



P-ISSN: 2349-8528

E-ISSN: 2321-4902

IJCS 2020; 8(1): 113-116

© 2020 IJCS

Received: 06-11-2019

Accepted: 10-12-2019

**Lokesh BK**

Associate Professor of Plant Pathology, AEEC, Arabhavi, UAS, Dharwad, Karnataka, India

**Guruprasad Ballol**

Associate Professor UAS, Dharwad, Karnataka, India

**Basamma Kumbar**

Assistant Professor of plant pathology, ARS, Bijapur, UAS, Dharwad, Karnataka, India

## Fungicide chemicals for the integrated management of rust disease in chickpea

**Lokesh BK, Guruprasad Ballol and Basamma Kumbar**

### Abstract

Chickpea is one of the major pulse crop affected by various diseases, the rust caused by (*Uromyces ciceris-arietini*) (Grogon) Jacz. & Boyer is considered as one of the most destructive disease of chickpea. Rust pathogen affects in all growth stages results in substantial losses in terms of both quality and quantity parameters of grain and this reinforces the need to exploit several management strategies including chemical control. Therefore, present investigation was carried out to examine the efficacy of total of twelve chemicals fungicides alone and/or in combination against rust disease of chickpea in two independent locations viz., Arabhavi and Dharwad during 2017-18. The field experiment consisting of three replication and thirteen treatments. The results of the experiment revealed that all the twelve fungicides tested were found effective for the management of chickpea rust disease as compare to control (water spray). However spray combination of Tebuconazole 50% + Trifloxystrobin 25% w/w 75 WG @ 1.0 g/l twice at onset of disease significantly reduced rust incidence with record of 14.28 PDI with high total yield of 12.36 qtl/ha followed by Tebuconazole 25 EC @ 1 ml/l recorded 15.72 PDI with yield of 12.22qtl/ha, Propiconazole 25EC @ 1.0 ml/lit (Tilt) recorded 16.41 PDI with higher yield of 11.17 qtl/ha) found effective in reducing the disease. While, Difenconazole 25 EC@1 ml/l showed 17.45 PDI and yield of 10.56qtl/ha, Tebuconazole 50% + Trifloxystrobin 25% w/w 75WG @ 0.5 g/l recorded 18.25 PDI and 10.36qtl/ha of yield and Pyraclostrobin 25 EC @ 1 ml/l observed with 20.02 rust PDI with yield of 10.32qtl/ha showing equally effective in reducing rust percent disease incidence and increased yield when compared to control that recorded highest rust disease incidence (53.71 PDI) and lower yield (6.16 qtl/ha).

**Keywords:** Fungicide chemicals, chickpea

### Introduction

Chickpea is a key pulse crop being grown in 8.75 million ha with an annual production of 8.25 million tons and national productivity is 925 kg/ha (Singh, 2011). Chickpea is a major and cheap source of protein compared to animal protein. Chickpea is cultivated for its seeds. They are rich source of protein and form an important part of vegetarian diet. Chickpea seeds contain about 17-20% of protein. During the period of 1991-93 to 2006-08, highest increase in productivity of chickpea has been recorded in Andhra Pradesh (124%) followed by Karnataka (63%), Maharashtra (53%) and Gujarat (40%). (Nene *et al.* 2012) [10]. In Andhra Pradesh the area under chickpea has increased from 71000 ha in 1991-1993 to 517000 ha in 2006-08 and productivity from 621 kg/ha to 1397kg/ha resulting in 16 times production increase. In Maharashtra the area increased from 566000ha in 1991-93 to 1.24 mha in 2006-08 with production from 288000 to 959000 tonnes. (Sunilkumar Shirasangi, *et al.* 2017) [18]. In Karnataka, the area increase was 2.7 times with a production increase of 4.4 times between 1991 and 2006.

Chickpea is best suited to areas having low to moderate rainfall and a mid-cold weather. Excessive rains soon after sowing or at flowering stage are harmful for the crop. Severe cold is injurious, and is very harmful. Rust (*Uromyces ciceris-arietini*) (Grogon) Jacz. & Boyer is prevalent in the Mediterranean region, South Eastern Europe, southern Asia including India, eastern Africa and Mexico (Sunilkumar Shirasangi, *et al.* 2017) [18]. It is not considered serious as it appears late in the season when the crop is maturing and moderate warm weather favours rust development. Chickpea rust is a disease of local importance but it is present in almost every region of the world where chickpea is grown. The disease is widespread in the Mediterranean, South-east Europe, South Asia, East Africa and Mexico (Rubiales *et al.*, 2001). Normally, chickpea rust epidemic begins late in the season so yield components are usually less affected by the infection (Ragazzi, 1982; Jones, 1983) [12, 6].

**Corresponding Author:****Lokesh BK**

Associate Professor of Plant Pathology, AEEC, Arabhavi, UAS, Dharwad, Karnataka, India

Chickpea rust Pathogen produces large pustules (up to 1 mm) on leaves that appears first as small, round, brown spots, which may coalesce and turn dark later. Masses of brown uredospores develop under the epidermis at the centre of the spots and are released from the mature pustule when the epidermis ruptures (Sunilkumar Shirasangi, *et al.* 2017) <sup>[18]</sup>. Severely infected crop looks rusty because the foliage is coated with rust pustules and urediniospores. The rust appears first mainly on the leaves as small, round or oval, cinnamon brown, powdery pustules. These pustules tend to coalesce. Sometimes a ring of small pustules can be seen around larger pustules, which occur on both leaf surfaces but more frequently on the lower one. Occasionally pustules can be seen on stems. Severely infected plants may dry up prematurely.

Development of rust resistant variety is considered the most adequate control strategy, but, no complete levels of resistance are available in commercial cultivars which emphasize to integrate several control strategies including chemical control (Sillero *et al.*, 2006) <sup>[13]</sup>. Since then, a number of generations of fungicides are available and their efficiency against chickpea rust has not been properly tested yet. Thus, scrutinization for the best fungicides in management of chickpea rust under field condition is required.

### Materials and Methods

Investigations on chickpea rusts were carried out at two different location *viz.*, Arabhavi and Dharwad during *rabi*

2017-18. The field experiment was laid out in randomized block design with thirteen treatments along with three replications and chickpea variety A-1 was used for the study. The crop was sown with 30×10 cm spacing having a gross plot size of 5.0 x 3.0 m and net plot size of 4.8 x 2.4 m. The seed rate was used at 50 kg/ha. To prevent the crop from soil and seed borne diseases, the seeds were treated with *Rhizobium* culture Vitavax at 2gm/kg seed is common for all the treatments.

Twelve different fungicides chemicals alone or in combination (Table 1.) were evaluated under present field investigation. Crop was sprayed twice with each fungicide at recommended doses. First spray was done at the appearance of symptoms (45 days after sowing) and second sprays after 15 days interval, respectively. Control plot were sprayed with same volume of water. Disease severity was recorded using 0-9 rating scale (Mayee and Datar, 1986) <sup>[9]</sup> before the beginning of first spray and subsequent observations were recorded and final disease severity was recorded 15 days after second spray.

The periodical data were also recorded on rust severity with the initiation of the disease at fifteen days interval. At the end of the season grain yield (kg/ha) from each plot was estimated and then converted to kg/ha. Rust disease severity was recorded by following 0-9 scale and percent disease index (PDI) was calculated along with seed yield per hectare and the economic return in the form of net income, benefit cost ratio was also worked out.

**Table 1:** Recording of chickpea rust severity

Rating value	Description
0	No symptoms on leaves
1	Uredosori covering 1% or less of leaf area
3	1-10% of the leaf area covered with brown powdery uredosori
5	Uredosori covering 11-25% for leaf area
7	Uredosori covering 26-50% of leaf area
9	Uredosori covering 51% or more of leaf area

Further these scales were converted to per cent disease index (PDI) using the formula

$$PDI = \frac{\text{Sum of numerical disease ratings}}{\text{No. of plants observed}} \times \frac{100}{\text{Maximum disease grade}}$$

### Results and Discussion

*In vivo* studies by using different fungicides chemicals was conducted at two different locations during *rabi*, 2017 to evaluate the efficacy of twelve fungicides with a control against chickpea rust as explained in material and methods. Disease severity was recorded by following 0-9 scale and Per cent Disease index (PDI) was calculated along with seed yield per plot, yield per ha and B: C ratio.

During experimental studies, the incidence of rust disease in chickpea was higher at Dharwad location when compared to other location Arabhavi; where observed slightly less rust disease incidence during *rabi* 2017 (Table 1). Rust symptoms appear initially on the leaves as small, round or ellipsoidal, Cinnamon-brown, powdery pustules. Pustules form on both leaf surfaces but more frequently on lower leaves.

All the tested fungicides *viz.*, Hexaconazole 5 EC @1 ml/l(T1), Propiconazole 25 EC @1 ml/l(T2), Tebuconazole 25 EC @1 ml/l(T3), Difenoconazole 25 EC@1 ml/l(T4), Pyraclostrobin 25 EC @1 ml/l(T5), Trifloxystrobin @1 ml/l(T6), Mancozeb 75 WP @ 2 g/l(T7), Zineb 68% +

Hexaconazole 4% WP @ 2 g/l(T8), Carbendazim 12% + Mancozeb 63% WP @ 1 g/l(T9), Fluopyram 17.7% +Tebuconazole 17.7% @ 1ml/l(T10), Tebuconazole 50% + Trifloxystrobin 25% w/w 75WG @ 0.5 g/l(T11), Tebuconazole 50% + Trifloxystrobin 25% w/w 75 WG @ 1.0 g /l, (T12) was found effective against rust disease and also found significant over untreated control(Table 1). The pooled mean per cent rust disease incidence was ranged from 14.28 to 53.17 PDI at two different locations.

The pooled data for the management of rust disease in chickpea by evaluation of different fungicides at two different locations of Arabhavi and Dharwad during *rabi* 2017-18 (Table-1) revealed that tested fungicides significantly showed low incidence of rust disease in Tebuconazole 50% + Trifloxystrobin 25% w/w 75 WG @ 1.0 g /l sprayed plot with 14.28 PDI and yield of 12.36 qtl/ha (Table1).

The results revealed that all twelve tested fungicide was found effective in controlling rust disease of chickpea. Application of Tebuconazole 50% + Trifloxystrobin 25% w/w 75 WG @ 1.0 g /l resulted significant reduction in the incidence of rust with 14.28 PDI and yield of 12.36 qtl/ha followed by Tebuconazole 25 EC @1 ml/l showed minimum 15.72 PDI and high yield of 12.22 qtl/ha, Propiconazole 25 EC @1 ml/l recorded 16.41 PDI and 11.17 qtl/ha yield and Difenoconazole treatment observed with minimum of 17.45 PDI and 10.56 qtl/ha yield when compared to highest

incidence of rust was recorded in control plot with 53.71 PDI and lowest yield of 6.16qtl/ha.

Foliar spray with fungicides alone and/or in combination significantly reduced the rust incidence of 14.28 PDI in comparison to control (53.71PDI). The data on efficacy of different chemical fungicides found that, Tebuconazole 50% + Trifloxystrobin 25% w/w 75 WG @ 1.0 g /l recorded 18.25 PDI and 10.36qtl/ha of yield followed by Pyraclostrobin 25 EC @1 ml/l recorded 20.02 PDI and 10.32 qtl/ha yield, Fluopyram 17.7%+ Tebuconazole17.7% @ 1ml/l (18.49 PDI and 9.92qtl/ha yield), Trifloxystrobin @1 ml/l (18.73 PDI and 9.58 qtl/ha), Similarly, Hexaconazole 5 EC @1 ml/l (21.97 PDI with 8.97 qtl/ha yield), Zineb 68% + Hexaconazole 4% WP @ 2 g/l (24.27PDI and 7.36qtl /ha yield), Carbendazim 12% + Mancozeb 63% WP @ 1 g/l(25.30PDI and 7.34qtl/ha yield),Mancozeb 75 WP @ 2 g/l 25.88 PDI with 7.30 qtl/ha yield was recorded and found more or less equally effective against rust of chickpea when compare to Control (T13) was found to observed with highest of 53.71 PDI and lowest of 6.16 qtl/ha yield.

Estimation of Percent increase in yield over control due to individual fungicides will provide us the information about the role of individual fungicides in reducing rust disease incidence. The combination of Tebuconazole 50% + Trifloxystrobin 25% w/w 75 WG @ 1.0 g /l recorded double the percent of yield increased to 12.36 qtl/ha over control 6.16 qtl/ha followed by Tebuconazole 12.22 qtl/ha, Propiconazole, 11.17qtl/ha, Difenconazole 10.56 qtl/ha have recorded significant increase in percent of yield over both locations. In the present investigation highest benefit cost ratio was observed in Tebuconazole 50% + Trifloxystrobin (2.33) followed by Tebuconazole (2.16), Propiconazole, (2.13), Difenconazole (2.10).

## Discussion

The results on efficacy of chemical fungicides tested against rust disease of chickpea during both the locations revealed that all the fungicides are effective for the management of

disease as compare to control, however Tebuconazole 50% + Trifloxystrobin 25% w/w 75 WG @ 1.0 g /l, Tebuconazole, Propiconazole, Difenconazole, Pyraclostrobin are very equally effective among all. The observation are on par with results agreed by Sunilkumar Shirasangi, *et al.* 2017<sup>[18]</sup>, who reported maximum yield was recorded in Propiconazole (12.22 q/ha), followed by Difenconazole (11.33 q/ha) and Hexaconazole (11.11q/ha). Least yield was recorded in control (9.11 q/ha), while the remaining treatments were at par with each other; these differences observed in the efficacy among tested fungicides depend on their fungicidal action. These fungicides showed considerable reduction in rust percent disease incidence. Similar observation on efficiency of tebuconazole in reducing the rust severity with good increase in yield of pea was earlier demonstrated (Huge and Nahar, 1997; Basandrai *et al.*, 2013; Emeran *et al.*, 2011; Sugha *et al.*, 2008)<sup>[5, 2, 3, 17]</sup>. There is considerable differences among fungicides in their capability to suppress the disease development. These results are in agreement with the reports of Hemachandra 2000<sup>[4]</sup>, who reported that four sprays of Propiconazole (0.1%) at seven days interval resulted lowest disease severity (20.5%) of pea rust caused by *U. fabae* with highest grain yield (1037.50 kg/ha) followed by Hexaconazole (0.1%) and the results are supported by the work of Ashwani *et al.* 2013<sup>[1]</sup>. Efficiency of triazoles (difenconazole, epoxiconazole, tebuconazole) and their combination with benzimidazoles (carbendazim-flutriafol and carbendazim-flusilazole) in pea rust management was also demonstrated (Emeran *et al.*, 2011; Scherm *et al.*, 2009)<sup>[3, 14]</sup>. Triazoles are sterol synthesis inhibitors and many of them have good action against rust diseases (Kuck *et al.*, 1995)<sup>[8]</sup>. In absence of accessibility of resistant varieties, fungicides application can be a suitable short term strategy for rust disease management in chickpea. Thus new generation fungicides and/or combination of new and old generation fungicides provide a promising approach for the management of rust disease in chickpea.

**Table 2:** Fungicides chemicals for the management of chickpea rust at Arabhavi & Dharwad and pooled data for Rabi 2017

Tr. No.	Treatment Details	Arabhavi Rabi 2017		Dharwad Rabi 2017		Pooled data	
		Mean PDI	Yield (q/ha)	Mean PDI	Yield (q/ha)	Mean PDI	Yield (q/ha)
T1	Hexaconazole 5 EC @1 ml/l	7.15 (15.52)	9.82	32.49 (34.76)	8.1	21.97 (25.14)	8.97
T2	Propiconazole 25 EC @1 ml/l	5.86 (14.02)	10.52	24.52 (29.69)	11.8	16.41 (21.85)	11.17
T3	Tebuconazole 25 EC @1 ml/l	4.6 (12.39)	10.83	24 (29.35)	12.6	15.72 (20.87)	12.22
T4	Difenconazole 25 EC@1 ml/l	6.51 (14.79)	9.65	25.62 (30.42)	11.1	17.45 (22.61)	10.56
T5	Pyraclostrobin 25 EC @1 ml/l	8.94 (17.41)	9.10	27.97 (31.94)	11.5	20.02 (24.67)	10.32
T6	Trifloxystrobin @1 ml/l	8.25 (16.7)	9.20	26.08 (30.73)	10.0	18.73 (23.71)	9.58
T7	Mancozeb 75 WP @ 2 g/l	14.25 (22.19)	7.10	34.11 (35.75)	7.5	25.88 (28.97)	7.30
T8	Zineb 68% + Hexaconazole 4% WP @ 2 g/l	12.23 (20.48)	7.45	32.71 (34.9)	7.3	24.27 (27.69)	7.36
T9	Carbendazim 12% + Mancozeb 63% WP @ 1 g/l	14.94 (22.75)	6.98	32.74 (34.92)	7.7	25.3 (28.83)	7.34
T10	Fluopyram 17.7%+ Tebuconazole17.7% @ 1ml/l	9.28 (17.74)	9.00	25.28 (30.2)	10.8	18.49 (23.97)	9.92
T11	Tebuconazole 50% + Trifloxystrobin 25% w/w 75WG @ 0.5 g/l	9.42 (17.88)	8.65	24.63 (29.77)	12.5	18.25 (23.83)	10.36
T12	Tebuconazole 50% + Trifloxystrobin 25% w/w 75 WG @ 1.0 g /l	4.31 (11.98)	11.25	22.09 (28.05)	13.5	14.28 (20.01)	12.36
T13	Control	21.58(27.69)	6.89	68.19	5.4	53.71	6.16

				(55.7)		(41.7)	
	S.Em	0.78	0.26	0.43	0.37	2.11	0.80
	CD (5%)	2.25	0.74	1.25	1.06	6.11	2.32
	CV	5.20	4.08	3.89	5.28	5.23	4.05

Value in parenthesis are angular transformed

**Table 3:** Yield and economics of chickpea as influenced by rust disease at Dharwad and Arabhavi during 2017

Treatment No.	Treatment details	Pooled yield q/ha 2017	Cost of cultivation	Gross Returns	Net Returns	BCR
T <sub>1</sub>	Hexaconazole 5 EC @ 1 ml/l	8.97	19850	40473	20623	2.04
T <sub>2</sub>	Propiconazole 25 EC @ 1 ml/l	11.17	20150	48978	28828	2.13
T <sub>3</sub>	Tebuconazole 25 EC @ 1 ml/l	12.22	20915	51407	30492	2.16
T <sub>4</sub>	Difenoconazole 25 EC @ 1 ml/l	10.56	20850	45507	24657	2.10
T <sub>5</sub>	Pyraclostrobin 25 EC @ 1 ml/l	10.32	20950	44394	23444	2.12
T <sub>6</sub>	Trifloxystrobin @ 1 ml/l	9.58	21050	42650	21600	2.03
T <sub>7</sub>	Mancozeb 75 WP @ 2 g/l	7.30	20650	33553	12903	1.62
T <sub>8</sub>	Zineb 68% + Hexaconazole 4% WP @ 2 g/l	7.36	20560	34115	13555	1.66
T <sub>9</sub>	Carbendazim 12% + Mancozeb 63% WP @ 1 g/l	7.34	20230	33578	13348	1.66
T <sub>10</sub>	Fluopyram 17.7% + Tebuconazole 17.7% @ 1 ml/l	9.92	22550	41917	19367	1.86
T <sub>11</sub>	Tebuconazole 50% + Trifloxystrobin 25% w/w 75WG @ 0.5 g/l	10.36	21525	53142	31617	2.27
T <sub>12</sub>	Tebuconazole 50% + Trifloxystrobin 25% w/w 75 WG @ 1.0 g/l	12.36	23400	54593	31193	2.33
T <sub>13</sub>	Control	6.16	19650	28015	8365	1.43
	S.Em±	0.80				
	Cd (5%)	2.32				
	CV	4.05				

## References

- Ashwani KB, Daisy B, Pankaj M, Sharma BK. Fungicidal management of rust, powdery mildew and ascochyta blight in seed crop of pea. *Pl Dis Res.* 2013; 28:22-28.
- Basandrai AK, Basandrai D, Mittal P, Sharma BK. Fungicidal management of rust, powdery mildew and Ascochyta blight in seed crop of pea, *Pl. Dis. Res.* 2013; 28:22-28.
- Emeran AA, Sillero JC, Fernández-Aparicio M, Rubiales D. Chemical control of faba bean rust (*Uromyces viciae-fabae*). *Crop Prot.* 2011; 30:907-912.
- Hemachandra L. Prediction model for lentil rust and its integrated management. Ph.D., thesis. Rajendra Agric Univ, Bihar, India, 2000.
- Huge HI, Nahar MS. Efficacy and economics of different fungicides in controlling rust and powdery mildew of garden pea, Bangladesh. *J Sci. Industry. Res.* 1997; 32(4):533-536.
- Jones DR. Chickpea rust-a disease new to Australia. Queensland Department of Primary Industry Farm Note AGDEX 168/673, 1983.
- Khedekar SA. Studies on soybean rust (*Phakopsora pachyrhizi* Syd.) and chickpea rust (*Uromyces ciceris-arietini* (Grognot) Jacz. and Boy). PhD thesis. Univ Agric Sci, Dharwad, Karnataka, India, 2012.
- Kuck KH, Scheinplug H, Pontzen R. DMI fungicides. In: Lyr, H. (Ed.), *Modern Selective Fungicides: Properties, Applications, Mechanisms of Action*, second ed. Gustav Fischer Verlag, New York, 1995, 205-258.
- Mayee CD, Datar VV. *Phytopathometry*. Technical Bulletin-1 (Special Bulletin 3), Marathwada Agric. Univ. Parbhani, 1986, 218.
- Nene YL, Reddy MV, Haware MP, Ghanekar AM, Amin KS, Pande S *et al.* Field Diagnosis of Chickpea Diseases and their Control. Information Bulletin No. 28 revised). Patancheru, A.P. 502 324, India: International Crops Research, Institute for the Semi-Arid Tropics, 2012, 60.
- Pandey RN, Gohel NM, Pratik Jaisani. Management of Wilt and Root Rot of Chickpea caused by *Fusarium oxysporum* f. sp. *ciceri* and *Macrophomina phaseolina* through Seed Biopriming and Soil Application of Bio-Agents. *Int. J Curr. Microbiol. App. Sci.* 2017; 6(5):2516-2522.
- Ragazzi. Pulse Research Laboratory, Division of Genetics, Indian Agricultural Research Institute, New Delhi 110012, India, 1982. E-mail: hasan\_ra@rediffmail. com
- Rubiales D, Pérez-De-Luque A, Fernández Aparicio M, Sillero JC, Román B, Kharrat M *et al.* Screening techniques and sources of resistance against parasitic weeds in grain legumes. *Euphytica.* 2006; 147:187-199.
- Scherm H, Christiano RSC, Esker PD, Del Ponte EM, Godoy CV. Quantitative review of fungicide efficacy trials for managing soybean rust in Brazil. *Crop Prot.* 2009; 28:774-782.
- Sillero JC, Fondevilla S, Davidson J, Vaz Patto MC, Warkentin TD, Thomas J *et al.* Screening techniques and sources of resistance to rusts and mildews in grain legumes. *Euphytica.* 2006; 147:255-272.
- Singh NP. Project Co-coordinator Report. All India Coordinated Research Project, Kanpur-208024, 2010-11.
- Sugha SK, Banyal DK, Rana SK. Management of pea (*Pisum sativum*) rust (*Uromyces fabae*) with fungicides. *Indian J Agr. Sci.* 2008; 78:269-271.
- Sunilkumar Shirasangi, Basavarajappa MP, Nargund VB. *In vivo* Evaluation of Fungicides against Chickpea Rust Caused by [*Uromyces ciceris-arietini* (Grognot) Jacz. and Boy], *Environment & Ecology.* 2017; 35(4E):3809-3812.