Research Paper :

Integrated management of Asian soybean rust caused by *Phakopsora pachyrhizi* in India

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SUMMARY

In this study, different treatments comprising of achook (0.15% Azadirchtin EC), a neem based product alone and combination with different fungicides were evaluated during *Kharif* 2008 and 2009 under natural epiphytotic conditions at MARS, UAS, Dharwad. The treatments were applied thrice with first one immediately after appearance of rust symptoms in the field and subsequently at 10 days interval. The study over two years revealed that spraying with achook (0.15% Azadirachtin EC)0.5%-hexaconazole0.1%-achook(0.15%Azadirachtin)0.5% recorded minimum (38.41) Per cent Disease Index (PDI) followed by 42.91 PDI in case of spraying with achook (0.15% Azadirachtin EC) 2%.However,application hexaconazole 0.1% alone recorded minimum incidence of 23.81 PDI. The untreated check recorded maximum PDI (77.45 PDI). Maximum seed yield of 12.30q/ha was recorded in hexaconazole 0.1% followed by 11.21q/ha in achook (0.15%AzadirachtinEC) 0.5%-Hexaconazole0.1%Achook (0.15%Azadirachtin) 0.5%.Minimum seed yield of 6.96q/ha was recorded in untreated check. The present findings will open a new window of opportunity for utilization of achook (0.15% Azadirachtin EC) as one of component in development of spray schedule against Asian soybean rust in India.

Key words : Asian soybean rust, *Phakopsora pachyrhizi*, Ecofriendly, Botanicals, Integrated management

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Asian soybean rust is an economically important disease occuring in the soybean growing regions of the world. The predominantly associated pathogen, *Phakopsora pachyrhizi*, has been known to drastically reduce yields in Asia. In areas where the pathogen occurs in most virulent form yield losses up to 80% have been reported. Basically the pathogen was confined to eastern hemisphere before it had appeared in epiphytotic form in Hawaii region in 1994. At present, the pathogen has been reported from different continents such as Africa, Asia, Australia, South America and Hawaii. The rapid spread of *P. pachyrhizi* and potential for severe yield losses makes this as the most destructive foliar disease of soybean. Soybean rust has a major impact on both total soybean production and productivity in India. In India it was first reported on soybean in 1951 (Sharma and Mehta, 1996).Two *Phakopsora* species are known to cause soybean rust (Ono *et al.*, 1992).The more aggressive species is *Phakopsora. pachyrhizi,* known as the Asian soybean rust. *Phakopsora meibomiae* is relatively the less virulent species has been limited to western hemisphere and not known to cause severe yield losses in soybean.

Most of the research on control has focused on the use of fungicides and host plant resistance. Some cultural practices have been recommended which minimize the impact of rust (Desborough,1984; Hartman *et al.*, 1992).The recommendations differed, but were based upon avoiding the conditions that promote disease development or were practices that optimized overall yields. Research on biological control has been limited in the management of soybean rust both in India and abroad. In recent years, the studies on use of Indigenous Technology Knowledge (ITK) measures in the managing the diseases have been demonstrated successfully in crops like sorghum, tomato, banana and black pepper (Jahagirdar, 1998: Jahagirdar *et al.*, 2000; Jahagirdar *et al.*, 2008).The soybean growers of the subcontinent are seriously facing the infestation of rust disease in the last few years with a yield loss ranging from 30-100%.There are no resistant cultivars at present for Asian soybean rust and continuous application of fungicides has further aggravated the concern over pesticide resistance. Hence, keeping these points in view, the present study was aimed at development

of spray schedule with botanicals which form the basis for sustainable management of rust disease in the subcontinent.

MATERIALS AND METHODS

The present study was taken up at Main Agricultural Research Station (MARS), University of Agricultural Sciences (UAS), Dharwad during *Kharif* 2008 and 2009 comprising nine different treatments. The treatments were applied thrice with first one immediately after appearance of rust symptoms in the field and subsequently at 10 days interval. The botanicals were applied thrice starting from disease appearance and chemicals subsequently at 10 days interval (Table 1). The details of the experimentation comprised of 9 treatments replicated three times with a plot size of 2.7x4.0mt on susceptible cultivar JS 335.The different dates of treatment application were as follows,04-09-2008, 15-09-2008 and 01-10-2008 during 2008 and 18-9-2009,25-9-2009,2-10-2009 during 2009. The seasonal conditions revealed late on set of monsoon in the region. The total rainfall received in 2008 was 926.8mm spread over 60 rainy days. In 2009, total rainfall received was 1022.6mm spread over 66 rainy days. The receipt of more normal rainfall during August and September months resulted in epiphytotics of rust during the season. Thus, the season was more congenial for development of strategies for rust management. Observations on rust severity were recorded as per the scale of Mayee and Datar (1986) when the crop was 85 days old. For scoring the intensity of rust, ten plants were randomly selected in the central rows of the plots. The per cent disease index (PDI) was further calculated and seed yield(q/ha) was also recorded. The data were statistically analysed as per Sukhatme and Amble (1985).

Table 1 : Details of treatments followed in the management of Asian soybean rust

Treatments	Time of spray after sowing		
	45 to 50 DAS/Immediately after disease appearance	55 to 60 DAS/10 Days after first spray	65 to 75 DAS/10 days after second spray
T_1	Achook 0.15% EC @ 0.5%	Achook 0.15% EC @ 0.5%	Achook 0.15% EC @ 0.5%
T_2	Achook 0.15% EC @ 1.0%	Achook 0.15% EC @ 1.0%	Achook 0.15% EC @ 1.0%
T_3	Achook 0.15% EC @ 2.0%	Achook 0.15% EC @ 2.0%	Achook 0.15% EC @ 2.0%
T_4	Achook 0.15% EC @ 0.5%	Hexaconazole @ 0.1%	Achook 0.15% EC @ 0.5%
T_6	Achook 0.15% EC @ 0.5%	Mancozeb @ 0.25%	Achook 0.15% EC @ 0.5%
T_7	Hexaconazole @ 0.1%	Hexaconazole @ 0.1%	-
T_8	Mancozeb (Indofil M-45) @ 0.25%	Mancozeb (Indofil M-45) @ 0.25%	-
T_9	Unsprayed control		

RESULTS AND DISCUSSION

It is evident from Table 2 that during 2008, spraying with achook 0.5%-hexaconazole 0.1%- achook 0.5% recorded minimum (38.27) per cent disease index (PDI) followed by 41.97 PDI in case of spraying with achook 2.0%. However, application of hexaconazole 0.1% alone recorded minimum incidence of 23.21 PDI. The untreated check recorded maximum PDI (67.90). Maximum seed yield of 11.35q/ha was recorded in hexaconazole 0.1% followed by 10.0q/ha in combination treatment of achook 0.5%-hexaconazole@0.1%-achook 0.5%. Minimum seed yield of 4.46q/ha was recorded in untreated check. The results of *Kharif* 2009 showed that achook 0.5% - hexaconazole 0.1% - achook 0.5% recorded minimum (34.9) per cent disease index (PDI) followed by 44.0 PDI in case of spraying with achook 2.0%. However, application of hexaconazole 0.1% alone recorded minimum incidence of 24.4 PDI. The untreated check recorded maximum disease intensity of 87.0 PDI. Spraying with achook alone 1 and 2% was found stastically at par with mancozeb. In all the achook treated plots, the foliage remained green that has resulted in better seed yield and reduction of disease pressure which may be due to SAR action which needs further investigation. Maximum seed yield of 13.24q/ha was recorded in hexaconazole 0.1% followed by 12.81q/ha in combination treatment of achook 0.5% - hexaconazole 0.1% - achook 0.5% which were stastically at par with each other. However, minimum seed yield of 9.45q/ha was recorded in untreated check (Table 2).

The study over two years revealed that spraying with achook 0.5%-hexaconazole 0.1%-achook 0.5% recorded minimum (38.41) per cent disease index (PDI) followed by 42.91 PDI in case of spraying with achook 2%. However, application of hexaconazole 0.1% alone

Table 2 : Integrated management of soybean rust through botanicals and chemicals

Sr. No.	Treatments	PDI			Seed yield(q/ha)		
		2008	2009	Mean	2008	2009	Mean
1.	Achook (0.15% Azadirachtin EC) @ 0.5%	50.61 (45.3)	44.3 (41.7)	47.45	7.86	10.45	9.16
2.	Achook (0.15% Azadirachtin EC) @ 1.0%	48.15 (43.9)	44.0 (41.5)	46.11	7.69	11.16	9.43
3.	Achook (0.15% Azadirachtin EC) @ 2.0%	41.97 (40.3)	45.9 (42.7)	42.91	10.00	10.93	10.47
4.	Achook (0.15% Azadirachtin EC) @ 0.5% - Hexaconazole @ 0.1% - Achook (0.15% Azadirachtin EC) @ 0.5%	38.27 (38.2)	34.9 (36.2)	38.41	9.61	12.81	11.21
5.	Achook (0.15% Azadirachtin EC) @ 0.5% - Mancozeb @ 0.25% - Achook (0.15% Azadirachtin EC) @ 0.5%	45.68 (42.5)	47.3 (43.5)	46.49	8.25	12.11	10.18
6.	Hexaconazole @ 0.1%	23.21 (28.79)	24.4 (29.6)	23.81	11.35	13.24	12.30
7.	Mancozeb (Indofil M-45) @ 0.25%	45.68 (42.5)	45.2 (42.3)	45.44	8.04	10.04	9.04
8.	Neem oil @ 1.0%	53.08 (46.8)	35.7 (36.7)	44.39	6.64	10.74	8.69
9.	Unsprayed control	67.90 (55.5)	87.0 (68.9)	77.45	4.46	9.45	6.96
	S.E.±	4.12	1.93	4.85	0.52	0.65	0.63
	C.D. (P=0.05)	12.32	5.72	15.80	1.54	1.96	2.07
	CV (%)	16.68	7.76	14.98	11.17	10.25	9.23

Figures in parenthesis are arcsine values

recorded minimum incidence of 23.81 PDI. The untreated check recorded maximum PDI (77.45 PDI). Maximum seed yield of 12.30q/ha was recorded in hexaconazole 0.1% followed by 11.21q/ha in achook 0.5%-hexaconazole 0.1%-achook 0.5%.Minimum seed yield of 6.96q/ha was recorded in untreated check. The botanical achook was not found phytotoxic in any of the tested concentrations. The successful management of panama disease of banana caused by *Fusarium oxysporum* f. sp. c*ubense*, foot rot of black pepper, TMV of tobacco and Fusarium wilt of tomato have been reported by Jahagirdar, 1998; Jahagirdar *et al.*, 2000; Jahagirdar *et al*., 2003; Jahagirdar *et al*., 2008 and Padmodaya, 1994. The present findings opened a new window of opportunity in utilization of Achook (0.15% Azadirachtin EC) as one of spray component in developing strategic management schedule against Asian soybean rust in India. The application of neem oil alone has not resulted in significant reduction in disease pressure. Thus, the study clearly indicated benefits of schedule of neem spray along with fungicide giving good protection against Asian soybean rust. The application of achook–hexaconazole-achook recorded at par seed yield with chemical control. This is a good indication to develop an eco-friendly disease management strategy against Asian soybean rust in India. There is a need to further explore the role of defense genes being triggered by use of botanical elicitor like achook leading to Induced Systemic Resistance (ISR) in soybean. The present investigations are the first line of research in managing Asian soybean rust by utilization of neem based products in India.

Conclusion:

The botanical achook 0.5% can be used along with hexaconazole 0.1% for developing Integrated Disease Management spray schedule against Asian Soybean rust in India which will help in reducing the chemical pesticides usage in long term sustainable management. The present findings have drawn the first line of research on utilization of botanicals in managing rust and enhancing both yield and quality parameters of soybean in India.

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