Occurrence and Distribution of Chickpea Rust (*Uromyces ciceris-arietini*) in Major Chickpea growing Regions of Andhra Pradesh.

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ABSTRACT

Chickpea rust, caused by the fungal pathogen *Uromyces ciceris-arietini*, poses a significant threat to chickpea cultivation. The present study was aimed to assess the prevalence and distribution of chickpea rust in five major chickpea growing districts of Andhra Pradesh, India, during the *rabi* season of 2022-23. A roving survey was conducted across forty-nine villages covering fifteen mandals. The results revealed varying levels of per cent disease incidence and per cent disease index of chickpea rust was recorded across the districts. Among the five districts surveyed, the highest mean disease incidence was observed in Prakasam (31.48 %) followed by Kurnool (14.51%), Anantapuramu (12.06 %), Bapatla (6.78%) and Nandyal (3.94%) district. The disease severity in terms of per cent disease index (PDI) was calculated using disease grades collected for individual plants in the surveyed fields, the maximum mean PDI was recorded in Prakasam (45.09%), followed by Anantapuramu (24.57%), Kurnool (23.56%), Bapatla (12.53%) and Nandyal (8.02%) district. In Andhra Pradesh, the mean disease incidence of chickpea rust ranged from 0 to 55.90% and the disease severity (PDI) ranged from 0 to 91.2%. The study provides valuable insights into the distribution and severity of chickpea rust, highlighting the areas that require immediate attention for disease management and prevention.

Key words: *Chickpea, Per cent disease severity, Rust and Uromyces ciceris-arietini*

Chickpea (*Cicer arietinum*) is one of the most important pulse crops cultivated worldwide, providing a significant source of dietary protein, essential minerals and vitamins. It is the third-largest food legume crop in the world, producing 63.70 Mt of output annually over an area of 13.1 Mha (Merga and Haji, 2019). India ranks first in area and production with 9.69 million hectares, 13.12 million tonnes and with a productivity of 1142 kg ha^{-1} (Indiastat, 2020-2021). In Andhra Pradesh, it covers an area of 0.459 million hectares and produces 0.559 million tonnes annually with a productivity of 1218 kg ha^{-1} during 2019-2020. (ICAR-AICRP on Chickpea PC report, 2020-21).

However, the cultivation of this vital legume is threatened by various diseases caused by fungal pathogens. Among these pathogens, *Uromyces ciceris-arietini* has emerged as a prominent threat to chickpea *Uromyces ciceris-arietini,* commonly known as chickpea rust, is a biotrophic fungal pathogen belonging to the family *Pucciniacea*. It specifically targets chickpea plants and causes

devastating yield losses in regions where the crop is cultivated extensively. This fungal pathogen has the potential to decimate entire chickpea fields if not properly managed. Its dissemination is primarily facilitated by the movement of infected seeds, wind-borne spores, and contaminated farming equipment. Once introduced into a new area, the pathogen establishes itself and spreads rapidly, leading to significant economic losses for farmers.

Rust appears in early February as small, round to oval, light or dark brown raised pustules formed on the under surface of the leaves. Later stage pustules turn black. Afterwards, these pustules appear on the upper surface of leaves, petioles and pods. The affected leaves prematurely fall, and therefore the yield was considerably reduced (Suganyadevi *et al.*, 2020). Chickpea rust was reported previously from northern states of India *viz.,* New Delhi, Western Maharashtra and South Gujarat (Asthana, 1957; Saksena and Prasada, 1955; Deshmukh *et al.,* 2010; Deshmukh *et al.,* 2018 and Verma and Singh 2019) and in Southern states of India, Chickpea rust was

reported from Karnataka and Chhattisgarh only. (Hiremath *et al.,* 1987; Nargund *et al.,* 2011; Khedekar, 2012 and Sunil Kumar 2015)

In Andhra Pradesh, disease has been appearing at different locations in major growing areas since 2019 and no systematic work was done till now to know the occurrence and distribution of the chickpea rust in different districts of Andhra Pradesh. Hence the present study was taken up with an objective to know the disease status of chickpea rust in major chickpea growing districts of Andhra Pradesh.

MATERIAL AND METHODS

A roving field survey was conducted in five districts (Kurnool, Nandyal, Anantapur, Prakasam and Bapatla) of Andhra Pradesh during *rabi* 2022–23 to determine the incidence and distribution of chickpea rust. In each district, three mandals were surveyed randomly and three villages were selected for each mandal except in Giddalur mandal in Prakasam district, where seven villages were surveyed.

In each village, five chickpea fields were selected randomly on both sides of the road. In each field, ten chickpea plants were randomly selected at five spots each and the disease severity was recorded using 0-9 scale developed by Mayee and Datar (1986). Further, these scales were converted to Per cent Disease Index (PDI) using the formula given by Wheeler (1969).

Disease scale for the chickpea rust (Mayee and Datar, 1986)

Grade	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% of leaf area
7	Uredosori covering 26-50% of leaf area
9	Uredosori covering 51% or more of leaf area.

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

RESULTS AND DISCUSSION

Chickpea rust is a foliar disease that occurs occasionally and appears late in the crop growing season. As a result, the disease often has less impact on the yield component. However, an early infection can significantly reduce production in chickpea. Surveying the rust disease over time reveals how severely it impacts production and quality, in addition to revealing the presence of different races in various agroclimatic zones. Therefore, an effort was made to know the occurrence and distribution of chickpea rust in major chickpea-growing regions of Andhra Pradesh. The present survey results revealed that an irregular incidence of chickpea rust in 15 mandals of five districts of Andhra Pradesh during *rabi* 2022. The disease incidence was not uniform across the fields that were surveyed. The data collected during the field survey was presented in Table 1 and the collection sites are represented in Fig 1.
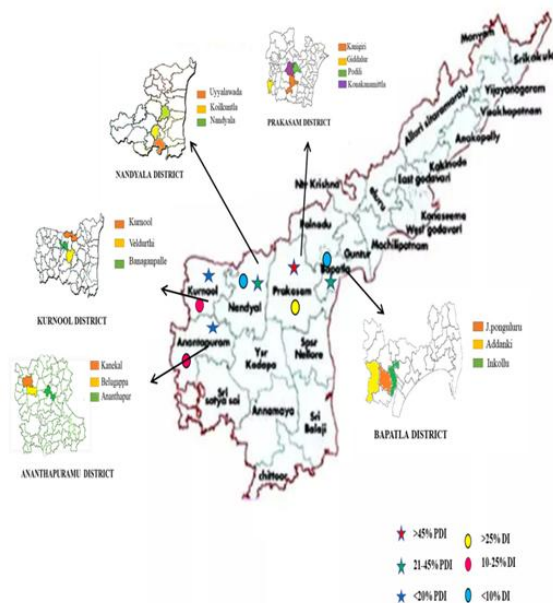

Fig.1. Andhra Pradesh map showing data collection sites during survey.

Among the five districts surveyed, the highest mean disease incidence was observed in Prakasam (31.48%) followed by Kurnool (14.51%), Ananthapuramu (12.06 %), Bapatla (6.78%) and Nandyal (3.94%) (Fig.3). Similarly, the disease severity in terms of per cent disease index (PDI) was calculated using disease grades collected for individual plants in the surveyed fields, the maximum mean PDI was recorded in Prakasam (50.83%), followed by Ananthapuramu (24.57%), Kurnool (23.56%), Bapatla (12.53%) and Nandyal (8.02%) (Fig.4).

The mandal wise disease incidence and per cent disease index were graphically represented in Fig.5. Though, the mean disease incidence was low in Kurnool (14.51%), Ananthapuramu (12.06%) and Bapatla (6.79%) districts compared to Prakasam district (31.48 %), the disease range is approximately same with that district. The disease incidence in Kurnool district ranged from 0 to 48.66% whereas in Ananthapuramu it ranged from 0 to 46.7%. However, the disease incidence of chickpea rust in Prakasam district was ranged from 0 to 55.90%. In Bapatla district it was 0 to 43.60%. But in Nandyal district the disease was found in only one location *i.e.,* RARS, experimental fields of Nandyal. This was due to late sowing of experimental fields *i.e.,* second week of December, 2022.

The highest disease severity (PDI) was recorded in Budigumma village (91.2%) of Ananthapuramu district and the lowest PDI (0 %) was observed in various locations (30 villages) (Table 1). Similarly, the per cent disease index of chickpea rust in Kurnool district was ranged from 0 to 81.74%. In case of Anantapur the disease index was 0 to 91.2%. Where as in Prakasam it was ranged from 0 to 75.50%. The disease index in Bapatla district was 0 to 60.40%. The rust severity ranged from 0 to 72.84% in northern Karnataka during *rabi*, 2014-15 (Sunil Kumar, 2015).

Delayed sowings under irrigated conditions and unseasonal rainfall in the month of December and crops grown surrounding areas such as maize, sorghum, cotton and sugarcane which were responsible for creation of microclimate favourable to rust (Sunil Kumar, 2015). In addition to this, favourable minimum temperature and relative humidity are the essential factors along with other weather parametersare the main reason for uredospore germination and spread of the pathogen happens.

During field survey, it was observed that most of the farmers were cultivating JG-11 chickpea variety and other growing varieties were JAKI 9218, KAK2 and NBeG-452. The major farming situation was rainfed black soils in Andhra Pradesh. The major weeds that are found during field survey are *Abutilon theophrasti* and *Chrozophora tinctoria.* During the survey it was also observed that severely rust infected plants produced very few pods compared to healthy plants. The mean loss of chickpea yield of 0.38g/plant was observed with 10 % increase in disease intensity (Dalela, 1962).

Morphology of the pathogen

The microscopic examination of freshly collected disease samples indicated the presence of uredospores and teliospores. These uredospores are echinulate, cinnamon-brown in colour with 3-5 scattered germ pores that are covered by a hyaline cap and the teliospores are dark brown in colour and have a verrucose surface with a single apical pore and a hyaline pedicel. The microscopic images of uredospores and Teliospores were given in Fig.6. The mean size of uredospores observed across the location was 20.64-30.3 µm X 20.55-29.75µm. Similarly, the mean size of the teliospore was 20.49-30.40µm X 21.56-30.43 µm. It was found that there is no difference in size of uredospores and teliospores that are collected from different locations in Andhra Pradesh. The uredospores was globose, subglobose, ellipsoid to obovoid, and dark brown in colour and measured approximately 23-31X20-23 mm and teliospores were dark brown in colour which are globose, subglobose, ellipsoid to obovoid and measured about 19-23X17-22 mm (Stuteville *et al.,* 2010).

Thus the study highlighted the importance of roving survey to know the distribution and severity of chickpea rust in A.P. chickpea growing regions and also the microscopic examination of urediospores teliospores for conformation of the pathogen.

LITERATURE CITED

Asthana R D 1957. Some observations on the incidence of *Uromyces ciceris-arietini* (Grognon) Jakz. and Boyer on *Cicer arietinum* L. *Nagpur Agricultural College Magazine.* 31: 1-4.

Fig.2.Rust pustules arranged in a circular manner both on upper surface of leaf (a) and lower surface of leaf(b), small irregular pustules on upper leaf surface (c) and rust pustule on branch of the chickpea plant (d)
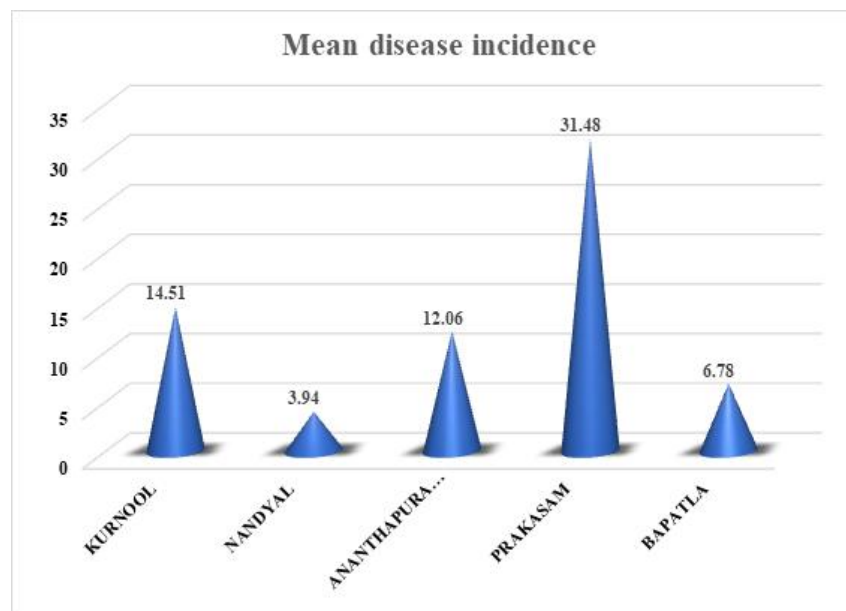

Fig.3 District wise mean disease incidence of chickpea rust in Andhra Pradesh
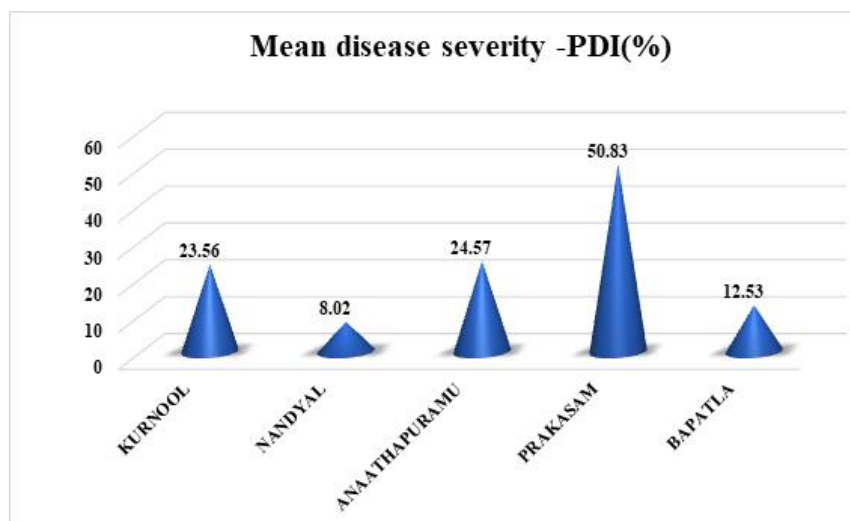

Fig.4 District wise mean disease severity of chickpea rust in Andhra Pradesh
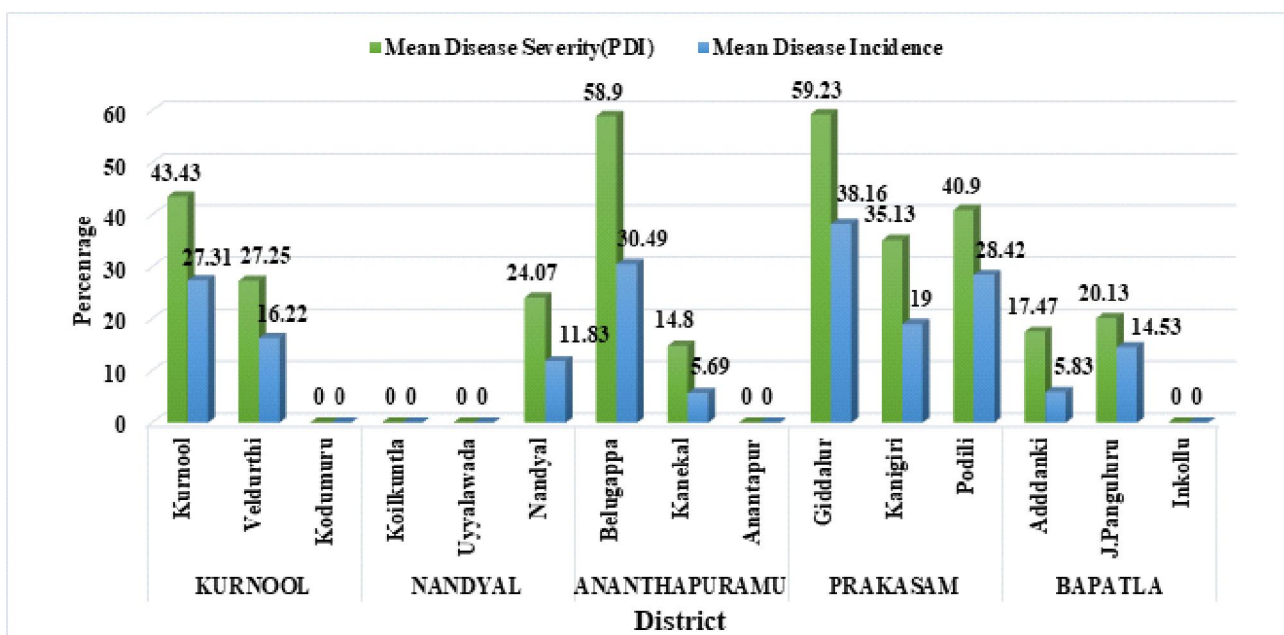
Fig.5. Mandal wise disease incidence and severity of chickpea rust in five districts of Andhra Pradesh.

(a)

(b)
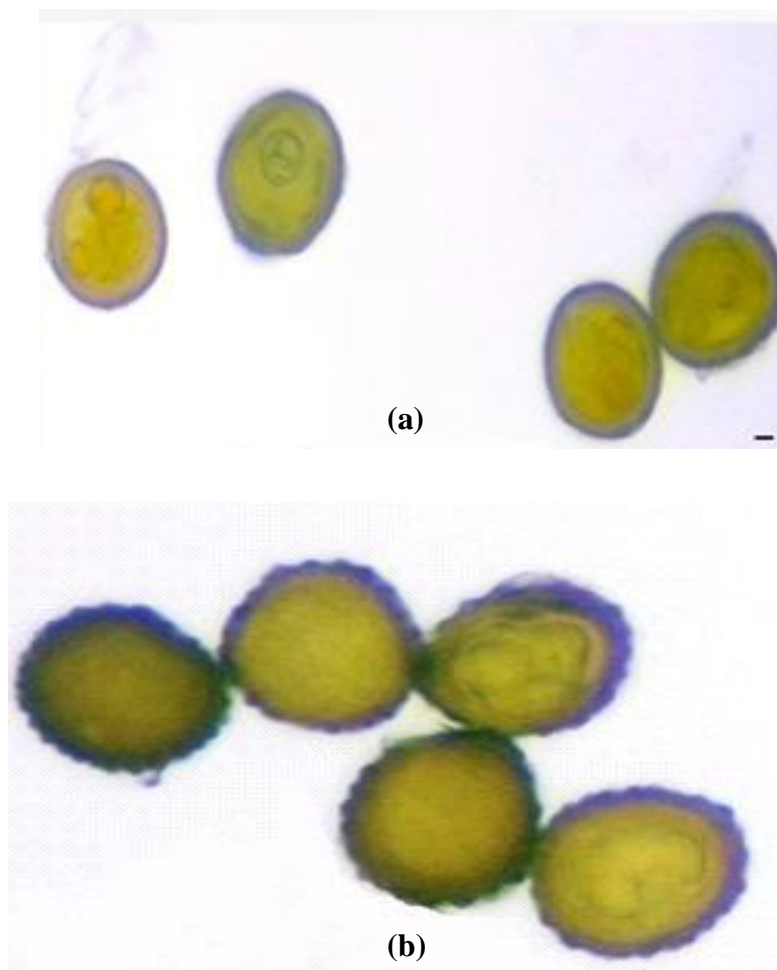
Fig.6 Microscpoic observation of uredospore (a) and teliospore(b) of U*romyces ciceris-arietini*

Table 1. The details of Incidence and severity of chickpea rust in major chickpea growing areas of Andhra Pradesh during *rabi*, 2022-23.

S. No	District	Mandal	Village	Longitude	Latitude	Date Of Visit	Variety	Stage Of the Crop	Farming Situation	Disease Incidence (%)	PDI (%)
1	K U R N O O L	Kurnool	Gargeyapuram	15.77803	78.1454	24.01.23	JG-11	PFS	Rainfed	35.9	55.7
2			Nandenpalli	15.7909	78.092	24.01.23	JG-11	HS	Rainfed	46.03	74.6
3			Pasupula	15.77343	78.0675	25.01.23	JG-11	HS	Rainfed	0	0
			Mandal mean							27.31	43.43
4		Veldurthi	Mallepalle	14.36339	78.1063	25.01.23	NBeG-452	HS	Rainfed	48.66	81.74
5			Bommireddipalli	14.04388	78.1745	25.01.23	JG-11	HS	Rainfed	0	0
6			Cherukulapadu	15.54444	77.8957	25.01.23	JG-11	HS	Rainfed	0	0
			Mandal mean							16.22	27.25
7		Kodumur	Kodumur	15.67669	77.7808	26.01.23	JG-11	HS	Rainfed	0	0
8			Pulakurthy	15.74478	77.7096	26.01.23	JG-11	HS	Rainfed	0	0
9			Anugonda	15.66856	77.9016	26.01.23	JG-11	HS	Rainfed	0	0
			Mandal mean							0	0
									District Mean	14.51	23.56
									Range	0 to 48.66	0 to 81.74

	Mandal	Village	Latitude	Longitude	Date	Variety	HS/PS			
10	Koilkuntla	Koilkuntla	15.23792	78.3054	28.01.23	JG-11	HS	Rainfed	0	0
11		Kalugotla	15.27113	78.3446	28.01.23	JG-11	HS	Rainfed	0	0
12		Kampamalla	15.20744	78.3726	28.01.23	JG-11	HS	Rainfed	0	0
					Mandal mean				**0**	**0**
13	Uyyalawada	Kondupalle	15.11782	78.4635	28.01.23	JG-11	HS	Rainfed	0	0
14		Bodemmanur	15.06829	78.4074	28.01.23	JG-11	HS	Rainfed	0	0
15		Govindapalle	15.06086	78.36	28.01.23	JG-11	HS	Rainfed	0	0
					Mandal mean				**0**	**0**
16	Nandyal	Ayyalur	15.46109	78.5115	29.01.23	JG-11	HS	Rainfed	0	0
17		Billalapuram	15.48781	78.5168	29.01.23	JG-11	HS	Rainfed	0	0
18		RARS	15.46478	78.4777	26.02.23	JG-11	PS	Rainfed	35.5	72.2
					Mandal mean				**11.83**	**24.07**
					District mean				**3.94**	**8.02**
					Range				**0-33.50**	**0-72.20**

(District label along rows 10–18: NANDYAL)

S.No	District	Mandal	Village	Latitude	Longitude	Date	Variety				
19	ANANTAPURAMU	Beluguppa	Budigumma	14.73375	77.2793	16.02.23	JG-11	HS	Rainfed	44.76	91.2
20			Duddekunta	14.83275	77.2956	16.02.23	JG-11	HS	Rainfed	46.7	85.5
21			Gundlapalli N.	14.70557	77.0544	16.02.23	JG-11	HS	Rainfed	0	0
			Mandal mean							30.49	58.9
22		Kanekal	Sollapuram	14.81669	77.1562	16.02.23	JG-11	HS	Rainfed	17.08	44.4
23			Malyam	14.80042	77.1083	16.02.23	JG-11	HS	Rainfed	0	0
24			Kanekal	14.82029	77.0455	16.02.23	JG-11	HS	Rainfed	0	0
			Mandal mean							5.69	14.8
25		Anantapur	Chinnampalli	14.68624	77.4971	16.02.23	JG-11	HS	Rainfed	0	0
26			Ankampalli	14.69008	77.5441	17.02.23	JG-11	HS	Rainfed	0	0
27			Chiyyedu	14.60122	77.6866	17.02.23	JG-11	HS	Rainfed	0	0
			Mandal mean							0	0
			District Mean							12.06	24.57
			Range							0 to 46.7	0 to 91.2

No	District	Mandal	Village	Latitude	Longitude	Date	Variety	Category	Status	Value1	Value2
28	P		Thallapalle	15.32054	78.898	04.02.23	JG-11	NHS	Rainfed	28.5	55.4
29	R		Podalakuntapalli	15.35604	78.9667	02.03.23	JG-11	NHS	Rainfed	42.8	67.7
30	A	Giddalur	Dodempalli	15.30323	78.8899	02.03.23	JG-11	NHS	Rainfed	26.5	54
31	K		Rangareddypalli	16.93602	77.7797	02.03.23	JG-11	NHS	Rainfed	40.8	55.4
32	A		Yadavalli	15.25533	77.4527	28.02.23	JG-11	NHS	Rainfed	34.73	60.14
33	S		Ambavaram	14.07519	78.7736	28.02.23	JG-11	NHS	Rainfed	37.8	59.8
34	A		Narayanapuramu	18.63548	85.5448	28.02.23	JG-11	NHS	Rainfed	55.9	62.2
	M					Mandal mean				38.15	59.23
35			Machavaram	18.01797	78.2388	29.02.23	JG-11	FS	Rainfed	27.3	52.4
36		Kanigiri	Yeruvaripalli	15.36488	79.4887	29.02.23	JG-11	VS	Rainfed	29.7	53
37			Gangavaram	15.53245	79.915	29.02.23	JG-11	VS	Rainfed	0	0
						Mandal mean				19	35.13
38			Podili	15.60716	79.6153	02.03.23	JG-11	NHS	Rainfed	43.45	75.5
39		Podili	Mallavaram	15.63656	79.6252	02.03.23	JG-11	NHS	Rainfed	41.8	65.3
40			Kostalapalli	15.63929	79.6372	02.03.23	JG-11	NHS	Rainfed	0	0
									Mandal Mean	28.41	40.9
									District mean	31.48	50.83
									Range	0-55.90	0-75.50
41			Korisipadu	15.75799	80.0343	28.03.23	JG-11	NHS	Rainfed	17.5	52.4
42	B	Addanki	Kalavakuru	15.86266	79.9821	28.03.23	JG-11	NHS	Rainfed	0	0
43	A		Chinnakothapalle	15.90691	79.9595	28.03.23	JG-11	NHS	Rainfed	0	0
	P					Mandal Mean				5.83	17.47
44	A	Janakapuram	Chandaluru	15.78573	80.1387	29.03.23	JG-11	NHS	Rainfed	43.6	60.4
45	T	ram	ThurpuKopperapadu	15.78077	80.0976	29.03.23	JG-11	PFS	Rainfed	0	0
46	L	Panguluru	Jagarlamudivaripalle	15.82342	80.0465	29.03.23	JG-11	PFS	Rainfed	0	0
	A								Mandal Mean	14.53	20.13
47		Inkollu	Inkollu	15.82645	80.1978	29.03.23	KAK2	NHS	Rainfed	0	0
48			Gangavaram	15.81557	80.1705	29.03.23	KAK2	NHS	Rainfed	0	0
49			Koniki	15.7887	80.1733	29.03.23	KAK2	NHS	Rainfed	0	0
									Mandal Mean	0	0
									District Mean	6.78	12.53
									Range	0 to 43.60	0 to 60.40

Dalela G G 1962. A technique for estimating crop loss in the rust [*Uromyces ciceris-arietini* (Grogn.) Jacz.] of gram (*Cicer arietinum* L.). Agra Univ. J. Res. (Sci.) 11:117-121.

Deshmukh A J, Singh P, Prajapati V P and Patel B 2018. First report of occurrence of rust in South Gujarat, India. *International Journal of Economic Plants.* 5 (2): 93-95.

Deshmukh G P, Pawar K B and Harer P N 2010. Occurrence of rust on chickpea in Western Maharashtra. *Journal of Maharashtra Agricultural Universities.* 35 (3): 485-486.

Hiremath P C, Reddy B M R, Deshpande V P and Hegde R K 1987. Occurrence of rust epidemic on Bengalgram in Karnataka. *Current Research*, University of Agricultural Sciences, Bangalore. 16 (12): 171-172.

Indiastat 2020-2021. https://www.indiastatagri.com/data/agriculture/gram-or-bengal-gram-chickpea.

Khedekar S A 2012. *Studies on soybean rust (Phakopsora pachyrhizi syd.) and chickpea rust [Uromyces ciceris-arietini (Grognot) Jacz. and Boy.*] (Doctoral dissertation, PhD thesis, Department of Plant Pathology, University of Agricultural Sciences, Dharwad, India).

Mayee C D and Datar V V 1986. *Phytopathometry, Technical Buletien-1* (Special Buletein3), Marathwada Agricultural University, Parbhani, India. 218

Merga B and Haji J 2019. Economic importance of chickpea: Production, value, and world trade. *Cogent Food and Agriculture.* 5 (1): 1615718.

Nargund V B, Benagi V I, Salimath P M, Rao M S L, Nagaraju P and Basavarajappa M P 2011. Effect of climate change in relation to severity of chickpea rust in northern Karnataka. *National Symposium on Integrated Disease Management Strategies in Relation to Climate Change in South India.*

Saksena H K and Prasada R 1955. Studies on gram rust, *Uromyces ciceris-arietini (Grogn.) Jacz. Indian Phytopathology.* 8 (2): 94-98.

Stuteville D L, Graves W L, Dixon L J, Castlebury L A and Minnis A M 2010. *Uromyces ciceris-arietini*, the cause of chickpea rust: new hosts in the Trifolieae, Fabaceae. Plant disease. 94 (3): 293-297.

Suganyadevi M, Pandiyan M, Sasmitha R, Sivaji M, Tilagavathi T and Yuvaraj M 2020. Diseases of Chickpea (Cicer arietinum) and its Management. *Biotica Research Today*, *2*(5), pp.129-131.

Sunil Kumar S 2015. Studies on chickpea rust (*Uromyces ciceris-arietini* (Grognot) Jacz. and Boy). *M. Sc.(Ag.) Thesis.* University of Agricultural Sciences, Dharwad, India.

Verma K P and Singh H K 2019. First report of chickpea rust from Chhattisgarh. *Journal of Mycopathological Research.* 57 (2): 125-126.

Wheeler B E J 1969. *An Introduction to Plant Diseases.* John Wiley publication, London. 301.