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Growth and Development of *Commelina benghalensis* L. from Four Seed Types

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Commelina benghalensis L.의 생장 연구

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ABSTRACT

The experiment was conducted to study the growth, developmental pattern, and seed production of *Commelina benghalensis* L. grown from four seed types; large and small aerial seeds, and large and small underground seeds. Plants from the four seed types differed in growth rate. Based on dry weight and leaf area, plants from large underground seeds emerged and grew faster in the first 2-4 weeks after seeding(WAS) but plants from small aerial seeds grew faster during the 4-6 WAS; thereafter, there was no significant difference in growth rate among plants from the four seed types.

Based on seed production, plants from large aerial seed produced more seeds(1473) than those from small seeds(1006). Small aerial types represented 75-77% of the total seed production, large aerial seed 21-23%; only 2-4% were underground seeds.

The results suggest that the plants from large underground seeds might have better competitive ability than those of small aerial seeds during the early growth stage due to faster germination and higher dry matter production.

Key words : *Commelina benghalensis*, growth, development, seed production

INTRODUCTION

Commelina benghalensis L. is considered one of destructive weeds in tropical, subtropical, and temperate parts of the world.; it causes major crop yield and quality losses[8]. It behaves as perennial in tropical and subtropical areas, but only as an annual in some temperate zone countries. It reproduces by seed and by stolon[2].

C. benghalensis is important because it is persistent in cultivated lands and difficult to control. Under moist conditions, the seed grows rapidly, form dense mat, and can smother low-growing crops such as vegetables and cereals[2]. Budd et al.[1] observed that *C. benghalensis* roots readily

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at the nodes of the creeping stems or cuttings broken in cultivation. The ability to grow rapidly from vegetative cutting makes this especially difficult to control in the field[2].

C. benghalensis has been described in detail by Maheswari and Maheswari[5]. The biology of this weed species, including its seed dormancy, germination, growth, and development, has been reported by Walker and Evenson[6,7]. This weed produces four seed types : two are underground and two aerial. Freshly harvested aerial seeds and small underground seeds are highly dormant because of their hard seed coat[3,4,7]. Such coat-imposed dormancy not only controls time of germination of seeds but also influences their persistence in soil.

The differential germination behavior of the four seeds types can lead to potential weediness in many countries. Moreover, a rapid vegetative growth and ability to regrow from node cutting makes a formidable weed species[2]. Despite its seriousness, information on growth and development, reproductive behavior of four seed types of *C. benghalesis* is limited. An understanding of the growth and developmental pattern may help in developing strategies to control *C. benghalensis*. Therefore, this study was carried out to obtain a basic information on the growth and development of plants from four types of *C. benghalensis* seeds.

MATERIALS AND METHODS

Seed Collection and Separation

Mature aerial and underground fruits of *C. benghalensis* were hand picked in farmer's field in Los Baños, in Philippines. Seeds were classified into four groups according to their morphological differences and position in the fruits--a large aerial seed(mean weight, 5.2mg with a range of 4.0-6.1 mg; seed dimension, length × width × thickness, 2.8 × 1.9 × 1.2mm), a small aerial seed(3.2mg, 2.6-3.8 mg, 2.1 × 1.5 × 1.2mm), a large underground seed (11.5mg, 8.3-13.33mg, 4.4 × 2.4 × 1.7mm), and a small underground seed(5.4mg, 4.4-6.4mg, 2.2 × 2.2 × 1.5mm)

Plant Establishment

The experiment was carried out in the open area of Agronomy Unit at the International Rice Research Institute. Seeds of four seeds types were clipped by cutting in the hilum region of each seed with a sharp blade to overcome innate dormancy. Ten seeds of each type were placed at a depth of 1cm in a plastic tray(30 × 21 × 11cm) filled with silty loam soil(pH 5,5, organic matter 1.51%, CEC 23(100meq/100g). The trays were set on benches and exposed to the weather. The seedling were thinned to one per pot at 1-leaf stage. After thinning, urea at 100kg/ha was applied. Seeds were planted in July and final harvest was in September, 14 WAS.

Destructive samplings of all replicates were done at 2, 4, 6, 8, 10 and 14 WAS. Leaf area, dry weight and number of aerial and underground fruits per plant were measured at each sampling time to calculate relative growth rate(RGR) and net assmilation rate(NAR). The experiment was replicated four times per sampling and laid out in a factorial design(four seed types × 6 sampling times).

RESULTS AND DISCUSSION

Variation at Different Growth Stages

As seedling from the four seed types developed, variation in leaf area and dry weight became evident. Plants from large underground seeds grew faster and more vigorously than those from the three other types during the first 4 weeks as indicated by the greater dry matter production and leaf area(Table 1). Plants from small seeds were relatively small. After 6 weeks, seedling from the

four seed type showed no significant difference in dry weight and leaf area. Walker and Evenson[6] reported that dry weight of plants from the four seed types did not differ throughout the growing period.

The RGR of plants from the four types of seeds during the 2-4 WAS was very similar, but the contribution of the NAR to RGR was different (Table 2). Plants from small underground and aerial seed had a higher capacity to produce dry matter per unit leaf area than plants from large seeds. During the 4-6 WAS the RGR of plants from small aerial seed was greater than that of plants from the three other types, although the dry weights of the whole plants were similar. That was attributed to the higher capacity of small aerial seeds to increase dry weight in terms of the area of its assimilatory surface. This result

Table 1. Leaf area and dry weight of *Commelina benghalensis* grown from four seed types at different growth stages.

Growth stage (week)	Large underground Seed	Small underground seed	Large aerial seed	Small aerial seed	LSD (0.05)
			Leaf Area (cm^2)		
2	16	11	11	5	1
4	486	338	417	229	50
6	1234	1154	1277	1213	ns
8	1679	1540	1516	1462	ns
10	999	859	982	847	ns
14	-	-	-	-	-
			Dry Weight (g)		
2	0.05	0.03	0.03	0.02	0.0
4	2.8	2.0	2.3	1.4	0.4
6	15.0	13.4	15.8	15.3	ns
8	28.7	30.1	24.3	25.3	ns
10	29.4	25.3	26.2	25.7	ns
14	28.6	23.2	23.7	20.0	ns

ns = Not significant

Table 2. Relative growth rate and net assimilation rate of *Commelina benghalensis* from four seed types at different growth stages.

Growth stage (week)	Large underground Seed	Small underground seed	Large aerial seed	Small aerial seed	LSD (0.05)
			Relative Growth Rate (mg/mg/day)		
2 - 4	309	304	308	300	ns
4 - 6	121	124	138	174	9
6 - 8	49	53	31	35	ns
8 - 10	43	-13	5	1	ns
			Net Assimilation Rate ($mg/cm^2/day$)		
2 - 4	1.30	1.68	1.03	1.50	0.4
4 - 6	1.33	1.13	1.13	1.63	0.3
6 - 8	0.68	0.63	0.27	0.41	ns
8 - 10	0.03	-0.03	0.12	0.03	ns

ns = Not significant

suggests that different seed types would show different growth rates and, thus, different competitive abilities, depending on the growth of the associated crop. Walker and Evenson[6] also found differences in growth rate of plants grown from the four seed types.

The plants from large underground seeds might have better competitive ability than those from small aerial seeds during early growth stage because of faster germination and higher dry matter production.

Seed Production

Aerial flowers had started to develop between 4-6 WAS together with underground flowers(Fig. 1A). Numbers of underground fruits per plant were similar(Fig 1B). More aerial fruits were produced on plants from large seeds than from small seeds(Table 3).

The four seed types had similar numbers of underground fruits per plant. The number of seeds per plant followed the same trend as the fruit number. Total seed production from the four seed types was from 1006 to 1437. Plants from large aerial and underground seeds produced more seeds than those from small aerial seeds. The results reported here disagree with the findings of walker and Evenson(1985a) who reported that more aerial fruits were produced on plants from aerial than from underground seeds.

A greater number of aerial than underground fruits was produced on plants from each seed type. Aerial fruits contained one large and three and four small seeds, whereas underground fruits contained one large and one to three small seeds. The greatest number of seeds produced was of the small aerial types, representing 75-77% of the total; large aerial seeds represented 21-23%. The total number of underground seeds represents only 2-4%. This suggests that aerial seeds function mainly in increasing the distribution of the species within its habitat.

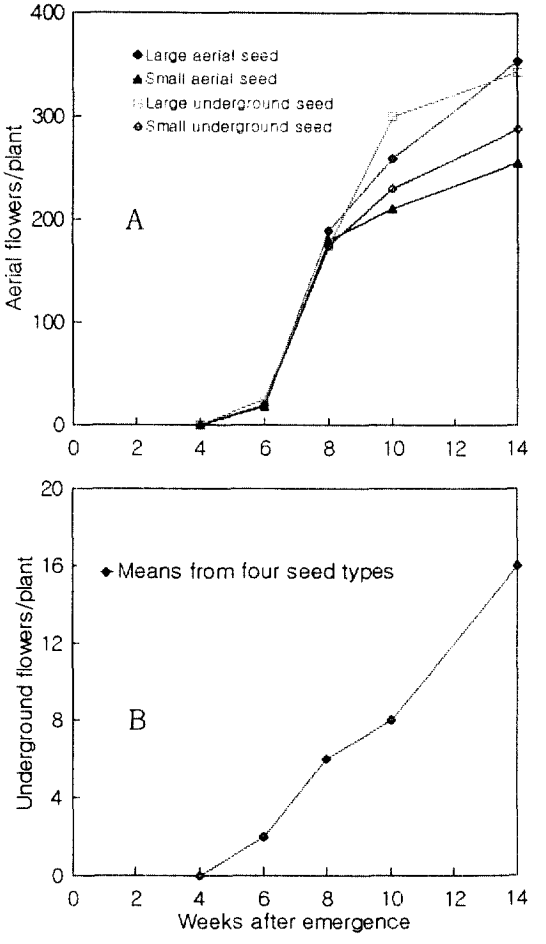

Fig. 1. Changes with time in aerial flowers (A) and underground flower development (B) on plants grown from the four seed types.

However, aerial seed germination is more strictly influenced by the environment. Since aerial seeds germinate on the soil surface, a favorable combination of environmental factors is a prerequisite to their germination and establishment. Also, seedlings germinated from thess seeds come almost exclusively from seeds situated at or near the soil surface ; therefore, they should be vulnerable to control by herbicides[1].

On the other hand, although the number of underground seeds produced was smaller, these seeds, particularly the large ones, were considered

Table 3. Seed production of *Commelina benghalensis* plants grown from four seed types.

Attribute	Seed production (no.) from				
	Large aerial	Small aerial	Large underground	Small underground	LSD (0.05)
Fruit per plant					
Aerial	354	256	344	288	55
Underground	14	12	22	19	ns
Seed per fruit					
Large aerial	0.9	0.9	0.8	0.9	ns
Small aerial	3.1	3.0	2.8	3.2	ns
Large underground	0.8	0.7	0.7	0.7	ns
Small underground	1.4	1.1	1.2	1.4	ns
Seed per plant					
Large aerial	305	223	283	245	55
Small aerial	1102	762	965	915	200
Large underground	12	8	15	12	ns
Small underground	18	13	26	20	ns
Total	1437	1006	1289	1192	223

ns = Not significant

important for survival of the species[6]. They are better protected from extremes of climate, herbicides, and foraging animals than are the aerial fruits[1]. All those characteristics can ensure the survival of the large underground seeds.

摘 要

크기가 다른 4종류의 종자를 생산하는 *C. benghalensis*의 생장 및 종자 생산 양상을 조사한 결과는 다음과 같다.

1. 4종류의 종자에서 자란 식물의 생장 및 종자생산 양상은 서로 달랐다. 파종후 생장은 지하부 굵은종자에서 유래된 식물이 다른 종자에서 자란 것보다 초기 2-4주 사이에 생장이 빨랐으나 지상부 작은 종자에서 유래된 것은 2-6주 사이에 빨랐다.
2. 종자 생산량은 지상부 작은 종자가 75-77%로 대부분을 차지하였고 그 다음이 지상부 큰 종자(21-23%)였으며 지하부 종자는 2-4%로 작았다.

이상의 결과에서 *C. benghalensis*에서 생산하는 4종류의 종자중에서 지하부 굵은 종자는 지상부 작은종자보다 초기에 경합력이 크고 *C. benghalensis*는 불량한 환경에도 잘 적응할 수 있을 것으로 사료된다.

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