

INTEGRATED MANAGEMENT OF FOLIAR DISEASES OF INDIAN MUSTARD

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SUMMARY

Integrated management of white rust, Alternaria blight and powdery mildew of Indian mustard by using plant extracts and fungicides as seed treatments as well as in combinations of foliar sprays against these diseases in two varieties *i.e.*, Varuna and RH 9801. The efficacy of different plant products like neem seed extract (5.0%), jamun seed extract (5.0%) and neem oil (5.0%) was tested by applying foliar sprays at different intervals for control of all these three diseases of Indian mustard. Among three botanicals, three foliar spray of neem oil (5.0%) was found most effective in controlling all the three diseases in both varieties Varuna and RH 9801. Fungicidal seed treatment with Apron SD-35 (6g/kg) followed by three sprays of mancozeb (0.2%) were applied at different intervals after date of sowing found maximum control of white rust and alternaria blight (70.3 and 82.1 per cent, respectively) in both the varieties. Whereas, the minimum disease intensity on leaves and pods was observed 10.7 and 8.0 per cent, respectively, in treatment, where two sprays of mancozeb (0.2%) at 47 and 107 DAS followed by one spray of sulfex (0.2%) at 131 DAS, were applied with maximum disease control of 74.6 and 73.3 per cent on leaves and pods, respectively. The significant yield per plot 2.4 kg/plot was observed in the treatment where three sprays of mancozeb or two sprays of mancozeb with one spray of sulfex were applied as compared to control (1.74 kg/plot). The results are very important in present context of integrated management with eco-friendly approaches of white rust, alternaria blight and powdery mildew of Indian mustard

Key words : White rust, alternaria blight, powdery mildew, botanicals, fungicides, Indian mustard

Indian mustard is one of major oil seed crop and its leaves are fed to animals (Manmohan, 2013). In this, the control of diseases by use of different botanicals and fungicides with varying degree of success has been reported in the literature. Ideally a chemical compound should not only be safe to the human beings and other mammals, but also to the microbes. With the growing awareness of harmful effects of pesticides, use of disease tolerant cultivar, crop rotation or sanitation practices, bio- agents, plant extracts to integrate with less fungicidal spray is gaining importance in recent years. The concept of integrated disease management seeks to minimize the advantages in the use of fungicides. The plant products are known to have antifungal activities which are economically safe and antifungal activities which are environmentally safe and non-phytotoxic also. Therefore, the present study was undertaken to generate information

on potential plant products (Neem oil, Neem Seed Kernel Extract and Jamun Seed Extract) and fungicides (mancozeb, bavistin and sulfex) with seed treatments as well as in different combinations against major diseases (White rust, *Alternaria* blight and powdery mildew) of Indian mustard to find out effective and economical control.

MATERIALS AND METHODS

To test the effectiveness of different plant extracts and fungicides in different combinations as seed treatment and foliar spray against white rust, Alternaria blight and powdery mildew, experiments were carried out on two varieties (Varuna and RH-9801) in field plots (5 x 3m²) replicated thrice in randomized block design, at CCS Haryana Agricultural University, Hisar, during *rabi* seasons. The soil of experimental plots was sandy

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loam in texture, low in organic carbon (0.28%) and available nitrogen (170 kg N ha⁻¹), medium in available phosphorus (20 kg P₂O₅ ha⁻¹) having Ece 0.30 dS m⁻¹ and slightly alkaline in reaction (pH 7.7). All the experimental plots received recommended dose of fertilizers (80 kg N and 40 kg P₂O₅ ha⁻¹).

To test the efficacy of different plant products, Neem Seed Extract (*Azadirachta indica*) @ 5.0 % (w/v), Neem oil (*Azadirachta indica*) @ 5.0 % (w/v), Jamun Seed Extract (*Syzgium cumini* L.) @ 5.0 % (w/v), and fungicides Apron SD-35, mancozeb, sulfex were used against all the diseases of rapeseed mustard. The seed extracts of neem and jamun were prepared by grinding the dried seed in grinder, 250 g seed extract were dipped in one liter distilled water over night, the suspension were strained through triple fold muslin cloth and sprayed @ 5.0%. Apron SD-35 @ 6 g/kg was applied as alone as seed treatment as well as in combination with foliar sprays of mancozeb @ 0.2%, sulfex @ 0.2%, CaSO₄ @ 0.5% and salicylic acid @ 0.02%, three foliar sprays were applied at 47, 107 and 131 days after sowing. The disease intensity at different intervals of crop were recorded in each treatment and analyzed to conclude the results of integrated management of all the three diseases.

RESULTS AND DISCUSSION

White Rust

The results presented in Table 1 records that the maximum average disease severity of 65.3 per cent was recorded in control (unsprayed) plot in variety Varuna. The minimum average disease intensity of 19.3 per cent was recorded which three sprays of mancozeb (0.2%) applied at 47, 107 and 131 days after sowing.

Among foliar sprays of neem seed extract (5.0%), jamun seed extract (5.0%) and neem oil (5.0%) at different intervals of 47, 107 and 131 DAS, foliar spray of neem oil (5.0%) was found most effective in white rust control in both the varieties Varuna and RH-9801. Seed treated with Apron SD-35 (6g/kg) followed by three foliar spray with neem seed extract (5.0%), whereas seed treated with Apron SD-35 (6g/kg) followed by three foliar sprays with jamun seed extract, respectively, which were statistically on par in control of white rust in both varieties Varuna and RH-9801, whereas, seed treated with Apron SD-35 (6g/kg) followed by three foliar spray of neem oil (5.0%) was found better than other treatments in control of white

rust of both varieties. Seed treatment alone with Apron SD-35 (6g/kg) was found inferior from the other chemicals and plant products in the controlling white rust in both the varieties Varuna and RH-9801. The present results are in conformity with earlier findings (Godika and Pathak, 2009; Chandra *et al.*, 2009).

Alternaria Blight

The Alternaria blight data presented in table 2 revealed that in variety Varuna the maximum average disease intensity on leaves and pod in control was observed 50.0 and 31.0 per cent, respectively. The minimum average disease intensity on leaves and pods was 10.7 and 6.0 per cent, respectively in plots where three foliar sprays of mancozeb (0.2%) were applied at 47, 107 and 131 DAS and maximum control of 79.0 and 80.6 per cent, respectively, were observed in these plots. This treatment was followed by two foliar sprays of mancozeb at 47 and 107 DAS, followed by one spray of sulfex (0.2%) at 131 DAS and both the treatments were statistically on par.

In variety RH-9801, the maximum average disease intensity on leaves and pods were observed 50.0 and 25.3 per cent, respectively in control plot. The minimum average disease intensity of 9.3 and 5.0 per cent, respectively, on leaves and pods were observed in plot where three foliar sprays of mancozeb (0.2%) were applied at 47, 107 and 131 DAS which resulted in 81.4 and 80.6 per cent disease control on leaves and pods in variety RH 9801, respectively. While comparing both the varieties, the variety RH-9801 had slightly lower disease in comparison to Varuna (Table 2).

The application of neem seed extract (5.0%) and jamun seed extract (5.0%) or CaSO₄ or combination of seed treatment along with application of any of the treatment gave 50.0 per cent control of Alternaria blight in both the varieties. Hence, the application of eco-friendly chemicals provided good control of Alternaria blight. The foliar sprays of mancozeb (0.2%) were significantly higher from the sprays of neem seed extract (5.0%). Foliar sprays of neem oil (5.0%) was most effective in controlling the Alternaria blight in Indian mustard among all the eco-friendly products neem seed extract (5.0%), jamun seed extract (5.0%) and further it was observed that these were significantly better than control. The present results are in conformity with earlier findings (Godika and Pathak, 2009; Singh *et al.*, 2007 and Chandra *et al.*, 2009).

TABLE 1
Efficacy of different treatments on white rust intensity (%) on leaves of Indian mustard cvs. Varuna and RH-9801

Treatment	Conc. (%)	No. of sprays	Disease intensity (%) **					
			Varuna		RH-9801		Mean	
			DI (%)	DC (%)	DI (%)	DC (%)	DI (%)	DC (%)
T ₁ : ST	6 g/kg seed	-	52.0	20.4	52.0	18.8	52.0	19.6
T ₂ : Spray NSE	5.0*	3	35.7	45.1	35.0	45.3	35.4	45.2
T ₃ : Spray JSE	5.0*	3	37.3	42.6	36.0	43.8	36.7	43.2
T ₄ : Spray CaSO ₄	0.5*	3	39.3	39.5	38.3	40.1	38.8	39.8
T ₅ : Spray Neem oil	5.0*	3	33.3	48.7	32.7	49.0	33.0	48.8
T ₆ : Spray mancozeb	0.2*	3	19.3	70.3	19.0	70.3	19.2	70.3
T ₇ : Mancozeb+Sulfex	0.2 [®] +0.2 ^Δ	2+1	20.7	68.2	20.0	68.8	20.4	68.5
T ₈ : T ₁ +T ₂	5.0*	3	34.7	46.7	34.0	46.9	34.4	46.8
T ₉ : T ₁ +T ₃	5.0*	3	36.7	43.6	35.7	44.3	36.2	43.9
T ₁₀ : T ₁ +T ₄	0.5*	3	39.0	40.0	38.0	40.3	38.5	40.1
T ₁₁ : T ₁ +T ₅	5.0*	3	32.0	50.8	31.0	51.6	31.5	51.2
T ₁₂ : T ₁ +Salicylic acid (SA)	0.02 [®]	2	38.7	40.5	37.3	41.7	38.0	41.1
T ₁₃ : T ₁ +SA+Neem oil	0.02 [®] +5.0 ^ψ	1+2	33.3	48.7	33.0	48.4	33.2	48.6
T ₁₄ : T ₁ +SA+Mancozeb	0.02 [®] +0.2 ^ψ	1+2	24.0	63.1	22.0	65.6	23.0	64.3
T ₁₅ : T ₁ +SA+Mancozeb+Sulfex	0.02 [®] +0.2 [±] +0.2 ^Δ	1+1+1	24.3	62.6	23.0	61.0	23.7	61.8
T ₁₆ : Control	-	-	65.3	-	64.0	-	64.7	-
S. Em±			1.1		1.2		1.2	
C. D. (P=0.05)			3.2		3.5		3.4	

ST : Seed Treatment (Apron SD-35), NSE: Neem Seed Extract, JSE: Jamun Seed Extract, DAS: Days after sowing, S.A.: Salicylic acid, * Three sprays at 47, 107 and 131 DAS, ® Two sprays at 47 and 107 DAS, one spray at 131 DAS, One spray at 47 DAS, Two sprays at 107 and 131 DAS, ± One spray at 107 DAS, ** Date of sowing, Oct. 20th, 2010, DI: Disease intensity, DC: Disease control.

Powdery Mildew

The powdery mildew was recorded at the end of crop season in each treatment. The results of integrated management Table 3, revealed that in variety Varuna, the maximum disease intensity on leaves and pods was observed 42.0 and 30.0 per cent, respectively, in control. The minimum disease intensity on leaves and pods was observed 10.7 and 8.0 per cent, respectively, in treatment, where two sprays of mancozeb (0.2%) at 47 and 107 DAS followed by one spray of sulfex (0.2%) at 131 DAS, were applied and gave the maximum disease control of 74.6 and 73.3 per cent on leaves and pods, respectively. It was significantly higher than all other treatments.

Similarly in variety, RH-9801 the maximum disease intensity was on leaves and pods 42.0 and 43.0 per cent, respectively on leaves and pods in control (unsprayed) plot. The minimum average disease intensity of 9.7 and 8.0 per cent, respectively on leaves and pods were observed in plots where two sprays of mancozeb (0.2%) at 47 and 107 DAS followed by one spray of sulfex (0.2%) at 131 DAS were applied. On an average,

maximum disease control of 77.0 and 73.3 per cent, respectively, on leaves and pods were observed in treatment where two sprays of mancozeb (0.2%) at 47 and 107 DAS followed by one spray of sulfex (0.2%) at 131 DAS were applied while comparing both the varieties together, results revealed that two sprays of mancozeb (0.2%) followed by one spray of sulfex (0.2%) were better in controlling the powdery mildew diseases.

Efficacy of Integrated Diseases Management

The efficacy of integrated disease management on yield parameters in both the varieties Varuna and RH-9801 was evaluated. The yield parameters used were number of pods per plot, test weight (g) and yield (kg/plot). The perusal of data in Table 4 revealed that in variety Varuna, the maximum number of pods (412.0) was recorded in plot where three sprays of mancozeb (0.2%) were applied followed by two sprays of mancozeb (0.2%) and one spray of sulfex (0.2%) as compared to control. The maximum test weight (5.2g) was recorded in the plot where three sprays of mancozeb (0.2%) were applied followed by treatment where two sprays of

TABLE 2
Efficacy of different treatments on *Alternaria* blight intensity (%) on leaves and pods of Indian mustard cvs. Varuna and RH-9801

Treatment	Conc. (%)	No. of sprays	Disease intensity (%)**											
			Leaves						Pods					
			Varuna		RH-9801		Mean		Varuna		RH-9801		Mean	
			DI	DC	DI	DC	DI	DC	DI	DC	DI	DC	DI	DC
T ₁ : ST	6 g/kg seed	-	40.0	21.6	40.0	21.6	40.0	21.6	25.0	19.4	24.0	14.3	24.5	16.8
T ₂ : Spray NSE	5.0*	3	24.7	58.7	26.0	48.0	25.4	53.3	15.3	50.6	14.0	50.0	14.7	50.3
T ₃ : Spray JSE	5.0*	3	30.7	39.8	28.0	44.0	29.4	41.9	16.7	46.1	16.0	42.9	16.4	44.5
T ₄ : Spray CaSO ₄	0.5*	3	34.0	33.3	32.7	34.6	33.4	34.0	18.0	41.9	17.3	38.2	17.7	40.1
T ₅ : Spray Neem oil	5.0*	3	23.3	54.3	20.0	60.0	21.7	57.2	12.0	61.3	11.3	59.6	11.7	60.5
T ₆ : Spray mancozeb	0.2*	3	10.7	79.0	9.3	81.4	10.0	80.2	6.0	80.6	5.0	82.1	5.5	81.4
T ₇ : Mancozeb+Sulfex	0.2 [®] + 0.2 ^Δ	2+1	14.7	71.2	14.0	72.0	14.4	71.6	7.0	77.4	6.7	76.1	6.9	76.7
T ₈ : T ₁ +T ₂	5.0*	3	27.3	46.5	25.0	50.0	26.2	48.2	14.7	52.6	13.3	52.5	14.0	52.5
T ₉ : T ₁ +T ₃	5.0*	3	29.7	41.8	27.3	45.4	28.5	43.6	16.0	48.4	15.3	45.4	15.7	46.9
T ₁₀ : T ₁ +T ₄	0.5*	3	33.0	35.3	31.3	37.4	32.2	36.4	18.0	41.9	17.0	39.3	17.5	40.6
T ₁₁ : T ₁ +T ₅	5.0*	3	22.3	56.3	19.0	62.0	20.7	59.1	12.0	61.3	11.0	60.7	11.5	61.0
T ₁₂ : T ₁ +Salicylic acid (SA)	0.02 [®]	2	32.0	37.3	30.7	38.6	31.4	37.9	17.7	42.9	17.0	39.3	17.4	41.1
T ₁₃ : T ₁ +SA+Neem oil	0.02 [®] +5.0 ^w	1+2	24.7	51.6	21.0	58.0	22.9	54.8	12.7	59.0	11.3	59.6	12.0	59.3
T ₁₄ : T ₁ +SA+Mancozeb	0.02 [®] +0.2 ^w	1+2	16.0	68.6	16.0	68.0	16.0	68.3	8.0	74.2	8.7	75.0	8.4	74.6
T ₁₅ : T ₁ +SA+ Mancozeb+Sulfex	0.02 [®] +0.2 ⁺ +0.2 ^Δ	1+1+1	18.0	64.7	18.0	64.0	18.0	64.4	9.0	71.0	9.3	66.8	9.2	68.9
T ₁₆ : Control	-	-	50.0	-	50.0	-	50.0	-	31.0	-	25.3	-	28.2	-
S. Em±			1.9		1.4		1.7		1.6		1.2		1.4	
C. D. (P=0.05)			4.7		3.8		4.3		4.6		3.4		4.0	

Treatment and other details are given in Table 1.

TABLE 3
Efficacy of different treatments on powdery mildew intensity (%) on leaves and pods of Indian mustard cvs. Varuna and RH-9801

Treatment	Conc. (%)	No. of sprays	Disease intensity (%)**											
			Leaves						Pods					
			Varuna		RH-9801		Mean		Varuna		RH-9801		Mean	
			DI	DC	DI	DC	DI	DC	DI	DC	DI	DC	DI	DC
T ₁ : ST	6 g/kg seed	-	36.0	14.3	37.7	10.3	36.8	12.3	27.0	10.0	27.0	10.0	27.0	10.0
T ₂ : Spray NSE	5.0*	3	17.0	59.5	17.0	59.5	17.0	59.5	15.0	50.0	15.0	50.0	15.0	50.0
T ₃ : Spray JSE	5.0*	3	20.3	52.4	20.3	51.6	20.3	52.0	16.3	45.7	17.3	42.3	16.8	44.0
T ₄ : Spray CaSO ₄	0.5*	3	25.0	40.5	24.3	40.1	24.7	40.3	20.0	33.3	20.0	33.3	20.0	33.3
T ₅ : Spray Neem oil	5.0*	3	15.7	62.6	15.0	64.3	15.3	63.4	13.0	56.7	13.0	56.7	13.0	56.7
T ₆ : Spray mancozeb	0.2*	3	14.3	65.9	14.0	66.7	14.2	66.3	12.0	60.0	11.7	61.0	11.9	60.5
T ₇ : Mancozeb+Sulfex	0.2 [®] +0.2 ^Δ	2+1	10.7	74.6	9.7	77.0	10.2	75.8	8.0	73.3	8.0	73.3	8.0	73.3
T ₈ : T ₁ +T ₂	5.0*	3	16.7	60.3	16.3	61.1	16.5	60.7	15.0	50.0	15.0	50.0	15.0	50.0
T ₉ : T ₁ +T ₃	5.0*	3	18.7	55.5	18.3	56.4	18.5	55.9	16.0	46.7	15.3	49.0	15.7	47.8
T ₁₀ : T ₁ +T ₄	0.5*	3	23.0	45.2	23.0	45.2	23.0	45.2	18.0	40.0	17.3	42.3	17.7	41.2
T ₁₁ : T ₁ +T ₅	5.0*	3	15.3	63.5	14.7	65.1	15.0	64.3	12.3	59.0	12.0	60.0	12.2	59.5
T ₁₂ : T ₁ +Salicylic acid (SA)	0.02 [®]	2	22.3	46.8	22.0	47.6	22.2	47.2	17.3	42.3	17.3	42.3	17.3	42.3
T ₁₃ : T ₁ +SA+Neem oil	0.02 [®] +5.0 ^w	1+2	16.0	61.9	15.7	62.7	15.8	62.3	14.3	52.3	14.0	53.3	14.2	52.8
T ₁₄ : T ₁ +SA+Mancozeb	0.02 [®] +0.2 ^w	1+2	13.3	68.9	13.0	69.0	13.2	69.0	11.0	63.3	10.7	64.3	10.9	63.8
T ₁₅ : T ₁ +SA+Mancozeb+Sulfex	0.02 [®] + 0.2 ⁺ +0.2 ^Δ	1+1+1	12.0	71.4	11.7	72.2	11.8	71.8	9.7	67.7	9.0	70.0	9.4	68.8
T ₁₆ : Control	-	-	42.0	-	42.0	-	42.0	-	30.0	-	30.0	-	30.0	-
S. Em±			1.0		1.1		1.0		1.0		0.9		0.9	
C. D. (P=0.05)			2.8		3.1		2.9		2.8		2.6		2.7	

Treatment and other details are given in Table 1.

TABLE 4
Efficacy of different treatments on yield parameters of Indian mustard cvs. Varuna and RH -9801

Treatment	Conc. (%)	No. of sprays	Varuna			RH-9801		
			No. of pods/plot	1000-seed weight (g)	Yield/plot (kg)	No. of pods/plot	1000-seed weight (g)	Yield/plot (kg)
T ₁ : ST	6 g/kg Seed	-	293.3	4.4	1.8	319.3	4.5	1.8
T ₂ : Spray NSE	5.0*	3	341.7	4.8	2.0	350.7	4.7	1.9
T ₃ : Spray JSE	5.0*	3	320.7	4.7	1.1	327.7	4.7	1.9
T ₄ : Spray CaSO ₄	0.5*	3	299.3	4.6	1.9	300.7	4.5	1.9
T ₅ : Spray Neem oil	5.0*	3	361.7	4.9	2.1	378.0	4.8	1.9
T ₆ : Spray Mancozeb	0.2*	3	412.0	5.2	2.4	425.0	5.2	2.3
T ₇ : Mancozeb+Sulfex	0.2 [®] +0.2 ^Δ	2+1	405.0	5.1	2.4	418.7	5.2	2.2
T ₈ : T ₁ +T ₂	5.0*	3	345.0	4.8	2.0	361.3	4.7	1.9
T ₉ : T ₁ +T ₃	5.0*	3	330.0	4.8	2.0	339.7	4.7	1.9
T ₁₀ : T ₁ +T ₄	0.5*	3	304.3	4.6	1.9	311.0	4.5	1.9
T ₁₁ : T ₁ +T ₅	5.0*	3	365.0	4.9	2.1	389.0	4.9	2.0
T ₁₂ : T ₁ +Salicylic acid (SA)	0.02 [®]	2	312.0	4.7	1.9	317.0	4.6	1.9
T ₁₃ : T ₁ +SA+Neem oil	0.02 [®] +5.0 ^ψ	1+2	353.3	4.8	2.0	370.7	4.8	1.9
T ₁₄ : T ₁ +SA+Mancozeb	0.02 [®] +0.2 ^ψ	1+2	388.3	5.0	2.3	408.7	5.0	2.0
T ₁₅ : T ₁ +SA+Mancozeb+Sulfex	0.02 [®] +0.2 [±] +0.2 ^Δ	1+1+1	371.7	5.0	2.3	401.7	4.9	2.0
T ₁₆ : Control	-	-	282.0	4.2	1.7	273.0	4.4	1.6
S. Em [±]			16.7	0.3	0.2	8.1	0.2	0.2
C. D. (P=0.05)			48.1	NS	NS	23.39	NS	NS

Treatment and other details are given in Table 1.

mancozeb and one spray of sulfex were applied and it was at par where seed treatment + mancozeb + sulfex were applied. The maximum yield per plot (2.4 kg) was observed in the treatment where three sprays of mancozeb or two sprays of mancozeb + one spray of sulfex were applied as compared to control (1.74 9kg/plot) .

Similarly, in variety RH-9801, maximum number of pods (425.0) were recorded in plot where three sprays of mancozeb (0.2%) were applied in treatment followed by two sprays of mancozeb (0.2%) + one spray of sulfex as compared to control (273.0). The maximum test weight (5.2g) was observed in above mentioned treatments though these treatments were at par with seed treatment + Salicylic acid + mancozeb and seed treatment + Salicylic acid + mancozeb + sulfex. The maximum yield 2.26 kg/plot were recorded in the treatment as above as compared to control 1.69 kg/plot. These results revealed that three sprays of mancozeb (0.2%) were found highly effective on yield parameter of both varieties. The present results are in conformity with the earlier workers (Singh and Singh, 2003).

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