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A Diversity of *Complexipes moniliformis* in Korea

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한국에서 발견된 *Complexipes moniliformis* 種의 多樣性

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ABSTRACT: Various types of *Complexipes moniliformis* were found at two communities of *Cassia minosoides* var. *nomame* and lichen mixed with an unidentificable plant in Tae Ahn Kun (Chung Nam). The morphological features observed at the chlamydospore of *Complexipes moniliformis* were not significant, but the size of chlamydospores was quite different in the statistic analysis. The morphological features affected by environmental or genetic factors were discussed.

KEYWORDS: *Complexipes moniliformis*, diversity, morphology.

Walker (1979) collected mycorrhizal spores from the community of *Pinus* trees, and established new genus '*Complexipes*' from it. Its specific feature of *Complexipes moniliformis*, disc-shape of substanding hyphae, was considered to be quite different from bulbous hyphae in *Gigaspora* (including wiht *Scuttellospora*), and from straight or curved hyphae in *Glomus* or *Sclerocystis*.

Walker (1979) still suggested that the septa were found at the system of vascular-arbuscule in the plant roots. Hall (1985) and Trappe & Schenck (1982) mentioned that *Complexipes moniliformis* would be a species of Pyreonemataceae (Pezizales) in Discomycetes because of the septa found at the subtending hyphae and morphology of chlamydospores. They, however, never showed its ascocarps and its related evidences. *Complexipes moniliformis* was also considered to be other fungus rather than the fungus rather than the fungus belonged to Endogonales since the interaction between it and its host roots was reported to be 'ectendomycorrhizae' (Wilcox, 1974). Mosse and Brown (1968) indicated that any mycorrhyzal formation was not found at the soils containing *Complexipes moniliformis*. The plants involved in *Complexipes moniliformis* were reported to be the species of *Pinus resionosa, P. sylvestris, P. strobus,* and *Parthenocissus quinquefolia* (Walker, 1979).

This experiment was to observed the different sizes of chlamydospores and various features of the first cell at the subtending hyphae attached to chlamydospore of *Complexipes moniliformis,* and to speculate the features affected by the environmental or genetic factors.

Materials and Methods

Collections: Chlamydospores of *Complexipes moniliformis* were collected from two areas located at the hill facing toward the Yellow Sea (Do Lae Ri, Tae Ahn Eub, Tae Ahn Kun in Chung Nam). The soils around the plant roots

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were collected from October, 1989 to Feb. 1990, placed in the polyethylene bags, and stored in the dark rooms. The soils mixed with the plant roots were obtained from two different plant vegetation area (marked to 'A' and 'B'; The A marked here was the *Classia mimosoides* var. *nomame* Makino dominant community and B was unknown lichen (Fructicose with green apothecia and dark brown apothecia) and unidentificable plant dominant community.

Sieving: The chlamydospores found in two areas were collected by using Eum and Lee's procedures (1989). By the wet sieve method, missing of the chlamydospores sized with a 90 μm diameter was found through the 90 μm sieve. So, we removed the clay or sands by sucrose centrifuge and collected the chlamydospores with the wet 38 μm sieve.

Microscopic observations: The chlamydospores collected were placed in the slide with few drops of 20% glycerine solution and covered. Three parameters, the widest diameter of spore (a), horizontal (b) and veritical (c) diameters of the first cell at subtending hyphae attached to the chlamydospores were individually measured per spore as a unit of μm under a 1000 magnified microscope.

Results

Morphology: The sporocarps were not found in two plant communities (A and B indicated in Table I). Both chlamydospores were sightly collected from two plant communities representing the different plant (*Cassia mimosoides* var. *nomame* and Lichens mixed with an unidentificable herbaceous plant), but two to five chlamydospores sparsely aggregated with the hyphae (Fig. 1c). Both chlamydospores showing dark brown (A community) or pale brown (B community) and both having thick cell wall layers. The surface ornamentation was papillae. The entire features of both chlamydospores collected from two plant communities (called "populations") were similar to each other, but some individual variations within the subtending hyphae attached to chlamydospore were found within each plant community (see Fig. 1A, B, C and D).

Table I. Two different types of *Complexipes moniliformis* collected (measuring unit, μm).

Marked[a]	A (N=66)[b]			B (N=83)		
Parameters[c]	a	b	c	a	b	c
Average, μm	90.5	19.8	16.1	70.1	19.7	13.4
Standard deviation	8.7	4.9	4.9	9.6	3.7	4.2
Smallest	68	11	6	44	12	4
Biggest	110	33	30	87	30	26
CL (95%)	2.1	1.2	1.2	2.1	0.8	0.9
Spore color	Dark brown			Pale brown		
Plant communities	*Cassia mimodoides* var. *nomame*			Lichens and unknown herbs		

[a] Chlamydospores collected from the hill facing Yellow Sea (Do Lae Ri, Tae Ahn Myun, Tae Ahn Kun, Chung Nam). See the materials and methods in detail. All unit was μm.

[b] N meaned the numbers of spores collected and used in statistic analysis.

[c] Parameters, a b, and c, represented the widest diameter of chlamydospore, vertical and horizontal diameters of the first cell attached to chlamydospores, respectively. CL means the confidence level.

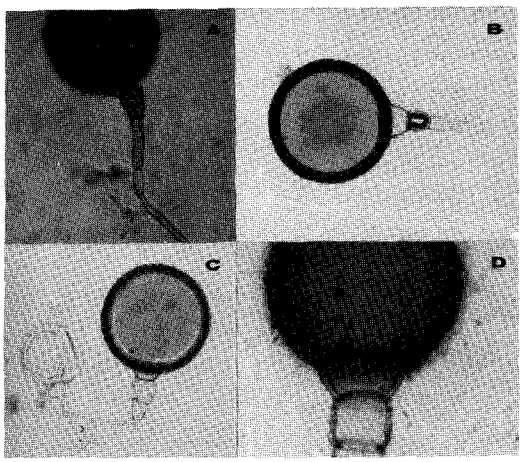

Fig. 1. Chlamydospores of *Complexipes moniliformis*.
A, D) 8×40, 8×100 Collected from *Cassia mimosoides* var. *nomame*, B, C) 8×40 Collected from Lichen

The shapes of the first cell of subtending hyphae were various within the spores collect-

ed from each plant community; cylindric (Fig. 1A), cup (Fig. 1D), disc (Fig. 1B and C) types. These kinds of the first cell in subtending hyphae attached to chlamydospores (called "first cell" here) were observed within the spores collected from both plant communities. Numbers of the septated cells at the subtending hyphae attached to an individual chlamydospore were also various and from two to six as shown in Fig. 1. The horizontal (b) and vertical (c) diameters of the first cell were estimated a spore with the widest diameters of spore (a), to define the shape of the first cell attached to the chlamydospore.

Measurements: The vertical diameters of the first cell attached to chlamydospores were plotted with the horizontal diameters of the first cell were uniformally distributed within two populations of total chlamydospores collected from plant communities, and the horizontal diameters of the first cell were also uniformally distributed within two groups of chlamydospores collected from both plant communities. The shapes of the firrst cell were various within each group of chlamydospores collected from plant communities. The widest diameter of chlamydospores were also plotted with the vertical diameters of the first cell attached to the chlamydospores (Fig. 2). Plotting of the widest diameter of chlamydospores were divided into two groups: 68-110 μm sized spores collected from the community A and 44-87 μm from the B community (Fig. 2).

The widest diameter of chlamydospores was significantly different between two populations at 95% confidence level (Table I). Histographics of widest diameter of chlamydospores were drawed with 5 μm units (Fig. 3). The widest diameter of chlamydospores collected from the community A (68 to 110 μm) was overlapped with and different from that from the community B (44 to 85 μm, see Fig. 3). If the addition of the diameters of chlamydospores collected from both communities A and B, the histography added were disrupted, but did not show a normal distribution in our collection samples.

Discussion

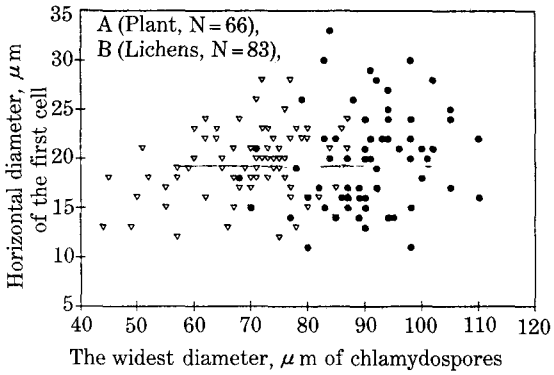

Fig. 2. Comparisons of the widest diameter of chlamydospore to the horizontal diameter of the first cell of *C. moniliformis*. Triangles and circles indicated the sizes of chlamydospore collected from A and B community, respectively.

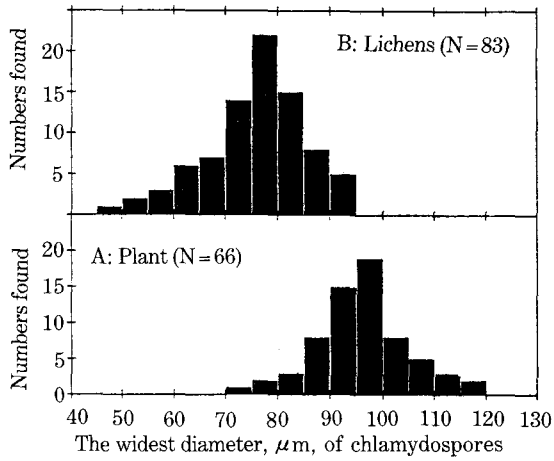

Fig. 3. Numbers found at the ranks of 5μm, the widst diameters of *C. moniliformis* chlamydospores.

In morphological features of *Complexipes moniliformis*, shapes of chlamydospores were same as Walker (1979) and Ka *et al.* (1990) described. The variations of the first cell of subtending hyphae were also various as Walker (1979) metioned. The diversity of its shapes were first recognized at observations of chlamydospores. The ratio of vertical to horizontal diameters of the first cell attached to chlamydospores were measured. The ratio mentioned in the above was reflected to the diver-

sity of shapes of the first cell; cylindric, cup, and disc shapes representing the numerical values. The diversity for the shapes of the first cells attached to chlamydospores should be considered to be due to the environmental effects, which was unknown. Assumed so in the above, the diversity should not be uniformally but discreted observed in both populations.

The widest diameter of chlamydospores was reported to be 55 to 110 μm (Walker, 1979), but was observed to be 44 to 110 μm (Walker, 1979), but was observed to be 44 to 110 μm in both sampling sites. The disrupted distribution appeared in the additions of the widest chlamydospore diameters with number observed were predicted to be two different populations of *Complexipes moniliformis* chlamydospores, due to the concept of species defined (Ehrinch, 1980). The size of chlamydospores was speculated to be resulted from genetic factors or host selection. If we assumed that the size of chlamydospores be due to environmental effects like the shapes of the first cell, the whole ranges of chlamydospore size should be uniformally distributed without a disruped peak within a whole range of chlamydospores, 48 to 110 μm. Thus, the widest diameter of chlamydospores was considered to be resulted from the genetic effects.

The characteristic of the widest chlamydospore diameter found in two different plant populations was considered to be due to fungal genetic or host. The spore (azygospore or chlamydospore) diameter was employed in the identification key of Endogonales (Tappe, 1982).

The size of chlamydospore diameter found in *Complexipes moniliformis* would be important to determined the concept of species in *Complexipes moniliformis.* The disrupted populations observed in Fig. 3 seemed to be a steps to separate a species into two varieties or species of *Complexipes moniliformis.* Therefore, more than the factors found here would be suggested for the confirmation of the above.

Several observations of chlamydospores within two different populations were made in our samples; The shapes of the first cells also found by Walker were quite different from the chlamydospores diameters which was not recognized by Walker (1979). This finding was believed to be important to determined the concept of species, *Complexipes moniliformis,* in the next work.

摘 要

두식물 군락에서 *Complexipes moniliformis*가 발견되었다. 발견된 균은 형태적으로 많은 차이점이 관찰되었으며, 이는 다른 보고와 동일한 결과를 얻었다. 그러나, 형태적인 차이점은 두식물군락에서 동일하였으나, 포자의 직경의 크기는 두 식물군락에서 유이성이 관찰되었다.

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