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## Effective Management of White rust (*Albugo candida*) of rapeseed through commercially available fungicides

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### ABSTRACT

*Brassica napus* (Rapeseed) affected by white rust is a major threat in Pakistan causing 60-90% yield losses. Two susceptible 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. It was concluded that among all fungicides, Swing 72% (Metalaxyl 8% +Mancozeb 64%) was found most effective in reducing the disease incidence reduced the disease incidence effectively up to 60-80%. upto 24.09% followed by Antracol (Propineb 70%)

### Introduction

*Brassica napus* is the 2<sup>nd</sup> 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 (Ahmed *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 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). That's why present study was planned to evaluate the efficiency of chemicals against white rust pathogen.

## **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 Susceptible varieties/lines 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 with standard doses of fertilizers. All the cultural practices were performed to keep the crop in healthy condition. Eight commercial fungicides (Rally 40% WP (Myclobutanil 40%), Chlorostrobil (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 and recommended concentrations' two sprays at 7 days' interval were applied against white rust disease under field conditions. Hand sprayer (HECHT-401, Model: HT-401) was used to apply the foliar concentration of spray.

Spraying was carried out at predefined intervals 07 and 14 days, respectively. Untreated rows of each varieties/lines in each block served as check. First spray of the fungicides was applied by Hand sprayer (HECHT-401, Model: HT-401) exactly one

month after the crop sowing. Fungicides with recommended doses were sprayed @ 0.25% and 0.50% as consecutive sprays 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. Data on disease incidence was recorded after every week using disease rating scale given by Li *et al.*, 2007 (Table 1). Disease ratings were taken 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:

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

INSERT TABLE 1 HERE

#### Statistical analysis

Data was analyzed by analysis of variance and treatments were compared by using Least Significant Difference (LSD) test (Steel *et al.*, 1997). Efficiency of fungicides in suppression of the pathogen and reduction of the disease was recorded. All the statistical tests were performed by using SAS statistical software (SAS institute, 1990).

#### RESULTS

Among all fungicides, Swing 72% (Metalaxyl 8% + Mancozeb 64%) efficiently reduced the disease incidence followed by Antracol (Propineb 70%) as compared to control. Among other fungicides Alliette 80% WP (Fosetyli-Aluminium 80%), was found most effective followed by Rally 40% WP (Myclobutanil 40%), Score, Chlorostrobin (Azoxystrobin 5.4%+Chlorothalonil 45%), Success 70% WP (Metalaxyl 8% + Chlorothalonil 64%) and Cytrol 75% (Thiophanate-methyle 35% + Chlorothalonil 40%) respectively contrasted with control (Table 2).

INSERT TABLE 2 HERE

Interaction among the treatment and varieties (TxV) demonstrated that Swing 72% (Metalaxyl 8% + Mancozeb 64%) was most effective followed by Antracol (Propineb 70%) on both DGL and Oscar varieties as compare to control. Among other fungicides Rally 40% WP (Myclobutanil 40%) showed high decrease in disease incidence followed by Chlorostrobin (Azoxystrobin 5.4% + Chlorothalonil 45%), Alliette 80% WP (Fosetyli-Aluminium 80%), Success 70% WP (Metalaxyl 8% + Chlorothalonil 64%),

Cytrol 75% (Thiophanate-methyle 35% + Chlorothalonil 40%), and Score respectively (Table 3, Fig. 1).

INSERT TABLE 3 AND FIG. 1 HERE

Interaction among treatments, varieties and concentration revealed that at both concentrations (0.25%, 0.5%) Swing 72% (Metalaxyl 8% + Mancozeb 64%) were most effective on both Oscar and DGL varieties as compared to control. Only at 0.5% concentration of Antracol (Propineb 70%) applied on Oscar resulted 27% reduction in disease incidence. All other fungicides at both concentration resulted in maximum disease incidence on both varieties but less than control (Table 4, Fig. 2).

INSERT TABLE 4 AND FIG. 2 HERE

Interaction among treatment, weeks and varieties revealed that minimum disease incidence was recorded by application of Swing 72% (Metalaxyl 8% + Mancozeb 64%) on both varieties after every 7 days interval. Similarly, maximum disease incidence was expressed by Cytrol 75% (Thiophanate-methyle 35% + Chlorothalonil 40%) followed by Score 250 EC (Difencconazole 250), Chlorostrobilin (Azoxystrobin 5.4%+Chlorothalonil 45%), Cytrol 75% (Thiophanate-methyle 35% + Chlorothalonil 40%), Success 70% WP (Metalaxyl 8% + Chlorothalonil 64%) and Rally 40% WP (Myclobutanil 40%) after 1<sup>st</sup> and 2<sup>nd</sup> week on both varieties respectively (Table 5, Fig. 3).

INSERT TABLE 5 AND FIG. 3 HERE

Evaluation of four-way interaction of treatments with weeks, varieties and concentrations expressed different disease incidence percentage. It was concluded that Swing 72% (Metalaxyl 8% + Mancozeb 64%) efficacy was actively and efficiently best at both concentrations after 1<sup>st</sup> and 2<sup>nd</sup> week on both varieties. Gradual decreasing trend was observed on these varieties after application of both concentrations with regular 7 days interval. There was sudden drastic decrease in disease incidence on Oscar after 14 days' interval spraying from 24.33% to 14.64%. Maximum disease incidence within 1<sup>st</sup> week on both varieties was expressed by Rally 40% WP (Myclobutanil 40%) followed by Chlorostrobilin (Azoxystrobin 5.4%+Chlorothalonil 45%), Alliette 80% WP (Fosetyli-Aluminium 80%), Success 70% WP (Metalaxyl 8% + Chlorothalonil 64%) and score respectively while after 2<sup>nd</sup> week this incidence was slightly decreased by application of Chlorostrobilin (Azoxystrobin 5.4%+Chlorothalonil 45%) followed by Success 70% WP (Metalaxyl 8% + Chlorothalonil 64%), and score (Table 8, Fig. 6 & 8).

INSERT TABLE 6 AND FIG. 4 HERE

## Discussion

Results of this study showed that Swing exhibited least disease incidence on both *Brassica napus* varieties as compared to control. Only 0.5% concentration of Antracol applied on these varieties resulted in high reduction in disease incidence. This work is similar to the findings of Rathi *et al.*, (2008) in which foliar spray of Ridomil MZ-72 WP containing active ingredient of 8% Metalaxyl and 64% Mancozeb @ 2g/L after two month of sowing showed significantly reduction in disease development. Incidence of WR was reduced up to 40%. Seed production was significantly increased up to 27% by this treatment. Similarly, Apron 35 S (Metalaxyl 35%) was used for seed treatment @ 6g/Kg seed followed by foliar spray of Ridomil MZ-72 WP @ 2g/L after 50-60 days' interval after sowing. However, this combination controlled 65% and 40% WR and stag-heads disease respectively. Seed yield was significantly enhanced up to 38% by this application. Similarly Rohilla *et al.*, (2001) evaluated foliar spray of Ridomil MZ-72 WP which effectively reduced inoculum pressure of *Alternaria brassicae* and *Albugo candida* in natural field conditions. It helped not only in reducing the disease severity on *brassica* but also assisted in increasing the yield potential. Similar results were also demonstrated by Apron 35-SD when applied as a foliar spray mixed with Ridomil MZ-72 WP against WR and AB.

Significant increase in yield was evident for their effectiveness. Among fungicides Swing and Antracol performance was found best in each application after 1<sup>st</sup> and 2<sup>nd</sup> week on both varieties. These findings are actively supported by (Talkuder *et al.*, 2012) in which efficacy of six fungicides namely Sunvit @ 0.2%, Ridomil gold 68 WP (Chlorothalonil + Mefenoxam) @ 0.2%, Contaf 25 EC (Triazole) @ 0.1%, Orzim 50 WP (0.1%), Zoom 50 WP (0.1%), and X-tra care 300 EC (myclobutanil) % 0.05% were evaluated to control white rust (*Albugo occidentalis*) of red amaranth (*Amaranthus* spp.). Among these Ridomil gold was found most effective to control white rust followed by Sunvit.

Higher efficiency of Mancozeb was recorded by Meena *et al.*, (2011) against white rust disease of *Brassica napus* that deduced disease incidence up to 64% and 19%. Similar results were obtained when it was combined with garlic extract and it minimize the disease development upto 61%. Meena *et al.*, (2011) also showed that chemical fungicides in combination with Eco-friendly products such as *T. harzianum* and *Pseudomonas fluorescence* demonstrated less effective results against *Alternaria* blight

but showed significantly superior and better results against WR and reduced the disease severity on leaves. Present investigations were also similar in which Swing 72% (Metalaxyl 8% + Mancozeb 64%) control the disease inoculum upto 40%.

Different concentrations and combinations of 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 in vivo and in vitro conditions against brassica's diseases. Inoculum was applied prior to spraying of different at different concentrations like 50ppm, 100ppm, 150ppm and 200ppm. Ridomil MZ was found significantly effective controlling disease upto 32%. Similarly, the mixture of Baviston and Captaf reduced disease development up to 25%. Application of these fungicide also supported in enhancing the yield potential up to ten-fold (Khan *et al.*, 2007). 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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