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In vivo Efficacy of Integrated Fungicides and Organics against Mustard White Rust in Konkan Region, India

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A B S T R A C T

Field integration of various fungicides, phytoextracts and essential oils (alone and in combination) as seed treatments and foliar sprays significantly reduced mustard white rust disease caused by *Albugo candida* (Pers.) Kuntze, over untreated control, along with enhanced seed and straw yields and better ICBR. Based on performance merit, the best treatments were Metalaxyl 35%SD- ST @ 6g/kg + Metalaxyl 4%+ Mancozeb 68%WP- FS @ 0.25%>Metalaxyl 4%+ Mancozeb 68%WP -FS @ 0.25% + *Azadirachta indica* @ 20%>Metalaxyl 4%+ Mancozeb 68%WP- FS @ 0.25%>Metalaxyl 35% SD- ST @ 6g/kg + Chlorothalonil 75% WP- FS @ 0.15%. Based on ICBR, the most economical treatment found were Metalaxyl 35%SD- ST @ 6g/kg + Metalaxyl 4%+ Mancozeb 68%WP-FS @ 0.25% (ICBR: 3.02), Metalaxyl 35% SD- ST @ 6g/kg + Chlorothalonil 75% WP- FS @ 0.15% (ICBR: 2.71), Metalaxyl 35% SD- ST @ 6g/kg (ICBR: 2.64), Thus, from the present field study, it is inferred that seed treatment of Metalaxyl 35% SD + three foliar sprayings of Metalaxyl 4%+ Mancozeb 68%WP @ 0.25% could be employed to manage effectively and economically the mustard white rust disease.

Introduction

Rapeseed-mustard is an inevitable component of India's traditional culinary system that can be used as a source of edible oil, raw material for industrial products and as a spice. It is the third major oil seed crop of the world, after soybean and oil palm (Abhishek *et al.*, 2017).

The yield of oil from different forms of rapeseed-mustard varies/ ranges from 37-49 per cent. The oil is utilized for human consumption, for frying purpose and seeds as spices and oil cake used as cattle feed and manure. Oilseed crops play a vital role in national economy. The mustard seed contains proteins (25.39%), fats (38.45%), ash (4.25%), carbohydrates (21.19%), fibres (6.36%), moisture (4.36%) etc. (Fahad and Mohammed, 2012).

Major constraints in mustard production are the pests and diseases that cause a high level deflation and challenge the existing oil seed economy of the country. White rust is the major and widely prevalent disease of rapeseed and mustard, in India. It is caused by an oomycotic fungi *Albugo candida*, which

appears in an epiphytotic form, inducing serious damage to the cruciferous crops (Kolte, 1985). Chemical compounds should not only be safe to human beings and other mammals, but also to environment including beneficial microorganisms. With the increased harmful effects of fungicides, the need to integrate organics with less fungicidal spray is gaining importance in recent years. Several organics *viz.*, neem leaf extract, neem oil, garlic extract, eucalyptus leaf extract etc. were earlier reported by several workers as potential alternatives for chemical fungicides against white rust disease.

Materials and Methods

Field experiments were planned and conducted to evaluate the efficacy of most effective three fungicides (based on present *in vitro* studies) *viz.*, systemic fungicide- Metalaxyl 35%SD, contact fungicide- Chlorothalonil 75% WP and combi fungicide- Metalaxyl 4%+ Mancozeb 68%WP, one each phytoextract- *Azadirachta indica*, and essential oil- *Allium sativum*, alone and in combinations to manage white rust of mustard. Three sprays of the treatments were undertaken, starting first spray at first appearance of white rust and second and third sprays at an interval of 10 days. All package of practices were followed and the crop was irrigated whenever required.

Observations

Observations were recorded on white rust intensity at first appearance of the disease symptoms, subsequently, three observations likewise, one day before second and third sprays; and last observation at 10 days after third spray.

For recording observations on white rust disease intensity / severity, mustard plants / treatment /replication were selected randomly and tagged. From each tagged plant, three leaves (bottom, middle and top) were selected to record disease intensity / severity by applying 0 to 9 grade disease rating scale as given in PLATE I (Bisht *et al.*, 2018).

Per cent disease intensity/index was calculated by applying the formula (Wheeler, 1969).

$$PDI = \frac{\text{Summation of numerical ratings}}{\text{No. of leaves / plants observed x Maximum rating}} \times 100$$

Per cent disease control (PDC) over untreated control was calculated by applying the following formula.

$$PDC = \frac{\text{PDI in Control plot - PDI in Treatment plot}}{\text{PDI in Control plot}} \times 100$$

Seed yield and straw yield

Seed yield and straw yield from each treatment plot were recorded and calculated on hectare basis, to study the effect of various treatments integrated to manage mustard white rust on mustard yield.

Economics of the treatments

To find out most effective and economical treatment, the incremental cost benefit ratio (ICBR) was worked out. For the purpose, cost of cultivation / production, cost of plant protection, gross monetary returns and net profit were considered, to calculate ICBR of the treatments integrated to manage mustard white rust.

Results and Discussion

Disease intensity

Results (Table 1 and Fig. 1) revealed that all of nine treatments attempted significantly influenced the white rust intensity on mustard.

The disease appeared first comparatively late at about 85 to 90 days after sowing, which later increased steadily upto third spraying and decreased thereafter.

At first appearance, the disease intensity ranged from 3.21 to 5.92 per cent and was non-significant. However it was least (3.21%) with T_1 - Metalaxyl 35%SD- ST @ 6g/kg andT_9- Chlorothalonil 75% WP- FS @0.15% +Garlic oilFS @0.1%.

One day before second spraying, the disease intensity ranged from 4.69 to 19.45 per cent. However, it was significantly least with (4.69%) T_3-Metalaxyl 35% SD- ST @6g/kg + Metalaxyl 4%+ Mancozeb 68%WP- FS @ 0.25%, which was at par with T_8- Metalaxyl 4% + Mancozeb 68% WP- FS @0.25% + *Azadirachta indica*- FS @ 20% (5.18%) and T_2 -Metalaxyl 4%+ Mancozeb 68% WP- FS @ 0.25% (5.92%). These were followed by T_5 - Metalaxyl 35%SD- ST @6g/kg+ Chlorothalonil 75% WP-FS @ 0.15% (6.41%), T_9- Chlorothalonil 75% WP- FS @0.15% + Garlic oil FS @0.1% (6.91%), both were at par, T_4-Chlorothalonil 75% WP- FS @0.15% (7.15%), T_1- Metalaxyl 35%SD- ST @ 6g/kg (7.65%), T_7- Garlic oil- FS @ 0.1% (12.09%) and T_6- *Azadirachta indica*- FS @ 20% (13.08%) as against maximum in untreated control (19.45%).

One day before third spraying, the disease intensity ranged from 8.88 to 38.27 per cent. However it was significantly least with T_3-Metalaxyl 35% SD- ST @6g/kg + Metalaxyl 4%+ Mancozeb 68%WP-FS @0.25% (8.88%), which was at par with T_8- Metalaxyl 4 Mancozeb 68%WP- FS @ 0.25% + *Azadirachta indica*- FS @ 20% (9.62%), and T_2-Metalaxyl 4%+ Mancozeb 68%WP- FS @ 0.25% (10.37%). These were followed by T_5-Metalaxyl 35% SD- ST @6g/kg + Chlorothalonil 75% WP- FS @ 0.15%(14.56%), T_9- Chlorothalonil 75% WP-FS @0.15% +Garlic oil– FS @0.1%(18.52%), T_4-Chlorothalonil 75% WP- FS @0.15% (19.01%), T_1- Metalaxyl 35%SD- ST @6g/kg (19.26%), T_7- Garlic oil- FS @0.1% (28.64%) and T_6- *Azadirachta indica*- FS @ 20% (30.12%) compared to highest in untreated control (38.27%).

Terminal disease intensity was significantly least with T_3- Metalaxyl 35%SD- ST @ 6g/kg+ Metalaxyl 4%+ Mancozeb 68%WP-FS @0.25%(6.41%), followed by, T_8-Metalaxyl 4%+ Mancozeb 68%WP- FS @0.25% + *Azadirachta indica* FS @ 20%(8.14%), T_2- Metalaxyl 4%+ Mancozeb 68%WP- FS @0.25% (8.88%), T_5-Metalaxyl 35% SD- ST @6g/kg+ Chlorothalonil 75% WP- FS @ 0.15% (12.84%), T_9-Chlorothalonil 75% WP- FS @0.15% +Garlic oil- FS @0.1% (16.54%), T_4-Chlorothalonil 75% WP- FS @0.15% (11.97%), T_1-Metalaxyl 35%SD- ST @6g/kg (18.52%), T_7-Garlic oil- FS@0.1% (26.66%) and T_6-*Azadirachta indica*- FS @ 20% (28.63%).

Mean disease intensity and its reduction

Based on mean disease intensity and its reduction over untreated control (Table 1 and Fig. 1), the most effective treatment T_3-Metalaxyl 35%SD- ST @ 6g/kg+ Metalaxyl 4%+ Mancozeb 68%WP- FS @0.25% was with least mean disease intensity (5.86%) and corresponding highest disease reduction (77.60%), followed by T_8- Metalaxyl 4%+ Mancozeb 68% WP-FS @0.25% + *Azadirachta indica*- FS @ 20% (6.97% and 73.36%, respectively), T_2- Metalaxyl 4%+ Mancozeb 68% WP- FS @ 0.25% (7.40% and 71.70%, respectively), T_5-Metalaxyl 35% SD-ST @ 6g/kg + Chlorothalonil 75% WP- FS @ 0.15% (9.56% and 63.44%, respectively), T_9-Chlorothalonil 75% WP- FS @0.15% + Garlic oil- FS@ 0.1% (11.29% and 56.84%, respectively), T_4-Chlorothalonil 75% WP- FS @ 0.15% (17.77% and 54.24%, respectively)

and T_1- Metalaxyl 35% SD- ST @ 6g/kg (12.16% and 53.52%, respectively).Rest of the treatments, T_7- Garlic oil- FS@ 0.1% (17.90%and 31.59%, respectively) and T_6- *Azadirachta indica*- FS @ 20% (19.38% and 25.93%, respectively) were the less effective. Thus among various treatments integrated to manage mustard white rust, the most effective in their order of merit were T_3- Metalaxyl 35%SD- ST @ 6g/kg+ Metalaxyl 4%+ Mancozeb 68%WP- FS @0.25%>T_8- Metalaxyl 4%+ Mancozeb 68% WP-FS @0.25% + *Azadirachta indica*- FS @ 20% >T_2- Metalaxyl 4%+ Mancozeb 68% WP- FS @ 0.25%. The results regarding effectiveness of fungicides are in context to the findings of Verma (1987), Verma (2005), Kanase (2008), Rathi and Singh (2009), Meena *et al.*, (2011), Bhairava *et al.*, (2015) and Salunke *et al.*, (2018).

Kanase (2008) reported Metalaxyl 8% + Mancozeb 64% WP- FS @ 0.2% as most effective with highest control (71.42%) of white rust of mustard, under field conditions. Rathi and Singh (2009)also reported seed treatment with Metalaxyl 35%WP @ 6g/kg, followed by foliar spray of Metalaxyl 8% + Mancozeb 64% WP @ 2g/lit water at 50- 60 DAS as most effective with minimum white rust intensity and highest disease control (12.2%, 64.2%, respectively), followed by ST with Carbendazim 50% WP @ 2g/kg + Metalaxyl 4%+ Mancozeb 68% WP –FS @2g/l (14.9%, 56.0%, respectively).

Treatments

Tr. No.	Treatments
T_1	Metalaxyl 35%SD- ST @6g/kg
T_2	Metalaxyl 4%+ Mancozeb 68%WP- FS @ 0.25%
T_3	Metalaxyl 35%SD- ST @6g/kg + Metalaxyl 4%+ Mancozeb 68%WP- FS @0.25%
T_4	Chlorothalonil 75% WP - FS @0.15%
T_5	Metalaxyl 35%SD- ST @6g/kg+ Chlorothalonil 75% WP-FS @0.15%
T_6	*Azadirachta indica*- FS @20%
T_7	Garlic oil- FS @0.1%
T_8	Metalaxyl 4%+ Mancozeb 68%WP - FS @ 0.25% + *Azadirachta indica* @ 20%
T_9	Chlorothalonil 75% WP-FS@0.15% +Garlic oil FS -@ 0.1%
T_{10}	Control (Untreated)

Observations

Grade/ scale	Description
0	No symptoms on leaf
1	Small raised blisters covering 1% of leaf area
3	Small raised blisters covering 1-10% leaf area
5	Blister, raised covering 11-25% of leaf area
7	Raised shiny white blisters covering 26-50% leaf area
9	Raised shiny blisters coalescing to form large patches, over 51% or more of the leaf area.

Table.1 Field efficacy of various treatments integrated against white rust disease of mustard

Tr. No	Treatments	Disease intensity*(%)				Mean PDI (%)	Mean PDC (%)
		At first appearance	Before Second Spray	Before Third Spray	10 Days After Third spray (Terminal)		
T_1	Metalaxyl 35%SD- ST @ 6g/kg	3.21 (10.32)	7.65 (16.06)	19.26 (26.03)	18.52 (25.49)	12.16 (20.41)	53.52 (47.02)
T_2	Metalaxyl 4%+ Mancozeb 68%WP- FS @ 0.25%	4.44 (12.16)	5.92 (14.08)	10.37 (18.79)	8.88 (17.34)	7.40 (15.79)	71.70 (57.86)
T_3	Metalaxyl 35%SD- ST @ 6g/kg + Metalaxyl 4%+ Mancozeb 68%WP-FS @ 0.25%	3.45 (10.70)	4.69 (12.51)	8.88 (17.34)	6.41 (14.67)	5.86 (14.01)	77.60 (61.75)
T_4	Chlorothalonil 75% WP - FS @ 0.15%	3.95 (11.46)	7.15 (15.51)	19.01 (25.85)	17.77 (24.93)	11.97 (20.24)	54.24 (47.43)
T_5	Metalaxyl 35%SD- ST @ 6g/kg+ Chlorothalonil 75% WP-FS @ 0.15%	4.44 (12.16)	6.41 (14.67)	14.56 (22.43)	12.84 (21.00)	9.56 (18.01)	63.44 (52.80)
T_6	*Azadirachta indica*- FS @ 20%	5.67 (13.78)	13.08 (21.20)	30.12 (33.29)	28.63 (32.35)	19.38 (26.12)	25.93 (30.61)
T_7	Garlic oil- FS @ 0.1%	4.19 (11.81)	12.09 (20.35)	28.64 (32.36)	26.66 (31.09)	17.90 (25.03)	31.59 (34.20)
T_8	Metalaxyl 4%+ Mancozeb 68%WP -FS @ 0.25% + *Azadirachta indica* @ 20%	4.93 (12.83)	5.18 (13.16)	9.62 (18.07)	8.14 (16.58)	6.97 (15.31)	73.36 (58.93)
T_9	Chlorothalonil 75% WP-FS@ 0.15% +Garlic oil FS -@ 0.1%	3.21 (10.32)	6.91 (15.24)	18.52 (25.49)	16.54 (24.00)	11.29 (19.63)	56.84 (48.93)
T_{10}	Control	5.92 (14.08)	19.45 (26.17)	38.27 (38.22)	40.98 (39.80)	26.16 (30.76)	-------
S.E.±		**0.58**	**0.65**	**0.52**	**0.48**	--------	--------
C.D. (P = 0.05)		**NS**	**1.94**	**1.56**	**1.41**	--------	---------

*Mean of three replications Figures in parenthesis are arc sine transformed values

PDI: Per cent Disease Intensity, PDC: Per cent Disease Control, ST: Seed Treatment, FS: Foliar sprays

Table.2 Economics of various treatments integrated to manage mustard white rust disease

Treatment details	Mean PDI (%)	Main product (q/ha)*	Byproduct (q/ha)*	Gross Returns (Rs/ ha) Δ	Cost of cultivation**	Cost of Plant Protection(Rs/ha)		Total cost (Rs/ha)	Net Profit (Rs/ha)	ICBR
						Treatments ***	Lab. Charges ΔΔ			
T_1- Metalaxyl 35% SD- ST @ 6g/kg	12.16	10.88	31.56	86226	32497.04	7.50	201	32705.54	53520.46	2.64
T_2- Metalaxyl 4%+ Mancozeb 68% WP- FS @ 0.25%	7.40	12.48	34.79	98553.5	32497.04	6975	201	39673.04	58880.46	2.48
T_3- Metalaxyl 35% SD- ST @ 6g/kg+ Metalaxyl 4%+ Mancozeb 68% WP- FS @ 0.25%	5.86	15.35	37.05	119782.5	32497.04	6982.5	201	39680.54	80101.96	3.02
T_4- Chlorothalonil 75% WP- FS @ 0.15%	11.97	11.19	32.63	88725.5	32497.04	3105	201	35803.04	52922.46	2.48
T_5- Metalaxyl 35% SD- ST @ 6g/kg + Chlorothalonil 75% WP- FS @ 0.15%	9.56	12.30	33.52	96940	32497.04	3112.5	201	35810.54	61129.46	2.71
T_6- *Azadirachta indica*- FS @ 20%	19.38	8.85	28.82	70925	32497.04	15000	201	47698.04	23226.96	1.49
T_7- Garlic oil- FS @ 0.1%	17.90	9.19	29.77	73610.5	32497.04	375	201	33073.04	40537.46	2.23
T_8- Metalaxyl 4%+ Mancozeb 68% WP FS @ 0.25% + *Azadirachta indica* @ 20%	6.97	13.58	35.72	106706	32497.04	21975	201	54673.04	52032.96	1.95
T_9- Chlorothalonil 75% WP- FS @ 0.15% + Garlic oil @ 0.1%- FS	11.29	11.86	33.08	93662	32497.04	3480	201	36178.04	57483.96	2.59
T_{10}- Control	26.16	7.77	28.16	62984	32497.04	00	201	32698.04	30285.96	1.93

*Mean of three replications, Δ: selling rates of mustard seeds @ Rs.7200 Rs/q; straw @ 250 Rs/q, Labour charges: 201 Rs/labour, ** As per Appendix I,
*** As per costs mentioned in the chapter III, ΔΔ: Seed treatments and spraying charges @ 201Rs/labour, ICBR: Incremental cost: benefit ratio.

Table.3 Effect of various treatments integrated to manage mustard white rust on seed and straw yield straw yield

Tr. No	Treatments	Mean PDI (%)	Mean PDC (%)	Seed yield* (q/ha)	Straw yield* (q/ha)
T_1	Metalaxyl 35%SD- ST @ 6g/kg	12.16 (20.41)	53.52 (47.02)	10.88	31.56
T_2	Metalaxyl4%+ Mancozeb 68%WP- FS @ 0.25%	7.40 (15.79)	71.70 (57.86)	12.48	34.79
T_3	Metalaxyl 35%SD- ST @ 6g/kg + Metalaxyl 4%+ Mancozeb 68%WP-FS @0.25%	5.86 (14.01)	77.60 (61.75)	15.35	37.05
T_4	Chlorothalonil 75% WP - FS @0.15%	11.97 (20.24)	54.24 (47.43)	11.19	32.63
T_5	Metalaxyl 35%SD- ST @ 6g/kg+ Chlorothalonil 75% WP-FS @0.15%	9.56 (18.01)	63.44 (52.80)	12.30	33.52
T_6	*Azadirachta indica*- FS @ 20%	19.38 (26.12)	25.93 (30.61)	8.85	28.82
T_7	Garlic oil- FS @ 0.1%	17.90 (25.03)	31.59 (34.20)	9.19	29.77
T_8	Metalaxyl 4%+ Mancozeb 68%WP -FS @ 0.25% + *Azadirachta indica* @ 20%	6.97 (15.31)	73.36 (58.93)	13.58	35.72
T_9	Chlorothalonil 75% WP-FS @ 0.15% +Garlic oil- FS @ 0.1%	11.29 (19.63)	56.84 (48.93)	11.86	33.08
T_{10}	Control	26.16 (30.76)	53.52 (47.02)	7.77	28.16
S.E.±		--------	---------	**0.16**	**0.28**
C.D. (P = 0.05)		-------	---------	**0.47**	**0.83**

*Mean of three replications, Figures in parenthesis are arc sine transformed values
PDI: Per cent Disease Intensity, PDC: Per cent Disease Control, ST: Seed Treatment, FS: Foliar sprays, Figures in parenthesis are arc sine transformed values

Fig.1 Effect of various treatments integrated on mustard white rust disease intensity and its reduction

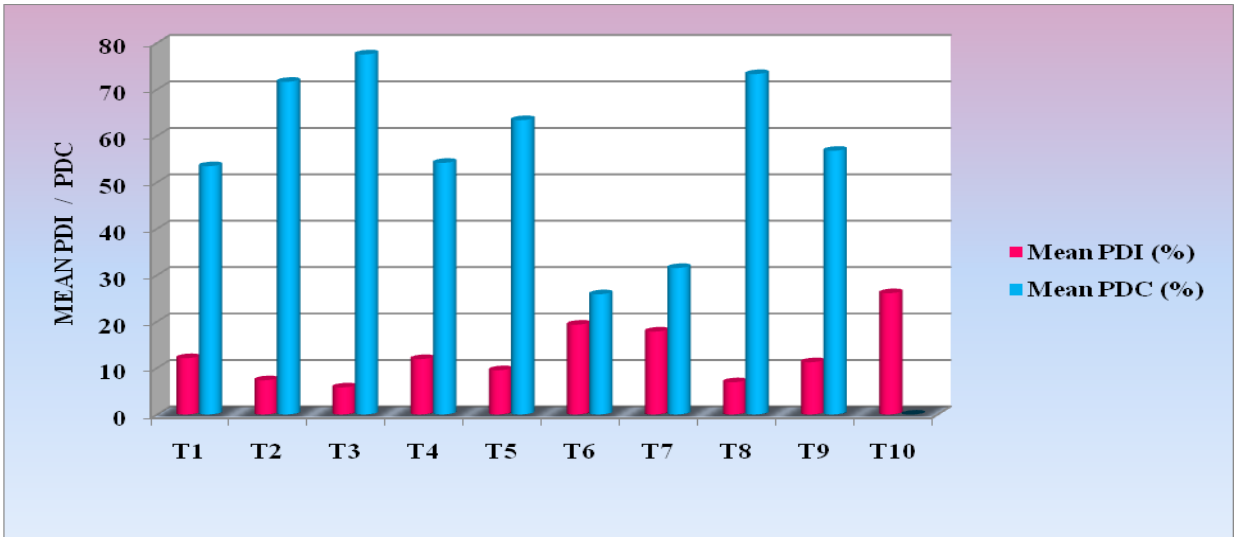


Fig.2 Effect of various treatments integrated to manage mustard white rust on seed and straw yield

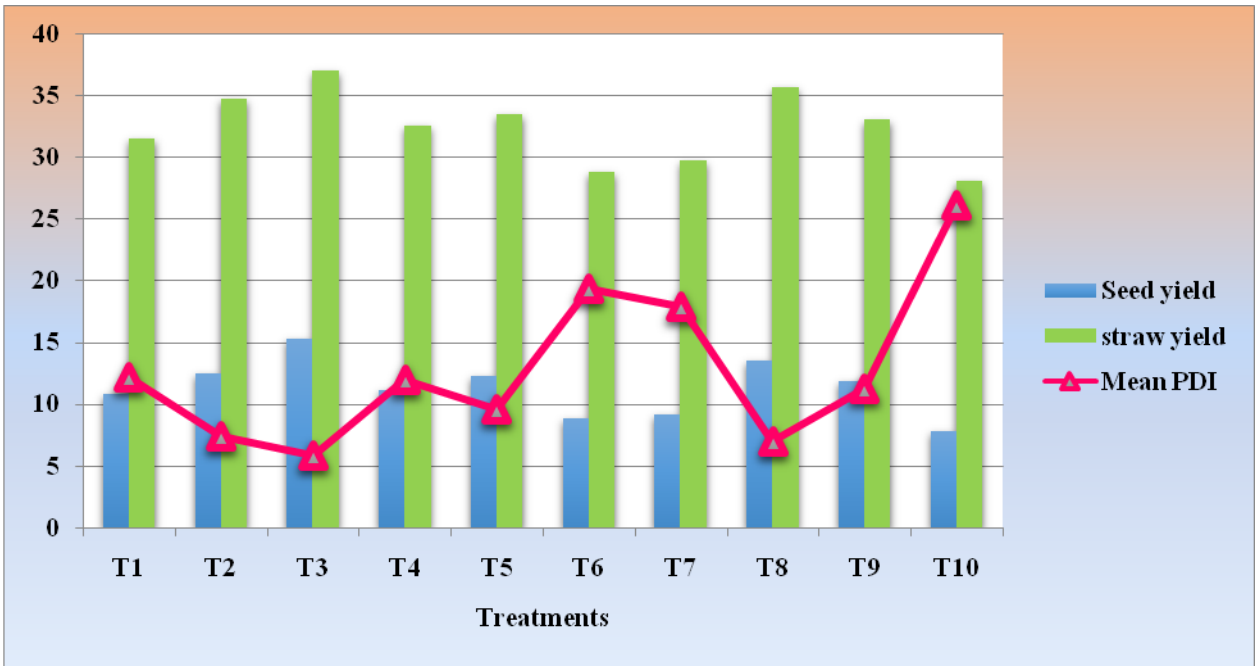
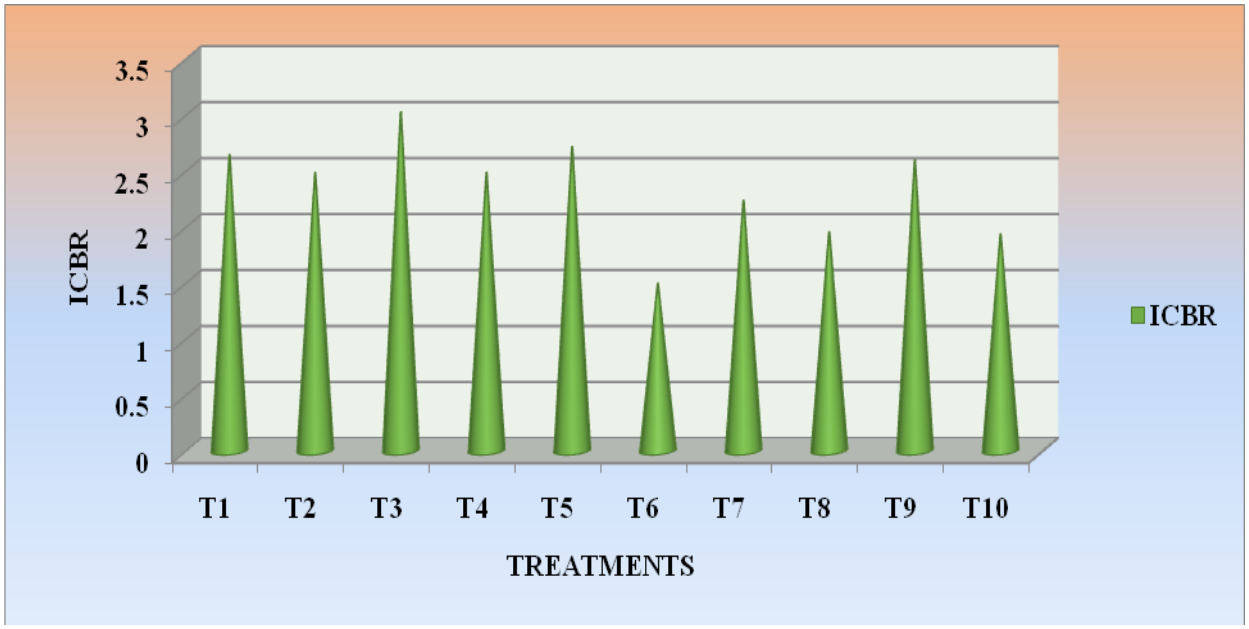


Fig.3 Effect of various treatments integrated to manage mustard white rust on ICBR



Seed treatment alone with Metalaxyl 35% SD @ 6g/kg with 53.52% white rust disease control was found inferior from other chemical treatments in controlling white rust. This is in conformity with earlier findings of Mohan *et al.*, (2017) who reported that Metalaxyl 35% SD- ST @ 6g/kg as less effective as compared to the other treatments with maximum disease severity (52%) and minimum disease control (20.4%).

However, alone foliar sprayings of *Allium sativum*@ 0.1% and of *Azadirachta indica* @ 20% were least effective in present study. Similarly, lower efficacy of phytoextracts alone against mustard white rust has also been reported earlier by, Verma (2005), Rathi and Singh (2009), Khodke *et al.,* (2016), Mohan *et al.,* (2017) and Salunke *et al.,* (2018).

Effect of various treatments integrated to manage mustard white rust on seed and straw yield

Results (Table 3, Fig. 2) revealed that the various treatments integrated to manage mustard white rust disease, significantly influenced the seed yield and straw yield. With the treatments, seed yield ranged from 8.85 to 15.35q/ha and straw yield ranged from 28.82 to 37.05 q/ha, as against 7.77 and 28.16q/ha, respectively in untreated control. However, T_3 -Metalaxyl 35%SD- ST @ 6g/kg + Metalaxyl 4%+ Mancozeb 68%WP-FS @ 0.25% resulted with highest seed yield (15.35 q/ha) and straw yield (37.05 q/ha), followed by T_8-Metalaxyl 4%+ Mancozeb 68%WP- FS @0.25% + *Azadirachta indica*@ 20% (13.58q/ha, 35.72q/ha, respectively), T_2- Metalaxyl 4%+ Mancozeb 68%WP- FS @0.25% (12.48 q/ha, 34.79 q/ha, respectively), T_5-Metalaxyl 35% SD- ST @6g/kg+ Chlorothalonil 75% WP- FS @ 0.15% (12.30q/ha, 33.52q/ha, respectively), T_9- Chlorothalonil 75% WP- FS @0.15% +Garlic oil-FS @0.1% (11.86q/ha, 33.08q/ha, respectively), T_4- Chlorothalonil 75% WP-FS @0.15% (11.19 q/ha, 32.63 q/ha, respectively) andT_1- Metalaxyl 35% SD- ST @6g/kg (10.88 q/ha, 31.56 q/ha, respectively).T_7- Garlic oil- FS@0.1% (9.19 q/ha, 29.77 q/ha, respectively) and T_6- *Azadirachta indica*- FS @ 20% (8.85 q/ha, 28.82 q/ha, respectively) resulted with minimum seed and straw yield. The similar results in respect of fungicidal treatments on mustard white rust disease control and enhanced corresponding seed yield were reported earlier by many workers. Salunke *et al.,* (2018) reported Metalaxyl 35% SD- ST+ Metalaxyl 8% + Mancozeb 64% WP as most effective with highest yield (7.77 q/ha). Rathi and Singh (2009) reported highest seed yield (1366 kg/ha) with Metalaxyl 35%WP- ST @ 6g/kg + Metalaxyl 8% + Mancozeb 64% WP- FS @ 2g/lit water at 50- 60 DAS, Muhammad *et al.,* (2017) reported Metalaxyl 8% + Mancozeb 64% WP @ 0.05% as most effective in controlling mustard white rust disease and with maximum seed yield (1361.033 kg/ha).

Economics of various treatments integrated to manage mustard white rust

Results obtained (Table 2, Fig. 3) on economics of the various treatments attempted, highest ICBR (3.02) resulted with T_3- Metalaxy l35% SD- ST @ 6g/kg Metalaxyl 4%+ Mancozeb 68% WP- FS @ 0.25, followed by T_5- Metalaxyl 35% SD- ST @ 6g/kg + Chlorothalonil 75% WP- FS @ 0.15% (ICBR: 2.71), T_1- Metalaxyl 35% SD- ST @ 6g/kg (ICBR: 2.64), T_9- Chlorothalonil 75% WP- FS @ 0.15% + Garlic oil @ 0.1%- FS (ICBR: 2.59), T_4- Chlorothalonil 75% WP- FS @ 0.15% (ICBR: 2.48) and T_2- Metalaxyl 4%+ Mancozeb 68% WP- FS @ 0.25% (ICBR: 2.48).

These results obtained on most economical treatment to manage mustard white rust were also reported earlier by several workers. Bhargava *et al.,* (1997) and Salunke *et al.,* (2018) are in conformity with the above findings, regarding economics of integrated management of white rust disease in mustard.

Bhargava *et al.,* (1997) reported that seed treatment with Metalaxyl 35%SD @6g/kg + three foliar sprays of Chlorothalonil 75%WP @ 0.2%, sprayed at 20, 40, 60 DAS resulted with highest C: B ratio (1:9.1). Salunke *et al.,*

(2018) reported Metalaxyl 35% SD- ST + Metalaxyl 8% + Mancozeb 64% WP- FS @ 0.2% with highest C: B ratio (1.98).

In field experiment conducted to manage white rust disease (*A. candida*) of mustard, one each found highly effective (*in vitro* studies) fungicides (systemic, contact and combi- fungicides), phytoextract and essential oil were integrated (alone and in combination) comprising a total of 10 treatments and attempted to manage mustard white rust (*A. candida*) disease, during *Rabi*, 2018-19. The results revealed that all of the treatments attempted exhibited significant reduction of white rust disease severity, over untreated control, with highest seed yield (q/ha) and ICBR. However, the most effective and economical treatment was Metalaxyl 35% SD- seed treatment @6g/kg + Metalaxyl 4%+ Mancozeb 68%WP- three foliar sprays @0.25%, which resulted with highest mean disease control (77.60%), significantly highest seed yield (15.3q/ha), straw yield (37.05 q/ha) and highest ICBR (3.02). The second and third best treatments found were Metalaxyl 4%+ Mancozeb 68% WP- three foliar sprays @0.25% + *Azadirachta indica*- three foliar sprays @ 20%, and Metalaxyl 4%+ Mancozeb 68% WP- three foliar sprays @ 0.25%.

References

Abhishek, Prasad, R., Kumar, D., Kumar, V., Kumar, M. and Kumar, D. (2017). Symptoms and Management of White Rust/ Blister of Indian Mustard *(Albugo candida)*. *Int. J. Curr. Microbiol. Appl. Sci*. 6(10): 1094-1100.

Bhairava, S. K., Prasad, D., Shekawat, U. S., Rai, P. K. and Koli, R. (2015). Disease management in Indian mustard through Integrated approaches. *Ann. Agric. Res. New Series.* 36(3): 251-257.

Bharghava, A. K., Sobti, A. K., Bharghava, L. P. and Nag, A. (1997). Chemical control of white rust of mustard through seed treatment cum spray and their economics. *Indian Phytopath*. 50(2): 242-245.

Bisht, K., Rana, M., Upadhyay, P. and R.P. Awasthi. (2018). Disease assessment key for white rust disease caused by *Albugocandida*, in rapeseed-mustard. *Pl. Path. J.* 17: 11-18.

Fahad, M.A. and Mohammed, S.A. Chemical composition and fatty acid content of some spices and herbs under Saudi Arabia conditions. (2012). *The Scient. World J*. 2012: 859892.

Kanase, S. S. (2008). Studies on management of white rust of mstard incited by *Albugo cruciferarum* (Kunze) Gray. *M. Sc. (Agri.) Thesis (unpublished),* DBSKKV. Dapoli.

Khodke, S. W., Giri, G. K., Gade, R. M. and Ingle, R. W. (2016). Management of Alternaria blight and white rust of mustard. *J. Pl. Dis. Sci.* 11(1): 90-92.

Kolte, S. J. 1985. Diseases of annual edible oilseed crops. *Rapeseed Mustard and Sesame diseases.* CRC press, Boca Raton, Florida, pp. 135.

Meena, P. D., Aswati, R P., Godika, S., Gupta, J. C., Kumar, A., Sandhu, P. S., Sharma, P., Rai, P. K., Singh, Y, P., Rathi, A. S., Prasad, R., Rai, D. and Kolte, S. J. (2011). Eco- friendly approaches managing major diseases of Indian mustard. *World Appl. Sci. J.* 12(8): 1192-1195.

Mohan, M., Mehta, N. and Avtari, R. (2017).Integrated management of foliar diseases of Indian mustard. *Forage Res.* 42 (4): 274-278.

Rathi, A. S. and D. Singh. (2009). Integrated management of *Alternaria* blight and white rust in Indian mustard. Oilseeds section, Department of Plant Breeding, CCS, Haryana Agriculture University, Hisar.

Salunke, S.S., Magar, J.S. and Somwanshi, S.D. (2018). Integrated management of white rust of mustard. *Int. J. Curr. Microbiol. App. Sci*. (*Special Issue*-6): 2700-2712.

Verma, G. (2005). Management of white Rust of mustard by use of chemicals and botanicals. *M. Sc. (Agri.) Thesis, JNKVV. Jabalpur*.

Verma, U. (1987). Studies on the White rust of Brassica caused by *Albugo candida* (Pers. ex. Lev.) Kunze. *Ph. D. Thesis, IARI. New Delhi.*

Wheeler, B. E. J. (1969). *An Introduction to Plant diseases,* John Wiley and Sons Ltd., London, pp. 301.

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