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YEAR-TO-YEAR VARIATION IN THE GERMINATION OF FRESHLY-HARVESTED SEEDS OF *ARENARIA PATULA* VAR. *ROBUSTA* FROM THE SAME SITE

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ABSTRACT

The freshly-matured seeds of *Arenaria patula* Michx, var. *robusta* (Stey.), which Maguire collected from the same site in three consecutive years, differed significantly in their dormancy and germination characteristics. Increase in dormancy appeared to be correlated with increase in precipitation (and thus soil moisture) during the 30-day maturation period prior to harvest. The preconditioning environment should be considered when comparing the dormancy and germination characteristics of seeds from different populations of a species or from the same population in different years or seasons.

INTRODUCTION

A number of papers have been published comparing the dormancy and germination characteristics of different populations of plant species distributed over wide altitudinal or geographical ranges (Baskin and Baskin, 1973). It appears that in most of these studies significant differences were found in the germination and/or dormancy breaking requirements. Where populational differences have been found, the general tendency has been for the investigator(s) to assign ecotypic status to plants in those populations (Habeck, 1958; Stearns and Olson, 1959; McKell *et al.*, 1962; Mergen, 1963; Fowler and Dwight, 1964; McNaughton, 1966; Wilcox, 1968; Winstead, 1971; and Pegtel, 1972), and for the most part, very little consideration has been given to preconditioning. Differences in the environment during maturation of seeds on the plant can cause highly significant differences in the dormancy breaking and germination requirements of the seeds produced. Environmental factors known to affect the physiological (and sometimes the morphological) status of the seed during maturation include: temperature, soil moisture, soil nutrients, light quality and photoperiod. After reviewing the literature, Baskin and Baskin (1973) concluded that if ecotypic differentiation between populations is to be studied with regard to seed dormancy and germination, seeds from the populations being studied should be grown for several generations in a uniform environment so that differences due to environmental preconditioning could be eliminated.

Since differences in factor intensity or concentration in the environment during maturation of the seed vary geographically and temporally, preconditioning may cause differences between two or more populations of a single species growing in different locations or in a single population in different years or seasons. This short communication reports the results of a study on the germination of freshly matured seeds of *Arenaria patula* Michx, var. *robusta* (Stey.) which Maguire collected from the same population during three consecutive years.

Arenaria patula var. *robusta*, a member of the Caryophyllaceae, is a winter annual that occurs in shallow, limestone-derived soils in Missouri, Kentucky and Tennessee (Gleason, 1952). In the Bluegrass Region of Kentucky seeds germinate in September and October, and a rosette is formed in autumn. Plants overwinter as rosettes. Flower buds are formed in March, and flowering begins in mid to late April. The flowering period lasts from 4 to 6 weeks with the peak occurring in early to mid May. By late May and early June most of the seeds in the population are mature. At maturity the capsules dehise, releasing the seeds which lie dormant on the soil surface until autumn.

MATERIALS AND METHODS

Freshly-matured seeds of *A. patula* var. *robusta* were collected from a large population of plants growing in shallow, limestone-derived soil in Mercer County, Kentucky on 12 June 1971, 4 June 1972 and 9 June 1973. Random collections of whole plants were made, and plants were shaken gently in paper bags to separate the seeds from other plant parts. Germination experiments were started within 3 days after collection.

Seeds from the three collection dates were incubated at five constant temperatures (5, 10, 15, 20 and 25 C) and four alternating temperature regimes (15/6, 20/10, 30/15 and 35/20 C) in light (14-hr photoperiod) and in darkness. All temperatures were ± 1 C. At the alternating temperature regimes the high and low temperatures were maintained for 12 hr each day. The photoperiod at all temperatures was 14 hr, and at the alternating temperature regimes it extended from 1 hr before the beginning of the high temperature to 1 hr after the beginning of the low temperature period. The light source was 20 W "cool white" fluorescent tubes, and light intensity was approximately 2,100 lux. Seeds were placed in 9-cm plastic Petri dishes on two layers of Whatman No. 1 filter paper moistened with distilled water, and three replications of 50 seeds each were used in each treatment. In the dark treatments, Petri dishes containing the seeds were wrapped with Saran wrap to retard loss of water and then with aluminum foil to provide darkness. Seeds at the 14-hr photoperiod were checked for germination after 15 and 30 days and those in constant darkness after 30 days. Protrusion of the radicle through the seed coat was the criterion of germination.

Temperature and precipitation data for the 30 days prior to seed harvest are presented because this was the period of seed maturation, a very sensitive period for preconditioning of seeds (Rowe, 1964). The temperature data were recorded 5 cm above sod on flat ground at the University of Kentucky Research Farm in Lexington about 15 miles north of the seed collection site. The average daily maximum and minimum temperatures for the 30 days prior to collection of seeds were calculated from daily maximum and minimum temperatures during this period. Daily precipitation records were obtained from a weather station (High Bridge Lock #7) 1 mile southeast of the *A. patula* var. *robusta* population (U.S.D.C., 1971, 1972, 1973).

RESULTS

No germination occurred in constant darkness in freshly-matured seeds collected in 1972 or 1973, and only four seeds collected in 1971 germinated. Germination percentages of seeds at the 14-hr photoperiod for each of the three study years are presented in table 1. Significant differences (P<.05) between years in germination after 15 days occurred at 15, 20 and 20/10 C. Too few seeds germinated at the other six temperatures for meaningful statistical analyses. After 30 days significant differences in germination between years occurred at 15, 20, 15/6, 20/10 and 30/15 C. Differences in germination at 10 C after 30 days were not statistically significant at the .05 probability level. Too few seeds germinated at 5 and 35/20 C for meaningful statistical analyses.

TABLE 1:

Percent germination (mean ± SE) of freshly-matured seeds of A. patula *var.* robusta *after 15 and 30 days at 14-hr photoperiod.*

	Year collected	5°	10°	15°	20°	25°	15/6°	20/10°	30/15°	35/20°C
15 days	1971	0.0	0.0	26.7±4.1	10.7±1.8	0.0	0.7±0.7	29.3±5.7	0.7±0.7	0.0
	1972	0.0	0.0	18.0±4.6	0.7±0.7	0.0	0.7±0.7	22.7±2.4	0.0	0.0
	1973	4.0±1.2	1.3±1.3	7.3±0.7	1.3±1.3	0.0	0.0	2.7±1.8	0.0	0.0
(A.O.V.)				P<.05	P<.05			P<.05		
30 days	1971	0.0	10.7±3.5	54.0±2.0	26.0±4.2	0.0	20.7±4.7	60.7±8.8	18.0±5.8	0.0
	1972	0.0	2.0±1.2	35.3±5.7	0.7±0.7	0.0	7.3±3.3	42.7±7.4	39.3±5.3	0.0
	1973	4.0±1.2	4.0±1.2	17.3±3.5	9.3±2.4	0.0	2.6±1.3	8.0±1.2	22.0±1.2	0.7±0.7
(A.O.V.)			P<.05	P<.05	P<.05		P<.05	P<.05	P<.05	

Temperature and precipitation data for the 30 days prior to seed harvest are given in table 2. There was very little difference in the 30-day average daily maximum and minimum temperatures for the three years. However, large differences occurred in the amount of precipitation. The best overall germination occurred in 1971, the year with the least rainfall, and the lowest overall germination occurred in 1973, the year with the most rainfall.

TABLE 2:

Temperature and Precipitation Data during the 30 days prior to seed harvest in 1971, 1972 and 1973.

Year	Aver. max.	Aver. min.	Rainfall	Number days with rain
1971	28.9 C	12.1 C	37.3 mm	7
1972	26.4	10.4	63.2	7
1973	28.7	9.9	183.1	13

DISCUSSION

The results presented in this paper clearly show that there are significant yearly differences in the dormancy and germination characteristics of freshly-matured seeds of *A. patula* var. *robusta* collected from the same site. It is very likely that these differences are caused by yearly variations in environmental conditions during the life cycle of the plant and especially during the seed maturation stage. Since many environmental factors or combinations of factors can cause differences in dormancy and germination characteristics of seeds (Baskin and Baskin, 1973), it would be impossible to say what caused the year to year differences in germination of the seeds. Since temperatures between years varied only slightly during seed maturation (Table 2), it is not likely that the differences in germination were caused by temperature. However, differences in germination between the 3 years were positively related to differences in precipitation. Seeds produced during the wettest year (1973) germinated to lower percentages than those produced in the drier years (1971 and 1972). Furthermore, seeds produced during 1972 when there were 63.2 mm of precipitation during the 30-day maturation period were more dormant than seeds produced in 1971 when 37.3 mm of rain fell. Cotton seeds produced under 50 and 42% soil moisture germinated to lower percentages than seeds produced under 34, 26 and 18% soil moisture (Carver, 1936). Soil moisture also has been found to affect dormancy and germination of seeds of *Avena fatua* L. ssp. *fatua* (L.) Thell. Seeds produced under high soil moisture conditions (100-75% available moisture) were more dormant than those produced under low soil moisture conditions