The Bioscan 7(4): 601-603, 2012
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
www.thebioscan.in

TEBUCONAZOLE: A NEW TRIAZOLE FUNGICIDE MOLECULE FOR THE MANAGEMENT OF STEM ROT OF GROUNDNUT CAUSED BY *SCLEROTIUM ROLFSII*

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KEY WORDS
Stem rot
Sclerotium rolfsii
Management
Yield, BCR

Received on :
30.06.2012

Accepted on :
26.10.2012

ABSTRACT
The bio-efficacy of formulations of tebuconazole 2% DS was evaluated for the management of stem rot of groundnut and its effect on dry pod yield. Application of tebuconazole 2%DS @ 1g/kg seed to groundnut kernels prior to sowing was found to be highly effective in the management of stem rot of groundnut with least disease incidence (7.31%) with higher pod yield (2664 kg/ha) and benefit cost ratio (5.42). The fungicide was also very effective in farm and large scale demonstration trials in controlling the stem rot and also resulted higher percent increase in yield (9.95%) over recommended fungicide carbendazim (3g/kg seed). Hence, seed treatment of tebuconazole 2%DS @ 1g/kg seed has been recommended and included in the university package of practices of University of Agricultural Sciences, Raichur, Karnataka for the farmers of region to manage the disease.

INTRODUCTION

In Karnataka, groundnut *(Arachis hypogaea)* is cultivated in an area of 1.30m ha with production of 1.14m t and productivity being 589 kg/ha (Anon., 2009). Several reasons including damage caused by diseased have been attributed to its low productivity (Ghewande, 1987). The soil borne pathogen, *Sclerotium rolfsii* Sacc. is an important pathogen of groundnut. The sclerotia of the pathogen are the principal means of survival in soil and debris (Garren, 1961). The disease is distributed throughout the world and prevalent particularly in warm dry climates. It was first reported by Mc Clintock (1917) in Virginia. Garren (1959) has estimated the losses in southern USA; it's about 10 to 20m dollar/annum. In severely infected fields, yield loss ranges from 10 to 25 per cent and occasionally it reaches up to 80 per cent (Mehan *et al.*, 1995).

In India, stem rot of groundnut was first recorded by Butler and Bisby (1931) and causes yield losses of over 25 per cent (Mayee and Datar, 1988). An ailment of stem rot of groundnut causes 13 to 59 per cent yield loss during both the rainy and summer seasons (Nautiyal, 2002). Few triazole fungicides such as propiconazole and difenoconazole have been recommended to manage the disease successfully (Brenneman *et al*., 1994 and Cilliers *et al.,* 2003). Rakholiya and Jadeja (2009) spray application of fluchloraline@ 1.5a.i.kg/ha, seed treatment with Vitavax + Thiram at @ 3.0g/kg seeds was alos reported to be effective against stem rot of groundnut.

In recent years, irregularity in supply of water from Tunga Bhadra and Upper Krishna Project canals and unpredictable rainfall, coupled with disease problem makes groundnut cultivation unprofitable, particularly in north eastern Karnataka. Among few major diseases of groundnut, stem rot has become endemic and posing lot problem to farmers. The continuous use of same fungicide to control the disease may lead to development of resistance against the pathogen. Moreover, there is no resistant or tolerant variety to stem rot which will suit to agro-climatic conditions of the region. Hence, evaluation of new fungicide molecules for the management of stem rot is very important to reduce the loss and also to check the sudden epidemic of the disease. Therefore, the present study was conducted to find out the effectiveness of formulations of certain new fungicides against stem rot of groundnut.

MATERIALS AND METHODS

A field experiment was conducted to at Main Agricultural Research Station, Raichur, Karnataka for two seasons. Groundnut cultivar, KRG-1, susceptible to *Sclerotium rolfsii* was sown in 5 x 3 sq. m sick plots during rainy season in 2002 and 2003. The experiment was laid out in a randomized block design with three replications and seven treatments as mentioned below.

T_1 - Tebuconazole 2% DS @ 0.75 g/kg seed; T_2 - Tebuconazole 2% DS @ 1.00 g/kg seed; T_3 - Tebuconazole 2% DS @ 1.25 g/kg seed; T_4 - Mancozeb 75WP @ 3.00 g/kg seed; T_5 - Carbendazim 50% WP @ 2.00 g/kg seed; T_6 - *Trichoderma viridae* @ 4.00 g/kg seed; T_7 - Untreated control

The test fungicides at different concentrations along with bioagent *Trichoderma viridae* were applied to groundnut seed

kernels prior to sowing. The treated seeds were shade dried and sown. The observation on disease incidences of stem rot was recorded a week before the harvest of the crop. All the plants were counted for stem rot incidence and ten diseased plants were physically examined for number of pods showing complete or partial rotting. The data were converted into per cent disease incidence. The pod yield was recorded from the whole plot and converted to per ha.

$$\text{Stem rot (\%)} = \frac{\text{Number of infected plants}}{\text{Total number of plants}} \times 100$$

Farm trials (FT) and large scale demonstration trials (LSD)

Based on the experimental results over two seasons during 2002-03, farm and large scale trials were conducted to test the efficacy of best treatment that is tebuconazole (1g/kg seed) in comparison to a recommended fungicide of carbendazim (3g/kg seed) in farmers fields. Seven farm trials (1000 mt^2 area each) were laid out in farmers fields of Raichur and Gulbarga districts in addition to one large scale trial (8000mt^2) in Raichur district with a spacing of 30x10 cm during kharif, 2004 and 2005. All the recommended package of practices for tillage, manuring and irrigation etc. were followed. Two treatments include tebuconazole 2% DS (1g/kg) in comparison with a recommended fungicide of carbendazim (3g/kg seed) were selected for trials to confirm their efficacy against the disease in 6 farm trials and one large scale demonstration trial. The test fungicides were applied to groundnut seeds a day prior to sowing and shade dried. In each fungicidal treatment, the observation on incidence of stem rot and dry pod yield were recorded as mentioned above.

RESULTS AND DISCUSSION

Results (Table 1) indicated that tebuconazole @ 1.25g/kg seed was found highly effective in reducing the incidence of stem rot followed by its lower dosage that is tebuconazole @ 1.00g/kg seed, they were on par each other and significantly different from lower dosage (Tebuconazole @ 0.75g/kg) in addition to other fungicidal treatments. The fungicides *viz.,* mancozeb, carbendazim and *Trichoderma viridae* were also effective in controlling the disease but they were not superior to tebuconazole (1-1.25g/kg). Significantly least disease incidence of 6.71% was recorded in tebuconazole @ 1.25g/kg while, it was 7.31 per cent in tebuconazole @ 1.00g/kg when compared to tebuconazole @ 0.75g/kg (9.86%), mancozeb (13.31%), carbendazim (11.31%) and *Trichoderma viridae* (10.26%).

The data pertaining to dry pod yield indicated that all treatments recorded significantly increased grain yield by reducing disease incidence when compared to control (Table 1). However, tebuconazole @ 1.25g/kg recorded highest average dry pod yield of 2773kg/ha followed by tebuconazole @ 1.00g/kg (2664kg/ha) and they were on par with each other when compared to other treatments. The lesser pod yield in other fungicidal treatments varied from 2311 to 2465kg/ha and while, untreated control (2023kg/ha) recorded least yield. Further, the results of effectiveness of tebuconazole (1g/kg seed) was confirmed by testing their efficacy in farm and large scale demonstration trials also. Lower stem rot (4.12%) and higher pod yield (1327kg/ha) was recorded in tebuconazole @ 1.00g/kg when compared to higher disease incidence (7.00%) and lesser grain yield (1190kg/ha) in recommended fungicide carbendazim (3g/kg).

With regard to cost benefit ratio (Table 1), tebuconazole @ 1.00g/kg recorded highest BC ratio when compared to all other fungicidal treatments. The treatment recorded BCR of 5.42 while, it was slightly less (4.86 and 5.20) in case of its higher dosage (1.25g/kg) and lower dosage (0.75g/kg) respectively. Further, the treatment (Tebuconazole @ 1.00g/kg) was superior to a recommended carbendazim with respect to increase in groundnut yield. An overall increase in yield of 11.50 per cent was obtained in the treatment over recommended carbendazim in farm trials and large scale demonstration trials (Table 2).

Findings with respect to disease management of stem rot under field condition by use of fungicides were well endorsed by earlier workers (Ray and Das, 1987; Brenneman *et al*., 1994). Brenenman *et al*. (1994) who tested the effect of propiconazole and reported that the fungicide could be used effectively for the management of stem rot of groundnut. Cilliers *et al*. (2003) tested various chemical, biological and cultural control strategies against *Sclerotium rolsii* under field condition. Among them they identified difenoconazole as a best fungicide that could possibly be applied for the control of stem rot. Difenoconazole significantly reduced the growth rate of *S. rolfsi*. The cultivation of infected fields with an inversion plough significantly reduced infection of groundnuts by *S. rolfsii* and also improved the quality of the produce.

Seed treatment of tebuconazole @ 1.25g/kg followed by its lower dosage (1.00g/kg seed) was found significantly superior in the management of stem rot with least disease incidence and higher pod yield in experimental trials as well as farm and large scale demonstration trials. From the farmers point of view, the treatment which gives maximum returns is more important than a mere control of the disease. Hence the

Table 1: Bio-efficacy of formulations of tebuconazole 2% DS against stem rot of groundnut during kharif, 2002-2003

Sl. No.	Treatment	Dosage(per g/kg)	Stem rot (%)			Pod yield (kg/ha)			B:C ratio
			2002	2003	Pooled Mean	K-02	K-03	Pooled Mean	
1	Tebuconazole	0.75	9.50 (17.95)	9.90 (18.34)	9.86 (18.29)	2333	2658	2495	5.20
2	Tebuconazole	1.00	7.16(15.50)	7.51(15.86)	7.31 (15.64)	2406	2923	2664	5.42
3	Tebuconazole	1.25	6.90(15.20)	6.51(14.71)	6.71 (14.62)	2561	2985	2773	4.86
4	Mancozeb	3.00	11.60(19.80)	14.38(22.61)	13.31 (21.44)	2250	2631	2440	1.37
5	Carbendazim	2.00	9.91(18.30)	11.43(20.33)	11.31 (19.80)	2340	2590	2465	4.12
6	*Trichoderma viridae*	4.00	9.91(18.30)	10.33(18.78)	10.26 (18.67)	2257	2565	2311	3.00
7	Untreated control	-	17.88(24.90)	22.22(28.10)	20.05 (26.50)	1826	2220	2023	—
CD at 5%			2.54	2.04	2.27	162	170	166	—

* Figures in parenthesis are angular transformation values

Table 2: Performance of tebuconazole 2% DS versus carbendazim against stem rot and yield of groundnut in farm trials (FT) and large scale demonstrations (LSD) during 2004 and 2005

Season and year	District	No. of trials	Stem rot (%) Tebuconazole (1g/kg seed)	Carbendazim (2g/kg seed)	Pod yield (kg/ha) Tebuconazole (1g/kg seed)	Carbendazim (2g/kg seed)	Percent increase in yield over Tricyclazole
2004	FT, Raichur	4	4.50	6.10	1244	1129	
	FT, Gulbarga LSD,	2	2.10	5.00	2210	2100	
	Raichur	1	4.00	6.20	1442	1226	
Mean			3.53	5.80	1535	1396	9.95
2005	FT, Raichur	4	5.50	10.10	865	707	
	FT, Gulbarga LSD,	2	3.50	6.00	1180	1080	
	Raichur	1	5.00	8.20	1565	1446	
Mean			4.70	8.10	1119	985	13.60
Grand mean			4.12	7.00	1327	1190	11.5

FT- Farm trial and LSD –Large scale demonstration

economic analysis of different fungicidal spray schedules was taken up to have an idea whether to recommend the chemical to the farmers or not. In the present study, tebuconazole @ 1.00g/kg not only reduced the disease incidence but also gave the higher benefit cost ratio of 5.42 compared to its higher dosage (4.86). The results of present findings are in agreement with Adiver (2007) who reported that triazoles such as tebuconazole, cyperconazole, difeniconazole and diniconazole provide excellent control of foliar fungal diseases and some soil borne diseases including stem rot. Fungicides belonging to trialzoles group inhibit biosynthesis of ergosterol which plays an important role in structure of cell membrane of fungi (Dahmen, *et al.,* 1989; Waterfield and Sisler, 1989). These fungicides have systemic character and can penetrate the inside of seed and can be used as seed treatment and applied to green plants safely (Sudini *et al*., 1999). Active ingradients of these fungicides which were determined that as having no side effects on groundnut seeds after germination.

Based upon the results in experimental as well as farm and large scale trials, tebuconazole has been recommended and included in the university package of practices of University of Agricultural Sciences, Raichur, Karnataka for the farmers of region to manage stem rot disease of groundnut. Hence, seed treatment of new fungicide molecule that is tebuconazole @ 1g/kg could be used for treatment of groundnut seeds for the management of stem rot of groundnut.

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