Viral disease outbreak and diagnosis in chickpea 
(Cicer arietinum L.) under Tamil Nadu: A new report

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DOI: https://doi.org/10.22271/chemi.2020.v8.i3t.9400

Abstract
Chickpea (Cicer arietinum L.) is an important legume crop in the world. In global wide, it was cultivated during rabi season (Nov-Feb). Under India, it was cultivated during cool winter season mostly depending upon rainfall and dew distribution. In Tamil Nadu, mostly north – western districts are considered as chickpea belt. Regularly crop period, wilt or root rot diseases are highly prevalent and drastically reduced yield. Since, Rabi (2017-18) a new disease was occurred and reported that causing yield loss (40-60%) from vegetative to podding stage by failure of seed formation on mostly in Coimbatore and Tirupur 
districts. Under extensive survey, a viral outbreak of incidence occurred due to chlorotic stunt disease, maximum recorded in Poolankinar (28.6%) on cv. CO 4 and the least incidence has been recorded in Kuppuchipalayam (12.9%) on cv. JAKI-9218 at age of 65 days old crop. Based on symptomatic diagnosis viz., chlorosis, reddening of leaf petioles, shortening internodes, bushy appearance was characterized initial stages and later failure attained in blooming and pod formation. This disease was the most prevalent in North India. Perusal of literature showed that the occurrence of this disease in Tamil Nadu seems to be new. Hence, this may be a new report based on the visual diagnosis.

Keywords: Chickpea, chlorotic stunt, leaf hopper, O. albicintus, yield loss

Introduction
Chickpea (Cicer arietinum L.) is one of the major cool winter pulse crop in global wide (Merga and Haji, 2019) [1]. It’s especially cultivated for their nutritional availability and easily digestible fibres for children’s diet (Wallace et al., 2016) [2]. Under worldwide, chickpea was cultivated in arid and semi-arid regions on (Rabi) rainfed conditions during November onwards (Thaware et al., 2015) [3]. In globally, India accounts for 75% of world’s chickpea production on 13.98 million ha area with production 137.3 lakh tonnes and productivity 982 kg/ha which represents 40 to 68.0% and 48.1% of the national pulse acreage and production (Kumari and Khanna, 2018) [4]. In Tamil Nadu, chickpea was cultivated in an area of 6820 hectares with a production of 4177 tonnes and a productivity of 645 Kg / ha. There are four major districts where cultivated in Tamil Nadu viz., Tirupur (2441 ha), Dharmapuri (2110 ha), Coimbatore (892 ha) and Dindigul (537 ha) with two types of chickpeas were cultivated viz., desi and kabuli (Murali Sankar et al., 2018) [5]. In past triennial periods, chickpea cultivation and production has been drastically reduced due to several factors like biotic (pest and diseases) and abiotic factors viz., insufficient rainfall, relative humidity, rapid increasing of atmospheric temperature, changes in soil nutritional status and unavailability of climatic-optimal cultivars (Liberato et al., 2018) [6]. Especially, the pathogens and their causing diseases are most influenced the yield loss from seedling to harvesting stages through self-recapture ability and rapid changing of virulence nature (Jimenez-Diaz et al., 2015) [7]. Regularly, chickpea was noticed that more than thirty diseases by fungal, bacterial, viral and nematodes also (Nene et al., 1996) [8]. Especially, viral diseases are play as a major constraint in chickpea yield before flowering to pod setting stages (Abraham and Makkouk, 2002) [9]. Approximately, 14 virus species have been reported in cool legume crops (Kumari et al., 2004) [10].
Among the 14 species chlorotic stunt disease (CSD) is an important catastrophic endemic disease in India (Horn et al., 1995) [11] and causing severe yield loss on crop stages viz., before flowering (100%) and flowering to pod maturation (75-100%) (Reddy and Kumar, 2004) [12]. It was caused by chickpea chlorotic dwarf virus (CpCDV) (genus: Mastrevirus; family: Geminiviridae) and infects several plant families viz., Fabaceae, Cucurbitaceae and Solanaceae (Kanakala and Kuria, 2019) [13]. It has been transmitted through leafhopper O. albicinctus (Syria) and O. orientalis (India) (Makkouk et al., 2012; Zerbini et al., 2017) [14,15].

Generally, it occurred during ramification to flowering stage, it has been easily identified and diagnosed by their typical symptoms viz., chlorotic, yellowing, internode shortening, bushy appearances of leaves, leaves turning yellowish (Kabuli) while leaf reddening, phloem vessels were bruised in collar region (Desi) (Kraberger et al., 2015) [16]. The infected plants become stunted, non-flowering, if except go to podding – shrunked small and unmatured seeds are formed (Shahmohammadi et al., 2020) [17]. Keep these views, an extensive survey and diagnosis was carried out for prevalence of chlorotic stunt incidence and diagnosed under field conditions on chickpea growing areas of Tamil Nadu.

**Material and Methods**

**Survey and assessment of incidence**

An extensive survey was conducted in major chickpea growing areas in districts of Coimbatore and Tirupur districts in Tamil Nadu during Rabi, 2017-18. In each district major chickpea cultivated villages were selected for a view to assess the chlorotic stunt incidence. Three fields were selected and in each farmers field 0.1 ha area was selected at random. Total and infected plants were counted in all the selected areas and the wilt incidence was calculated by using the following formula described by Noo et al. (2016) [18],

\[
\text{Per cent disease incidence} = \frac{\text{Number of infected plants}}{\text{Total number of plants}} \times 100
\]

**Table 1:** The name of the villages surveyed along with districts surveyed one furnished below in the

| S. No. | Districts | Survey conducted villages | Geo-informatics | Varieties | Age of the crop (Days) | Per cent disease incidence (%) |
|-------|-----------|---------------------------|----------------|-----------|------------------------|--------------------------------|
| 1.    | Coimbatore| Idigurai                  | 11.11, 76.96   | CO 4      | 66                     | 23.2^d                         |
| 2.    |            | Athipalayam               | 11.12, 76.98   | CO 4      | 60                     | 28.2^b                         |
| 3.    |            | Periyakanakpalayam        | 11.14, 76.94   | CO 4      | 70                     | 22.7^e                         |
| 4.    |            | Kuppuchipalayam           | 11.02, 77.39   | CO 4 & JAKI - 9218 | 72 & 65                  |
| 5.    | Tirupur    | Poolankinar               | 10.59, 77.19   | CO 4      | 65                     | 70                             |
| 6.    |            | Kanakkampalayam           | 10.57, 77.22   | CO 4      | 70                     | 66                             |
| 7.    |            | R. Velur                  | 10.55, 77.19   | Local     | 58                     | 23.1^d                         |

**Diagnosis**

In field conditions, based on symptomatic descriptions by (Makkouk et al., 2003) [19] the infected plants were examined through growth transformations viz., plant height, changing of internodes growth, transformation of leaf petioles, colouration of leaves and collar pith portion and plant age also observed visually.

**Results and Discussion**

**Survey and assessment of incidence**

Under survey conducted in major chickpea growing areas of Tamil Nadu during Rabi, 2017-18; chlorotic stunt incidence was significantly observed in all chickpea growing areas at 12.9 to 28.6%, among them, the maximum incidence was recorded in Poolankinar (28.6%) on cv. CO 4 within age of 65 days of crop. The least incidence has been recorded in Kuppuchipalayam (12.9%) on cv. JAKI-9218 at age of 65 days old (Table 1, Figure 1). These results were coincided with a great outbreak of chlorotic stunt in major states viz., Andhra Pradesh, Maharashtra, Uttar Pradesh, Rajasthan in India during 2012 and 2015 in Tunisia noted by Kanakala et al. (2012) and Kumari et al. (2015) [20,21].

**Table 1:** Survey and occurrence of chlorotic stunt disease in major chickpea growing areas of Tamil Nadu during 2017-18.

| S. No. | Districts | Survey conducted villages | Varieties | Age of the crop (Days) | Per cent disease incidence (%) |
|-------|-----------|---------------------------|-----------|------------------------|--------------------------------|
| 1.    | Coimbatore| Idigurai                  | CO 4      | 66                     | 23.2^d                         |
| 2.    |            | Athipalayam               | CO 4      | 60                     | 28.2^b                         |
| 3.    |            | Periyakanakpalayam        | CO 4      | 70                     | 22.7^e                         |
| 4.    |            | Kuppuchipalayam           | CO 4      | 72                     | 24.3^e                         |
| 5.    | Tirupur    | Poolankinar               | CO 4      | 65                     | 12.9^f                         |
| 6.    |            | Kanakkampalayam           | CO 4      | 70                     | 24.6^e                         |
| 7.    |            | R. Velur                  | Local     | 58                     | 23.1^d                         |

SEd 0.99

CD (P=0.05) 0.441
Fig 1: Viral outbreak (Chlorotic stunt) in major chickpea growing areas of Tamil Nadu (2017-18)

Diagnosis
In field conditions, symptoms are in random conditions on whole field. The infected plants are chlorosis, yellowing, pointed numerous leaf petioles, shortening of internodes, leaf marginal reddening (Desi) and collar portion of plant also reddening and busy appearance was observed without flowering (Figure 2). These results were noted and similarly with descriptions of Abraham et al. (2006) and Horn et al. (1996) [22, 23].

Fig 2: Diagnosis of chlorotic stunt disease in chickpea (Cicer arietinum L.) under field conditions

References
1. Merga B, Haji J. Economic importance of chickpea: Production, value and world trade. Cogent Food. Agric. 2019; 5:1615718.
2. Wallace TC, Murray R, Zelman KM. The nutritional value and health benefits of chickpea and hummus. Nutrients. 2016; 8(12):766.
3. Thaware DS, Kohire OD, Gholve VM. Survey of chickpea wilt (Fusarium oxysporum f. sp. ciceris) disease in Marathwada region of Maharashtra state. Adv. Res J Crop Improv. 2015; 6(2):134-138.
4. Kumari S, Khanna V. Biological management of vascular wilt of chickpea (Cicer arietinum L.) incited by Fusarium oxysporum f. sp. ciceris by antagonistic rhizobacteria co-inoculated with native Mesorhizobium. International J Curr. Microbiol. Appl. Sci. 2018; 7(1):920-941.
5. Murali Sankar P, Vanitha S, Kamalakannan A, Anantha Raju P, Jeyakumar P. Prevalence of Fusarium oxysporum f. sp. ciceris causing wilt in chickpea and its pathogenic, cultural and morphological characterization. International J Curr. Microbiol. Appl. Sci. 2018; 7(2):1301-1313.
6. Liberato Amaral C, Bacarin Pavan G, Mastrotti Pereira FC, da Costa Aguiar Alves PL. Periods of weed interference in chickpea grown under different doses of nitrogen fertilizer. Acta Sci. Agron. 2018; 40:e35666.
7. Jimenez-Diaz RM, Castillo P, Jimenez-Gasco MM, Landa BB, Navas-Cortes J. Fusarium wilt of chickpeas: Biology, ecology and management. Crop Protec. 2015; 17:16-27.
8. Nene YL, Sheila VK, Sharma SB. A world list of chickpea and pigeon pea pathogens. (5th Eds.). ICRISAT, Patancheru, Andhra Pradesh, India, 1996.
9. Abraham A, Makkouk KM. The incidence and distribution of seed-transmitted viruses in pea and lentil seed lots in Ethiopia. Seed Sci. Technol. 2002; 30:567-574.
10. Kumari SG, Makkouk, KM, Attar N, Ghulam W, Lesemann DE. First report of chickpea chlorotic dwarf virus infecting spring chickpea in Syria. Plant Dis. 2004; 88:424.
11. Horn NM, Reddy SV, Reddy DVR. Assessment of yield losses caused by chickpea chlorotic dwarf geminivirus in chickpea (Cicer arietinum L.) in India. European J Plant Pathol. 1995; 101:221-224.
12. Reddy SV, Kumar LP. Transmission and properties of a new luteovirus associated with chickpea stunt disease in India. Current Sci. 2004; 86:1157-1160.
13. Kanakala S, Kuria P. Chickpea chlorotic dwarf virus: an emerging monopartite dicot infecting mastrevirus. Viruses. 2019; 11:5.
14. Makkouk K, Pappu H, Kumari SG. Virus diseases of peas, beans and faba bean in the Mediterranean region. Adv. Virus Res. 2012; 84:367-402.
15. Zerbini FM, Briddon RW, Idris A, Martin DP, Moriones E, Navas-Castillo J et al. ICTV virus taxonomy profile: Geminiviridae. J Gen. Virol. 2017; 98:131-133.
16. Kraberger S, Kumari SG, Hameed AA. Molecular diversity of chickpea chlorotic dwarf virus in Sudan: high rates of intra-species recombination – a driving force in the emergence of new strains. Infection, Genet. Eval. 2015; 29:203-15.
17. Shahmohammadi N, Dizadji A, Bihmta MR, Kvarnheden A. Diversity and occurrence of chickpea chlorotic dwarf virus on legumes from Iran. Plant Pathol. 2020; 69:139-148.
18. Noo S, Tabassom G, Tara Y, Nader A, Kaveh B. An overview of viral disease on chickpea and impact on chickpea production in Iran. International J Curr. Res Acad. Rev. 2016; 4(4):98-109.
19. Makkouk KM, Kumari SG, Shahraeen N, Fazlali Y, Farzadfar S, Ghotbi T. Identification and seasonal variation of viral diseases of chickpea and lentil in Iran. J Plant Dis. Protec. 2003; 110:157-169.
20. Kanakala S, Sakhare A, Verma HN, Malathi VG. Infectivity and the phylogenetic relationship of a mastrevirus causing chickpea stunt disease in India. European J Plant Pathol. 2012; 135:429-438.
21. Kumari SG, Najar A, Timouni S, Male MF, Kraberger S, Varsani A. First report of chickpea chlorotic dwarf virus naturally infecting chickpea in Tunisia. New Disease Reports. 2015; 32:16.
22. Abraham AD, Menzel W, Lesemann DE, Varrelmann M, Vetten HJ. Chickpea chlorotic stunt virus: A new polerovirus infecting cool-season food legumes in Ethiopia. Phytopathol. 2006; 96(5):437-446.
23. Horn NM, Reddy SV, van del Huvel JFJM, Reddy DVR. Survey of chickpea (Cicer arietinum L.) for chickpea stunt disease and associated viruses in India and Pakistan. Plant Dis. 1996; 80:286-290.