［Technical Brief］

Growth Characteristics of Shoots and Roots of Wild Grapes Native to Japan

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Abstract

In this study, we aimed to determine the shoot and root growth patterns of five species of wild grapes native to Japan and related hybrids. Ebizuru (*Vitis ficifolia* var. *lobata*), Ryukyuganebu (*V. ficifolia* var. *ganebu*), Shiohitashibudou (unidentified genotype; tentative name), Shiragabudou (*V. shiragai*), Yamabudou (*V. coignetiae*), 'Kadainou R-1' (Ryukyuganebu × *V. vinifera* 'Muscat of Alexandria'), New Hybrid ('Kadainou R-1' × *V. labruscana* 'Bailey Alicante A') and 'Muscat of Alexandria' were used as plant materials. The root and shoot growth rates of all grapes peaked between full bloom to veraison; however, the specific timing of growth, such as a bud break, differed depending on the species. The shoot and root growths of Yamabudou ceased the earliest among the grapes.

Key words: root growth, shoot growth, *Vitis*, wild grape

Introduction

Grapes undergo series of phenological stages, namely, bud break, vegetative growth, full bloom, berry set, maturation, leaf fall and dormancy, during each production year. The timing of each phenological stage has important implications in viticulture practices, such as timing of fertilization, and factors affecting carbohydrate content and nutrient sink activity. Hence, such knowledge will enable the establishment of physiology-based criteria for irrigation and fertilization scheduling. In earlier works, the growth patterns of roots and/or shoots under different environmental and cultivation conditions for several grape cultivars were determined (Comas et al. 2005, McKenry 1984, Morlat and Jacquet 2003, Smart et al. 2006); however, less effort has been made to determine the phenological stages of wild grapes native to Japan and their related hybrids. Hence, in this study, we aimed to determine the seasonal root and shoot growth patterns of potted vines of wild grapes and related hybrids.

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Materials and Methods

Ebizuru (*Vitis ficifolia* var. *lobata*), Ryukyuganebu (*V. ficifolia* var. *ganebu*), Shiohitashibudou (unidentified genotype; tentative name) (Nakagawa et al. 1991), Shiragabudou (*V. shiragai*), Yamabudou (*V. coignetiae*), 'Muscat of Alexandria' (*V. vinifera*), 'Kadainou R-1' (Ryukyuganebu × 'Muscat of Alexandria') and New Hybrid ('Kadainou R-1' × *V. labruscana* 'Bailey Alicante A') were used as plant materials. Self-rooted vines (two years old) grown in 4.5 L transparent plastic boxes were

used. The soil medium consisted of sand, soil and compost in a 1:2:1 ratio. The grapevine pots were covered with silver plastic film to allow the roots to grow up to the surface of the boxes. The root and shoot growths of three plants per genotype were recorded every two weeks over a one-year period, from November 2006 to October 2007. To estimate root growth, all new roots in a box appearing at the surface of the transparent plastic box were marked with a sharp colored pencil each time and the length was recorded. Shoot growth was recorded by measuring the length of each longest shoot as it appeared. All lateral shoots were trimmed at two nodes. The potted grapevines were grown under a sideless plastic house. They were not fertilized, but watered enough twice a week.

Results and Discussion

Root growth of Ebizuru typically started immediately after bud break and peaked during full bloom (Fig. 1). The next root growth peak appeared around veraison. Shoot growth started at the same time as root growth and its rate was highest during full bloom, decreasing steadily after that stage. Both the root and shoot growths of Ryukyuganebu had two major peaks (Fig. 2). The first major root growth peak appeared together with the highest shoot growth rate; however, the second peak was delayed 4 weeks relative to that of shoot growth. The root growth of Shiohitashibudou, Shiragabudou and Yamabudou followed the same pattern as that of shoot growth (Figs. 3-5). However, the shoot growth of Yamabudou apparently slowed around the berry

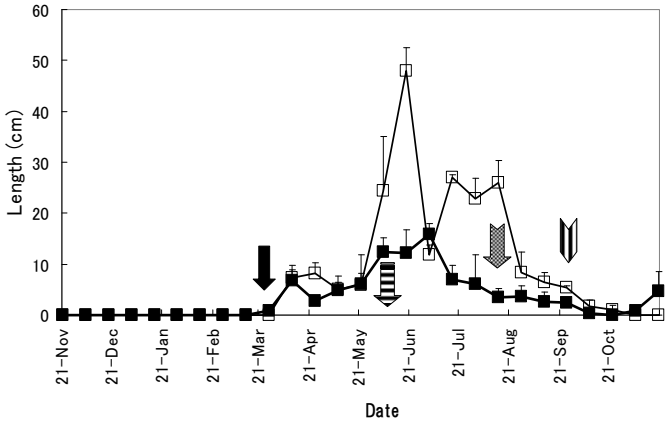

Fig. 1 Growth patterns of shoot (■) and root (□) of Ebizuru (*Vitis ficifolia* var. *lobata*). Vertical bars represent mean ± standard error. ⬇: bud break, ▥: full bloom, ⇓: veraison, ⫼: maturation.

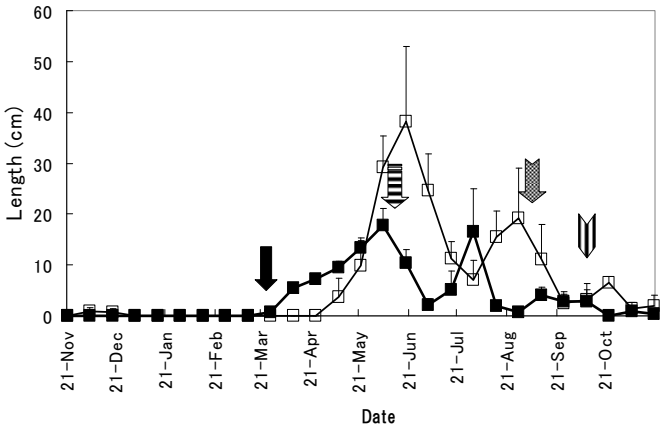

Fig. 2 Growth patterns of shoot and root of Ryukyuganebu (*V. ficifolia* var. *ganebu*). Vertical bars represent mean ± standard error. Symbols are the same as those in Fig. 1.

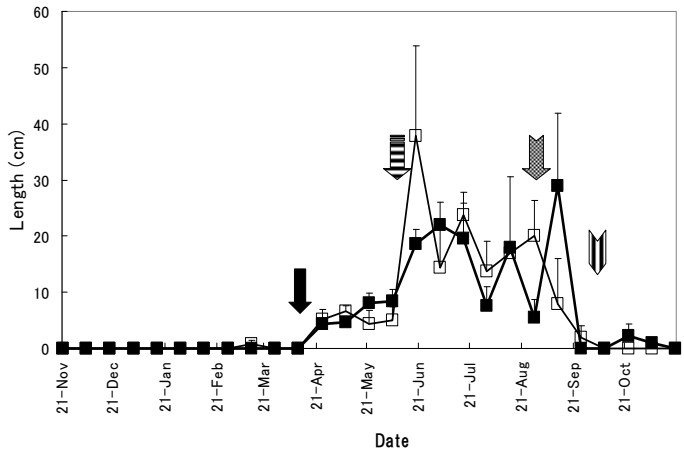

Fig. 3 Growth patterns of shoot and root of Shiohitashibudou (*V.* sp.; tentative name). Vertical bars represent mean ± standard errors. Symbols are the same as those in Fig. 1.

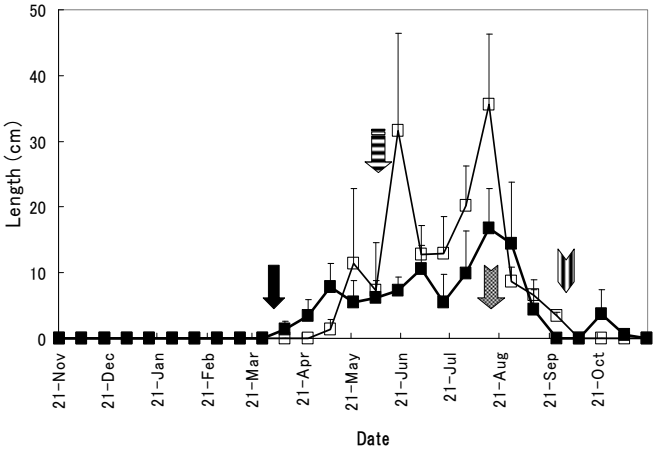

Fig. 4 Growth patterns of shoot and root of Shiragabudou (*V. shiragai*). Vertical bars represent mean ± standard error. Symbols are the same as those in Fig. 1.

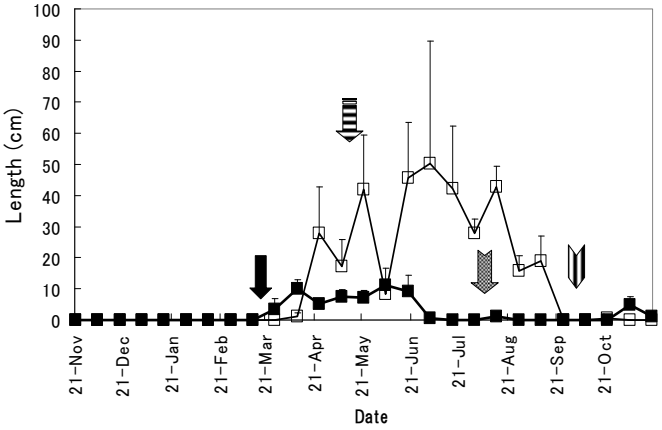

Fig. 5 Growth patterns of shoot and root of Yamabudou (*V. coignetiae*). Vertical bars represent mean ± standard error. Symbols are the same as those in Fig. 1.

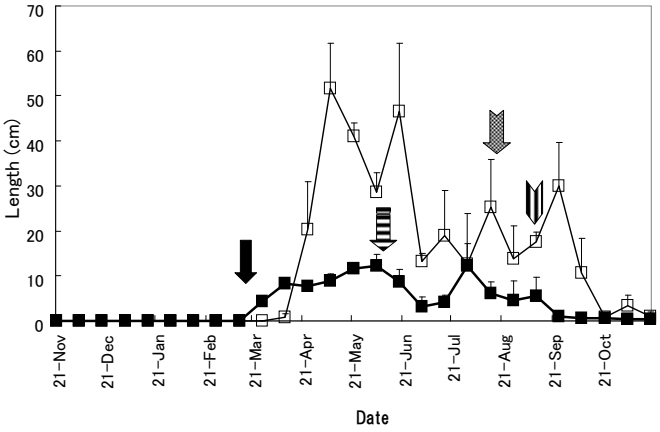

Fig. 6 Growth patterns of shoot and root of 'Kadainou R-1'. Vertical bars represent mean ± standard error. Symbols are the same as those in Fig. 1.

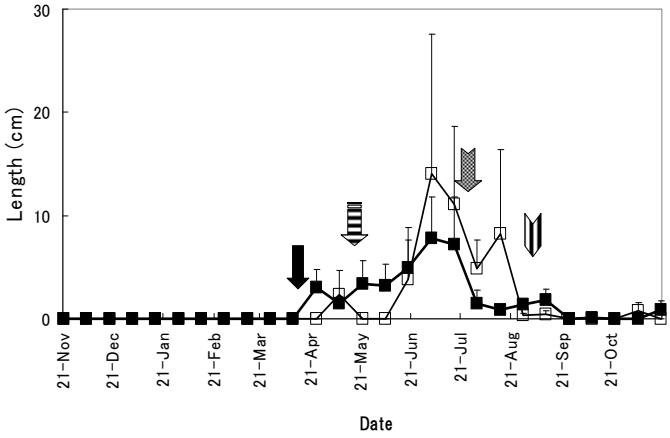

Fig. 7 Growth patterns of shoot and root of New Hybrid ('Kadainou R-1' × 'Bailey Alicante A'). Vertical bars represent mean ± standard error. Symbols are the same as those in Fig. 1.

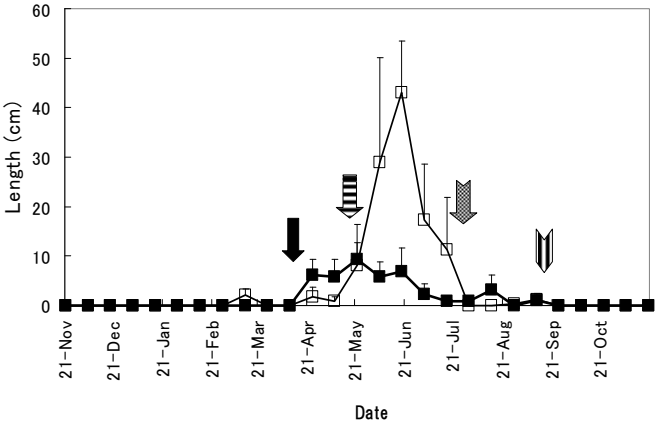

Fig. 8 Growth patterns of shoot and root of 'Muscat of Alexandria'. Vertical bars represent mean ± standard error. Symbols are the same as those in Fig. 1.

maturation stage (approximately ten weeks after full bloom).

The hybrid 'Kadainou R-1' had four root growth peaks, namely, during bud break, full bloom, veraison and full maturation (Fig. 6). However, shoot growth had two major peaks: during full bloom and before veraison. New Hybrid showed two major peaks of root growth: during veraison and before harvest. Shoot growth followed a pattern similarto that of root growth (Fig. 7). The root growth of 'Muscat of Alexandria' had one major peak between full bloom and veraison; however, shoot growth was most active from the late bud break stage to the early veraison stage (Fig. 8).

Root and shoot growths were most often active from bud break until before leaf fall in all wild and hybrid grapes with the exception of Yamabudou. Little growth was observed in these grapes after veraison. Generally, in grapevines, root production occurs in summer, but the specific timing varies widely between bloom and harvest. There is little root growth in the few weeks prior to harvest and when the vines are dormant. Major root growth peaks in grapes have been reported between bloom and veraison (Eissenatat et al. 2006); however, root growth precedes shoot growth in other species such as lychee (O'Hare and Turnbull 2004), peach (Williamson and Coston 1989), and Japanese Holly (Mertens and Wright 1978). Generally, shoot growth rate in grapes is highest before flowering, after which it declines as the vine starts to direct its energy toward fruit production (Cooperative Research Center for Viticulture 2005). The shoot and root growth patterns of Yamabudou were more specific than those of the other wild

and hybrid grapes. Yamabudou is distributed in the alpine region of Japan (Nakagawa et al. 1991), but the mean average temperature of the experimental area in July was approximately 26ºC during the year of observation. Hence, it is likely that Yamabudou stopped its vegetative growth because of unfavorable temperature conditions. In Yamabudou, the photosynthetic rate at low temperatures is much higher than that at high temperatures (Shiraishi et al. 1997). Another possible reason is that Yamabudou enters dormancy very early compared with other wild (Mochioka et al. 1996) and hybrid grapes (unpublished). In Yamabudou, the content of abscisic acid, which is highly negatively correlated with grape bud dormancy, is high in early fall, indicating deeper dormancy (Mochioka et al. 1996). Thus, it is likely that Yamabudou enters dormancy earlier than the other grapes, resulting in earlier cessation of shoot growth.

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［Technical Brief］

日本原産野生ブドウの新梢および新根の生長特性

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要　約

5 種類の日本原産野生ブドウ（エビヅル、リュウキュウガネブ、仮称シオヒタシブドウ、シラガブドウ、ヤマブドウ)、野生ブドウと栽培品種を交雑した‘香大農 R-1’（リュウキュウガネブ×‘マスカット・オブ・アレキサンドリア’）と新交雑種（‘香大農 R-1’×‘ベーリー・アリカント A’）および比較のため栽培品種である‘マスカット・オブ・アレキサンドリア’の新梢および新根の生長パターンについて調査した。全ブドウの新梢と新根の生長量のピークは満開期からベレーゾン期の間に現れたが、種類により時期が異なっていた。特に、ヤマブドウでは新梢と新根の生長は他のブドウより早く停止した。