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EFFECTIVE MANAGEMENT OF WHITE RUST (*ALBUGO CANDIDA*) OF RAPESEED THROUGH COMMERCIALLY AVAILABLE FUNGICIDES

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A B S T R A C T

Brassica napus (Rapeseed) affected by white rust is a major threat in Pakistan causing 60-90% yield losses. Two varieties of *Brassica napus* DGL and Oscar were sown in research area of department of Plant Pathology during 2016-17. Eight commercial fungicides were applied to check their efficacy to manage the white rust disease. Two concentrations (0.25% and 0.50%) of each fungicide were applied on weekly interval with hand sprayer separately on each variety. Among all fungicides, Swing 72% (Metalaxyl 8% +Mancozeb 64%) was found most effective in reducing the disease incidence. It reduced the disease incidence effectively up to 24.09% followed by Antracol (Propineb 70%) 34.7%. It is suggested that these fungicides can be used in the field for effective management of white rust of rapeseed.

Keywords: *Brassica*, *Albugo candida*, white rust, Chemicals management

INTRODUCTION

Brassica napus is the 2nd most important oilseed crop. It has been cultivated in Asia, China, South Africa, Europe, and Canada since 2000 BC (Warwick *et al*., 2006; Yao *et al*., 2012). It is cultivated on an area of 25 million hectares with 46 million tons' production worldwide (FAO, 2004). In Pakistan, it is cultivated on an area of 193.6 thousand hectares and its production of seed and oil content is 181 and 56 thousand tons respectively in 2015 (PODB, 2015) and it fulfills the 17% of oil requirement of Pakistan which is subjected to many diseases. Among all diseases, White Rust (WR) is the most destructive disease of *Brassica* in hot and humid areas of Pakistan caused by *Albugo candida* (Armstrong, 2007; Abbas *et al*., 2008)). It causes 20-90% yield losses throughout the world (Kumar and Kalha, 2005; Mishra *et al* 2009). The *candidum* (*candida*) specie of genus *Albugo* causing white rust was first reported by Gmelin (1792) while in Pakistan it was reported from FATA and Bajur Agency (Ahmad *et al*., 1997). It is an obligate parasite and can be survived by means of producing oospores in infected plants parts and in soil for more than 20 years (Gupta *et al*., 2004; Hina *et al*., 2014). Optimum temperature for effective infection is 12-22°C and relative humidity (RH) 60-90% (Sullivan *et al*., 2002). It contains different beneficial chemicals like amino acids, folate, glucosinolate, carotenoids, ascorbic acid, tocopherols, phenolic, sugar, minerals and vegetable oil content. These compounds play vital role in human, animal's nutrition as well as play significant role in the survival of plant (Jahangir *et al*., 2009; Huber *et al*., 2009; Rossetto *et al*., 2013). Mainly it produces two types of infection: local and systemic. Local infection is characterized by the formation of raised creamy white sporangial pustules on the undersurface of leaves, on tender shoots. The affected tissue turns necrotic and dies. Systemic infection is usually seen in young inflorescences and terminal leaves. It stimulates hypertrophy and hyperplasia resulting in abnormal

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swelling and malformation of the affected organs. Floral organs turn green, become greatly enlarged and distorted, and seed formation is prevented (Saharan and Mehta, 2002; Mishra *et al.,* 2009).

There are many management strategies available against the white rust disease like resistant varieties, crop rotation, chemical and biological control, and cultural practices. Resistant cultivars are the best option to control the disease as they are eco-friendly, locally adapted to the environment, and durable. Due to unavailability of exotic resistant germplasm farmer has to cultivate susceptible varieties. Different plant extracts are also used to manage this disease (Nwachukwu and Umechuruba, 2001). These plant extracts are environment friendly which have been successfully used to manage this disease. Use of resistant varieties is most cost effective method and it may limit the use of fungicides. But the emergence new races of pathogen overcome resistance genes in currently grown cultivars (Fravel *et al.,* 2003). So, another rapid and effective way of controlling white rust disease is an application of fungicides. As other alternative methods such as biological control, plant extracts, and agricultural practices are becoming less effective. Somehow these methods are time consuming and labor requiring. There are chances of adulterated formulations of biological formulation which will result in loss of money and crop (Abada *et al*., 2008). That's why, these are necessary to maintain the potential yield as fungi produces countless spores to withdraw nutrients from the plant (Lenard and Nathan, 2006). When disease suddenly appear, it is very difficult for a farmer either to apply different organic formulations or totally uproot plants. Chemicals will protect by forming layer on leaves surface while some have ability to penetrate the system and help the plant to reverse the biochemical changes induced by the pathogen. These are rapid and quick remedy and easy to apply in case of sudden outburst of disease. Many field trials of different concentrations of fungicides were resulted in 30-65% disease control in India. Seed treatment and foliar spraying of different fungicides concentrations were tested on multiple varieties to validate them as cost effective (Rathi and Singh, 2010). Application timing of fungicides play critical role in controlling WR disease especially in late sown crop. It is being suggested by Mehta, Khangura and Sokhi (2000) that two to three foliar sprays of a fungicide will be enough to manage this disease.

Disease incidence fluctuates with cropping seasons depending on the prevalent weather conditions. That leads farmers to follow different strategies of control. Mostly fear of farmer is losing their crop yield which force them to apply abundant fungicides as a preventive measure at calendar based spraying intervals. Some other farmers apply fungicides based on their experience and weather forecast conditions. The current strategies might contribute to increase pesticide concentration in the surface waters of the region (Konstantinou *et al*., 2006). Main objective of present study was to evaluate the efficiency of chemicals against white rust pathogen to minimize its yield losses under field conditions.

MATERIALS AND METHODS

Evaluation of Fungicides in Field Conditions: The experiment was conducted in the research area of Department of Plant Pathology, University of Agriculture Faisalabad in December 01, 2016. Two varieties of brassica (DGL and Oscar) were collected from Oilseed Research Institute, Ayub Agricultural Research Institute (AARI), Faisalabad. These varieties were planted on flat bed surface under Randomized Complete Block Design (RCBD) with plant to plant (P×P) distance 45 cm and bed to bed (B×B) distance 75 cm with three replications of each variety. The size of the plot was adjusted to 10 ft x 10 ft with four rows. All the cultural practices were performed to keep the crop in healthy condition with the application of standard doses of fertilizers. Eight commercial fungicides (Rally 40% WP (Myclobutanil 40%), Chlorostrobin (Azoxystrobin 5.4%+Chlorothalonil 45%), Alliette 80% WP (Fosetyli-Aluminium 80%), Success 70% WP (Metalaxyl 8% + Chlorothalonil 64%), Swing 72% (Metalaxyl 8% +Mancozeb 64%), Cytrol 75% (Thiophanate-methyle 35% + Chlorothalonil 40%), Antracol (Propineb 70%) and Score 250 EC (Difenconazole 250EC) taken from market. Two concentrations 0.25% and 0.50% were made by dissolving 25 mg and 50 mg in 100 ml water. Hand sprayer (HECHT-401, Model: HT-401) was used to apply the foliar concentration of spray on each row of variety. Untreated rows of each varieties/lines in each block served as check/control. First spray of the fungicides was applied by Hand sprayer (HECHT-401, Model: HT-401) one month after the crop sowing just

after the appearance of initial symptoms in the field. First spray was carried out immediately after the appearance of the disease symptoms and repeated after seven days according to the treatment plan. Disease ratings were recorded by visual observations at the initiation of primary symptoms disease and continued till the physical maturity of the crop or when the leaves became necrotic due to fungal attack. Data was collected on weekly basis using following method:

$$\text{Disease incidence (\%)} = \frac{\text{No. of infected plants}}{\text{Total No. of plants}} \times 100$$

Statistical Analysis: Data was analyzed by analysis of variance and treatments were compared by using Least Significant Difference (LSD) test (Steel *et al.,* 1997). All the statistical tests were performed by using SAS statistical software (SAS institute, 1990).

RESULTS

All the fungicides used in this study exhibited significantly effective results to manage the white rust disease. Among all fungicides, Swing 72% (Metalaxyl 8% + Mancozeb 64%) reduced the disease incidence very efficiently after application of both concentrations in both weeks. In addition to this, the results of Swing 72% (Metalaxyl 8% + Mancozeb 64%) were more prominent on Oscar with the mean values of disease incidence 19.977%, 17.157% and 14.64%. It suggested that second concentration of this fungicide is most effective. Moreover the 0.50% concentration of Antracol (Propineb 70%) showed better results as compared to control. Similarly, both concentrations of Score 250 EC (Difenconazole 250EC) resulted in decreasing the disease incidence first but later it gradually increased. Although the disease was suddenly enhanced but it was less as compared to control. Moreover, maximum disease incidence on both varieties was expressed by Rally 40% WP (Myclobutanil 40%) followed by Chlorostrobin (Azoxystrobin 5.4%+Chlorothalonil 45%), Alliette 80% WP (Fosetyli-Aluminium 80%), Success 70% WP (Metalaxyl 8% + Chlorothalonil 64%) and Score 250 EC (Difenconazole 250EC) respectively. Among all Swing 72% (Metalaxyl 8% + Mancozeb 64%) ranked first followed by Antracol (Propineb 70%) and Success 70% WP (Metalaxyl 8% + Chlorothalonil 64%). In addition, Most least effective fungicide was found Cytrol 75% (Thiophanate-methyle 35% + Chlorothalonil 40%) followed by Chlorostrobin (Azoxystrobin 5.4%+Chlorothalonil 45%), Rally 40% WP (Myclobutanil 40%)and Score 250 EC (Difenconazole 250EC). Although they reduced the disease as compare to control but they can not be recommended for quick remedy (Table 6).

Table 6. Evaluation of interaction of treatments with concentrations, weeks and Varieties (TxWxVxC) against white rust of brassica.

Treatments		Disease incidence %							
		After Week 1				After Week 2			
		DGL		Oscar		DGL		Oscar	
Sr		Conc. 1	Conc. 2	Conc. 1	Conc.2	Conc. 1	Conc. 2	Conc. 1	Conc. 2
1	Rally	38.733 vwx	34.553 ab	45.910 ij	44.610 klm	37.143 yz	29.837 hi	43.897 mn	42.670 pqr
2	Chlorostrobin	42.757 pq	41.023 tu	34.327 abc	48.523 de	48.50 ef	43.763 mno	30.790 fg	34.977 a
3	Allette	33.377 de	45.483 ijk	29.263 ij	41.803 rst	38.317 wx	39.423 v	33.910 bcd	42.757 pq
4	Success	38.283 wx	44.297 lm	39.023 vw	45.077 jkl	46.257 hi	33.527 cde	42.157 qr	47.623 efg
5	Swing	32.953 e	31.607 f	19.977 m	17.157 n	27.047 k	25.063 l	24.337 l	14.640 o
6	Cytrol	44.320 lm	50.457 c	43.277 nop	44.660 klm	40.920 tu	49.290 d	42.847 opq	37.933 xy
7	Antracol	38.713 vwx	31.633 f	34.263abcd	28.877 j	40.683 u	26.730 z	41.597 stu	25.130 l
8	Score	32.827 e	30.610 gh	48.203 ef	47.570 g	36.967 z	34.283 abcd	47.100 h	45.073 jkl
9	Control	68.7a	68.7a	68.7a	68.7a	63.3 b	63.3 b	63.3 b	63.3b
		LSD				0.946			

C 1= 0.25%, C 2= 0.50% (Conc. = concentration)

***** Mean values in a column sharing similar letters do not differ significantly as determined by the LSD test (P ≤ 0.05).

DISCUSSION

Our results were supported by the results of Rathi *et al.,* (2009) in which they executed the foliar application of Ridomil MZ-72 WP containing active ingredient of 8% Metalaxyl and 64% Mancozeb @ 2g/l to control the white rust disease. Ridomil MZ-72 WP significantly reduced the disease incidence ranging from 64 to 30%. Our findings are prominently similar with reduction range of 40% in disease after the twice application of swing @ 2.5g/l.

Similarly, Rohilla *et al.,* (2001) evaluated foliar spray of Ridomil MZ-72 WP which effectively reduced *Albugo candida* inoculum in open field conditions. They found it helpful in reducing the disease incidence quickly on

brassica. They used Apron 35-SD (Propineb) as a foliar spray mixed with Ridomil MZ-72. This combination resulted in significant reduction of white rust disease. Our results support the findings of Kuyucuklu and Ozer, (1994), they conducted an experiment to determine the efficacy of fungicides and concluded that Antracol 50 WP (propineb 70%), Polyram DF (metiram complex 80%) and Curzeb 50 WP (mancozeb 45% + cymoxanil 5%) gave 60, 74 and 80% efficacy, respectively.

These findings were quite match able to Talkuder *et al.,* (2012). They also conducted similar experiment on Ridomil gold 68 WP (Chlorothalonil + Mefenoxam) @ 0.2%, Contaf 25 EC (Triazole) @ 0.1%, and X-tra care 300 EC (myclobutanil) % 0.05% to control white rust (*Albugo occidentalis*) of red amaranth (Amaranthus spp.). Among these Ridomil gold was found most effective one to control white rust.

Meena *et al.,* (2011) conducted different experiments to check efficiency of Mancozeb against white rust disease of *Brassica*. Its results support the results of this study. After different trials she demonstrated the lowering of disease incidence up to 64% and 19%. Meena *et al.,* (2011) showed that chemical fungicides in combination with Eco-friendly products such as *T. harzianum* and *Pseudomonas fluorescence* will give better results against WR. Khan *et al.,* (2007) findings on different fungicides and their combinations are actively in the favor of our research theme. They evalutes Bavistom, Topsin M and Ridomil MZ were evaluated and compared with other four commercial fungicides like Captaf, Indofil M-45, Indofil Z-78 and Thiram white rust. Ridomil MZ was found significantly effective controlling disease up to 32%. Topsin M and Ridomil formulations are similar to Swing 72% (Metalaxyl 8% + Mancozeb 64%) 72% (Metalaxyl 8% +Mancozeb 64%) and Antracol (Propineb 70%) (Propineb 70%) and support the results investigated by this research.

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