Biological Characteristics of *Calystegia japonica*

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메꽃의 生物學的 特性

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ABSTRACT

The growth of *Calystegia japonica* Choisy as affected by pH, drying, burial, soil moisture and light intensity was determined. Germination of *C. japonica* rhizome was not affected by pH's ranging from 4.8 to 8.7, while the greatest growth after germination was obtained at pH 5.7. Drying longer than 14 h at 35°C brought about a significant reduction in percent survival and the subsequent growth of *C. japonica*. A significant decrease in growth of *C. japonica* occurred when the rhizome was buried at 0 cm and deeper than 8 cm. The greatest growth was obtained when the soil moisture content reached 40 to 60% of saturated soil. Increasing percent available light resulted in decrease in the plant height, but increase in the root length and dry weight.

Key words: Calystegia japonica, pH, drying, burial, soil moisture, light intensity.

INTRODUCTION

C. japonica is a serious perennial weed that occurs in upland crops and orchards throughout the country. Pyon and Lee (1982) reported that *C. japonica* was one of the most dominant weeds occurring in orchards in May. Ryang et al. (1984) determined the importance values of this weed decreasing from 76% in June to 18% in November in upland areas.

C. japonica belongs to the family Convolvulaceae. One distinguished feature of this weed in morphology is hastate leaf base. *C. japonica* resembles *Calystegia hederacea* Wall in appearance, but the entire leaf form differs. The former has narrower and longer leaf than the latter (Numata and Yoshizawa, 1975). Establishment and spread of this weed are accomplished by a high capacity for vegetative reproduction. However, propagation by seed does not occur (Numata and Yoshizawa, 1975). In upland fields many severed rhizomes of *C. japonica* are found after tillage done prior to planting. New plants are easily established from these rhizomes.

No information is available in the literature on the requirements for germination and growth of *C. japonica* rhizomes. Therefore, the experiments were designed to investigate the factors necessary for the growth of this plant.

MATERIALS AND METHODS

Rhizomes used in these experiments were collected from fields naturally infested with *C. japonica* in July, 1984 and were cut into small segments having one bud. Preliminary test revealed that the rhizomes were non-dormant. Unless otherwise

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stated, five rhizomes were planted 1 cm deep in sieved clay loam soil in plastic pot (14 cm in diameter by 18 cm deep) containing one drain hole in the bottom. The soil was maintained at approximately 60 to 80% field capacity by frequent watering. All the pots were placed under natural conditions. Dry weights were determined after the plant parts were dried at 100°C for 24 h. All treatments were replicated four times.

pH Rhizomes were placed in a 250ml Erlenmeyer flask on Toyo No. 2 filter paper with pH buffer solution. Various pH solutions ranging from 4.8 to 8.7 were prepared using 0.1M-KH_2PO_4 with 0.1M-K_2HPO_4. Ten ml of the solution were added to each flask. After placing the flasks at room temperature (approximately 22°C), the dry weight was determined 10 days after planting.

Drying Rhizomes were placed in dry storage at 35°C. The rhizomes were removed from the storage 2, 6, 10, 14 and 18 h later, and were planted in the pots. The percent survival and the growth of survived plants were recorded 2 weeks after planting (WAT).

Burial Rhizomes were planted at depths of 0, 2, 4, 6, 8 and 10 cm in plastic pots. Plant height, dry weight and total length of newly formed rhizomes were determined 4 WAT.

Soil moisture Rhizomes were planted at 20, 40, 60, 80 and 100% soil moisture of saturated soil. To maintain the saturated condition for 100% soil moisture, amount of water per pot lost for one day was measured each day by adding water to saturation. For other levels of soil moisture amounts of water to be added each day were determined from percentage corresponding to respective moisture levels times the amount of water per pot required for saturation. The plants were harvested to determine plant height, root length, number of leaves and dry weight 2 WAT.

Light intensity A rectangular frame was covered with black polyethylene net and then the pots were placed in the frame. Light intensity inside the frame was measured at 1300 hours daily during the experimental period and averaged. The light intensity was expressed in terms of available light relative to 100% light. plant height, root length, number of leaves and dry weight were counted 3 WAT.

RESULTS AND DISCUSSION

pH Germination of *C. japonica* rhizomes was not affected by pH's ranging from 4.8 to 8.7 (data not presented). However, difference in the subsequent growth of *C. japonica* as affected by pH was observed (Fig. 1). Dry weight of *C. japonica* was greatest at pH 5.7. As the pH decreased or increased, the dry weight decreased. At pH's between 6.7 and 8.7 there was no significant difference in the dry weight. Thus, optimum pH for growth appeared to be around 5.7. The results indicated that pH would not be a limiting factor for germination and growth of *C. japonica*. In upland areas, the soil pH does not often reach below 4.8 and above 8.7. Ryang and Chun (1982) reported that average pH of upland soils in Korea is 5.7.

Drying Viability and growth of *C. japonica* rhizomes varied with length of drying (Table 1.). Percent survival of rhizomes was not affected by drying for 2 to 10 h. However, drying for 14 h resulted in great decrease in percent survival. No

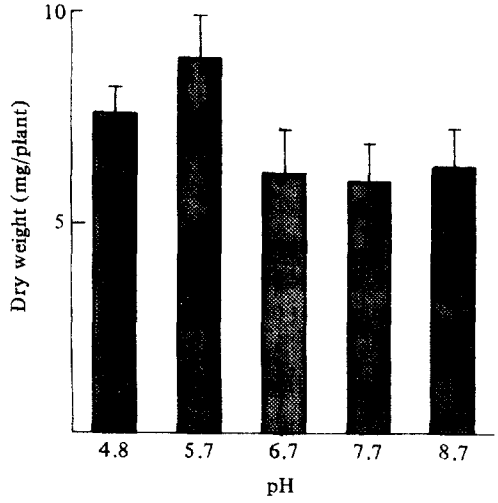

Fig. 1. Effect of pH on growth of *Calystegia japonica* rhizome. Means and standard deviations are presented.

Table 1. Effect of drying on growth of *Calystegia japonica* rhizome.[a]

Period of drying (h)	Percent survival (%)	Plant height (cm)	Root length (cm)	Number of leaves (No.)	Dry weight (mg/plant)
2	100	18.3a	3.7a	3.7a	26a
6	100	10.5b	3.1a	3.5a	18b
10	100	11.5b	3.8a	3.5a	20b
14	25	7.3c	1.4b	3.6b	12c
18	0	0 d	0 b	0 b	0d

[a]In a column, means followed by a common letter are not significantly different at the 5% level by Duncan's multiple range test.

Table 2. Effect of depth of buring of growth of *Calystegia japonica* rhizome.[a]

Depth of burying (cm)	Plant height (cm)	Dry weight (mg/plant)	Length of new rhizomes (cm/plant)
0	6.8b	121c	3.6c
2	9.5ab	179b	16.7a
4	11.7a	256a	19.3a
6	10.4a	177b	17.7a
8	10.5a	188b	10.1b
10	8.6b	132c	5.3bc

[a]In a column, means followed by a common letter are not significantly different at the 5% level by Duncan's multiple range test.

survived rhizomes were found with drying for 18 h.

Subsequent growth of *C. japonica* rhizomes after drying was influenced. Plant height decreased significantly with increasing length of drying, while root length and number of leaves were not greatly affected by drying. A significant decrease in dry weight due to increasing length of drying was also observed. The effects may be attributed to reduction of moisture content in the rhizomes. Visperas (1975 as cited in Mercado, 1979) determined decreased moisture contents of *Scirpus maritimus* L. tubers with increasing days of drying, resulting in decrease in germination.

Burial There was no significant decrease in plant heights of *C. japonica* emerged between 2 and 8 cm deep (Table 2). A significant decrease in plant height was obtained from rhizomes planted 0 and 10 cm deep. Growth of *C. japonica* as affected by burial depths was more obvious in dry weight than in plant height. The greatest dry weight was obtained when the rhizomes were buried 4 cm deep, whereas burial shallower or deeper than 4 cm resulted in significant reduction in dry weight. Production of new rhizomes was also affected by burial depths. The total length of rhizomes newly formed was greatest when buried 4 cm deep, but least when buried 0 cm deep. Decrease in the growth of *C. japonica* emerged 0 cm deep was due probably to partial desiccation of the rhizomes. However, delayed emergence of *C. japonica* buried 10 cm deep resulted in decrease in the growth.

Soil moisture *C. japonica* required 40 to 60% soil moisture content of saturated soil for the optimum growth (Table 3). Although there was no significant decrease in plant height, root length and number of leaves between soil moisture contents ranging from 40 to 80%, dry weight decreased significantly at 80% soil moisture content. When the soil moisture content decreased from 60 to 20%, reductions of 89, 75, 81 and 85% were recorded in the plant height, root length, number of leaves and dry weight, respectively. On the other hand, *C. japonica* did not survive at 100% soil moisture content. The results indicated that *C. japonica*

Table 3. Effect of soil moisture on growth of *Calystegia japonica*[a].

Soil moisture (%)	Plant height (cm)	Root length (cm)	Number of leaves (No.)	Dry weight (mg/plant)
100	0 b	0 b	0 b	0 c
80	17.8 a	3.9 ab	5.0 a	14 b
60	19.2 a	8.6 a	5.3 a	20 a
40	15.4 a	5.1 a	4.5 a	17 ab
20	2.0 b	2.1 b	1.0 b	3 c

[a]In a column, means followed by a common letter are not significantly different at the 5% level by Duncan's multiple range test.

Table 4. Effect of light intensity on growth of *Calystegia japonica*[a].

Available light (%)	Plant height (cm)	Root length (cm)	Number of leave (No.)	Dry weight (mg/plant)
100	7.4 c	18.3 a	9.6 a	166 a
30	21.7 b	12.8 b	10.0 a	97 b
10	21.3 b	8.8 c	8.8 a	38 c
2	36.6 a	8.5 c	9.1 a	36 c

[a]In a column, means followed by a common letter are not significantly different at the 5% level by Duncan's multiple range test.

was relatively sensitive to both high and low soil moisture conditions.

Light intensity Variations in light intensity markedly influenced the growth of *C. japonica*. Decrease in light intensity resulted in increase in plant height (Table 4). When available light reduced to 2%, the plant height was five times taller than that when subjected to 100% light. A reversed trend was obtained in root length. The root length decreasingly responded to decrease in light intensity. However, there were no significant differences due to light intensity in number of leaves. On the other hand, a marked reduction in dry matter was observed when the light intensity decreased from 100% to 10% available light, whereas no further decrease occurred at 2% available light. This indicates that *C. japonica* is sensitive to high levels of light intensity, but less sensitive to low levels of light intensity. It suggests that *C. japonica* can be considered as a shade-tolerant plant.

Results from this study provide some practical significances. Manipulation of soil factors such as pH would not be a proper treatment towards control of this weed, since the weed is relatively tolerant to a wide range of pH. However, tillage practices are predicted to reduce persistence of *C. japonica* rhizomes in soil. Although tillage tends to distribute rhizomes uniformly through the soil profile, the rhizomes buried at depths of 8 cm or deeper result in decrease in the growth. On the other hand, imposing soil moisture at or near saturation or continuous drying would be detrimental to *C. japonica* rhizomes placed at shallower depths.

摘　　要

田作 및 果樹園의 主要 多年生 雜草의 하나인 메꽃(*Calystegia japonica* Choisy)의 生育에 미치는 pH, 乾燥時間, 發生深度, 土壤水分 및 光度의 影響을 調査하였다. 메꽃 地下莖의 發芽는 pH 4.8부터 pH 8.7 사이에서는 影響을 받지 않았으나, 發芽後의 生育은 pH 5.7에서 가장 좋았다. 地下莖 生存率은 35℃에서 14時間 以上 乾燥되면 急激하게 減少되고, 生存되더라도 그 生育은 극히 低調하였으며, 發生深度가 0cm 혹은 8cm 以下로 될 때에는 生育이 크게 떨어졌다. 土壤水分 40～60%가 生育에 最適水準이었다. 메꽃의 草長은 光度의 增加로 減少되었지만, 根長과 乾物重은 增加하였다.

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