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Aspects of Germination, Emergence, and Seed Production of Three *Ipomoea* Taxa[1]

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Abstract. The influence of seed age, planting depth, and temperature on the germination and emergence of ivyleaf morningglory [*Ipomoea hederacea* (L.) Jacq. var. *hederacea*], white morningglory *(Ipomoea lacunosa* L.), and entireleaf morningglory *(Ipomoea hederacea* var. *integriuscula* Gray) was studied by using pure seed of each taxa that were collected in 1972, 1973, and 1974. Germination of acid-scarified white and entireleaf morningglory seed ranged from 64 to 98% at continuous 20, 25, 30, 35, and 40 C and at an alternating 20/30 C cycle. The ivyleaf morningglory germination range was 50 to 98% at these temperatures, except at 40 C germination was <25%. Germination of nonscarified seed was generally 30 to 60% lower than scarified seed for the three taxa. Germination of seed collected in 1972 for all three taxa was less than 10% with 6 days of exposure to 45 C and 100% relative humidity, and germination of seed collected in 1973 and 1974 ceased with 12 days of exposure. Maximum emergence for all taxa occurred at planting depths of 1.3 and 2.5 cm. Seed age influenced seedling emergence of white morningglory and ivyleaf morningglory but not entireleaf morningglory. Total numbers of seed produced per plant for white, entireleaf, and ivyleaf morningglory were 15,200, 14,600, and 5,800, respectively.

Additional index words. Seed age, temperature, planting depth, nonscarified, scarified.

INTRODUCTION

Ivyleaf morningglory, white morningglory, and entireleaf morningglory are troublesome annual vines that infest many horticultural and agronomic crops. These taxa are distributed throughout the central and southern United States.

There is evidence that the viability of many weed seeds results from their innately developed impermeable seed coats or from a hardness developed after burial in the soil (2, 6, 10). Some classic seed burial experiments showed that many species maintained their viability in storage or in undisturbed soil for more than 30 yr. From Duvel's buried seed experiment, Toole and Brown (10) reported that germination of white morningglory, after burial for 39 yr at depths of 55 and 105 cm, was 31 and 21%, respectively. They attributed the inhibition of germination to an insufficient oxygen supply, as the seed germinated when they were brought to the soil surface.

Stoller and Wax (9) reported that a large proportion of buried ivyleaf morningglory seed developed seed hardness after one winter in the soil. They considered hard seed coats to be the principle mechanism for seed survival after 3 yr. Purple moonflower *(Ipomoea turbinata* Lagasca y Segura) seed longevity in the soil is also attributed to a hard seed coat (4).

Lewis (8), investigating the relationship of burial depth, soil type, and water table level on the survival of some crop and weed seeds, observed that the water table level had the greatest effect on survival. Seeds placed below the water table for periods of up to 2 months remained dormant. Bruns and Rasmussen (3) stated that storage in fresh water increased the percentage germination of field bindweed *(Convolvulus arvensis* L.) over a 5-yr period.

Cole and Coats (5), observing the effect of temperature on seedling emergence of tall morningglory [*Ipomoea purpurea* (L.) Roth.], noted that this species could germinate and become established over a temperature range of 15 to 35 C. They observed that germination and dry-weight transfer from the cotyledons to the root-hypocotyl were slower at the lower temperature, although both occurred.

Maximum emergence of 70% for purple moonflower occurred in a range from 2.5 to 7.5 cm, with 40% emergence occurring from 15 cm (4). Under field conditions, tall morningglory and ivyleaf morningglory emergence was greater than 50% when buried to a depth of 7.5 cm in sandy loam or 5.0 cm in silt loam (11).

The objective of this study was to evaluate the influence of seed age, planting depth, and temperature on the germination and emergence of three *Ipomoea* taxa. Seed production by each taxon was also monitored.

MATERIALS AND METHODS

Studies were conducted at the Southern Weed Science Laboratory, Stoneville, Mississippi and the Noble Pace Seed Technology Laboratory, Mississippi State, Mississippi during 1975 and 1976. Pure seed of each *Ipomoea* taxon for 1972, 1973, and 1974 were collected from a weed nursery at Stoneville. After processing, the seed were stored at a constant 5 C in the dark. After April 15, 1975, they were stored for 1 to 8 months at 22 C until used in the following studies. Seeds were scarified by submerging them for 1 h in concentrated sulfuric acid. Then they were removed from the acid, rinsed for 15 min in running water and air-dried. The data were subjected to analysis of variance and the means separated by Duncan's new multiple range test.

Accelerated seed aging. The effect of seed aging was studied by the procedures of Delouche and Baskin (7). The aging chamber was maintained at 45 ± 0.5 C and 100% relative humidity. Nonscarified seed from each taxon and seed age were put into small wire baskets and placed in the aging chamber. Two samples of 50 seed each were removed every day through 8 days, every other day from 10 through 20 days and every fourth day from 24 through 36 days. The seed were germinated at an alternating 20/30 C, as prescribed by the Association of Official Seed Analysts (1), and germination counts were made at 4, 14, and 21 days. After 14 days any firm seed were pricked to allow water imbibition and completion of germination. The number of seed germinating and those with hard impermeable seed coats at 14 days are reported.

Germination response to temperature. To determine the ef-

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fect of temperature on germination, nonscarified and scarified seed were germinated at continuous 20, 25, 30, 35, 40 C, or at a 12 h alternating 20/30 C cycle. The percentage of germination of four replications of 25 seed of each taxon and seed age was recorded after 4 and 14 days.

Seedling emergence. The influence of taxa and seed age on emergence from varying soil depths was evaluated in greenhouse studies. The planting depths ranged from 1 to 20 cm in 30-cm clay pots, with five replications of 10 seed per depth. The seed were planted in Bosket sandy loam and the soil saturated with water after planting. Seedlings were considered emerged when the cotyledons were entirely above the soil surface. Emergence was recorded daily for 30 days.

Seed production. Under noncompetitive field conditions, the number of seed pods and seed produced by individual plants for each taxon was determined at weekly intervals. The seed of each taxon were planted on June 2, 1975 in a Bosket sandy loam in a randomized complete block design with three replications.

RESULTS AND DISCUSSION

Accelerated seed aging. With 6 days of exposure to accelerated aging germination of white morningglory seed that were produced in 1973 and 1974 remained above 75%, but by 12 days germination had declined to zero (Figure 1A). The percent of such seed with hard seed coats was less than 15% (Figure 1B). Germination of white morningglory seed produced in 1972 was highest (50%) after 2 days of accelerated aging and then it declined rapidly to almost 0 with 8 days of exposure. The percentage of hard seed produced in 1972 ranged from 32 to 66% at all exposures to accelerated aging.

Ivyleaf morningglory seed produced in 1974 had a high initial germination of 80%, but then it deteriorated to zero with 12 days of exposure to accelerated aging (Figure 2A). The percentage of this seed with hard seed coats remained constant at around 20% (Figure 2B). Initial germination of the 1973 ivyleaf morningglory seed ranged from 40 to 50% but then it declined to zero with 12 days of exposure. The percentage of this seed with hard seed coats fluctuated between 26 and 64%, with a mean of 48%. The highest germination of the 1972 ivyleaf morningglory seed was 52%. Germination ceased after 6 days of exposure, but the percentage of this seed with hard seed coats ranged from 54 to 86%, with a mean of 69%.

Germination for all seed ages of entireleaf morningglory ranged between 74 and 82%, with the capacity to germinate terminating with 6 days of exposure for the 1972 seed and with 12 days for the 1973 and 1974 seed (Figure 3A). The percentage of hard seeds for the 1973 and 1974 seed ranged from 5 to 20% (Figure 3B). The percentage of hard seed from the 1972 seed lot ranged from 6 to 28%, except that seed exposed to aging for 8, 12, 18, or 36 days ranged from 54 to

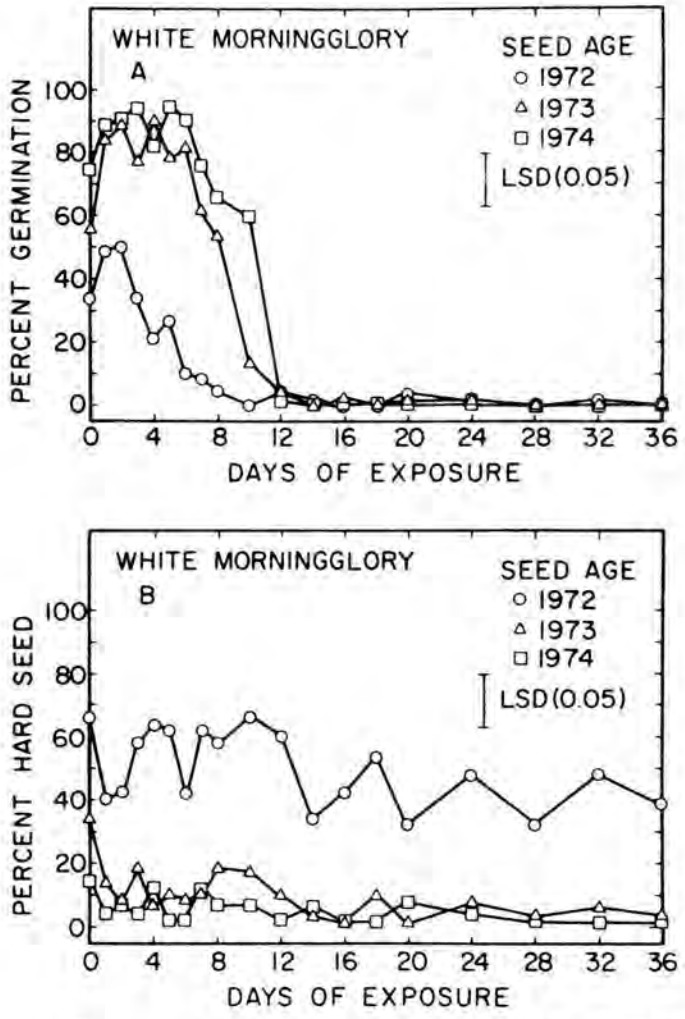

Figure 1. Percentage germination (A) and hard seed (B) of white morningglory seed for three seed ages after accelerated aging and subsequent germination at 20/30 C.

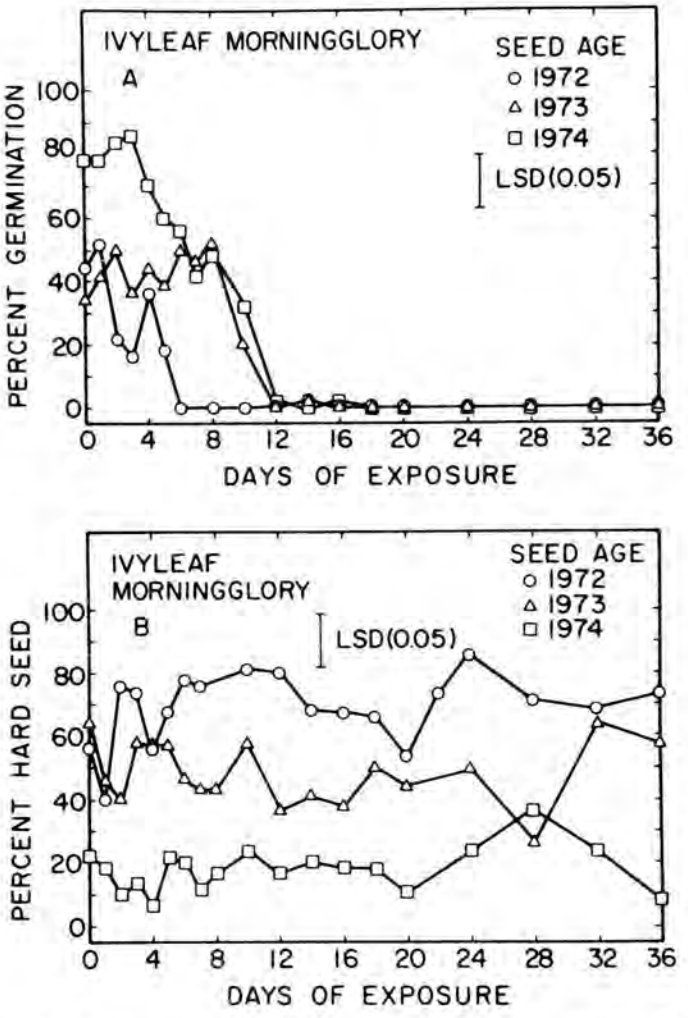

Figure 2. Percentage germination (A) and hard seed (B) of ivyleaf morningglory seed for three seed ages after accelerated aging and subsequent germination at 20/30 C.

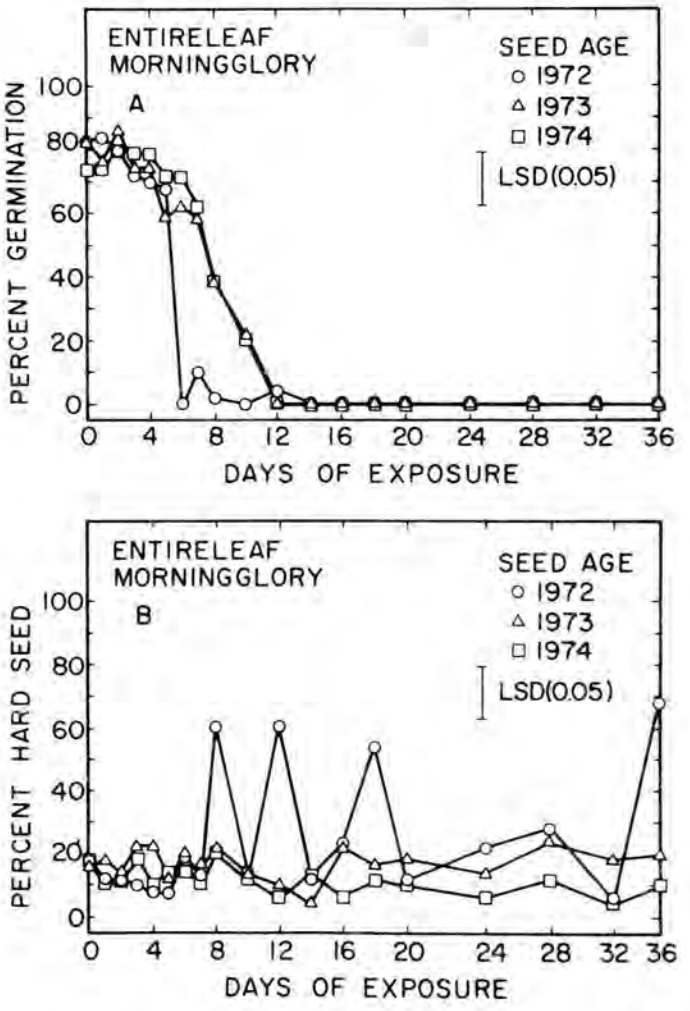

Figure 3. Percentage germination (A) and hard seed (B) of entireleaf morningglory seed for three seed ages after accelerated aging and subsequent germination at 20/30 C.

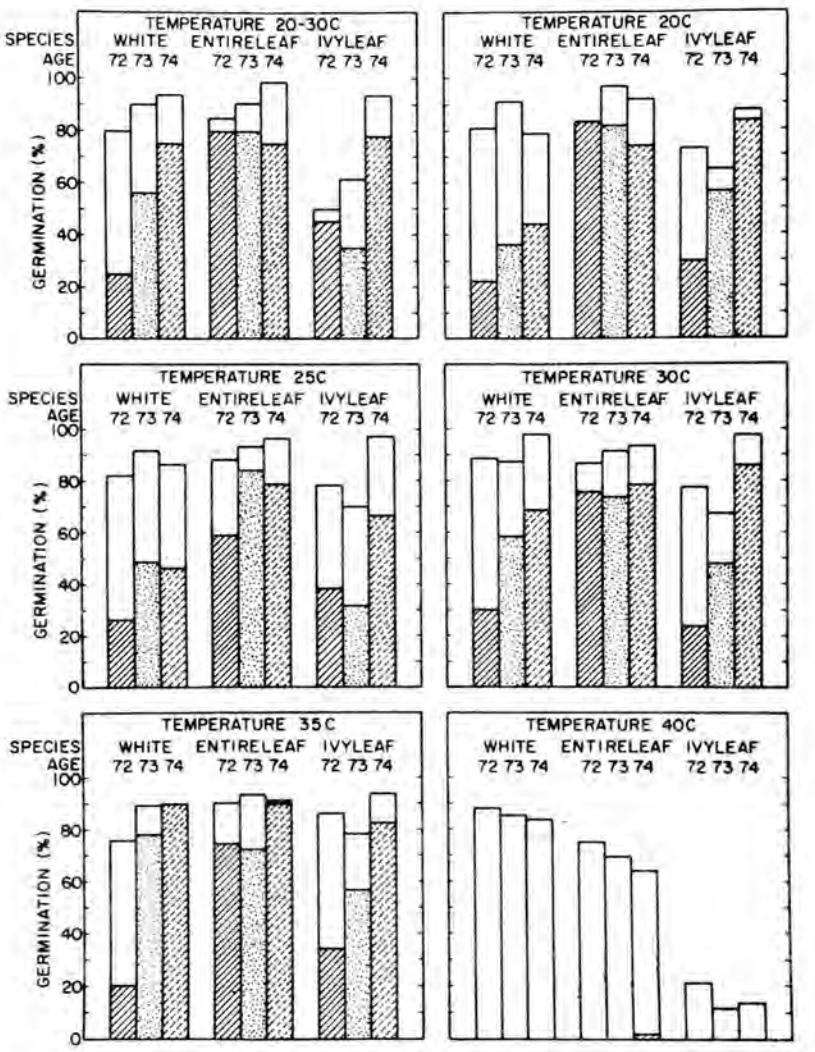

Figure 4. The influence of age, temperature, and scarification on the germination of white, entireleaf, and ivyleaf morningglory seed. Shaded bars represent nonscarified seed and the nonshaded bars represent acid-scarified seed. The LSD's (0.05) for acid-scarified and nonscarified seed were 10 and 9%, respectively.

68%.

In general, all three species lost their ability to germinate when seed were exposed to aging for 6 to 12 days. Further, the percentage of hard seed increased for white and ivyleaf morningglory the longer the seed were kept in storage.

Germination response to temperature. The influence of temperature on the germination of nonscarified and scarified seed of the three *Ipomoea* taxa, each at three ages is presented in Figure 4. Nonscarified seed failed to germinate at 40 C for all taxa, except for the 1974 seed of entireleaf morningglory, which showed 2% germination. Germination of entireleaf morningglory seed ranged between 60 and 90% at all other temperatures. White morningglory seed from 1973 and 1974 germinated best at continuous 35 C, with germination percentages being 78 and 90%, respectively. The germination of white morningglory seed from 1972 was less than 30% for all temperatures. Germination of the 1974, 1973, and 1972 ivyleaf morningglory seed ranged from 66 to 86%, 35 to 56%, and 24 to 45%, respectively for all temperatures, except seed at 40 C did not germinate. The average germination of seed for all taxa produced in 1972, 1973, and 1974 was 37, 49, and 62%, respectively. Averaged across seed age and germination temperature, germination of entireleaf morningglory seed was 20% higher than that of white or ivyleaf morningglory.

Germination of acid-scarified seed of white morningglory for all seed ages ranged from 74 to 98% at all temperatures studied. Eighty-four to 98% of the entireleaf morningglory seed germinated at all temperatures, except at 40 C the range was only 64 to 75%. In contrast, ivyleaf morningglory seed germinated 14 to 21% at 40 C. At the other temperatures the 1974 ivyleaf morningglory seed germinated between 88 and 98%. The 1972 and 1973 seed germination was 10 to 40% less than the 1974, depending on the temperature.

Cole and Coats (5) reported that tall morningglory has the ability to germinate equally well at temperatures ranging from 20 to 35 C. Our data also showed that these three *Ipomoea* taxa also possessed the ability to germinate equally well at temperatures ranging from 20 to 35 C or 20/30 C but not at 40 C.

Seedling emergence. Emergence began the fourth day after planting, with 50% of the total occurring within the first week. Maximum emergence for all three *Ipomoea* taxa occurred at depths of 1.3 and 2.5 cm (Table 1). These results agree with those reported by Wilson and Cole (11), working with ivyleaf morningglory. When averaged across all depths, seed age did not influence the ability of entireleaf morningglory seed to emerge. The emergence of 1972 white morningglory seed was significantly lower than 1973 and 1974 seed. Ivyleaf morningglory seedling emergence was significantly lower for the 1972

Table 1. Percentage emergence of white, entireleaf, and ivyleaf morningglory as influenced by seed age and depth of burial in greenhouse study.

Taxa	Year	Planting depth (cm) 1.3 (%)	2.5 (%)	5.1 (%)	7.6 (%)	10.2 (%)	Mean[b] emergence (%)
White morningglory	1972	44	34	12	2	4	19[cd]
	1973	72	60	36	16	30	43[a]
	1974	58	46	24	20	42	38[a]
Entireleaf morningglory	1972	52	40	38	4	4	28[bc]
	1973	54	60	14	18	22	34[ab]
	1974	50	40	14	4	22	26[bc]
Ivyleaf morningglory	1972	20	20	6	2	2	10[d]
	1973	40	28	26	8	10	15[cd]
	1974	48	48	22	16	28	32[ab]
Mean emergence (%)[a]		48[a]	42[a]	21[b]	10[c]	18[b]	

[a]Means in this line not followed by a common letter differ significantly from one another at P=0.05.

[b]Means in this column not followed by a common letter differn significantly from one another at P=0.05.

and 1973 seed than for the 1974 seed.

Seed production. The number of seed pods and seed produced by these three *Ipomoea* taxa was determined in the field in 1975. Ivyleaf morningglory produced 1,800 seed pods per plant 21 weeks after emergence, entireleaf morningglory 3,200 pods, and white morningglory 7,000 pods (Figure 5A). In spite of the greater production of seed pods by white morningglory, the number of seed produced by white and entireleaf morningglory was about 15,000 seed per plant (Figure 5B). This similar level of seed production resulted because entireleaf morningglory averaged 4.5 seed per pod, while white morningglory produced only 2.2 seed per pod. In contrast ivyleaf morningglory produced only 5,800 seed per plant, with an average of 3.3 seed per pod.

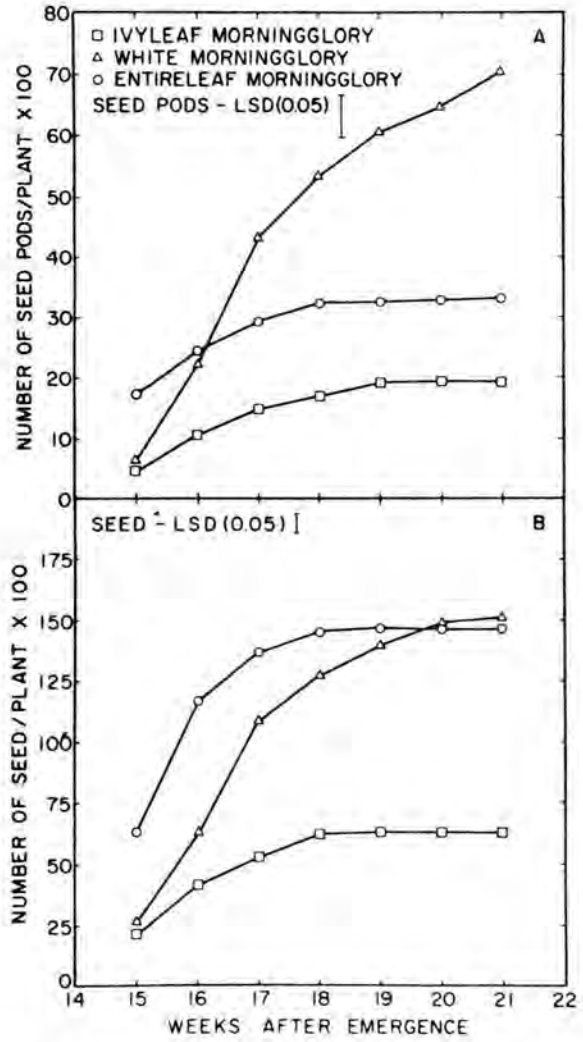

Figure 5. Seasonal production of seed pods (A) and seed (B) of white, entireleaf, and ivyleaf morningglory.

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