

Effects of Morphological Characterization in Different Bolting Period of Lettuce

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Abstract. Bolting is the beginning of flowering and plays an important role in plant growth and development. Detecting changes between and after bolting will provide the foundations for molecular studies of lettuce. Here, we observed morphological characterization and paraffin section in different parts of the lettuce in different growth period. The results showed that as the seedling grew, the lettuce transformed from vegetative growth to reproductive growth, the growth rate of the leaves became slow, the internodes of the stem were significantly elongated, at the same time, the growing cone had significantly increased in size and become long. The results imply that paraffin section can allow a preliminary judgment of lettuce period which can provide a foundation material for molecular studies of lettuce.

Introduction

As one of the most preferred leafy green vegetables, lettuce has some advantages, such as low investment, high yield, rich nutritional value and rapid growth. Although lettuce cultivation has expanded quickly, most varieties of lettuce sold in China are foreign varieties. Furthermore, because lettuce prefers cold climates, the high temperatures in summer usually cause early bolting, which can seriously affect the eating texture and market price of the vegetable [1]. Therefore, detecting specific phenotypic changes between and after bolting can provide a theoretical basis for further study of lettuce bolting. Recent studies have mainly focused on the nutritional quality [2, 3], gene research [4,5], and hydroponics[6] of lettuce but have rarely considered the effect of the changes of lettuce before and after bolting stage. Therefore, in this experiment, we determination the morphological changes in different lettuce period stage, and were proved by paraffin section, which will provide a theoretical basis for further study on bolting in lettuce.

Materials and Methods

Cultivation of Experimental Materials

The tested materials were samples of the self-cultivated variety “PS11”. We selected healthy, full seeds for pre-germination. When the radical appeared, the same seeds were sown in 50-hole cell trays filled with substrate (composition of substrate was peat: vermiculite: perlite =2:1:1) in growth chambers at 25/15 °C (day/night). The photoperiod was 14 h day/10 h night and was provided by a PRX-450D-30 climate incubator (approximately 220 mmolm⁻² s⁻¹). After the seedlings in the five-leaf stage were transplanted into pots. These seedlings were treated at different temperatures.

The samples were examined for three growth period.

Paraffin Section

The flower buds were washed with distilled water and fixed using glutaraldehyde fixative before being stored in a refrigerator at 4°C. We selected a safranin and fast green staining method to observe the cytologic observations. The samples were fixed, underwent 7 levels of dehydration and xylene transparency, and embedded before the sections were sliced, dewaxed, and stained with safranin and fast green before sealing. The slice thickness was 15 µm. The slices were observed under a microscope and photographed.

Results

Three typical periods of lettuce were selected by using morphological characterization. As shown in Figure 1, there were significant differences among them. Figure 1A shows that the lettuce in six leaf stage which also called vegetative growth period had not fully grown; the plant was small, the density was low, and there were no significant changes around the edges of the leaves. With the lettuce growing to the eve of bolting, the leaves were strong, the density was suitable, and the edges of the leaves were obviously curly and wavy (Figure 1B). During the eve of bloom, in other words, in the late of bolting stage (Figure 1C), lettuce was in the reproductive growth stage, the internode of the stem was significantly elongated and deepening of leaf color (Figure 1C).

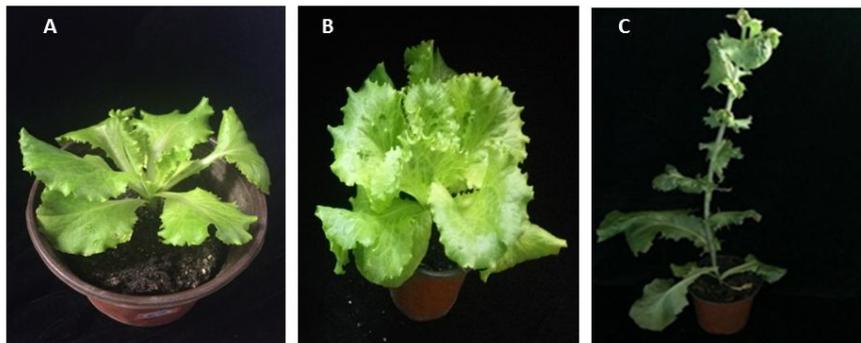


Figure 1. Morphological characterization of different bolting periods in lettuce

Fig. 1A shows six leaf stage of lettuce. Fig. 1B shows lettuce on the eve of bolting.

Fig. 1C shows lettuce that was on the eve of bloom, in other words, in the late of bolting stage.

Next, we selected several representative paraffin section pictures to describe the above bolting period of the lettuce. Figure 2 represents different period of stem tips. When lettuce is in vegetative growth period, the meristem of the shoot tips had a flat and smooth surface with young leaves and leaf primordia (Figure 2A). As the seedling grew, the lettuce began to transform from vegetative growth to reproductive growth, and the growing cone had increased in size and become long (Figure 2B). After bolting, the changes of growing cone are more obvious (Figure 2C).

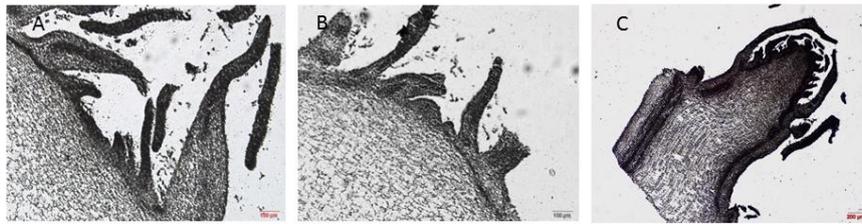


Figure 2. Paraffin sections of different period of lettuce.

Fig. 2 is a paraffin section corresponding to Fig. 1

Discussion

Bolting signifies the transition from vegetative to reproductive growth in lettuce and is a key period of plant [7]; thus, to explore the changes of different plant bolting stage is significant for further research. Bolting is influenced by such factors as light [8], temperature [9], water [10], and mineral nutrients [11], so in this paper, we guarantee the same growth conditions and avoid external interference to determinate the physiological index of lettuce. Three representative periods before and after bolting were determined. Morphological characterization shows that once the lettuces began to reproductive growth, the growth rate of the leaves became slow, the internodes of the stem were significantly elongated (Figure 1). Furthermore, combination of paraffin sections with morphological characterization allowed having a clear understanding of the apical meristem of lettuce, as the seedling grew, the lettuce transformed from vegetative growth to reproductive growth, and the growing cone had significantly increased in size and become long (Figure 2). Therefore, paraffin section can allow a preliminary judgment of lettuce period which can provide foundation materials for molecular studies of lettuce.

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