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Research Paper

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Kresoxim methyl, a strobulin fungicide for managing Asian Soybean rust caused by Phakopsora pachyrhizi Syd. and enhancement of yield in soybean

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ABSTRACT

Field screening of new fungicide molecules and botanicals against Asian soybean rust Phakopsora pachyrhizi Syd. was taken up during kharif growing season 2009 and 2010 at Main Agricultural Research Station, Dharwad. pooled analysis over two years recorded minimum severity of 24.5 PDI in two applications of Kresoxim Methyl @ 1.0 ml/l at 30 DAS and at flower initiation stage followed by two applications of Hexaconazole @ 1ml/lit starting first at 30 days after sowing (31.1PDI). Maximum PDI was recorded in untreated check (91.3 PDI). The pooled analysis over two years, recorded mean maximum seed yield of 17.10q/ha in two applications of Kresoxim Methyl @1ml/l starting first at 30 days after sowing and second at flower initiation followed by 15.45 q/ha at two applications of Hexaconazole@1ml/l starting first at 30 days after sowing and second at flower initiation. The minimum seed yield of 9.29q/ha was recorded in untreated check The large scale demonstration over one acre area in two talukas revealed that two sprays with Kresoxim methyl @1ml/lit has helped in realization of 4.61% seed yield increase over Hexaconazole @1ml/lit.during 2011-12 and 8.41% seed yield over Hexaconazole @1ml/lit during 2012-13. highest net income (Rs.27550) with cost benefit ratio of 1:2.01 was obtained with Kresoxim Methyl @ 1.0 ml/l at 30 DAS and at flower initiation stage followed by two applications of Hexaconazole @ 1ml/lit starting first at 30 days after sowing (Rs.26850/- and C:B ratio of 1:2.34).Thus, application strobulin fungicide Kresoxim methyl @0.1% twice was found effective in the management of soybean rust and enhancement of soybean yield per unit area in India.

KEYWORDS : Asian soybean rust, field screening, new molecules, P. pachyrhizi.

INTRODUCTION

In recent years, Asian soybean rust caused by *Phakopsora pachyrhizi Syd.* has become one of the major disease which was known to occur in Korea, Japan, Australia, China and India (Sangawongse,1973;Anderson *et al.*,2013). The severity of the disease is favoured by assured rainfall/ irrigated conditions with moderate temperatures and extended leaf wetness (Bromfield, 1984). In India, the soybean rust was first noticed at Pantnagar of Uttar Pradesh during 1970 *kharif* season (Thapliyal, 1971) and subsequently it was observed at Kalyani in West Bengal and the foot hills of Uttar Pradesh. This disease has become a major production constraint in India after appearance as epidemic in the year 1997 in the states of Karnataka and Maharastra. Since then this disease is a major constraint in these two states all along with Krishna river belt favoured by more congenial microclimatic conditions.

Rust in Karnataka was severe and caused losses up to 20-80 per cent in JS-335 depending on its severity, stage of occurrence and favourable climatic conditions in northern Karnataka (Patil and Anahosur 1998 and Jahagirdar *et al.,* 2010 and 2011).

Severity of the disease is reported to cause yellowing, premature drying and defoliation. Usually on the lower leaves small, yellow lesions appear in the beginning which later develops into light brown to dark pustules. Since, there are limited sources of resistance available for the cultivation, farmers are largely depended on use of fungicides to manage this disease. Looking in to these bottle necks and also to tackle the problem of fungicidal resistance the present investigation was undertaken to identify the new effective molecule which derive maximum benefit to the farmers. The results are discussed in this paper.

MATERIAL AND METHODS

A field experiment was laid out in randomized block design with three replications at Main Agricultural Research Station, University of Agricultural Sciences, Dharwad during *kharif* 2009 and 2010. The recommended susceptible soybean genotype JS 335 was used. Six different treatments comprising of four levels of new molecule fungicides Kresoxim methyl at different levels of application along with positive check were screened for their effectiveness against rust (Table1). Further, the molecule was also evaluated for its effectiveness under large scale demonstration and farm trials in the farmers fields during 2011 and 2012.

The observations on PDI and seed yield(q/ha) were recorded. The Per cent Disease Index (PDI) was computed by selecting five plants at random and recording rust severity as per 0-9 scale of Mayee and Datar (1986). Observations were recorded after 10 days of 1st and 2nd spray and final observations on rust severity was recorded on 90 DAS and computed results are presented. The economic analysis was done by working out the gross income and net income. Benefit cost ratio was also worked out taking into account total cost of cultivation in control and additional cost for fungicides and their sprays. The data was stastically analyzed (Sukhatme and Amble 1985) after suitable transformations.

RESULTS AND DISCUSSION:

The results of investigation pertaining to fungicidal efficacy and economic analysis are presented in Table 1, 2 and 3

Diseases severity and fungicide performance (PDI):

Six different treatments of Kresoxim Methyl at different concentrations, number of applications and stage of applications were evaluated against soybean rust. During 2009, spraying with Kresoxim Methyl @ 1.0 ml/l at 30 DAS and at flower initiation stage recorded minimum (27.5) Per cent Disease Index (PDI) followed by 36.2 PDI in case of two applications with Hexaconazole 5%EC @ 1ml/l at 30 DAS and at flower initiation stage. The untreated check recorded maximum PDI (89.9). During 2010, spraying with Kresoxim Methyl @ 1.0 ml/l at 30 DAS and at flower initiation stage recorded minimum disease severity (21.5) Per cent Disease Index (PDI) followed by 25.9 PDI in case of two applications with Hexaconazole 5%EC @ 1ml/l at 30 DAS and at flower initiation stage. The untreated check recorded maximum PDI (92.6). Single application of Kresoxim methyl@0.1% at 30 DAS and at flower initiation stage was not effective in reducing the disease pressure. However, two application of Kresoxim methyl@ 0.7ml/lit was statistically on par with two application of Hexaconazole @ 1ml/lit.during 2009 growing environment. The pooled analysis over two years recorded minimum severity of 24.5 PDI in two applications of Kresoxim Methyl @ 1.0 ml/l at 30 DAS and at flower initiation stage followed by two applications of Hexaconazole @ 1ml/lit starting first at 30 days after sowing (31.1PDI). Maximum PDI was recorded in untreated check (91.3 PDI).

The evaluation of Kresoxim methyl@1ml/lit in the farmer's fields spread over different growing environments revealed significant reduction in the disease pressure when compared to Hexaconazole@ 1ml/lit. during 2011 and 2012. The large scale demonstration over one acre area in two talukas revealed that two sprays with Kresoxim methyl @1ml/lit has recorded disease severity of 26.8 and 13.2 PDI in Hirebagewadi and Hukkeri talukas respectively when compared to two sprays with Hexaconazole @1ml/lit(31.3 and 16.7 PDI) in Hirebagewadi and Hukkeri talukas respectively.

Fungicide influence per se yield and yield attributes:

During 2009,the maximum seed yield of 18.60 q/ha was recorded in Kresoxim Methyl @ 1.0 ml/l at 30 DAS and at flower initiation stage followed by Hexaconazole 5%EC @ 1ml/L at 30 DAS and at flower initiation stage (16.97q/ha) which was statistically on par with and differed significantly. The treatments Kresoxim Methyl @0.7ml/l at 30 DAS and at flower initiation stage(16.57q/ha) and Hexaconazole 5%EC @ 1ml/l at 30 DAS and at flower initiation stage(16.97q/ha) were statistically on par with each other. However, minimum seed yield of 9.51q/ha was recorded in untreated check.

During 2010,the maximum seed yield of 15.60 q/ha was recorded in Kresoxim Methyl @ 1.0 ml/l at 30 DAS and at flower initiation stage followed by Hexaconazole 5%EC @ 1ml/L at 30 DAS and at flower initiation stage (13.93q/ha) which was statistically on par with and differed significantly with other treatments. The other treatment where relatively better seed yield(12.61q/ha) was recorded in two applications of Kresoxim Methyl @0.7ml/l at 30 DAS and at flower initiation stage. However, minimum seed yield of 9.07q/ha was recorded in untreated check.

The pooled analysis over two years, recorded mean maximum seed yield of 17.10q/ha in two applications of Kresoxim Methyl @1ml/l starting first at 30 days after sowing and second at flower initiation followed by 15.45 q/ha at two applications of Hexaconazole@1ml/l starting first at 30 days after sowing and second at flower initiation. The minimum seed yield of 9.29q/ha was recorded in untreated check. In seed yield analysis in demonstrations taken over 10 growing environments of Belgaum,Dharwad and Haveri districts revealed the realization of seven per cent increase in seed yield in case of Kresoxim methyl@1ml/lt over Hexaconazole. The large scale demonstration over one acre area in two talukas revealed that two sprays with Kresoxim methyl @1ml/lit has helped in realization of 4.61% seed yield increase over Hexaconazole @1ml/lit.during 2011-12 and 8.41% seed yield over Hexaconazole @1ml/lit during 2012-13. Hegde *et al.* (1996) also reported significant variation for yield components as a result of higher disease pressure resulting in severe reduction of pods per plant and 100 seed weight. The present results were strongly supported by Jahagirdar *et al.* (2011) who reported the effectiveness of kresoxim methyl (0.1%) twice spray for the management of rust in northern Karnataka and also Devaraj *et al* (2013) reported the combination of neem based pesticide with new fungicide as better option in managing the rust disease of soybean and reduce risk of resistance development in long run. Meena *et al* (2012) also reported use of fungicide as integral component while assessing the impact of improved technologies in south eastern Rajasthan.

Economic analysis for fungicidal management of Asian soybean rust:

In the present investigation, highest net income (Rs.27550) with cost benefit ratio of 1:2.01 was obtained with Kresoxim Methyl @ 1.0 ml/l at 30 DAS and at flower initiation stage followed by two applications of Hexaconazole @ 1ml/lit starting first at 30 days after sowing (Rs.26850/- and C:B ratio of 1:2.34). The other treatment, two application of kresoxim methyl @0.7ml/lit starting from 30 DAS and second at flowering stage recorded net income of Rs.23975/- with C:B ratio of 1:1.84.The minimum net income of Rs.13000/- with C:B ratio of 1:1.23. Thus, investigations for the first time brought effectiveness of a strobulin fungicide Kresoxim Methyl @ 1.0 ml/l at 30 DAS and at flower initiation and realization of higher yield levels and better economic returns in managing soybean rust in Karnataka.

Table 1: Field Evaluation Kresoxim Methyl 500 G/L SC against rust of soybean

Sl. No.	Treatment	Percent Disease Index			Seed Yield (q/ha)		
		2009	2010	Pooled	2009	2010	Pooled
1	One application of Kresoxim methyl @ 0.7 ml/L at flower initiation stage.	43.3 (41.5)*	54.1 (47.4)	45.3 (42.3)	12.57	11.81	12.19
2	Two applications of Kresoxim methyl @ 0.7 ml/l starting first at 30 days after sowing and second at flower initiation stage	38.8 (38.5)	39.3 (38.8)	38.9 (38.6)	16.57	12.61	14.79
3	One application of Kresoxim methyl @ 1.0 ml/L at flower initiation stage	42.6 (40.7)	42.2 (40.5)	42.4 (40.6)	12.96	12.17	12.56
4	Two applications of Kresoxim methyl @ 1.0 ml/L starting first at 30 days after sowing and second at flower initiation	27.5 (31.6)	21.5 (27.6)	24.5 (29.7)	18.60	15.60	17.10
5	Two applications of Hexaconazole 5% EC @ 1.0 ml/l starting first at 30 days after sowing and second at flower initiation stage	36.2 (36.9)	25.9 (30.6)	31.1 (33.9)	16.97	13.93	15.45
6	Untreated check	89.9 (71.5)	92.6 (74.2)	91.3 (72.9)	9.51	9.07	9.29
	S. Em±	2.48	1.96	1.58	1.52	0.35	0.20
	CD (5%)	7.55	5.94	5.74	4.16	0.89	0.51
	CV (%)	10.33	8.52	9.48	18.43	18.43	14.60

***Figures in parenthesis are arcsine transformed values**

Table 2:Farm Trial Results on Field Evaluation Kresoxim Methyl 500 G/L SC against rust of soybean (Kharif 2011 and 2012)

Years / Location	Percent Disease Severity		Yield (Q/ha)		Percent Increase in yield over T2
	T1 (Kresoxim Methyl @ 1ml/lit)	T2 (Hexaconazole @ 1ml/lit)	T1 (Kresoxim Methyl @ 1ml/lit)	T2 (Hexaconazole @ 1ml/lit)	
2011-12					
EEU, Dharwad	34.81	37.56	18.30	17.78	
JDA, Haveri	18.0	22.0	17.90	16.80	
EEU, Arbhavi	8.00	15.00	22.0	20.00	
JDA, Belgaum	3.0	5.0	12.40	12.00	
JDA,Dharwad	-	-	18.20	17.60	
2012-13					
EEU, Dharwad	29.15	31.27	18.00	17.40	
EEU, Arbhavi	10.0	16.5	21.4	19.4	
JDA, Dharwad	-	-	10.0	9.2	
JDA ,Haveri	4.0	6.0	10.5	8.2	
JDA, Belgaum	-	-	16.3	15.8	
			165.0	154.2	7.00

Table 3: Large Scale Demonstration on Field Evaluation Kresoxim Methyl 500 G/L SC against rust of soybean (Kharif 2011 and 2012)

Sl. No.	Name of the farmer of Locations	Percent Disease Severity		Seed yield (Q/ha)		
		T1	T2	T1	T2	Percent increase in Seed Yield over T2
	2011-12					

1.	Sri. S.B. Allayyanavarmath (Hirebagewadi)	26.8	31.3	20.4	19.5	4.61
	2012-13					
2.	Eranagouda Patil (Hukkeri)	13.2	16.7	18.00	16.6	8.41

Note: T1 (Kresoxim Methyl @ 1ml/lit), T2 (Hexaconazole @ 1ml/lit)

Table 5:Economic analysis on field evaluation Kresoxim Methyl 500 G/L SC against rust of soybean

Sl No	Treatment	Economic analysis (pooled)				
		Seed Yield (kg/ha)	Gross income	Cost of cultivation	Net income	B:C rato
1	One application of Kresoxim methyl @ 0.7 ml/L at flower initiation stage.	1291	32275	11750	20525	1:1.75
2	Two applications of Kresoxim methyl @ 0.7 ml/l starting first at 30 days after sowing and second at flower initiation stage	1479	36975	13000	23975	1:1.84
3	One application of Kresoxim methyl @ 1.0 ml/L at flower initiation stage	1306	32650	12200	20450	1:1.68
4	Two applications of Kresoxim methyl @ 1.0 ml/L starting first at 30 days after sowing and second at flower initiation	1658	41450	13700	27550	1:2.01
5	Two applications of Hexaconazole 5% EC @ 1.0 ml/l starting first at 30 days after sowing and second at flower initiation stage	1532	38300	11450	26850	1:2.34
6	Untreated check	940	23500	10500	13000	1:1.23

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