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Integrated Management Of White Rust Of Rapeseed-Mustard Under Organic Farming System In Manipur

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Abstract: ***Field experiments were carried out for two consecutive rabi seasons (2014-15& 2015-16) to observe the integrated effect of certain plant extracts, amendments of organic manures and alteration of sowing dates. For plant extract experiment, the highest disease severity was found in V_2(14.47%) while the lowest in V_4 (7.70%). Overall control of disease due to plant extract was 57.30% (V_1). Azadirachta indica provided the best results in all the varieties used. Field trials of soil amendments resulted significant effect on White rust of rapeseed – mustard. Overall assessment showed that maximum disease control was observed under T_5 treatment. Regarding alteration of sowing date, sowing of the crop earlier than usual sowing time receded the disease severity of white rust. Chances of getting more diseases were favoured by late sowing crop.***

Keywords: Organic manures, Sowing dates, IPM, White rust, Rapeseed – Mustard.

I. INTRODUCTION

Rapeseed – mustard is one of the most important cruciferous crops basically cultivated for oils and vegetables during *rabi* season across the globe. Rapeseed and mustard are the third most important edible oilseed crops of the world after soybean and oil palm. While in India rapeseed-mustard is the second most important oilseed crop after groundnut both in area and production [1, 2]. In Manipur about 25% of the total edible oil requirements are met from domestic productions of oilseed crops such as groundnut, soybean, rapeseed and mustard [3]. Thus rapeseed- mustard plays an important role for oil and vegetable need of the state. Cultivation of the crop during *rabi* season is very much congenial however, pest and diseases are main constraints which hamper the cultivation of the crop. More than 30 diseases are known to occur on *Brassica* crops including rapeseed-mustard in India [4]. White rust caused yield losses of 23- 54.5 % [5]. Integrated management of fungal diseases play an important role in organic agriculture as no single measure is fit for disease management strategies. Integrated management namely use of medicinal plants, soil amendment by different organic manures, traditional agronomic practices such as alterations of sowing dates etc. resulted significant reduction of diseases. As such the present investigation on integrated management of White rust was taken up with the view of developing eco-friendly disease management strategies.

II. MATERIALS AND METHODS

Field trials were carried out for two consecutive *rabi* seasons (2014-15 & 2015-16) to study the integrated management of White rust using four experimental varieties viz., two susceptible varieties of rapeseed i.e. *Brassica rapa* (L.)var. M*27* (V_3) & *B. rapa* (L.)var. *ragini* (V_4)and two local cultivars of mustard i.e. *B. juncea* (L.) Czern. & Coss. cv. Local Yella (V_1) and *B.juncea* Czern. and Coss. cv. Lamtachabi (V_2). Seeds (5-6 nos.) were sown in plots [(2.2 x 1.3) m^2] in the last week of October by broadcasting method and only one plant was kept by thinning after two weeks. The experiment was laid out in a randomized block design and three replications were maintained. A spacing of (30 x 10) with row to row and plant to plant distances were kept to grow

the crop. The IPM strategies include use of plant extracts, use of organic manures and alteration of sowing dates.

A. EFFECT OF PLANT EXTRACTS

To see the effect of certain plant extracts such as *Azadirachta indica*, *Acorus calamus*, *Eryngium foetidum*, *Michelia champaca*, leaf extracts (15%) were prepared using the method [6]. Stock solution was prepared by mixing leaves and sterile distilled water @1gml^{-1} (V/W). The freshly prepared plant extracts were sprayed at evening hours using sprayer. Foliar spraying @5L/plot was applied which starts at 45 DAS at the appearance of disease. Two consecutive sprays were done at 15 days interval at vegetative and early initiation of flowering stage. Only water spray served as control. After the last spray weekly monitoring of DI (disease incidence) and DS (disease severity) were carried out.

B. EFFECT OF ORGANIC MANURES

Various organic manures such as compost, cow dung, piggery waste, poultry manure, rice husk etc. were used to observe the effect of organic manures. The organic manures except compost were obtained from the nearby areas of Kakching, the experimental site. Compost is prepared using the method [7]. The details of composting are sown in table 10 .Field preparation was done two weeks prior to seed sowing. Organic manures are amended @18 tonnes/ hectare (5 kg /plot) at the time of field preparation. The plot without any amendment serve as control. Three replications were maintained for each treatment. The crop was laid out in RBD and raised under irrigated condition. Other cultural practices are same as above. The different combinations of organic manures used in the present study were given as follows:

T_1: Poultry manure + FYM @1:4 i.e. 1kg + 4kg
T_2 : Piggery waste +FYM @1:4 i.e. 1kg + 4kg
T_3 : Cowdung+Rice husk @3:2 i.e. 3kg+2kg
T_4 : Compost+FYM@ 1:1 i.e. 2.5 kg+2 .5kg
T_5: Poultry manure+Piggery waste+Cowdung+ Rice husk +Compost+ FYM (Equal proportion i.e. 0.83kg)
T_0: Control

C. EFFECT OF DATE OF SOWING

Field experiments were carried out for two *rabi* seasons (2014-15 & 2015-16) in RBD. Experiments on sowing date were carried out by sowing the seeds on five different dates viz., 30.09.14 (D_1), 15.10.14 (D_2), 30.10.14 (D_3), 14.11.14 (D_4) and 29.11.14 (D_5) by keeping an interval of 15 days. Rapeseed-mustard seeds (5-6 numbers) were sown in the last week of October in plots [(2.2 X 1.3) m^2] keeping 5 cm border line with three replications and raised under irrigated condition. Only one plant was kept for each sub-plot by thinning after two weeks of plantation. The time of sowing seeds ranged from September to November. Regular irrigation was done as rain is scanty in winter season. Other normal agronomic practices including weeding were followed.

D. SAMPLING AND SCORING OF DISEASE PARAMETERS

A weekly sampling were carried out and monitoring were conducted up to six weeks. Here, disease parameters such as disease incidence and severity and area under disease progress curve were worked out. 0-6 scale [8] was used to score White rust disease severity.

E. DATA ANALYSIS

Data on disease severity was statistically analyzed using one-way ANOVA to know significant differences among the various IPM treatments. MS –Excel was used for analysis of data. The percent inhibition of the different treatments over control was calculated by the formula [9].

III. RESULTS AND DISCUSSION

A. EFFECT OF MEDICINAL PLANTS

Field evaluation of medicinal plants resulted significant effect on disease severity of rapeseed –mustard varieties at 5% level of significance (Table 1- 4).The highest disease severity was recorded in V_2 (14.47%) while the lowest in V_4 (7.70 %). This result showed that the rapeseed varieties are associated with less diseases than the local cultivars which may be due to the potential of hybrid vigour. . Among the four plants evaluated *Azadirachta indica* provided the best results in all varieties of the crop. However, the effect of the remaining plant extracts resulted varied outcomes. Overall control of plant disease due to plant extract was 57.30% (V_1) and respective AUDPC was 87.50. Similarly in the rest of the varieties the lowest AUDPC were detected in neem spray. Medicinal plants play an important role in the management of fungal diseases of rapeseed - mustard besides their roles in curing human ailments. The ingredients responsible for antifungal activity of *A. indica* were the presence of oil in plant parts [10]. Antifungal activity of aqueous exracts of different plants has been recorded [11]. Azadirachtin and limonoids present in neem are considered as most bioactive ingredients having insecticidal and microbial property [12, 13].

B. EFFECT OF ORGANIC MANURES

Field trials of soil amendments conducted for two consecutive *rabi* seasons (2014-15 & 2015-16) to see its effect on white rust of rapeseed-mustard showed significant effect (table 5-8). Maximum disease control for White rust was found in V_3 (51.69%). Overall assessment showed that maximum disease control was observed under treatment (T_5) i.e. in combination of all the organic manures and the least was detected in T_2 treatment which is a combination of piggery waste and FYM. This may be due to the healthy growth of plants that resist the occurrence of diseases. The use of organic amendments such as animal manure, green manure, compost and peats has decreased

Test Plants	Disease Incidence (%)			Disease Severity (%)			% over control	AUDPC
	2014	2015	Mean	2014	2015	Mean		
A. vasica	40.94	42.31	41.62	13.32	14.10	13.71	33.09	137.10
A. indica	31.61	30.76	31.18	8.97	8.53	8.75	57.30	87.50
E. foetidum	38.76	39.42	39.09	12.26	12.71	12.48	39.09	124.80
M. champaca	36.43	36.67	36.55	9.62	10.39	10.00	51.19	100.05
Control	48.19	46.71	47.45	19.63	21.36	20.49		204.90
C.D. at 5%	*1.12							

**Significant at 5% level of significance.*

Table 1: In-vivo effect of various plant extracts on disease parameters of White rust in mustard (V_1)

Test Plants	Disease Incidence (%)			Disease Severity (%)			% over control	AUDPC
	2014	2015	Mean	2014	2015	Mean		
A. vasica	45.17	47.96	46.56	12.27	12.94	12.60	34.34	126.00
A. indica	36.03	36.67	36.35	10.00	11.09	10.54	45.07	105.40
E. foetidum	48.70	49.93	49.31	14.06	14.88	14.47	24.60	144.70
M. champaca	40.99	39.09	40.04	10.35	12.01	11.18	41.74	111.80
Control	52.59	53.34	52.96	18.70	19.68	19.19		191.90
C.D. at 5%	*0.68							

**Significant at 5% level of significance.*

Table 2: In-vivo effect of various plant extracts on disease parameters of White rust in mustard (V_2)

Test Plants	Disease Incidence (%)			Disease Severity (%)			% over control	AUDPC
	2014	2015	Mean	2014	2015	Mean		
A. vasica	21.87	19.02	20.44	10.18	11.02	10.60	34.85	106.00
A. indica	15.66	14.42	15.04	7.28	8.36	7.82	51.94	78.20
E. foetidum	24.74	22.42	23.58	12.05	13.04	12.54	22.92	125.40
M. champaca	18.90	20.45	19.67	8.24	7.98	8.11	50.15	81.10
Control	30.11	29.17	29.64	15.96	16.59	16.27		162.70
C.D. at 5%	*0.52							

**Significant at 5% level of significance.*

Table 3: In-vivo effect of various plant extracts on disease parameters of White rust in rapeseed (V_3)

Test Plants	Disease Incidence (%)			Disease Severity (%)			% over control	AUDPC
	2014	2015	Mean	2014	2015	Mean		
A. vasica	18.94	19.60	19.27	8.21	8.10	8.15	52.28	81.50
A. indica	16.11	17.64	16.87	6.77	8.64	7.70	54.92	77.00
E. foetidum	26.46	28.20	27.33	11.06	11.59	11.32	33.72	113.20
M. champaca	22.60	23.04	22.82	9.97	9.66	9.81	42.56	98.10
Control	31.68	32.59	32.13	16.50	17.67	17.08		85.40
C.D. at 5%	*0.52							

**Significant at 5% level of significance.*

Table 4: In-vivo effect of various plant extracts on disease parameters of White rust in rapeseed (V_4)

Amendments	Disease Incidence (%)			Disease Severity (%)			% Disease control	AUDPC
	2014	2015	Mean	2014	2015	Mean		
T_1	32.23	33.49	32.86	18.69	19.61	19.15	26.94	191.50
T_2	42.91	44.01	43.46	22.46	22.98	23.34	11.64	231.60
T_3	39.30	37.16	38.23	20.20	18.97	19.58	25.29	195.80
T_4	28.86	27.64	28.25	16.07	17.59	16.83	35.79	168.30
T_5	35.66	34.56	35.11	17.76	15.59	16.67	36.40	166.70
T_0	48.76	49.79	49.27	25.88	26.55	26.21		262.10
C.D. at 5%	*0.56							

**Significant at 5% level of significance.*

Table 5: In-vivo effect of soil amendments on disease parameters of White rust in mustard (V_1) under organic farming system in Manipur

Amendments	Disease Incidence (%)			Disease Severity (%)			% Disease control	AUDPC
	2014	2015	Mean	2014	2015	Mean		
T_1	29.61	29.07	29.34	19.55	18.37	18.96	31.33	189.60
T_2	44.70	43.41	44.05	23.81	23.63	23.72	14.09	237.20
T_3	39.61	41.18	40.39	21.72	21.42	21.57	21.88	215.70
T_4	34.71	33.66	34.18	18.66	17.41	18.03	34.70	180.30
T_5	27.34	28.41	27.87	17.69	16.02	16.85	38.97	168.50
T_0	49.44	48.52	48.98	27.48	27.74	27.61		277.40
C.D. at 5%	*0.67							

**Significant at 5% level of significance.*

Table 6: In-vivo effect of soil amendments on disease parameters of White rust in mustard (V_2) under organic farming system in Manipur

Amendments	Disease Incidence (%)			Disease Severity (%)			% Disease control	AUDPC
	2014	2015	Mean	2014	2015	Mean		
T_1	21.81	19.67	20.74	12.26	12.02	12.14	39.66	121.40
T_2	25.95	26.94	26.44	15.83	16.06	15.94	20.77	159.40
T_3	23.78	24.93	24.35	13.35	14.12	13.73	31.76	137.30
T_4	16.23	17.36	16.79	11.73	11.32	11.52	42.74	115.20
T_5	18.04	19.07	18.55	10.67	8.77	9.72	51.69	97.20
T_0	31.05	29.32	30.18	21.08	19.16	20.12		201.20
C.D. at 5%	*0.49							

**Significant at 5% level of significance.*

Table 7: In-vivo effect of soil amendments on disease parameters of White rust in rapeseed (V_3) under organic farming system in Manipur

Amendments	Disease Incidence (%)			Disease Severity (%)			% Disease control	AUDPC
	2014	2015	Mean	2014	2015	Mean		
T_1	22.66	23.37	23.01	14.52	12.89	13.70	36.46	137.00
T_2	24.72	26.36	25.54	16.73	16.06	16.39	23.98	163.90
T_3	19.23	21.39	20.31	13.27	14.38	13.82	35.90	138.20
T_4	17.95	16.92	17.43	12.34	11.25	11.79	45.31	117.90
T_5	16.88	15.39	16.13	11.36	10.54	10.95	49.21	109.50
T_0	33.11	32.28	32.69	21.30	21.82	21.56		215.60
C.D. at 5%	*0.14							

*Significant at 5% level of significance.

Table 8: In-vivo effect of soil amendments on disease parameters of White rust in rapeseed (V_4) under organic farming system in Manipur

The incidence of disease caused by soil-borne pathogens [14,15]. The lowest AUDPC was also resulted in T_5 treatment. Effect of soil amendments using compost, FYM, straws, saw dust, neem cake, margosa cake etc. on fungal diseases of different crops were reported by different workers of different time [16,,17, 18].

C. EFFECT OF DATE OF SOWING ON FUNGAL DISEASES OF RAPESEED-MUSTARD

Sowing of the crop earlier than D_1 (30.09.2014) receded the disease severity of White rust (Table 9). Chances of getting more diseases were favoured by late sowing crop. It was agree with the findings that the incidence of White rust of mustard was increased with delayed sowing [19,20]. In rapeseed varieties first disease severity increase and gradually decrease when sown late. These may be due to susceptibility and physiological condition of the crop.

Treatments	Year	Disease Incidence (%)				Disease Severity (%)				AUDPC			
		V_1	V_2	V_3	V_4	V_1	V_2	V_3	V_4	V_1	V_2	V_3	V_4
D_1(30.09.14)	2014	38.52	40.37	23.21	23.70	13.32	14.69	10.80	10.77	129.70	145.40	113.00	110.6
	2015	36.79	39.26	22.47	21.43	12.62	14.39	11.80	11.36				
Mean		37.65	39.81	22.84	22.56	12.97	14.54	11.30	11.06				
D_2(15.10.14)	2014	41.60	42.10	23.70	25.55	13.88	14.84	10.99	11.33	137.50	148.00	114.30	116.80
	2015	43.45	44.58	24.81	24.32	13.62	14.77	11.88	12.03				
Mean		42.52	43.34	24.25	24.93	13.75	14.80	11.43	11.68				
D_3(30.10.14)	2014	44.19	45.50	26.17	27.65	12.58	13.51	11.55	11.11	134.50	138.00	118.20	115.50
	2015	45.87	46.86	24.44	25.31	14.32	14.10	12.10	11.99				
Mean		45.03	46.18	25.30	26.48	13.45	13.80	11.82	11.55				
D_4(14.11.14)	2014	46.85	48.09	28.89	31.73	15.43	15.95	13.76	13.17	150.40	163.50	136.10	133.00
	2015	46.87	48.46	29.38	30.00	14.65	16.76	13.47	13.43				
Mean		46.86	48.27	29.13	30.86	15.04	16.35	13.61	13.30				
D_5(29.11.14)	2014	49.20	50.13	29.88	30.12	17.43	17.39	12.43	11.10	177.40	187.70	129.90	117.50
	2015	50.61	51.48	29.63	31.23	18.06	18.77	12.99	12.40				
Mean		49.90	50.80	29.75	30.67	17.74	18.08	12.71	11.75				
*C.D. at 5%						0.15	0.18	0.29	0.22				

Table 9: Effect of sowing dates on White rust in Rapeseed – Mustard varieties under organic farming system in Manipur during rabi seasons 2014 -15 & 2015 -16

Sl. No.	Items	Quantity
	A. Vegetable mixtures	
1.	Monocots	
	a. *Eleusine indica* (L.) Gaertn.	8kg.
	a. *Cyperus pilosus* Vahl. Enum	4 kg.
	b. *Leersia hexandra* SW	8 kg.
	c. Cynodon dactylon	4 kg.
2.	Dicots	
	a. *Sesbania sesban*	3.5 kg.
3.	Kitchen Wastes	
	a. Various residues of daily kitchen wastes	1 kg.
4.	**B. Hard and woody Materials**	
	a. Sawdust (soaked)	1 kg.
	b. Sugarcane leaves about to fall (soaked)	0.5 kg.
5.	**C. Animal dung**	
	a. Fresh cow dung	7 kg.
6.	**D. Bases**	
	a. Wood Ash	0.52 kg.
7.	**E. Water**	
	a. Water	24Litre
8	a. Maturation	90 Days
	b. Yield	65 kg.

Table 10: Different compositions for the preparation of Compost

IV. CONCLUSION

In the present study use of plant extracts, amendment of organic manures and alteration of sowing dates showed significant effect. These implementations could play an important role in integrated disease management strategies of White rust of rapeseed –mustard.

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