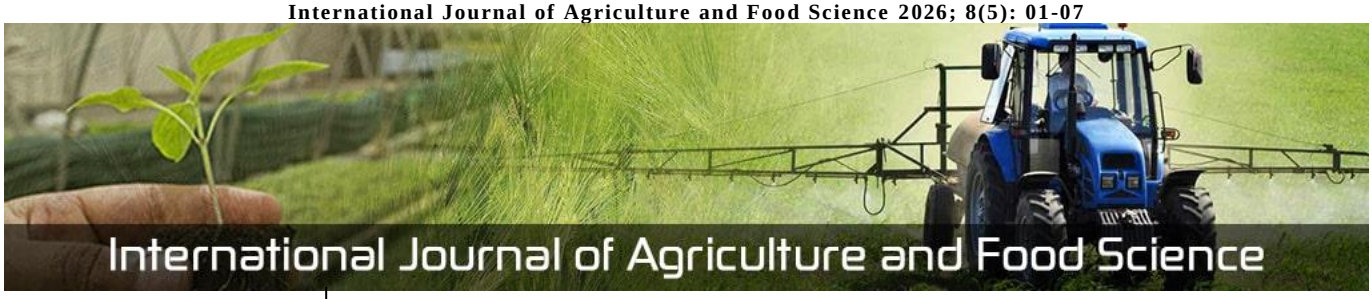

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Prevalence of *Fusarium* spp. causing wilt in chickpea and its cultural and morphological characterization

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Abstract
Chickpea (*Cicer arietinum* L.) is a major pulse crop in India, valued for its high nutritional content, but it is severely affected by wilt disease caused by *Fusarium* spp. The present study was conducted to assess the incidence, isolation, pathogenicity and variability of the wilt pathogen in major chickpea-growing areas of Junagadh district, Gujarat, during *Rabi* 2023-24 and 2024-25. A roving survey covering six talukas revealed that wilt disease was prevalent in all surveyed locations, with mean disease incidence ranging from 16.45 to 22.09 per cent. The highest incidence was recorded in Mendarda (22.09%), followed by Bhesan (20.45%), while the lowest was observed in Junagadh (16.45%). At the village level, disease incidence varied widely, ranging from 4.35 to 37.08 per cent, indicating significant spatial variability.A total fourteen isolates of *Fusarium* spp. were obtained from infected plants and evaluated for pathogenicity on susceptible chickpea cultivar JG-62. All isolates were pathogenic, exhibiting disease incidence between 50.00 and 100.00 per cent. Among them, isolates FOC-4 and FOC-11 were highly virulent, causing 100 per cent wilt incidence, whereas FOC-8 and FOC-13 showed comparatively lower virulence (50.00%). Considerable variability was observed among isolates in terms of cultural and morphological characteristics. Colony diameter ranged from 80.07 to 87.87 mm, with FOC-8 showing maximum growth. Differences were also recorded in colony colour, texture, margin and sporulation. Morphologically, microconidia were hyaline, oval to elliptical and mostly unicellular, while macroconidia were hyaline, falcate and multi-septate. Chlamydospore formation varied among isolates, indicating heterogeneity within the pathogen population.

Keywords: Chickpea, *Fusarium* wilt, survey, cultural variability, morphological variability

Introduction
Chickpea (*Cicer arietinum* L.) is the world's third most important pulse grown in tropical, subtropical and temperate regions of the world. In addition to source of protein chickpea has carbohydrate 38-59 per cent, fiber 3 per cent, oil 4.8-5.5 per cent, ash 3 per cent, calcium 0.2 per cent and phosphorus 0.3 per cent. Its protein and carbohydrate digestibility varies from 76 to 78 per cent and from 57 to 60 per cent (Hulse, 1991; Huisman and Vanderpoel, 1994) [7, 8]. Chickpea has several potential health benefits and in combination with other pulses and cereals, it could have beneficial effects on some of the important human diseases such as CVD, type 2 diabetes, digestive diseases and some cancers (Jukanti *et al.*, 2012) [9].
India occupies a prominent position in global chickpea cultivation and is recognized as the largest producer of chickpea, contributing about two-thirds to seventy per cent of the world production. Australia ranks second, followed by countries such as Pakistan, Turkey, Myanmar and Ethiopia. During 2024-25, chickpea production in India was 11.11 million tonnes from an area of 10.91 million hectares with an average productivity of 1018 kg/ha. The major chickpea-producing states of the country are Madhya Pradesh, Maharashtra, Rajasthan, Gujarat and Uttar Pradesh, which together contribute substantially to national chickpea production (Anon., 2025; Anon., 2022a) [3, 2]. In Gujarat, during 2020-21 chickpea grown in 0.82 million hectares, producing 1.44 million tones with average productivity of 1761 kg/ha which was high as compared to national average productivity (Anon., 2022 b)[2].
Chickpea is prone to more than 50 pathogens. These include wilt (*Fusarium oxysporum* f. sp. *ciceri*), black root rot (*Fusarium solani*), wet root rot (*Rhizoctonia solani*), dry root rot (*Rhizactonia bataticola*), Aschochyta blight (*Aschochyta rabie*), damping-off (*Pythium* spp.) and collar rot (*Sclerotium rolfsii*) which are of considerable importance. Out of these diseases, *Fusarium* wilt is the most important disease of chickpea and is wide spread in

chickpea growing areas, where the crop growing season is dry and warm (Nene *et al.*, 1984) [12].

Wilt is a major limiting factor that causes the maximum yield loss in chickpea. Yield losses due to *Fusarium* wilt of chickpea have been observed as high as 60 per cent (Singh *et al.*, 2007) [17]. However, under congenial weather conditions the extent of loss may be up to 100 per cent (Kumari and Khanna, 2014) [10]. Therefore, farmers need real-time information to make effective management decisions. Survey of the disease can help scientists to validate the disease forecasting model and provides information about possible shifts in races, ultimately helping them in providing all the information required to farmers regarding chickpea wilt management. It is a routine practice for farmers to spray fungicides mandatory for wilt management after its initiation.

2. Materials and methods

2.1 Survey on farmer's field affected by wilt of chickpea

The roving survey on the incidence of chickpea wilt was conducted at major chickpea growing talukas of Junagadh district (Gujarat) during Rabi 2023 and 2024 at seedling or flowering or seed formation stage of the crop to record *Fusarium* wilt incidence and to collect disease samples. Purposively six talukas were selected and from each taluka four villages were selected randomly. Four fields were selected randomly in each village on the survey route. In each field, mark randomly for diseased and healthy plants were count in one square meter area in fields, four such spots will randomly selected and average incidence of disease was calculated. The per cent disease incidence (PDI) was calculated by using the formula given as below.

$$\text{PDI} = \frac{\text{Number of infected plants}}{\text{Total no. of plants observed}} \text{ x } 100$$

2.2 Isolation, purification and pathogenicity of pathogen causing wilt in chickpea

Collection of Disease Samples

Naturally infected chickpea plant showing typical symptoms of wilt disease *viz.*, when split open vertically from collar region downward, black discoloration of xylem vessels were collected from different locations of farmer's field as well as research farm. The samples were placed in brown paper bags, properly labeled with the respective sample details and transported to the laboratory, where they were stored in a refrigerator for further studies. The collected plant parts were carefully examined for disease symptoms, which were thoroughly documented for subsequent analysis.

Isolation and Purification

The survey involved collecting plant samples from farmers' fields and research farms which were then brought to the laboratory of Department of Plant Pathology, Junagadh Agricultural Universsity, Junagadh for pathogen isolation. Pathogen was isolated from the diseased roots/stem tissues of chickpea plants showing characteristics symptoms. Standard tissue isolation procedure was followed for isolation of the pathogens as given by Tuite (1969) [19].

Pathogenicity

All isolates were screened for their pathogenicity of chickpea wilt on susceptible cultivar JG-62 during Rabi season 2023-24 under net-house. The inoculum of each isolates of *Fusarium* spp. were prepared on half boiled sorghum media and incubated at 28±2 ºC for 10 days. These inoculums were used for soil inoculation at 40 g kg-1 soil in all the pots. For each isolate, set of three pots (15 cm width × 15 cm depth) were prepared. One set of pot constituting three pots to be filled with sterilized soil only. These pots were considered as uninoculated control. Three test tubes were inserted at equal distance and about 6 cm deep in each pot for supplementary inoculation.

Eight chickpea seeds of wilt susceptible cultivar JG-62 were sown in each pot. Germination of seeds was counted at eight DAS (day after sowing). Watering was also done as and when required. The plants were observed regularly for the appearance and development of disease symptoms. Secondary inoculation was done by adding inoculums prepared on potato dextrose broth. Liquid culture (30 ml/pot) along with piece of mycelial met (2×107 cfu/ml) inoculated in hole made by removal of test tubes so that inoculum was directly leached to the root zone.

Inoculation was done in all pots, except control. As the symptoms of disease appeared, the fungus was re-isolated from the roots of diseased plant and the re-isolated fungus was brought to pure culture, which was later compared with the original one for prove Koch's postulates.

2.3 Study of cultural and morphological variability of the wilt causing pathogen

Cultural and Morphological Variability

The present study aimed to evaluate the cultural variability of fourteen isolates of *Fusarium* spp. (Table 2) on Potato Dextrose Agar (PDA) medium. Twenty ml of PDA were aseptically poured into each sterilized Petri plate. A 5 mm disc from a seven-day old, actively growing culture of each isolate was inoculated at the center of the pre poured plates. The plates were incubated at 28±2 °C and the radial growth, colony characteristics, growth habit and sporulation of the isolates were evaluated after 10 days of incubation. The morphological characters of different isolates of *Fusarium* spp. including colony characters, pigmentation, growth habit and sporulation. The number of horizontal and vertical septa and size of conidia were measured from 10 days old culture under high power magnification.

3. Results and discussion

Survey on farmer's field affected by wilt of chickpea

A roving survey for the incidence of chickpea wilt was carried out at farmer's field comprising major chickpea growing regions of Gujarat during Rabi 2023-24 and 2024-25 in Junagadh, Vanthali, Mendarda, Bhesan, Malia and Mangrol talukas of Junagadh district. During the survey, the wilt disease was found prevalent in all the regions and percent disease incidence presented in Table 3.

Among the surveyed talukas, Mendarda recorded the highest mean disease incidence of 22.09 per cent, followed by Bhesan (20.45%), Malia (18.15%), Mangrol (17.39%), Vanthali (17.27%) and Junagadh (16.45%). The comparatively higher disease incidence in Mendarda taluka might be due to favourable soil moisture and temperature conditions that support the survival and multiplication of the wilt pathogen in the soil.

At the village level, considerable variation in disease incidence was observed. In Junagadh taluka, the highest incidence was recorded in Vijapur (20.21%) followed by

Vadal (19.05%), Sukhpur (16.30%), while the lowest incidence was observed in Chokli (10.23%).

The findings of the present investigation are in agreement with earlier reports of several workers who observed considerable variation in wilt incidence across different locations. Parmar and Gohel (2021) [13] also observed that chickpea wilt was widely distributed in major chickpea growing regions of Gujarat with disease incidence ranging from 1.80 to 52.55 per cent. Sankar *et al.* (2018) [16] reported wilt incidence ranging from 34.00 to 57.33 per cent in major chickpea growing districts of Tamil Nadu.

Isolation and Purification of the Pathogen

A total fourteen isolates of *Fusarium* spp. were obtained from wilt-infected chickpea plants collected from different villages of Junagadh district during the roving survey. The isolates were coded as FOC-1 to FOC -3 for Junagadh taluka (Vadal, Sukhpur and Chokli), FOC-4 to FOC-6 for Vanthali taluka (Mahobatpur, Luvarsar and Sonaradi), FOC-7 and FOC-8 for Mendarda taluka (Alidhra and Mendarda), FOC-9 and FOC-10 for Bhesan taluka (Kharchiya and Mendapara), FOC-11 and FOC-12 for Malia taluka (Patla and Vadiya) and FOC-13 and FOC-14 for Mangrol taluka (Virpur and Shapur) as presented in Table 2.

Pathogenicity Test

Pathogenicity test indicated that these isolates varied in the percentage of infection depicted in Table 4 and Figure 1. Fourteen isolates with inoculation rate i.e. 40 g/pot were screened against chickpea variety JG-62. The per cent disease incidence ranged from 50.00 to 100.00 per cent among the isolates. Two isolates, FOC-4 (Mahobatpur) and FOC-11 (Patla), exhibited the highly virulence causing 100.00 per cent disease incidence, as all the inoculated plants developed wilt symptoms. Two isolates, FOC-1 (Vadal) and FOC-3 (Chokli), also shown virulence and produced 87.50 per cent disease incidence indicating severe pathogenic potential.

Moderate levels of disease were recorded with several isolates including FOC-6 (Sonaradi), FOC-7 (Alidhra) and FOC-9 (Kharchiya), each causing 75.00 per cent disease incidence. Similarly, isolates FOC-5 (Luvarsar), FOC-2 (Sukhpur), FOC-10 (Mendapara), FOC-12 (Vadiya) and FOC-14 (Shapur) produced 62.50 per cent disease incidence, indicating moderate virulence.

The lowest disease incidence 50.00 per cent was observed with isolates FOC-8 (Mendarda) and FOC-13 (Virpur), where only four out of eight inoculated plants developed wilt symptoms, suggesting comparatively low virulence.

Golakiya *et al.* (2018) [6], Qureshi *et al.* (2021) [15], Venkataramanamma *et al.* (2021) [21] and Varala *et al.* (2023) [20] confirmed the pathogenicity of F. oxysporum f. sp. ciceri on susceptible chickpea plants by artificial inoculation and observed typical wilt symptoms such as drooping, yellowing, vascular discoloration, drying and collapse of plants.

Cultural Variability

Among all the isolates, FOC-8 (Sonaradi) recorded the maximum colony diameter of 87.87 mm, suggesting its comparatively faster mycelial growth. It was found statistically at par with FOC-10 (Alidhra) (87.69 mm), FOC-6 (Luvarsar) (87.34 mm), FOC-4 (Chokli) (87.02 mm), FOC-12 (Khadpipli) (86.67 mm) and FOC-14 (Hadmatiya) (86.48 mm). These isolates exhibited comparatively vigorous colony growth on the culture medium. Relatively moderate colony growth was observed in isolates FOC-3 (Vijapur) (85.97 mm), FOC-2 (Sukhpur) (85.86 mm), FOC-5 (Mahobatpur) (85.25 mm) and FOC-11 (Mendarda) (85.24 mm).

Considerable variation was also observed in colony colour and texture. Most isolates produced white mycelial growth, although the density, aerial growth and texture differed significantly. For instance, FOC-3 exhibited dense fluffy mycelium, while FOC-6 and FOC-12 produced white fluffy dense mycelium covering the entire plate surface. Isolate FOC-5 produced profuse aerial mycelium, indicating vigorous vegetative growth, whereas FOC-9 and FOC-11 shown moderately aerial mycelial growth. In contrast, FOC-7 produced dull white sparse mycelium, suggesting comparatively reduced aerial development. Similarly, FOC-13 produced creamy white sparse mycelial growth (Table 5).

A distinct morphological feature was observed in isolate FOC-4, which produced pale orange dense mycelium with sector growth, indicating possible variation in pigment production and colony morphology. Such variations among isolates suggest the presence of morphological diversity within the pathogen population.

Variation was also observed in colony margins. Several isolates such as FOC-3, FOC-5, FOC-6, FOC-8, FOC-10, FOC-12 and FOC-14 shown regular colony margins, forming uniform circular colonies. In contrast, isolates FOC-1, FOC-2, FOC-4, FOC-7, FOC-9, FOC-11 and FOC-13 exhibited irregular margins, indicating uneven radial growth patterns.

The isolates also differed markedly in their sporulation capacity. Very abundant sporulation (++++) was observed in isolates FOC-2, FOC-4, FOC-6, FOC-10, FOC-11, FOC-12 and FOC-14 suggesting a higher reproductive potential. Good sporulation (+++) was recorded in isolates FOC-1, FOC-3, FOC-5, FOC-8, FOC-9 and FOC-13, whereas comparatively lower sporulation (++) was observed in FOC-7.

Similar findings have been reported by Gawande *et al.* (2016) [5], variation among thirty seven isolates in colony growth pattern, colony colour, radial growth and pigmentation. The mycelial growth ranged from thin and flat to thick, profuse and fluffy aerial growth and the isolates were grouped as fast, medium and slow growers on the basis of radial growth. Patra and Biswas (2017) [14] also observed variability among eleven isolates in colony type, mycelial colour, sporulation and colony diameter, with colonies showing fluffy, compact, sparse and cottony growth patterns.

Morphological Variability

The microconidia were hyaline, oval to elliptical and mostly unicellular, ranging from 5.64 to 6.41 × 2.16 to 2.43 µm, with the largest observed in FOC-10 and the smallest in FOC-11 (Table 6.). The macroconidia were hyaline, curved to falcate and multiseptate, measuring 15.64 to 19.41 × 3.16 to 3.43 µm, with maximum size in FOC-10 and minimum in FOC-11. Chlamydospores were present in most isolates but were absent or rare in FOC-1, FOC-7, FOC-9 and FOC-13.

The present findings on morphological variability are in close conformity with earlier reports on *Fusarium* spp. associated with chickpea wilt. Awachar (2014) [4], Nath *et*

al. (2017) [11], Thaware *et al.* (2017)[18] and Venkataramanamma *et al.* (2021) [21] reported considerable variation among isolates of *Fusarium* oxysporum f. sp. ciceri with respect to shape, size and septation of microconidia and macroconidia as well as chlamydospore formation.

4. Conclusions

The present investigation conclusively revealed that chickpea wilt caused by *Fusarium* spp. is widely prevalent in the major chickpea-growing talukas of Junagadh district with disease incidence ranging from 4.35 to 37.08 per cent at village level and 16.45 to 22.09 per cent at taluka level, indicating its serious and widespread nature. The disease exhibited considerable variation across locations, suggesting the influence of environmental and soil factors on its development. The pathogen isolates showed marked cultural and morphological variability. Colony diameter ranged from 80.07 to 87.87 mm, and variation was observed in colony colour, texture, growth pattern, margin and sporulation. Similarly, differences in conidial size and shape, along with the presence or absence of chlamydospores, confirmed the heterogeneous nature of the pathogen population.

Table 1: Villages covered during the survey in Rabi season of two consecutive years 2023-24 and 2024-25

Sr. No.	Taluka	Village	Latitude-Longitude
1.	Junagadh	Vadal	21.607143-70.497696
2.		Sukhpur	21.385986-70.40542
3.		Vijapur	21.451538-70.43078
4.		Chokli	21.601366-70.523943
5.	Vanthali	Mahobatpur	21.415285-70.417984
6.		Luvarsar	21.462266-70.398745
7.		Selra	21.471275-70.428471
8.		Sonaradi	21.450884-70.434375
9.	Mendarda	Mithapur	21.385602-70.405699
10.		Alidhra	21.372222-70.426485
11.		Mendarda	21.352858-70.432794
12.		Khadpipli	21.404665-70.419567
13.	Bhesan	Kariya	21.569838-70.616576
14.		Hadmatiya Vishal	21.600739-70.591779
15.		Kharchiya	21.597483-70.617929
16.		Mendapara	21.591508-70.612301
17.	Malia	Patla	21.603496-70.569943
18.		Dudhala	21.584181-70.606273
19.		Galodar	21.142747-70.273003
20.		Vadiya	21.129773-70.341428
21.	Mangrol	Virpur	21.412454-70.63748
22.		Shapur	21.105515-70.137291
23.		Bhatgam	21.375410-70.745692
24.		Vadla	21.597351-70.506542

Table 2: List of *Fusarium* spp. isolates collected from different talukas and villages

Sr. No.	Isolate	Taluka	Villages
1.	FOC-1	Junagadh	Vadal
2.	FOC-2		Sukhpur
3.	FOC-3		Chokli
4.	FOC-4	Vanthali	Mahobatpur
5.	FOC-5		Luvarsar
6.	FOC-6		Sonardi
7.	FOC-7	Mendarda	Alidhra
8.	FOC-8		Mendarda
9.	FOC-9	Bhesan	Kharchiya
10.	FOC-10		Mendarda
11.	FOC-11	Malia	Patla
12.	FOC-12		Vadiya
13.	FOC-13	Mangrol	Virpur
14.	FOC-14		Shapur

Table 3: Disease incidence of chickpea wilts across major chickpea growing talukas of Junagadh district

Sr. No.	Taluka	Village	PDI (%)
1.	Junagadh	Vadal	19.05
2.		Sukhpur	16.30
3.		Vijapur	20.21
4.		Chokli	10.23
Mean			**16.45**
5.	Vanthali	Mahobatpur	19.79
6.		Luvarsar	20.35

7.		Selra	8.77
8.		Sonaradi	20.17
Mean			**17.27**
9.	Mendarda	Mithapur	18.48
10.		Alidhra	23.53
11.		Mendarda	29.03
12.		Khadpipli	17.31
Mean			**22.09**
13.	Bhesan	Kariya	37.08
14.		Hadmatiya Vishal	32.97
15.		Kharchiya	9.90
16.		Mendapara	20.97
Mean			**20.45**
17.	Malia	Patla	17.65
18.		Dudhala	25.00
19.		Galodar	25.61
20.		Vadiya	4.35
Mean			**18.15**
21.	Mangrol	Virpur	16.82
22.		Shapur	16.50
23.		Bhatgam	21.18
24.		Vadla	15.04
Mean			**17.39**

Table 4: Per cent disease incidence (PDI) of different isolates of *Fusarium* spp. in chickpea

Sr. no.	Isolate	Villages	Per cent Disease Incidence#
1.	FOC-1	Vadal	87.50
2.	FOC-2	Sukhpur	62.50
3.	FOC-3	Chokli	87.50
4.	FOC-4	Mahobatpur	100.00
5.	FOC-5	Luvarsar	62.50
6.	FOC-6	Sonardi	75.00
7.	FOC-7	Alidhra	75.00
8.	FOC-8	Mendarda	50.00
9.	FOC-9	Kharchiya	75.00
10.	FOC-10	Mendarda	62.50
11.	FOC-11	Patla	100.00
12.	FOC-12	Vadiya	62.50
13.	FOC-13	Virpur	50.00
14.	FOC-14	Shapur	62.50

#Mean of three repetitions

Fig 1: Pathogenicity test of *Fusarium* isolate

Table 5: Cultural characteristics and sporulation patterns of *Fusarium* spp.

Sr. No.	Isolate	Growth rate*	Colour and texture	Margin	Sporulation	Mean colony diameter# (mm)
1	FOC-1	Medium	White thin flat slightly fluffy mycelium	Irregular	+++	84.20
2	FOC-2	Fast	White moderate mycelium with hairy concentric ring	Irregular	++++	85.86
3	FOC-3	Fast	White dense fluffy mycelium	Regular	+++	85.97
4	FOC-4	Fast	White dense mycelium with sector growth	Irregular	++++	87.02
5	FOC-5	Fast	White profuse aerial mycelium	Regular	+++	85.25
6	FOC-6	Fast	White fluffy dense mycelium	Regular	++++	87.34
7	FOC-7	Medium	Dull white sparse mycelium	Irregular	++	80.07
8	FOC-8	Fast	White fluffy mycelium with dense centre	Regular	+++	87.87
9	FOC-9	Medium	White moderately aerial mycelium	Irregular	+++	83.72
10	FOC-10	Fast	White fluffy growth dense at middle	Regular	++++	87.69
11	FOC-11	Fast	White moderately aerial mycelium	Irregular	++++	85.24
12	FOC-12	Fast	White fluffy dense mycelium	Regular	++++	86.67
13	FOC-13	Medium	Creamy white sparse growth	Irregular	+++	84.44
14	FOC-14	Fast	White dense aerial mycelium	Regular	++++	86.48
S.Em.±						0.57
C.D. at 5%						1.66
C.V.%						1.16

#Mean of three repetitions,

Sporulation: ++++ = Very good (>60 spores/microscopic field), +++ = Good (45.1-60 spores/microscopic field), ++ = Moderate (30.1-45 spores/microscopic field), + = Poor (<30 spores/microscopic field)
Growth rate: Fast (> 86 mean colony diameter), Medium (<86 mean colony diameter)

Table 6: Morphological characteristics of *Fusarium* spp.

Sr. No.	Isolate	Microconidia shape	Microconidia size (µm)	Macroconidia shape	Macroconidia size (µm)	No. of septa	Chlamydospores	Arrangement
1	FOC-1	Oval	5.82±0.42 × 2.21±0.18	Falcate	15.82±1.24 × 3.21±0.28	3-4	absent	Single
2	FOC-2	Elliptical	6.14±0.37 × 2.34±0.21	Falcate	16.14±1.36 × 3.34±0.31	2-3	Present	Chains
3	FOC-3	Oval	5.67±0.39 × 2.18±0.16	Slightly curved	15.67±1.18 × 3.18±0.25	3-4	Present	Single
4	FOC-4	fusoid to allantoid	7.20±0.41 × 5.41±0.19	Falcate	17.90±1.42 × 12.41±0.29	2-3	absent	-
5	FOC-5	Oval	5.91±0.36 × 2.27±0.17	Curved	16.91±1.27 × 3.27±0.26	3-4	Present	Single
6	FOC-6	Elliptical	6.05±0.44 × 2.36±0.20	Falcate	17.05±1.33 × 3.36±0.30	2-3	Present	Chains
7	FOC-7	Oval	5.73±0.38 × 2.19±0.15	Curved	15.73±1.21 × 3.19±0.27	3-4	absent	Single
8	FOC-8	Elliptical	6.22±0.40 × 2.38±0.18	Falcate	18.22±1.44 × 3.38±0.32	2-3	Present	Chains
9	FOC-9	Oval	5.88±0.35 × 2.24±0.17	Curved	16.88±1.29 × 3.24±0.28	3-4	absent	Single
10	FOC-10	Elliptical	6.41±0.43 × 2.43±0.19	Falcate	19.41±1.51 × 3.43±0.34	2-3	Present	Chains
11	FOC-11	curved to fusoid	15.30± 0.37 × 2.16±0.14	Curved	25.64±1.17 × 6..16±0.24	3-4	absent	-
12	FOC-12	Elliptical	6.09±0.39 × 2.35±0.18	Falcate	17.09±1.32 × 3.35±0.29	2-3	Present	Chains
13	FOC-13	Oval	5.97±0.41 × 2.29±0.17	Falcate	18.17±1.46 × 3.29±0.27	3-4	absent	Chains
14	FOC-14	Elliptical	6.16±0.38 × 2.33±0.16	Curved	16.96±1.25 × 3.33±0.26	3-4	Present	Single

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