

Original Article

Integrated Fungicidal Management for Downy Mildew of Pumpkin (*Pseudoperonospora cubensis*)

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Abstract

Downy mildew of pumpkin is caused by the fungus (*Pseudoperonospora cubensis*), which is responsible for considerable damage to the cucurbits. This pathogen plays a major role for yield losses in pumpkin crop. Current study was intended to verify the effectiveness of different fungicides alone and in combination against downy mildew of pumpkin. Diseased samples were collected for inoculation from different farms of Okara district. A pumpkin variety (Mahadeev) was inoculated by spraying method grown at experimental area of the Department of Plant Pathology, University of Agriculture, Faisalabad under randomized complete block design (RCBD). Selected chemotherapeutic mixtures were sprayed for the control of (*Pseudoperonospora cubensis*) under field condition. The data were recorded and analyzed statistically. Ipovalicarb (s) + Propanib (P) revealed maximum efficacy against disease (60%) followed by Tebuconazole (s) + Metiram (p) (58%) and Matlaxal (s) + Mancozeb (p) (55%), Cymoxinal (s) + Mancozeb (p) (52%), Difenconazole (s) + Mancozeb (p) (46%) and Chlorothalonil (p) + Fosytyle AI (39%) respectively. Thus, Ipovalicarb (s) + Propanib (P) can be used to manage the disease under field conditions.

1. Introduction

Pumpkin (*Cucurbita moschata* L.) is a valuable edible crop, widely grown and consumed in many tropical and subtropical countries around the world having worldwide production around 22,413,237 metric tons[1] and in Pakistan about 43, 995 tons[2]. The crop is affected by numerous biotic (Diseases and Insects) as well as abiotic (Air temperature (maximum and minimum), relative humidity and rainfall etc) factors. Among diseases, viral diseases especially papaya ring spot virus, zucchini yellow mosaic virus and watermelon mosaic virus[3] are most common while other diseases including brown etch of grammas (*Fusarium spp.* and *Didymella bryoniae*), bacterial leaf spot (*Xanthomonas campestris*) and Fusarium foot rot (*Fusarium solani*), powdery mildew (*Sphaerotheca fuliginea*) and especially downy mildew (*Pseudoperonospora cubensis*) damage the crop potentially[4]. Pumpkin downy mildew is among the most distressing and ubiquitous plant disease in cucurbits caused by fungal pathogen [5,6].

The subsequent principles are used for protection of cucurbits against *P. Cubensis*; selection of relatively resistant cultivar, use of effective fungicide rate, alternation of fungicides and appropriate spray intervals by determination of most suitable dates for application [7]. Chaudhry *et al*[8] conducted field experiment to evaluate fungicides against downy mildew on cucumber cultivated in 2006-2007. Five fungicides Dithane M-45, Copper oxychloride 50 WP, Ridomil Gold 72 WP, Success 72 WP and Alliet 80 WP were used @ 5, 4, 2, 2.5 and 2 g/L of water, respectively. Minimum disease incidence was recorded by applying Success (9%), Ridomil (9 %) and Alliet (11%) compared with control (78%). Ojiamboet *al.* [9] performed an experiment in which they evaluate the fungicide and observed that Fluopicolide was the most proficient, followed by the Propamocarb and Cyazofamid, whereas the Dimethomorph and Mandipropamid was the least efficient.

Keeping in view the above mentioned facts, current study was designed to evaluate combinations of different chemicals against downy mildew on pumpkin.

2. Materials and Methods

A single cultivar naming Mahadeev was obtained from Ayub Agriculture Research Institute Faisalabad and the experimental field was established at experimental area of Department of Plant Pathology, University of Agriculture, Faisalabad during last week of February 2012 under randomized complete block design (RCBD). All the demanded agronomic practices were followed to maintain the Pumpkin field crop in good condition

Inoculum was obtained from newly diseased leaves collected from different farms of district Okara having yellow color spots on the upper surface and yellowish brown sporulating lesions on lower surface. Sporulating areas on diseased leaf was gently cut into a disk with a surgical blade and placed into a Jar containing distilled water. After shaking vigorously, suspension was strained with a strainer. Later on 2 drops of sample was taken from this suspension and the number of spores was counted using haemocytometer adjusting concentration to at least 25,000 viable conidia per ml water and used immediately. For inoculation, the lower surface of each plant leaf was completely sprayed with a hand atomizer at 4 to 5 leaf stage. Fresh water was sprayed in the morning and evening to create humid conditions for potential sporulation.

Leaves of inoculated plants exhibit the typical symptoms of disease after 5 to 6 days of inoculation in the form of pale green spots on the dorsal sides of the leaves. The spots increase in size, turn yellow and coalesce to cover large areas of the leaves. Then they start turning necrotic tan brown from the centre. The ventral side of the leaves is

covered with light purple mycelium, bearing large lemon shaped sporangia.

Plants were carefully examined to estimate the severity of the infection of downy mildew based on the scale (0-9) used by [10]. For determination, % infection was classified into nine categories.

Disease incidence (%)=

$$\frac{\text{Number of Infected plants}}{\text{Total number of plants}} \times 100 \quad [11]$$

Table 1: Disease rating scale utilized for observations of Downy mildew of pumpkin.

Sr. No	Description	Infection (%)
1	No symptoms of disease	0
2	Only few leaves affected	1%
3	Less than half of the plant affected	5%
4	Most of the plants affected but the attack restricted mostly to one leaf per plant	10%
5	All the plants affected attack restricted to one or two leaves	20%
6	Three to four leaves of almost every plant affected and the crop look fair green	50%
7	Three to four leaves of almost every plant affected and the crops show blighted appearance.	75%
8	All the leaves of all plants severely attack greenness	90%
9	Completely blighted due to downy mildew	100%

Ten fungicides including (Melody Duo, Ridomil Gold, Tagula, Polyram, Curzate, Mancozeb, Score, DithaneM, Brvo and Alliet) were sprayed alone and in amalgamation on diseased plants to control the downy mildew of pumpkin. Each treatment was replicated thrice using RCBD design with 7days interval after the disease appearance. Data was analyzed using analysis of variance and treatments were compared by using Least Significant Difference (LSD) test [12]. All statistical tests were performed by using SAS/STAT Statistical analysis software (SAS Institute, 1990).

3. Results

All the above germplasm were susceptible to infection by *Pseudoperonospora cubensis*. The earliest symptoms appeared generally on the leaves beginning around 7 days of post-infection. Indication appears as small yellow brown spots on upper surface firstly on older leaves and then move towards younger leaves. Producing lesions may

remain chlorotic or turn into necrotic. The centre of the lesion ultimately revolves into tan brown and dies. Yellow spots sometimes gives a greasy appearance and do not have a separate margin.

The treatments combinations like Melody Duo (Iprovalicarb + Propanib) was used at the dose 2.8 g/L, Tagula + Polyram (Tebuconazole +Metiram) 4.6 mL/L, Ridomil Gold (Matlaxyl + Mancozeb) 2.3g/L, Curzate + Mancozeb (Cymoxinal + Mancozeb) 5.62 g/L, Score + Dithane (Difenconazole +Mancozeb) 3.4 mL/L and Bravo + Alliet (Chlorothalonil + Fosytyle) 4.6 g/L (Table 2) significantly reduce the disease under field condition.

Among all combinations of chemicals, Bravo + Alliet results in maximum diseases reduction with 39% efficacy followed by Score + Dithane M with 46%, Cymoxinal (s) + Mancozeb (p) with 52%, Matlaxal (s) + Mancozeb (p) with 55%, Tebuconazole (s) + Metiram (p) with 58% and Iprovalicarb (s) + Propanib (p) with 60% efficacy respectively (Table 2 and Figure 1).

Table 2: Efficacy of all treatments (fungicidal combinations) against the disease and mean disease incidence exhibited by the treatments during disease rating period

Treatment	Active Ingredient	Doze Used	Efficacy (%)	Disease Incidence
T ₀	Water	--	--	69.44 A
T ₆	Iprovalicarb (s) + Propanib (p)	2.8 g/L	60%	40.889 B
T ₅	Tebuconazole (s) + Metiram (p)	4.6 mL/L	58%	37.778 BC
T ₄	Matlaxal (s) + Mancozeb (p)	2.3g/L	55%	34.66 CD
T ₃	Cymoxinal (s) + Mancozeb (p)	5.62 g/L	52%	32.66 DE
T ₂	Score + Dithane M	3.4 mL/L	46%	30.44 EF
T ₁	Bravo + Alliet	4.6 g/L	39%	27.77 F
LSD			3.9565	

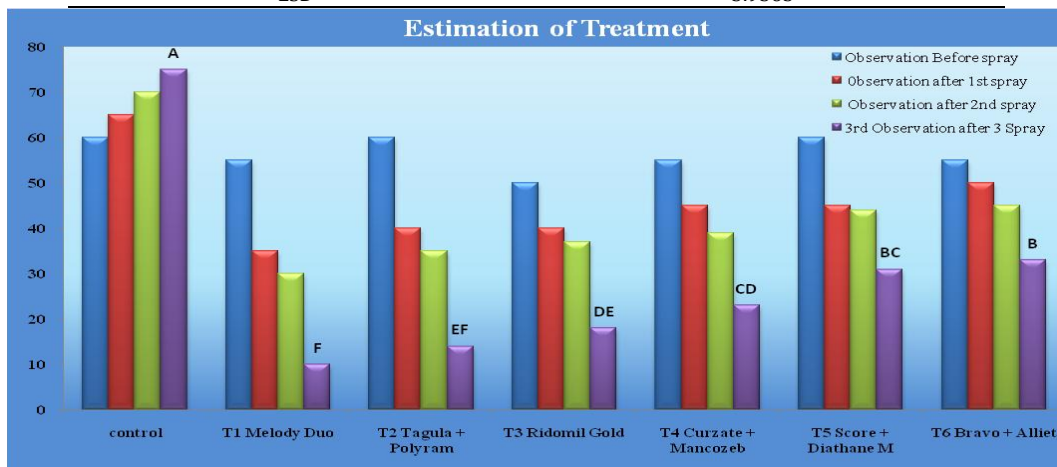


Figure 1: Graphical presentation of all fungicidal combination against the disease at different times.

4. Discussion

Chemical control is the most successful measure in defending crops against downy mildew disease. According to our results, commonly *pseudoperonospora cubensis* recorded fungi causing pumpkin downy mildew. These results confirm by the finding of Gisi U [5] who observed the *pseudoperonospora cubensis* from the downy mildew mass produce on the surface of pumpkin leaves and also observed the same fungi from the infected part of pumpkin downy mildew.

In our study, six fungicidal combinations Melody Duo, Tagula + Polyram, Ridomil Gold, Curzate + Mancozeb, Score + Dithane M, Bravo + Alliet with recommended dose were applied in field conditions. According to results, Melody Duo showed the best result among all fungicides due to dual chemistry of protective and curative mode of action that inhibits the growth of pathogen and also distress spore dispersion. Metalaxyl has a large range of activity and effects on the different pathogens inside the order. The major biological characters of metalaxyl are high in built fungi toxicity, curative and protective action against all Peronosporales. Metalaxyl has unique qualities like speedy uptake, acropetal systemically, leading to protection of new development, control of soil-borne diseases and systemic seed. These results match with Chaudhury et al [13]; observed different fungicides Dithane M-45, Copper oxychloride 50 WP, Ridomil Gold 72 WP, Success 72 WP and Alliet 80 WP were used @ 5, 4, 2, 2.5 and 2 g/L of water, respectively. Minimum disease incidence was recorded by applying Success (9%), Ridomil (9%), Melody (duo 8%) and Alliet (11%) compared with control (78%). Plots treated with Ridomil, Success Melody Duo and Alliet observed more length and yield of fruit with healthy vegetative growth per plant as compared to control and other fungicides.

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