progress curve (AUPDC) and rate of disease progress (r) on cucumber cv. Poinsett grown under low plastic tunnel

Sowing date	% Disease severity *	AUPDC	R	Yield(kg/plot)
15 December	48.70 (44.33)	251.73	0.061	17.50
30 December	51.30 (45.23)	266.25	0.062	13.25
15 January	66.10 (54.35)	300.59	0.072	11.50
30 January	73.30 (58.42)	334.73	0.074	8.0
CD(P≤0.05%)	1.59			1.50

* After 8 weeks of disease initiation, Figures in parentheses are arc sine transformed values, Data are mean of 2008-09 and 2009-10 crop seasons

Table 3: Performance of fungicides against downy mildew of cucumber cv. Poinsett grown under low plastic tunnel

Treatment	Dose (%)	Mean disease severity* (%)	Mean yield (kg/plot)
Amistar 25 SC (azoxystrobin) 0.15	0.1	13.37 (21.67)	15.32
Ridomil MZ (metalaxyl + mancozeb)	0.25	9.59 (18.01)	17.65
Ridomil Gold (metalaxyl M + mancozeb)	0.25	11.02 (19.56)	15.68
Curzate M-8 (cymoxanil + mancozeb)	0.25	18.99 (25.33)	15.21
Acrobat (dimethomorph)	0.25	20.66 (26.88)	13.32
Infinito (fluopicolide + propamocarb)	0.25	24.88 (29.90)	12.41
Mandipropamid	0.25	26.21 (30.65)	10.26
Antracol (propineb)	0.25	26.48 (30.95)	10.25
Indofil M-45 (mancozeb)	0.3	24.85 (32.01)	13.24
Polyram (metiram)	0.25	28.05 (32.02)	9.87
Kocide 3000 (copper hydroxide)	0.25	29.86 (32.98)	8.98
Control		79.48 (63.03)	7.54
CD(P≤0.05%)		1.27	1.20

* Recorded after 10 days of last spray, Figures in parentheses are arc sine transformed values
Data are mean of 2008-09 and 2009-10 crop seasons.

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