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Short communication

Increase in the number of decorative florets in the inflorescence of *Hydrangea* through phytoplasma infection

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ABSTRACT

Hydrangea (*Hydrangea* spp.) has two types of florets in an inflorescence. One has decoratively developed sepals and is termed as the decorative floret. The other has plain sepals and is termed as the non-decorative floret. Hydrangea is classified into two types according to its inflorescence: globular (hortensia) and lacecap. In hortensia, the surface of inflorescence is covered with decorative florets. In lacecap, decorative florets are situated around the periphery of the inflorescence. Japanese hydrangea phyllody (JHP) phytoplasma infection often leads to an increase in the number of decorative florets. JHP phytoplasma was inoculated into ten hortensia and five lacecap cultivars by grafting. The ratios of decorative florets to total florets were compared between the JHP phytoplasma-infected and non-infected plants. The infected plants showed lower decorative floret ratios in six hortensia cultivars and higher decorative floret rations in four lacecap cultivars. The composition of inflorescence was investigated using infected and non-infected plants of 'Midoribanaajisai' (hortensia cultivar) and 'Libelle' (lacecap cultivar). In 'Libelle', the lacecap type, an alteration in the lateral non-decorative floret to the decorative floret was observed and considered to be the main cause of increase in the decorative floret ratio.

1. Introduction

Some plant families have two types of florets in one inflorescence, such as Compositae plants, which have ligulate and tubular florets. Hydrangea (*Hydrangea* spp.) also has two types of florets in an inflorescence (Fig. 1). One has decoratively developed sepals and is termed as the decorative floret. The other has plain sepals and is termed as the non-decorative floret (Uemachi and Nishio, 2005). Hydrangea is classified into two types according to its inflorescence morphology: hortensia and lacecap. In hortensia, the surface of inflorescence is covered with decorative florets and in lacecap, decorative florets are situated around the periphery of the inflorescence.

In general, the terminal meristem of each branch of the inflorescence develops into a non-decorative floret (Uemachi and Nishio, 2000; Uemachi et al., 2006; Uemachi, 2007). In the lacecap cultivar, non-decorative florets appear to be formed as a lateral floret and undeveloped florets are observed in the axil of these non-decorative florets. This shows that laterally formed non-decorative florets are originally formed as an inflorescence (Fig. 1A). In the hortensia cultivar, in the higher node of the inflorescence, the lateral non-decorative florets are replaced by decorative florets (Fig. 1B; Uemachi and Nishio, 2000; Uemachi et al., 2006; Uemachi, 2007). The fate of the lateral bud development in an inflorescence determines the inflorescence morphology. However, the morphological characteristic of differentiation of decorative florets has not been well studied.

In hydrangea, phyllody is induced by infection with Japanese hydrangea phyllody (JHP) phytoplasma (Kanehira et al., 1996; Sawayanagi et al., 1999). Phytoplasmas are Mollicutes, plant pathogenic obligate bacteria lacking cell walls. In 1967, Doi et al. first discovered them in phloem tissue, and Oshima et al. (2004) determined the entire genome sequence. 'Midoribanaajisai' is a hydrangea cultivar with green colored floral organs that is infected with JHP phytoplasma. When JHP phytoplasma is eliminated from 'Midoribanaajisai', the green coloration of the floral organs changes to blue or pink, and when the phytoplasma-eliminated 'Midoribanaajisai' is reinfected with JHP phytoplasma, the green coloration of floral organs is recovered; this is direct evidence that green coloration of floral organs in 'Midoribanaajisai' is due to the JHP phytoplasma infection (Kesumawati et al., 2006).

An increase in the number of decorative florets in the inflorescence of the JHP phytoplasma-infected hydrangeas is often observed. In the present study, 15 hydrangea horticultural cultivars, ten hortensia and five lacecap cultivars, were inoculated with JHP phytoplasma and changes in decorative and non-decorative florets

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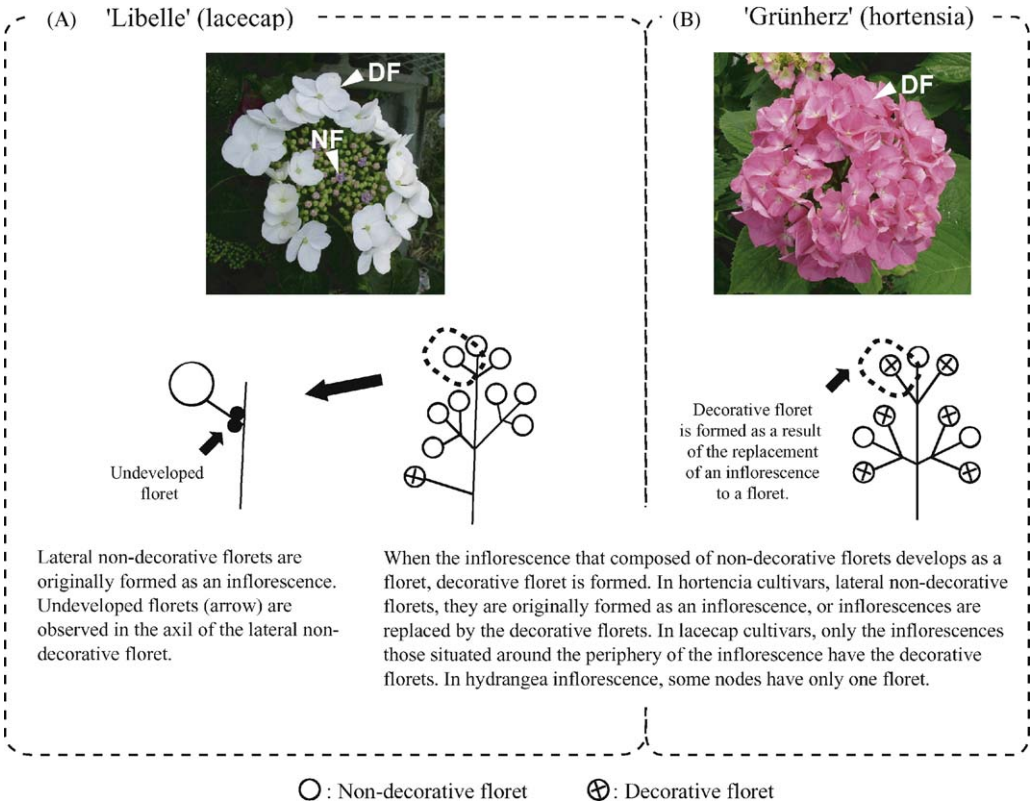

Fig. 1. Inflorescences of hydrangea. (A) Cultivar with lacecap type inflorescence, 'Libelle'. (B) Cultivar with hortensia type inflorescence, 'Grünherz'. 'Libelle'. DF: decorative floret. NF: non-decorative floret.

formation due to JHP phytoplasma infection were determined. Inflorescence composition is studied by disassembling JHP phytoplasma-infected and non-infected inflorescences and the mechanism underlying the increase of decorative floret formation is discussed.

2. Materials and methods

Fifteen horticultural cultivars of *Hydrangea* spp. were used as plant materials. 'Midoribanaajisai', 'Masja', 'Enziandom', 'Christmas', 'Grünherz', 'Green Glove', 'Benton', 'Madame Plumecoq', 'Renata', and 'Rosea' were used as representatives of the hortensia type. 'Ohkan', 'Hatsushimo', 'Fuirigaku', 'Blue Sky', and 'Libelle' were used as representatives of the lacecap type. Plants were planted in 51-cm-diameter pots filled with 40 L of potting soil. They were grown under 75% full sunlight with natural day length at the Kyoto University experimental farm (lat. 35°01′N, long. 135°47′E). The minimum winter temperature was around 0 °C, and the maximum light intensity in summer was around 100,000 lux. Preliminary experiments showed that phytoplasma can effectively

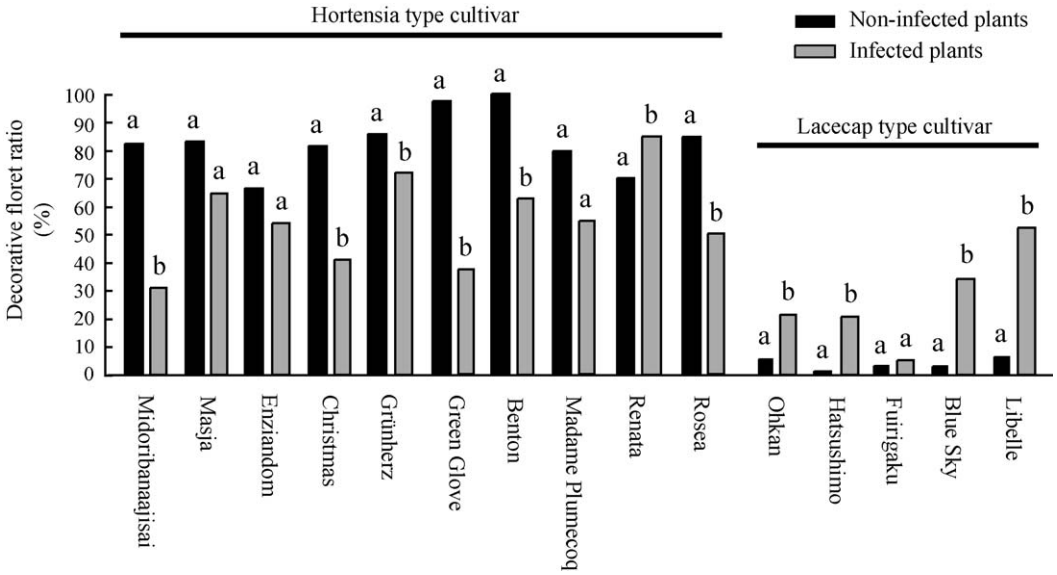

Fig. 2. Changes in the decorative floret ratio to total florets (black column indicates non-infected plants and gray columns indicate infected plants. 'Midoribanaajisai' to 'Rosea' are hortensia type cultivars and from 'Ohkan' to 'Libelle' are lacecap type cultivars.