The Bioscan 9(3): 1187-1190, 2014 (Supplement on Plant Pathology)
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
www.thebioscan.in

EFFECT OF FUNGICIDES AND PLANT RESISTANCE ACTIVATOR ON COLLETOTRICHUM LEAF SPOT OF SOYBEAN

Y. V. INGLE*, C. U. PATIL[1], K. D. THAKUR AND KALYANI INGLE[2]
[1]Regional Research Center, Amravati - 444 603 (MS)
[2]Plant Pathology Section, College of Agriculture, Nagpur
e-mail: yog_ingle@rediffmail.com

KEYWORDS
Fungicides
Resistance activator
Colletotrichum Leaf Spot and Soybean

Received on :
10.05.2014

Accepted on :
16.07.2014

***Corresponding author**

ABSTRACT
The efficacy different fungicides and plant resistance activator were evaluated against Colletotrichum Leaf Spot of soybean caused by *Colletotrichum dematium* f.s.p. *truncatum* (Andrus and Moore). In field, two sprays of tebuconazole (0.1%) at 25 days interval resulted in minimum disease index (11.76 and 20.49% at 45 and 70 DAS respectively) followed by propiconazole (0.1%), hexaconazole (0.05) and azoxystrobin (0.1%) and it also recorded highest per cent disease control *i.e.* 68.91, 66.97, 66.18% and 58.74% respectively over control. Maximum yield (2305 kg/ha) was recorded in tebuconazole sprayed plots followed by propiconazole (2239 kg/ha), hexaconazole (2181kg/ha), azoxystrobin (2033 kg/ha) and minimum was obtained in untreated control (1160kg/ha). It was also observed that in *in vitro* study complete inhibition (100%) was achieved by tebuconazole, propiconazole, hexaconazole and azoxystrobin at selected concentrations. Tested plant resistance activator not found efficient as fungicides. Hence, two spray of tebuconazole (0.1%) at 25 days interval has been advocated for management of Colletotrichum Leaf Spot of soybean.

INTRODUCTION

Soybean is achieved an important place in world's oilseed cultivation scenario, due to its high productivity, profitability and vital contribution towards maintaining soil fertility. Considering area under cultivation of soybean, Maharashtra state rank second in country. It plays a predominant role in economy of Maharashtra. A number of reasons including damage caused by disease have been ascribed to its low productivity. More than 100 pathogens are known to affect soybean, of which 35 are of economically important (Sinclair and Backman, 1989). Among the several diseases recorded on this crop, *Colletotrichum dematium* f.s.p. *truncatum* (Andrus and Moore) causal pathogen of *Colletotrichum* leaf spot / anthracnose and pod blight is recognized as one of the most destructive and widespread foliar and seed borne fungi of soybean. Sinclair (1992) reported that anthracnose incited by *Colletotrichum truncutum* (Schw) Andrus and Moore cause economic losses to the soybean, causing yield losses of 16-100 per cent. According to Wrather *et al.* (1997) the yield reduction caused by this disease in 1994 was recorded in major soybean producing countries with the highest yield reduction was around 77,500 ton in Brazil, followed by the United States of America (71,400 ton), Argentina (36,700 ton), India (35,000 ton) and Paraguay (12,200 ton). Few systemic and non systemic fungicides have been recommended to manage this disease successfully (Gopinath *et al.*, 2006 and Jagtap *et al.*, 2012). As the disease is highly influenced by environmental conditions, the results have been inconsistent. Few reports exist on the effects of resistance activators in soybean plants (Meyer *et al.*, 2006) excluding *Colletotrichum* leaf spot. The constant use of same fungicides to control the disease may lead to development of resistance against the pathogen. Use of resistance activator may help to reduce down the use of harmful chemicals and help to maintain ecosystem. Henceforth, assessment of newer fungicides and certain plant resistance activators for the management of *Colletotrichum* leaf spot disease is extremely imperative to decrease the loss and also to check the unpredicted epidemic of the disease. Therefore, the present study was conducted to find out the effectiveness of fungicides and plant resistance activators against *Colletotrichum* leaf spot of soybean.

MATERIALS AND METHODS

Field evaluation

The field experiment was carried out on the research field of the Regional Research Center, Amravati during *Kharif*, 2014 with Randomized Block Design in three replications. Susceptible soybean variety, JS-335 was sown at 45 x 05 cm spacing in plot size six rows of five meter length. The crop was raised as per recommended package of practices and protective irrigation was given as and when required. A total of eight fungicides *viz.* Thiophenate Methyl-0.1%, Tebuconazole - 0.1%, Triadomefon - 0.1%, Propiconazole-0.1%, Chlrothalonil - 0.2%, Hexaconazole - 0.05%, Azoxystrobin-0.1% and Carbendazim+ Mancozeb - 0.25% and two plant resistance activator namely Pyraclostrobin-0.25% and Salicylic acid @ 50 and 100 ppm were evaluated under field condition. Two sprayings of all the treatments were undertaken at 45 and 70 days after sowing of the crops. One plot/ replication was maintained as unsprayed control without

receiving any fungicides. Observations on foliage Colletotrichum leaf spot disease were recorded after each sprayings. For recording percent, disease index 0-9 scale was used (Anonymous, 2013). Rating scale is as 0-No lesions/spots/ discolouration, 1-1% area covered with lesions/spots/ discolouration, 3-1.1–10 % area covered with lesions/spots/ discolouration, 5-10.1–25 % area covered with lesions/spots/ discolouration, 7-25.1 –50 % area covered with lesions/spots/ discolouration, 9-More than 50 % area covered with lesions/ spots/discolouration. Five plants per treatment per replication were selected randomly and tagged for recording the observations. Three trifoliate leaves (bottom, middle and top) from main branch on each observation plant were selected for recording observations and per cent Colletotrichum leaf spot disease index was worked out as per the procedure given by Mayee and Datar, 1986. At harvest of the crops, an observation on seed yield was recorded in all the treatments and yield data was presented on hectare basis.

***In-vitro* evaluation**

Poisoned food technique (Nene and Thapliyal, 1993) was used to evaluate the efficacy of fungicides and plant resistance activator against *Colletotrichum truncatum*. Fungicidal and plant resistance activator suspensions were prepared by dissolving requisite quantities of each fungicide and plant resistance in warm PDA. After solidification of medium, plates were inoculated with eight days old pathogen separately. The 6 mm mycelia disc selected from peripheral growth of the plate by cork borer were used for inoculating the plates by keeping one disc per plate in the centre in inverted position. So as to make the mycelia growth touches the surface medium. The inoculated plates were incubated at room temperature for seven days. Three replicated plates were used for each concentration of every fungicide. Three replicated PDA plates received no fungicides served as control. Diameter of the colonies on PDA with and without fungicide was measured from the bottom side of the Petri dishes.

The colony diameter of the fungus pathogens on medium was recorded and percent inhibition was calculated by using following formula

$$\text{Percent growth inhibition} = \frac{C - T}{T} \times 100$$

C = Mycelial growth in control (mm)

T = Mycelial growth in treatment (mm)

RESULTS AND DISCUSSION

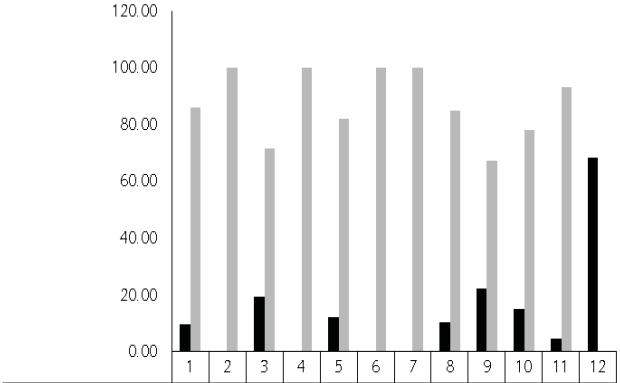
Field evaluation

Data presented in Table 1 it clearly indicated that, at 45 DAS tebuconazole-0.1% was found highly effective as minimum disease index (11.76%) with reducing the incidence of disease (64.15%) followed by propiconazole-0.1%, hexaconazole-0.05%, azoxystrobin-0.1%, carbendazim + mancozeb 0.25% and pyraclostrobin-0.25% recorded at par effect in reducing *Colletotrichum* Leaf Spot disease. The percent disease control achieved after first spray in the ranged from 24.41 to 64.15 per cent and maximum being observed in treatment tebuconazole-0.1% *i.e.* 64.15%. At 70 DAS, tebuconazole-0.1%, propiconazole-0.1%, hexaconazole-0.05% was found most effective in reducing disease infection 20.49, 21.77 and 22.29 per cent with maximum disease control 68.91, 66.97 and 66.18 per cent respectively. Second best set of treatments were found azoxystrobin-0.1% and carbendazim + mancozeb 0.25% recorded 27.20 and 28.70% PDI with per cent disease control 58.74 and 56.37% respectively. In concern to plant resistance activator, pyraclostrobin 0.25% registered 32.47% disease infection with 50.75 per cent disease control followed by salicylic acid @100 ppm recorded 38.23% disease infection with 42.00 per cent disease control.

Results of the present study indicated that tebuconazole, propiconazole, hexaconazole, azoxystrobin and carbendazim + mancozeb had the highest curative effect against *Colletotrichum* Leaf Spot. Finding with respect to disease management of *Colletotrichum* Leaf Spot under field condition by use of fungicides were well endorsed by earlier workers (Ghawade *et al.* 2009; Jagtap *et al.,* 2012 and Chaudhary *et al.,* 2013). Soto-Arias and Munkvold (2011) tested the effect of tebuconazole and pyraclostrobin and reported that the fungicides could be used effectively for the management of foliar disease of soybean. Ghawade *et al.* (2009) reported that fungicides propiconazole @ 0.1%, carbendazim @ 0.1% and hexaconazole @ 0.1% found effective in the management of anthracnose of soybean. Present results reported good disease control in the field with triazoles, benzimidazoles and strobilurins group of fungicides. These results are well corroborated with the earlier finding of Gopinath *et al.* (2006) and Bhardwaj and Sahu (2014).

Study of disease resistance induction in plants is a key alternative management approach to decrease the use of chemical product toxic to eco-system. Resistance activators such as pyraclostrobin and salicylic acid usually promote or induce resistance by synthesis of PR proteins (Hammerschmidt and Becher, 2000). Meyer *et al.* (2006) also reported that application of pyraclostrobin and salicylic acid were the most effective in control of *Rhizoctonia* foliar blight of soybean. The results of the present study show that plant resistance activator decreased disease infection over control however their efficacy not as superior compare to fungicides. The present studies are in accordance with Henry *et al.* (2011).

All the test treatments recorded significantly higher yield in



	1	2	3	4	5	6	7	8	9	10	11	12
Radial mycelial growth	9.67	0.00	19.3	0.00	12.3	0.00	0.00	10.3	22.3	15.0	4.67	68.1
%inhibition	85.8	100.	71.6	100.	81.9	100.	100.	84.7	67.2	78.0	93.1	

Figure 1: Efficacy of fungicides and plant resistance activator against *Colletotrichum dematium (in vitro)*

Table 1: Effect of different fungicides and plant resistance activator on Colletotrichum leaf spot of soybean

Sr No.	Treatments	PDI(%)45 DAS	PDC at 45 DAS(%)	PDI(%) 70 DAS	PDC at70 DAS(%)	Yield/ plot (kg)	Yield(kg/ha)
T1	Thiophenate Methyl-0.1%	18.27(25.27)*	44.32	33.40(35.28)*	49.33	1.59	1959
T2	Tebuconazole-0.1%	11.76(19.97)	64.15	20.49(26.85)	68.91	1.87	2305
T3	Triadomefon- 0.1%	22.03(27.93)	32.86	36.05(36.85)	45.31	1.49	1844
T4	Propiconazole-0.1%	11.93(19.82)	63.65	21.77(27.71)	66.97	1.81	2239
T5	Chlrothalonil-0.2%	20.03(26.55)	38.96	35.56(36.57)	46.06	1.51	1864
T6	Hexaconazole-0.05%	13.60(21.53)	58.55	22.29(28.10)	66.18	1.77	2181
T7	Azoxystrobin-0.1%	13.24(21.23)	59.64	27.20(31.42)	58.74	1.65	2033
T8	Pyraclostrobin-0.25%	15.62(23.10)	52.39	32.47(34.73)	50.75	1.61	1992
T9	Salicylic acid-50 ppm	24.80(29.85)	24.41	43.57(41.29)	33.91	1.32	1630
T10	Salicylic acid-100 ppm	20.48(26.84)	26.67	38.23(38.19)	42.00	1.50	1856
T11	Carbendazim + Mancozeb 0.25%	15.58(23.18)	52.51	28.76(32.38)	56.37	1.63	2012
T12	Untreated control	32.81(34.94)		65.92(54.29)		0.94	1160
	Test	Sig.		Sig.		Sig.	Sig.
	SE ±	1.38		1.26		0.06	72.91
	CD (P=0.05)	3.98		3.63		0.17	209.31

*Figures in parenthesis are arcsine-transformed value

Table 2: Efficacy of fungicides against *Colletotrichum dematium (in vitro*)

Sr No.	Treatments	Mean colony diameter(mm)	Percent growth inhibition
T1	Thiophenate Methyl-0.1%	9.67	85.82
T2	Tebuconazole-0.1%	0.00	100.00
T3	Triadomefon- 0.1%	19.33	71.64
T4	Propiconazole-0.1%	0.00	100.00
T5	Chlrothalonil-0.2%	12.33	81.91
T6	Hexaconazole-0.05%	0.00	100.00
T7	Azoxystrobin-0.1%	0.00	100.00
T8	Pyraclostrobin-0.25%	10.37	84.79
T9	Salicylic acid-50 ppm	22.33	67.24
T10	Salicylic acid-100 ppm	15.00	78.00
T11	Carbendazim + Mancozeb 0.25%	4.67	93.15
T12	Untreated control	68.17	
	Test	Sig.	
	SE ±	0.41	
	CD (P=0.01)	1.58	

the range of 1160 to 2305 kg/ha. Among the various treatments of fungicides and resistance activator, tebuconazole-0.1% was found most effective which recorded highest grain yield (2305 kg/ha) followed by propiconazole-0.1% (2239 kg/ha) and hexaconazole-0.05 % (2181 kg/ha). Among the plant resistance activator, pyraclostrobin 0.25% registered 1192 kg/ha yield followed by salicylic acid @100 ppm recorded 1856 kg/ha seed yield. Lowest yield obtained in control plot (1160 kg/ha).

Fungicides and plant resistance activator evaluated under field conditions against *Colletotrichum* Leaf Spot of soybean were found most effective in reducing the disease as well as increasing the seed yield over unsprayed control. Several workers (Shukla and Singh, 1993 Mittal, 2001 and Choudhary *et al.,* 2013) reported efficacy of these fungicides in controlling Colletotrichum Leaf Spot diseases and increasing the yields earlier.

In-vitro evaluation

The data from laboratory work (Table 2 and Fig.1) revealed that tebuconazole-0.1%, propiconazole-0.1%, hexaconazole-0.05% and azoxystrobin-0.1% completely inhibited (100%) the radial mycelial growth of *Colletotrichum dematium* f.sp. *truncatum*with. Carbendazim + mancozeb 0.25%, thiophenate methyl-0.1% and pyraclostrobin-0.25% also showed minimum growth 4.67, 9.67 and 10.37 mm with 93.15, 85.82 and 84.79% growth inhibition respectively. Triadomefon (0.1%) and salicylic acid @50 ppm was found least effective and caused minimum inhibition (71.64 and 67.24 % respectively) of the test pathogen.

Results of this study demonstrated that fungicides reduced mycelial growth *C. truncatum in vitro*. However, tebuconazole, propiconazole, hexaconazole and azoxystrobin were found most effective followed by Carbendazim + mancozeb, thiophenate methyl, pyraclostrobin and chlorothalonil. The results of the current laboratory evaluation supported the field evaluation study. The present results are in partial agreement with workers Swamy and Kulkarni (2003) and Kumar *et al.* (2003). Kumar *et al*. (2003) who observed fungicide, hexaconazole, propiconazole, penconazole and difenconazole were reported inhibitory to *C. gleosporioides, C. capsici* and *C. lindemuthianum*. These finding proved the observations reported by Shovan *et al.* (2008). They reported that the complete inhibition Colletotrichum was obtained with propiconazole (Tilt-25 EC) at all the selected concentration. Sundravadana *et al.* (2007) also reported that in *in vitro* tests, azoxystrobin completely inhibit mycelial growth of *C. gloeosporioides*. Jadhav *et al.* (2008) reported similar observations. They noticed that in laboratory experiment mancozeb + carbendazim 0.25%, propiconazole 0.1%, and carbendazim 0.1% showed 100% inhibition of the fungus. The present investigation helps the selection criteria for the preference of fungicide to develop a disease management of *Colletotrichum* Leaf Spot of soybean in the field. Moreover, two spray of tebuconazole (0.1%) at 25 days interval has been advocated for management of Colletotrichum Leaf Spot of soybean.

REFERENCES

Anonymous 2013. Annual Report of AICRP on Soybean, DSR, Indore

(MP).

Bhardwaj, N. and Sahu, R. K. 2014. Evaluation of fungicides, botanicals and essential oils against the fungus *Colletotrichum falcatum* causing red rot of sugarcane. *The Bioscan.* **9(1):** 175-178.

Choudhary, C. S., Jain, S. C. Kumar, R. And Chiudhary, J. S. 2013. Efficiency of different fungicides, biocides and botanical extract seed treatment for controlling seed-borne Coolectotrichum sp. in chilli. *The Bioscan.* **8(1):** 123-126.

Ghawde, R. S., Gaikwad, S. J. and Borkar, S. L. 2009. Evaluation of fungicides and screening of varieties against pod blight of soybean caused by *Colletotrichum truncatum*. *J. Soils and Crops* **6(1):** 97-97.

Gopinath, K., Radhakrishnan, N. V. and Jayaraj, J. 2006. Effect of propiconazole and difenconazole on the control of anthracnose of chilli fruits caused by *Colletotrichum capsici*. *Crop Protection* **25**: 1024-1031.

Hammerschmidt, R. and Becher, J. A. 2000. The role of salicylic acid in disease resistance. In: Agrawal, A. A., Tuzun, S., Bent, E. (Eds.),Induced Plant Defence Against Pathogens and Herbivores Biochemistry, Ecology and Agriculture. *APS Press, St. Paul.* pp. 37-53.

Henry, R. S., Johnson, W. G. and Wise, K. A. 2011. The impact of a fungicide and an insecticide on soybean growth, yield and profitability. *Crop Protection.* **30:**1629-1634.

Jadhav, S. K., Diwakar, M. P., Sawant, U. K. and Kadam, J. J. 2008. Management of leaf spot disease of kokum (*Gracina Indica)* incited by *Colletotrichum gloeosporiodes* Penz. *J. Plant Disease Science* **3(2):** 193-196.

Jagtap, G. P., Gavate, D. S. and Dey, U. 2012. Control of *Colletotrichum truncatum* causing anthracnose/pod blight of soybean by aqueous leaf extracts, bio-control agents and fungicides. *Scientific J. Agriculture.* **1(2):** 39-52.

Kumar, P. M. K., Nargund, V. B., Khan, A. N. A., Venkataravanappa, V. 2003. In vitro evaluation of fungicides and botanicals against *C. gloeosporioide and Alternaria alternata* causing post harvest diseases in mango. *Indian Phytopath.* **56(3):** 343.

Mayee, C. D. and Datar, V. V. 1986. *Phytopathometry: A Technical Bulletin.* VNMAU, Parbhani.

Meyer, M. C., Bueno, C. J., Desouza, N. L. and Yorinori, J. T. 2006. Effect of dose of fungicides and plant resistance activators on the control of Rhizoctonia foliar blight of soybean and on *Rhizoctonia solani in vitro* development. *Crop Protection.* **25:** 848-854.

Mittal, R. K. 2001. Yield losses by Frog-eye leaf spot and anthracnose disease in soybean under different sowing dates in the hills. *Indian Phytopath.* **54(1):** 32-34.

Nene, Y. L. and Thapliyal 1993. *Fungicides in Plant Disease Control.* 2nd Edn. *Oxford and IBH Publn,* New Delhi. pp. 531-532.

Sinclair, J. B. 1992. Discoloration of soybean seeds an indicator of quality. *Plant Disease.* **76(11):** 1087-1091.

Sinclair, J. B. and Backman, P. A. 1989. Compendium of Soybean Diseases. 3rd edn. *The American Phytopathological Society,* St. Paul.

Shovan, L. R., Bhuiyan, M. K. A., Begum, J. A. and Pervez, Z. 2008. *In vitro* control of *Colletotrichum dematium* causing anthracnose of soybean by fungicides, plant extracts and *Trichoderma harzianum*. *Int. J. Sustain. Prod.* **3(3):** 10-17.

Shukla, A. K. and Singh, D. P. 1993. Management of fungal disease of soybean by fungicidal sprays. *Legume Res.* **16(1-2):** 75-76.

Sundravadana, S., D. Alice, Kuttalam, S. and Samiyappan, R. 2007. Efficacy of azoxystrobin in *Colletotrichum gloeospriodes* growth and on controlling mango anthracnose. *J. Agricultural and Biological Science.* **2(3):** 10-15.

Soto-Arias, J. P. and Munkvold 2011. Impact of foliar fungicides on infection of soybean by Phomopsis spp. In Iowa, USA. *Crop Protection* **30:** 577-580.

Swamy, B. S. and Kulkarni, S. 2003.*In vitro* evaluation of fungicides and botanicals against *Colletotrichum capsici* (Syd) causing leaf spot of turmeric. *Indian Phytopath.* **56(3):** 339.

Wrather, J. A., Anderson, T. R., Arsayed, D. M., Gai, J., Plopper, L. D., Porta-Puglia, A., Ram, H. H. and Yorinori, J. T. 1997. Soybean disease loss estimates for the top ten soybean producing countries in 1994. *Plant Disease.* **81:** *107*-110.