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Effect of Fungicide Synergy on Downy Mildew Control in Onions

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Abstract: The synergistic effect of four different fungicides was studied on severity of onion downy mildew under natural field conditions during 1998-99. Area Under Disease Progress Curve (AUDPC) was the highest in treatment where no fungicide was applied. However, it was the lowest in Dithan M-45 + Ridomil. In this treatment bulb yield, bulb size and number of bulbs were also the highest, indicating that fungicide application reduced the disease severity and stabilized onion productivity.

Keywords: Onion, downy mildew, *Peronospora destructor,* fungicides

Introduction

Onion yields are very low in the North West Frontier Province (NWFP) of Pakistan due to several production constraints including the use of low quality seed, imbalanced fertilizers, uneven irrigations and particularly the attack of various insect-pests and diseases.

Among the different diseases, downy mildew (*Peronospora destructor*), inflicts heavy losses to onion crop in this province. Several fungicides are used to control this disease. Among these, the systemic fungicides metalaxyl and cyomaxanil are note worthy (Palti, 1989). Muhibullah (1992) used seven fungicides viz. Antracol, Cuprisan 311-Super D, Dithane M-45, Nemispor, Penncozeb, Sandofan M and Tri-Miltox forte against downy mildew of onion. Highly significant control of the disease was obtained with Ridomil MZ-71 WP and Sandofan M followed by Nemispor. Tahir *et al*. (1990) applied eight fungicides I-e Antracol 70 WP, Liromanzeb 80 WP, Daconil-75 WP, Ridomil MZ-72 WP, Duter-WP, Polyram combi, Tri-Miltox forte and Cupravit. Among these, Antracol-70 WP was the most effective, followed by Ridomil MZ-72 WP. These fungicides increased bulb yield by 8-52% over control. Teviodale *et al*. (1980) cited that Ridomil controlled the disease on bulb as well as seed crop. Similarly, Boyadzhiev *et al*. (1983) noted that Ridomil was very effective in reducing downy mildew infection in onions. Mirakhur *et al*. (1977) obtained best control of onion downy mildew with Difolitan and Guman. Smith *et al*. (1985) quoted that Mancozeb at 1.07 kg/ha and Chlorothalonil at 3.54 kg/ha completely controlled this disease. Loss and Stenina (1975) claimed that a mixture of Antracol and Polymercin gave best control of downy mildew. Rakhimov and Sadygov (1975) obtained good control of downy mildew by spraying 0.5-0.75% Copper Oxychloride, 0.75% Zineb, 0.5% Cuprisan and 1% Bordeaux mixture. Tolpa *et al*. (1979) recommended Copper Oxychloride at 40 g/100 l against *P. destructor*. However, in most cases the unscruplous use of these fungicides when applied alone, had not provided complete control of the disease. Therefore, the main objective of this research was to test the synergistic effect of different fungicides against onion downy mildew and to evaluate their role in enhancing onion productivity.

Materials and methods

Four different fungicides viz. Antracol, Copper Oxychloride, Dithane M-45 and Ridomil were used in different combinations in eleven treatments. One treatment was kept as untreated check. The experiment was laid out in a randomized complete block (RCB) design with four replications at the University Farm, NWFP Agricultural University, Peshawar. Seedlings of onion variety "Swat-I" were transplanted to field plots measuring 3×3 m size. On the first appearance of downy mildew, application of spray fungicides was started. In all three sprays were made at an interval of 10-days. Data on disease severity were recorded according to 1-9 rating scale whereas 1 indicated no disease and 9 foliage completely blighted (Muhibullah, 1992). Area Under Disease Progress Curve (AUDPC) was calculated by using the following formula (Shaner and Finney, 1977):

$$AUDPC = \{(x_i + x_{i-1})/2\}\{t_i - t_{i-1}\}$$

whereas
x_i = Present disease severity
x_{i-1} = Previous disease severity
t_i-t_{i-1} = Time difference between two consecutive disease severities.

Data on bulb yield, bulb number and bulb size were recorded at the time of harvest of the crop. All data were subjected to analysis of variance (ANOVA) and LSD Test to determine differences among the different treatments.

Results and Discussion

Area Under Disease Progress Curve (AUDPC): Data in Table 1 indicate significant differences ($p < 0.05$) among the treatments. The lowest AUDPC was calculated in treatment Dithane + Ridomil which showed 71.9% more reduction in disease severity than other treatments. When these fungicides were used separately, there was 68.2 and 21.2% lower attack in Ridomil and Dithane treated plots than the untreated check. The latter showed the highest value of AUDPC.

Bulb yield: The highest yield was recorded in treatment Dithane + Ridomil. This was followed by treatment Antracol + Copper oxychloride + Dithane M-45 + Ridomil and that of Ridomil. In treatment where no fungicide was applied, bulb yield was the lowest indicating that fungicide application helped increasing bulb yield by 2.8-102.8%.

Bulb size: Significant differences ($p < 0.05$) were observed among different treatments. The greatest bulb size was in treatment Dithane M-45 + Ridomil and the lowest in the untreated check. In general, downy mildew adversely affected bulb size, but the best fungicide treatment replenished this loss by 51.3%.

Number of bulbs: Plots treated with Dithane M-45 + Ridomil produced the highest number of bulbs while there was 28.8 bulbs/m^2 in the untreated check. This showed an increase of 43.4% of the former over the latter.

Downy mildew not only reduces onion yields but also affects its market value. The crop yield is reduced in the form of reduced bulb size and lower number of bulbs. The misshapen bulbs having lower storage capability result into low market value of onions.

Table 1: Effect of spray fungicides on severity of downy mildew and yield and yield components of onion

Treatment	AUDPC[1]	Yield (t/ha)	Bulb size (cm)	Bulb No (m²)
Antracol	394.0 BC (28.4)*	12.1 DE(12.0)*	4.6 CDE(17.9)*	34.3 BCDE(19.1)*
Copper Oxychloride	458.5 AB (16.7)	13.2 CDE (22.2)	4.5 DEF(15.4)	29.0 E (0.7)
Dithane M-45	433.5 ABC (21.2)	14.8 BCDE (37.0)	4.8 BCD (23.1)	35.3 ABCD (22.6)
Ridomil	175.1 DE (68.2)	17.8 B (64.8)	5.1 B (30.8)	37.3 ABC (29.5)
Antracol + Copper Oxychloride	436.9 ABC (20.6)	13.3 CDE (23.1)	4.3 EFG (10.3)	33.0 BCDE (14.6)
Antracol + Dithane M-45	458.5 AB (16.7)	13.5 CDE (25.0)	4.4 EF (12.8)	30.5 CDE (5.9)
Antracol + Ridomil	166.7 DE (69.7)	17.3 BC (60.2)	4.9 BC (25.6)	37.5 AB (30.2)
Copper Oxy. + Dithane M-45	462.7 AB (15.9)	11.1 E (2.8)	4.2 FG (7.7)	32.0 BCDE (11.1)
Copper Oxychloride + Ridomil	302.2 CD (45.1)	15.2 BCD (40.7	4.2 FG (7.7)	35.3 ABCD (22.6)
Dithane + Ridomil	154.2 E (71.9)	21.9 A (102.8)	5.9 A (51.3)	41.3 A (43.4)
Antra + Cop. Oxy. + Dith. + Rid.	250.0 DE (54.6)	18.1 AB(67.6)	4.5 DEF (15.4)	33.5 BCDE (16.3)
Untreated	550.2 A (00.0)	10.8 E (00.0)	3.9 G (00.0)	28.8 DE (00.0)
Mean	353.5	14.9	4.6	33.9
LSD value	136.6	4.1	0.4	6.9
CV (%)	136.6	19.1	5.7	14.3

[1]Area Under Disease Progress Curve

*Figures in parenthesis indicate decrease in AUDPC and increase in yield, bulb size and bulb number over the untreated check

The application of fungicides minimized downy mildew attack and subsequently increased yield in the fungicide treatments. This increase was 2.2-102.8% in bulb yield, 7.7-51.3% in bulb size and 1-43.4% in bulb number. In this case, treatment with Dithane M-45 + Ridomil gave the highest yield (21.9 t/ha), bulb size and bulb number. Fungicide Ridomil alone or when combined with Dithane M-45 showed the best performance in decreasing the disease severity and increasing onion yields. These studies were in line with the work of other workers. Muhibullah (1992) reported that out of seven fungicides used, highly significant control of the disease was obtained with Ridomil MZ-72 WP and Sandofan M followed by Nemispor. Tahir *et al*. (1990) concluded that Antracol 70 WP and Ridomil MZ-72 WP increased bulb yield by 52 and 42% respectively. Similarly, Boyadzhiev *et al*. (1983) noted Ridomil very effective in reducing downy mildew infection in onion. Issa *et al*. (1981) used mixture of Zineb + Maneb + Copper to control the disease. Bruton *et al*. (1986) found metalaxyl as the most effective fungicide against downy mildew disease of many crops.

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