IJIE Int. J. Indust. Entomol. 41(1) 11-14 (2020)
ISSN 1598-3579, http://dx.doi.org/10.7852/ijie.2020.40.3.11

ISSN 1598-3579 (Print)
ISSN 2586-4785 (Online)

Photographical observation of mulberry fruits (*Morus sp.*) during ripening

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Abstract

This work was preliminary report on the shape of mulberry fruits and mulberry flowers. The shape of mulberry was varied with mulberry cultivars as bended oval shape (Daeshim), oval shape (Gwasang No. 2), oval-cylindrical shape (Sagyeppong), uneven heart shape (Suwonppong), and roundish shape (Cheonggangsang). The style of female flowers was also varied with cultivars as no style (Palchung), short style (Gwasang No. 2), cone style (Susungppong), and rectangular style (Daedangsang). This observation suggested that the shape and flower of mulberries are different among mulberry cultivars. It needs to further systematic study to know the shape and flower of mulberry cultivars and to elucidate the relationship between the morphological characters and mulberry cultivars.

Int. J. Indust. Entomol. 41(1), 11-14 (2020)

Received : 18 Sep 2020
Accepted : 28 Sep 2020

Keywords:
Mulberry,
Shape,
Flower,
Style

Introduction

Mulberry, a fruit of mulberry tree, is harvested from May to Jun in Korea (Lee *et al.,* 1998). Mulberry is one of major sericultural products in Korea. Mulberry is sweet and taste with some functionality (Yang *et al.,* 2016; KFDA, 2012; Tang and Eisenbrand, 2011; Bae and Suh, 2007). The most cultivated mulberry variety in Korea is Gwasang No. 2, Cheongilppong, Iksuppong, Suwonppong (Sung *et al.,* 2013). Many researches have focused on the functionality and its related components. Ju's group studied on the bioactive materials extracted from different mulberry cultivars and reported the content of quercetin 3-O-rutinoside in mulberry cultivar Daeshim and Suhyang is 119.9 and 38.1 mg/100g DW, respectively (Ju *et al.,* 2018; Ju *et al.,* 2017). Cyanidin 3-O-glycoside and cyanidin 3-O-rutinoside also reported as major components in mulberry (Buthup *et al.,* 2013; Yang *et al.,* 2012; Pawlowska *et al.,* 2008; Naderi *et al.,* 2004).

The shape and morphology of each mulberies are different with the mulberry cultivars. However, the photographical observation of mulberry with ripening is not reported yet. This is preliminary report on the photographical observation of mulberry cultivars in Korea.

Materials and methods

Mulberry cultivars have been cultured in the experimental greenhouse and farm in National Institute of Agricultural Sciences, Korea. The flowers and mulberry were photographed with ripening.

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Results and Discussion

Cultivated mulberry varieties in Korea categorized 3 species as *Morus alba* L,, *Morus bombycis* Koridz, and *Morus Lhou* Koidz (Kim, 1990). Wild mulberry tree, *Morus mongolica* C.K. Schn, is nature in Korea (Kim, 1990). Korean moriculturalists have developed various mulberry cultivars for silkworm feed or mulberry production including Saealchan (Sung *et al.,* 2018; Sung *et al.,* 2016).

Photographs of mulberries from different mulberry cultivars with ripening were taken and shown in Fig. 1. Observed mulberry cultivars were Daeshim (Fig. 1(a)), Gwasang No. 2 (Fig. 1(b)), Sagyeppong (Fig. 1(c)), Suwonppong (Fig. 1(d)), and Cheonggangsang (Fig. 1(e)). As shown in Fig. 1, the color of mulberries turned from green to red and then black. Mulberry cultivar Daeshim looked bended oval shape with a certain number of styles on its surface, forming around mulberry. The height of style became shorter with ripening (Fig. 1(a)). Mulberry cultivar Gwasang No. 2 showed oval shape with a certain number of styles on its surface. The height of styles became shorter with ripening like Daeshim mulberry except a little longer (Fig. 1(b)). Mulberry of cultivar Sagyeppong showed oval-cylindrical shape with a certain number of long styles on its surface. The certain fibers of styles were presence on its ripened mulberry surface (Fig. 1(c)). Mulberry cultivar Suwonppong showed uneven heart shape with a certain number of long styles on its surface. Some fibers of styles were presence on its ripened mulberry surface like Sagyeppong mulberry (Fig. 1(d)). Mulberry cultivar Cheonggangsang showed roundish shape with a certain number of styles on its surface. Some fibers of styles were presence on its ripened mulberry surface like Sagyeppong mulberry (Fig. 1(e)). On the basis of observation, mulberry cultivars could be classed into two groups; no fiber presence group (Daeshim, Gwasang No. 2) and fiber presence group (Sagyeppong, Suwonppong, and Cheonggangsang). The style of the mulberry is different with the species in the same genus. The style belonging to *Morus bombycis* Koidz is long (Kim, 1990).

Photographs of male flower were shown in Fig. 2. Male flower consists of 4 perianths, 4 stamens, and one filament with 2 anthers (Kim, 1990). Tikader *et al.* (1995) reported that flowering distribution of mulberry tree varied over wide ranges i.e. only males, only females, females and males in separate branches of the same plant, males and females in same branch with equal and unequal proportions, males and females in the same

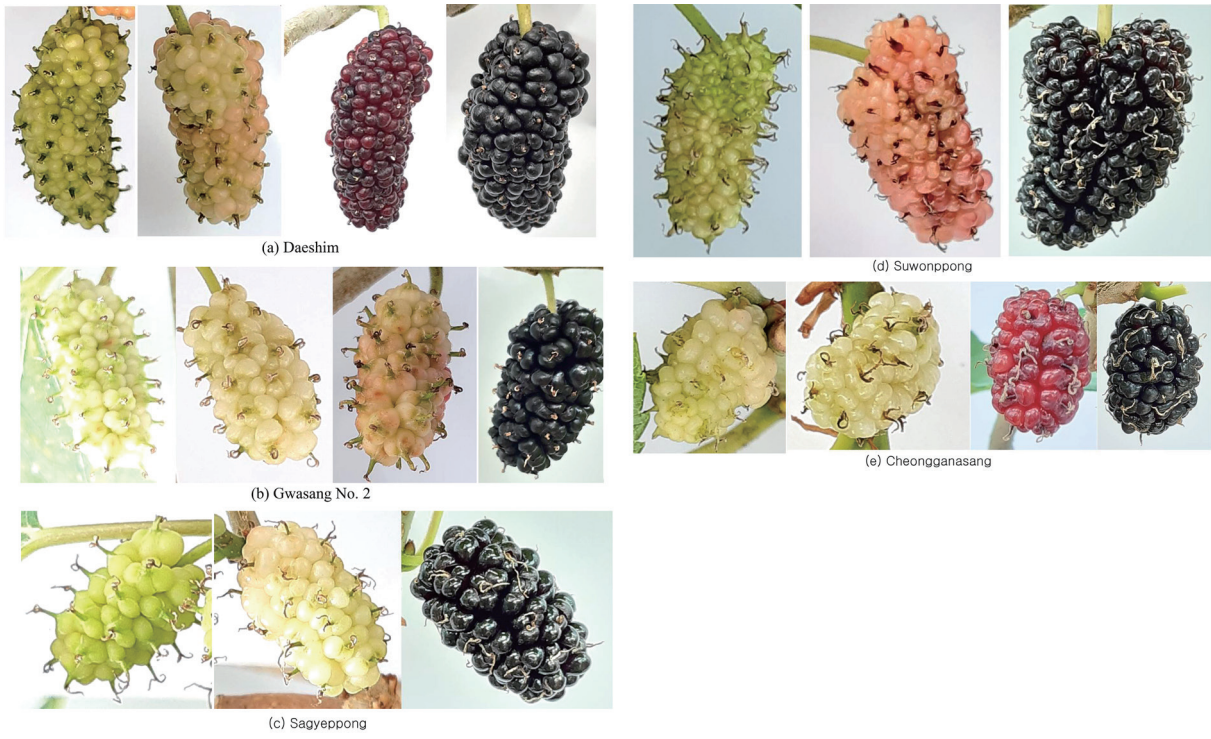

Fig. 1. Photographs of mulberries taken from different mulberry cultivars with ripening. (a) Daeshim, (b) Gwasang No. 2, (c) Sagyeppong, (d) Suwonppong, and (e) Cheonggangsang.

Fig. 2. Photographs of male flower with time.

inflorescence, and bisexual flowers. Flowering period is affected from fluctuation in temperature, humidity, and nutritional status of soil (Tikader *et al.,* 1995).

Female catkin is composed of 4 perianths and a pistil. Pistil is the female ovule-bearing part of a flower composed of ovary, style, and stigma. Each perianth closes to ovary (Kim, 1990). Photographs of female catkin were shown in Fig. 3. Four types of styles were observed as no style (Palchung), short style (Gwasang No. 2), cone style (Susungppong), and rectangle style (Daedangsang). Cultivar Palchung was bred for pollen parent in National Institute of Agricultural Sciences, RDA, Korea (Sung *et al.,* 2014). Female flower of Palchung, belonging to *Morus Lhou*, is agreed to the literature, no style (Kim, 1990).

Fig. 4 was shown some female flowers photo-taken. Gwasang

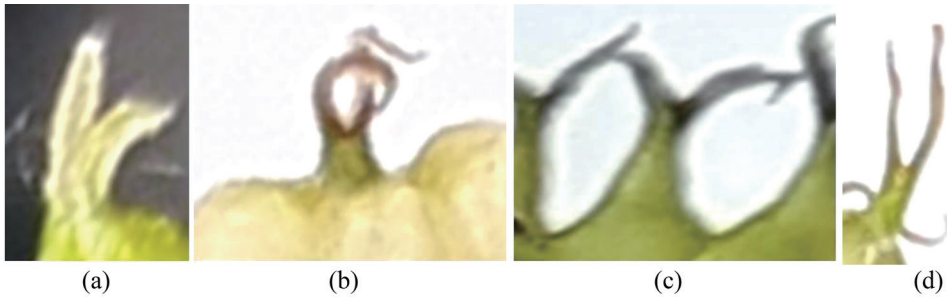

Fig. 3. Photographs of female flower. (a) Palchung, (b) Gwasang No. 2, (c) Susungppong, and (d) Daedangsang.

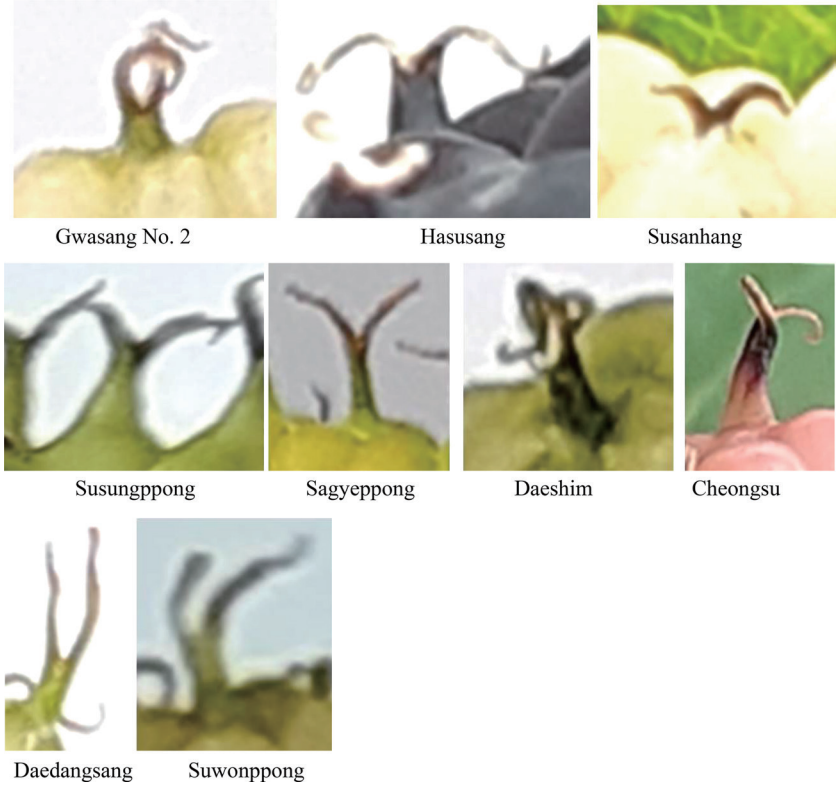

Fig. 4. Some photographs of female flower.

No. 2, Hasusang, and Susanhang are sorted to short style type. Susungppong, Sagyeppong, Daeshim and Cheongsu are sorted to cone style. Daedangsang and Suwonppong are sorted to rectangle style.

Some mulberry fruits and flowers were taken and observed the morphological characters. The shape of mulberry was varied with mulberry cultivars as bended oval shape, oval shape, oval-cylindrical shape, uneven heart shape, and roundish shape. The style of female flowers was also varied with cultivars as no style, short style, cone style, and rectangular style. This observation suggested that the shape and flower of mulberries are different among mulberry cultivars. It needs to further systematic study to know the shape and flower of mulberry cultivars and to elucidate the relationship between the morphological characters and mulberry cultivars.

Acknowledgments

This study was carried out with the support of the 'Research Program for Agricultural Science & Technology Development' (PJ01360602), National Institute of Agricultural Sciences, Rural Development Administration, Republic of Korea.

References

Bae S, Suh H (2007) Antioxidant activities of five different mulberry cultivars in Korea. LWT-Food Sci Technol 40, 955-962.

Butkhup L, Samapptto W, Samapptto S (2013) Phenolic composition and antioxidant activity of white mulberry (Morus alba L.) fruits. Int J Food Sci Tech 48, 934-940.

Ju W, Kwon O, Kim Y, Kim H, Sung G, Kim J (2018) Flavonoids analysis about mulberry fruit of Korean mulberry cultivar, 'Daeshim'. Int J Indust Entomol 37, 43-48.

Ju W, Kwon O, Lee MK, Kim H, Sung G, Kim Y (2017) Quali-quantitative analysis of flavonoids for mulberry leaf and fruit of 'Suhang'. Kor J Environ Agric 36, 252-258.

Korea Food and Drug Administration (KFDA) (2012) National Standard of Traditional Medicinal (Herbal and Botanical) Materials, 4th ed. Korea Food and Drug Administration (KFDA), Cheongju, Korea, URL: http://www.mfds.go.kr.

Kim M (1990) Moriculture (Jaesanghak, Korean). P.65, Hyangmoonsa, Seoul.

Lee HW, Shin DH, Lee WC (1998) Morphological and chemical characteristics of mulberry (Morus) fruit with varieties. Korean J Seric Sci 40, 1-7.

Naderi GA, Asgary S, Sarraf-Zadegan N, Oroojy N, Afshin-Nia F (2004) Antioxidant activity of three extracts of *Morus nigra*. Phytother Res 18365-18369.

Pawlowska AM, Oleszek W, Braca A (2008) Quali-quantitative analyses of flavonoids of *Morus nigra* L. and *Morus alba* L. (Moraceae) fruits. J Agri Food Chem 56, 3377-3380.

Sung GB, Kim H, Kang PD, Kim KY, Ji SD (2012) Characteristics of mulberry cultivar 'Sangberry (*Morus alba* L.) for fruit production. J Seric Entomol Sci 50, 171-177.

Sung GB, Kim KY, Ji SD (2013) Survey and analysis of mulberry tree for mulberry production. J Seric Entomol Sci 51, 48-55.

Sung GB, Kim YS, Ju WT, Kim HB (2018) Characteristics of newly bred mulberry variety, 'Saealchan' resistant to sclerotial disease. Int J Indust Entomol 37, 55-62.

Sung GB, Kim YS, Kim KY, Kim H, Ji SD, Kang PD (2014) Characteristics of mulberry cultivar 'Palchung' (*Morus Lhou(Ser.)* Koidz) for mulberry breeding as pollen parent. J Seric Entomol Sci 52, 147-154.

Tang W, Eisenbrand G (2011) Handbook of Chinese Medicinal Plants (1st ed.), pp. 777–781, Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim.

Yang C, Han B, Zheng Y, Liu L, Li C, Sheng S, *et al.* (2016) The quality changes of postharvest mulberry fruit treated by chitosan-g-caffeic acid during cold storage. J Food Sci 81, C881-C888.

Yang TP, Lee HJ, Ou TT, Chang YJ, Wan CJ (2012) Mulberry leaf polyphenol extract induced apoptosis involving regulation of adenosine monophosphate-activated protein kinase/fatty acid synthase in a 53-negative hepatocellular carcinoma cell. J Agr Food Chem 60, 6891-6898.