

Continuous observation of the number of flowers and seeds of dayflowers as a new teaching material for elementary school students

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Abstract.

Dayflowers (*Commelina communis*) are a one-year life plant and an angiosperm. Flowering in this plant is only in daytime and the unit of seeds consists of more than four seeds. This study was performed on one individual of dayflowers which naturally inhabited an round shaped transparent aquarium (30 cm diameter, 20cm hight) and kept near to the northern window of a laboratory and with mosses, soil and dead bodies of more than 50 adults of tettestrial isopode (*Armadillidium vulgare*) on the bottom. The number of flowers and the number of seeds in this individual are counted every day for more than 4 monthes from the beginning of June, 2016 till the death due to drying out of this individual. Water was supplied to the individual till the death every day. The aquarius was placed on the wooden table with height of 1 m which was faced at 30 cm to the northern glass window. The number of flowers were between 0 and 14 per one day, and the accumulurated number of seeds was 1005 (11th June – 13th October 2015). The peak number of flowers was about 12 in June and it was

gradually decreased and reached to zero in the late September. On the other hand, the peak of the number of seeds per one day was about 20 for one month from around 10th July and occurs in one month delaid season from the flowering. The observations of both flowing & making seeds and phototropism in dayflowers seem to be easy and suitable teaching materials for learning reproduction of angiosperm plants in science teaching scene in elementary school and junior and senior high schools.

Key words: Dayflowers, flowering, making seeds, observation, one year life

INTRODUCTION

Dayflowers (*Commelina communis*) are angiosperm and monocotyledonous plant and belong to Order: Dayflowers, and Family: Dayflowers. This is one year life plant. Flowers of this plant open in the morning and those close till the evening. Studies on Japanese dayflowers have been performed in several biological research fields. For example, Matsuo et al. (2009) studied on the relationsihp between temperature and the rate of seeds which germinated in two types of seeds (bigger and smaller ones). He showed that more than 85% of both types of seeds germinated under a wide range of 25°C to 40°C in a species of dayflowers. The ratio of germination was higher under light exposure by 20-30 % than that under darkness (Matsuo et al., 2003).

Tsuyama (1948) described detailed morphology of flowers of the plant, dayflowers. According to this manuscript, “flowers in this species consist of heart-shaped leaves as holdings inside which two branches as flowers-axis exist. One branch of the two is relatively thick and white colored with no hairs and it has one to four flowers (2 or 3 on average)”.

Nemoto and Sasaki (1993) showed that dayflowers can change their life strategy as an adaptation to light environment. For example,

dayflowers can spread their leaves close to the ground (0-10 cm) when they were implanted to hard and rough soils which were in open space, whereas the leaves have spread at higher places when the height of 20-30 cm from the ground was covered by black closes to shut down the light.

Dayflowers are competitive plants for growing products-plants for paddy fields and other agriculture field. Jo and Taniguchi (2011) reported that a herbicide, picric chloride was effective for deleting several weeds including dayflowers in Japanese radish field.

Daysflowers seem to an appropriate material for learning phototropism. However, there has no introduction of dayflowers as the teaching material for the phototropism. Research on phototropism can be back to the days of Charles Darwin and his son (Yamamoto, 2011). Two new findings on the phototropism by relatives to rice/wheat were made by them. one finding is that a blue light can induce the phototropism. Another one is that a sensory place to light is placed in an apical place of a stem, whereas the responding place to light is placed in the middle of the stem.

The first finding developed to further research on photoreception by the following scientists, and the second finding led to the discovery of Indol-Acetic-Acid (Auxin) which is the key hormone to be produced in the sensor place at the apical and transferred to the responding place of the phototropism (Tokutomi et al., 2008; Holland et al., 2009).

Goyal et al. (2003) reported molecular mechanism of photo receipt for phototropism. Phototropin is the most important photoreceptor for phototropism. Phytochrome and criptochrome can receive red light and blue light, respectively and are key substances for unsymmetrical growth of both side of a stem which causes phototropism. Various interactions among

different photo receiving pathways may control phototropism of angiosperm and cryptogam.

This study introduces an observation on flowering and making-seeds processes in a season from spring to autumn in dayflowers. Another observation of phototropism in dayflowers will be reported shortly. We will discuss whether the above two observations become new teaching materials in this text.

MATERIALS AND METHODS

Blooming and making seeds

About 100 individuals of tettestrial isopode (*Armadillidium vulgare*) were reared in December 2014 to April 2015 in a transparent and round-shaped aquarium (30 cm diameter, 20cm high) with mosses and with soil in the laboratory of biology, 5th floor of the third building, Faculty of Education, Kochi University. One individual of dayflowers grew in the aquarium and occupied all space of the aquarium. All alive tettestrial isopode individuals were removed. The aquarium was moved and located on a wooden table with 1 m height located 30 cm to northern window.

Because the individual of dayflowers showed clear phototropism of their leaves, the aquarium was rotated by 180° on 11th June 2015. On this date, the numbers of flowers and seeds made per day began to be counted everyday. Seeds of dayflowers were harved every day just after the counting. Water was supplied to the individual of dayflowers every day.

Observation of phototropism in dayflowers

On 11th June 2015, all leaves faced to northern direction. From the day when the aquarium was turned by 180°, photos of leaves were taken using degital camera from side, from upper angle and also from front every day after this date to examine the direction to which leaves were faced (Figure 1). The taking photo of leaves was continued for this individual to

become withered on 13th October 2015.

RESULTS AND DISCUSSION

Blooming and making seeds

Daily numbers of flowers and seeds made were varied 0 to 14 and 0 to 28, respectively. Accumulated number of flowers and seeds made is 241 and 1005, respectively (11th June - 13th October 2015). The number of flowers made per day was at maximum at the beginning of June 2015 and tended to be decreased gradually in the following 4 months (Pearson-test: $r=-0.239$, $p=0.053$) (Figure 2). The number of seeds was increased from the beginning of June to the beginning of August 2015 (Pearson-test: $r=0.476$, $p<0.001$) (Figure 3A). However, the number of seeds was decreased thereafter (Pearson-test: $r=-0.602$, $p<0.001$) (Figure 3B).

The peak of blooming was located in the middle of June to the middle of July 2015. On the other hand, seeds were made with maximum number in August 2015. It may take around 1.5 months for maturing seeds from blooming at 25°C-27°C of room temperature.

Observation of phototropism by dayflowers

The direction of all leaves which had been already grown (Figure 1A) was faced to northern direction to light source before the rotating of the aquarium. Thereafter, these old stems and leaves were drying out under the growing of new stems and leaves. Instead, new growth of stems and leaves occur facing to the direction of light source (north direction of lights from window) (Figure 1B, C).

Dayflowers as teaching materials for elementary school, junior and senior high schools students

Cultivation of dayflowers is relatively easy. If they can continue to supply water to them everyday, students are recommended to cultivate them from the stage of seeds in the class room. At the beginning of

new semester of April, the cultivation can start and the direction of aquarium as cultivation place can be rotated by 180° in the middle of growth of leaves and stems in June. Students can observe how new stems and leaves can grow facing to the direction of light source. They can also learn that dayflowers can grow their leaves by photosynthesis till the summer solstice to take reserves of energy and nutritional resources. They can also learn that energy and nutritional resource made by the photosynthesis can be transferred to seeds in the following 1 or 2 month(s). Dayflowers can be a good teaching material to learn seasonal adaptation of plants for elementary school students and also junior and senior school ones.

On the phototropism, a quantitative study as an observation of the direction of leaves and stems can be available for elementary school students. For junior and senior students, measurement of direction of leaves and stems can be available using photos taken by video camera from fixed positions. Such quantitative study is recommended for such senior students who can know the phenomena of phototropism in detail and lead to further understanding it.

Dayflowers are fine teaching materials to learn seasonal adaptation of plant growth, bloom and making seeds, and also to learn phototropism for elementary school students and also junior and senior schools students. Reasons of the suitability of dayflowers to science teaching materials are as follows. First, dayflowers are easy to be collected from the field for example in shores of water paddy fields. Second, blooming occurs only daytime of one day and easy to be counted. Third, seeds also easily can be detected and be easily harvested. Fourth, phototropism can be learned by observing clear facing of leaves and stems to the direction of light source, as a quick response.

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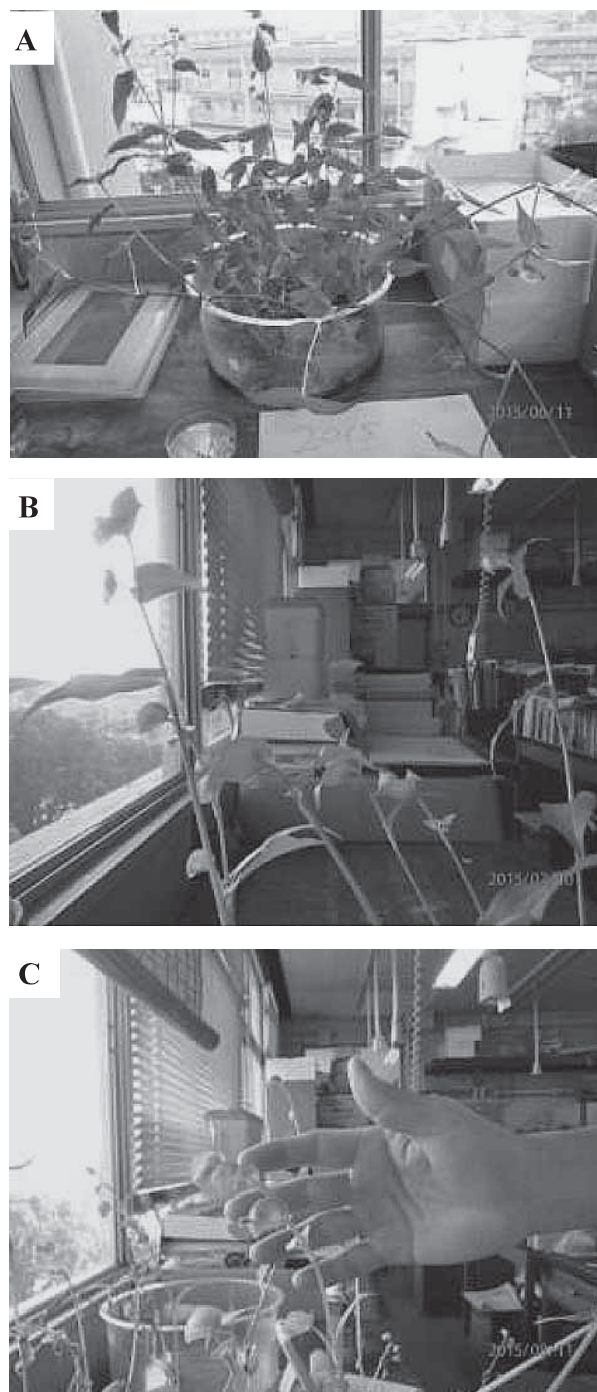


Figure 1: A aquarium which contains a individual of dayflowers was rotated by 180° on 11th June 2015 (A). All leaves faced to inside just after the rotation. After one month later, newly developed stems and leaves face outside into the light resource (B). After 2 months from the rotating, old stems and leaves withered but new stems and leaves which grow in upper place faced

outside into light resource (C).

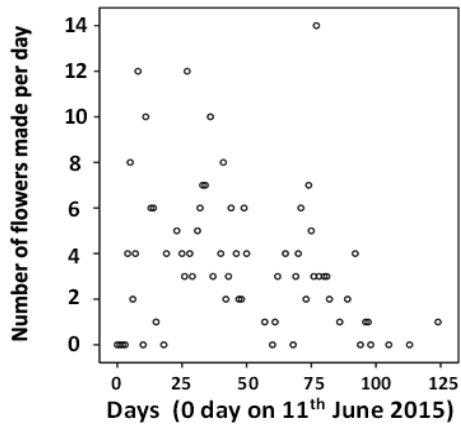


Figure 2: Time course of the number of blooming per day in dayflowers. The number of flowers was decreasing through July to August 2015.

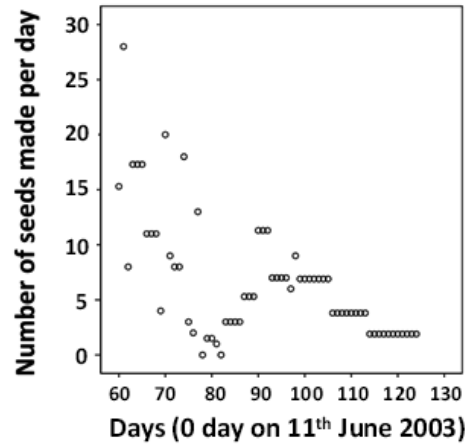


Figure 3-B: Time course of the number of seeds made per day in dayflowers. For 60 days in August to October 2015, the number was decreasing.

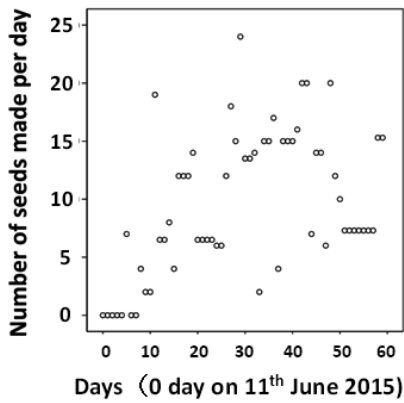


Figure 3-A: Time course of the number of seed per day in dayflowers. For 60 days in June and July 2015, the number was increasing.

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