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Growth and Development of Sitanion hystrix Process Study

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Abstract

Sitanion hystrix seed has a 2 month ripening period after seed dissemination. Mature seed begins germination in 3-4 days under laboratory conditions. Two ecotypes of the species are recognized, based on differential growth rate. The ecotypes are treated separately in the design of all experiments.

Field plots were prepared with plant material started in the greenhouse and later transplanted in the field. A water bath system was developed for use in the growth chamber to study seedling development in relation to soil temperature.

Objectives

1. Growth and development of seedlings as affected by soil moisture, soil water potential, soil and air temperature, and atmospheric humidity.
2. Growth and development of vegetative growth as a function of soil water potential, soil and air temperature, and net photosynthesis.
3. Growth and development of root system as a function of soil water potential, soil and air temperature, and net photosynthesis.
4. Transpiration rate and amount of water uptake in relation to root concentration and soil water potential.

Methods

To provide material for study, plants were started from seeds germinated at room temperature in petri dishes. As germination occurred, seedlings were transferred to plastic pots containing an equal mixture of silt loam, sand, and peat moss, and grown in the greenhouse. Pot sizes used were 900cc, 200cc or 140cc capacity, depending upon the need for large or small plants.

For the field study of growth as a function of net photosynthesis, transpiration rates, and moisture stress, plants were established in early fall. Aluminum tubes 10cm x 60cm were buried flush with the ground surface in 9 rows, a meter apart. Each row contained 18 tubes spaced 1/2 meter apart. Seedlings grown in 140cc cups for 3 weeks in the greenhouse were transplanted singly in each tube. Two seed sources were included. Seedlings of each seed source were restricted to nine individuals per row and randomly distributed within the row. A total of 162 plants were transplanted for this experiment.

For study of phenology, vegetative-culm ratio, and seed production of *Sitanion hystrix*, 277 plants grown in the greenhouse in 900cc containers for 3 1/2 months were outplanted during spring. Seeds for these plants were from 5 sources. Planting was done in rows a meter apart with 1/2 meter spacing between individuals. A normal row contained 30 individuals. Plants were watered 4 times during the summer months to insure their establishment for next year's observation.

Preparation for study of seedlings in the field consisted of hand seeding 12 meter square plots. Seeds were placed 1 dm apart and 1 cm plate with a 13cm x 64cm tube, sealed at the distal end, protruding downward from the center of the base plate. The tube recess was designed to facilitate enclosure of the whole plant, whether grown in tubes or pots, in the chamber system. The height of the plant crown is adjusted so that it is at the same level as the base plate. A circulatory fan is attached to the chamber ceiling.

A second chamber, 11cm x 11cm x 24cm, was constructed for seedlings grown in 200cc plastic pots. A small circulating fan is located at the bottom of the chamber.

To control air temperature in the assimilation chamber, a heat exchanger was constructed. The system is enclosed in a 7cm x 27cm x 57cm box and includes a water-cooled radiator (obtained from a car heater), a heating unit (100 watt light bulb), and a fan.

Findings

In the course of preparing plant materials for study, information on germination was obtained. Seeds collected on July 10 were found to be highly germinable after a ripening period of 2 months (Table 1). Freshly harvested seeds were slow to germinate, whereas mature seeds began germinating 3-4 days after placement in petri dishes with moistened blotters. After a 2 month ripening period, there was little change in seed germinability. Seeds stored under room conditions retained high germinability for 3 years. Deterioration was noticed with seeds stored for a period of 4 years. Low germinability occurred with seeds stored for a period of 5 years and most of these produced seedlings without radicles. It was found that Sitanion seed is highly sensitive to "ceresan", a mercuric fungicide. A small amount of this fungicide completely inhibited germination.

Table 1. Germination Percentages of Sitanion hystrix seed 4, 7, and 14 days after initiation of trial. Seed was collected July 10 near Emmett, Idaho.

Date of Trial	Germination percent after:		
	4 days	7 days	14 days
August 10	0	0	5
September 4	0	3	80
September 12	10	76	90
September 22	9	80	90
September 28	61	93	95

The growth rate of Sitanion plants from 2 seed sources was sufficiently different to warrant separate treatment in all subsequent experiments. The top growth, after 3 1/2 months in the greenhouse, from plants of the Emmett seed source averaged 3 times heavier than from the Burley source (Table 2). Average weight per tiller was twice as great, whereas tiller number was not as convincingly different due to large variability between individuals within the two populations. The climate of the two areas differs principally in the amount of precipitation. The Burley area receives about 250mm of precipitation annually; the Emmett area receives more than 300mm. However, there appears to be an overlap in the distribution of the two populations.

Table 2. Top growth of plants from Burley and Emmett seed sources after 3 1/2 months in the greenhouse. Oven dried at 70° C.

Seed Source	Wt/tiller (g)	Wt of top Growth (g)	No. tillers per plant
	$\bar{x} \pm s$	$\bar{x} \pm s$	$\bar{x} \pm s$
Burley	.07 ± .03	1.01 ± .40	15.57 ± 6.73
Emmett	.14 ± .05	3.04 ± 1.13	24.07 ± 10.80

Discussion

The 2 month ripening period of Sitanion seed delays field germination until fall when conditions for survival are more favorable. The rapidity of seed germination compares favorably with annual grasses such as cheatgrass. Rapid germination would increase the chances or successful establishment of Sitanion on ranges dominated by annual grasses as compared with slower germinating climax perennials. Seed viability deteriorates after 3 years but, under field conditions, seed logevity is probably less than 2 years.

The significantly different growth rates of plants from the 2 areas, Burley and Emmett, indicate that there is considerable variability in performance within the Sitanion hystrix taxon. A more thorough examination of fresh material needs to be made to determine whether the two populations included in the study are Sitanion hystrix var. hystrix and var. californicum recognized by Wilson (1963).

Preparation for a process study requires much planning and work because environmental conditions are manipulated rather than merely monitored as they occur in the field. Ideally, all but one of the independent variables of environment are controlled as plant performance is observed, but this is impractical when all combinations of variables are considered. The selection of variables to be manipulated is important if data are to have value in developing a simulation model at the community or biome level.

Literature Cited

Wilson, Douglas F. 1963. Revision of *Sitanion* (Triticeae, Gramineae). Brittania 15(4): 303-323.