R. Daubenmire

Route 1—Box 265A
Sorrento, Florida 32776

Annual Variation in the Flowering of Agropyron spicatum near Clarkston, Washington

Abstract

Inflorescence production by 18 plants was recorded in each of 10 years. Although there was a strong tendency toward synchronous vitality, this tendency was not relatable to standard temperature and precipitation data.

Introduction

Year-to-year variation in the vitality of plants is a matter of theoretical interest from both its autecological and synecological points of view. It is also of practical importance in seed collection and vegetation management. Any ability to predict good and bad seed years in advance is especially valuable.

The present report summarizes existing knowledge of the vitality of *Agropyron spicatum* Scribn. & Sm. in the Pacific Northwest, and presents new data from 10 yearly observations of the same individuals growing in the Larson Exclosure located a few km west of Clarkston, Washington.

Previous Observations and Experimental Work

Progeny tests have shown that *Agropyron spicatum* includes individuals which are genetically differentiated into caespitose and rhizomatous biotypes (Daubenmire, 1960, 1970), and since these are segregated environmentally they may be considered as ecotypes, or perhaps better as ecotype groups. In eastern Washington and northern Idaho, at least, it is abundantly clear that only caespitose individuals are found toward the drier limits of the species' environmental range; toward the wetter limits, the grass is represented by rhizomatous plants in all but freshly disturbed soils. On an areal basis, the phytomass of sterile tillers far exceeds that of flowering tillers in rhizomatous populations: the reverse is true for caespitose populations. In one community observed over a number of years (compositional details and environmental data reported as Stand 39, p. 93, in Daubenmire, 1970), individual plants flowered rarely, and weakly then, although the species was well represented by caespitose individuals.

Methods

The new observations reported here were made in an essentially climax stand of the *Agropyron spicatum*/*Poa sandbergii* association (compositional details and environmental data reported as Stand 56, p. 95, in Daubenmire, 1970), which has been completely protected from livestock, starting long before this study began, and had previously been only moderately grazed. *Agropyron spicatum* is the only sizable grass in the community, and it provides most of the community phytomass. Since the habitat is near the dry limits of the plant's ecological amplitude, all individuals are caespitose.

Twenty plants were selected to represent essentially the full range of basal diameters. Their positions were recorded, average diameters at the soil surface measured, and inflorescence counts started in 1964. Any inflorescence which appeared to be producing one or more fertile spikelets was counted. This procedure was done after the inflorescences were well developed but before any dissemination. Since observations could not be made in 1970, the annual counts covered a calendar span of 11 years.

Results and Discussion

Of the twenty individuals selected at the start of the study, two died and seven suffered a decline in basal diameter during the study (Table 1). The two that died were near the middle of the size range, with initial diameters of 158 and 177 mm. The death of one of these was associated with the establishment of a colony of ants in the soil beside the base of the plant.

TABLE 1. Numbers of inflorescences produced by each plant, arranged by diameter (mm) of plant and fruitfulness of the population as a whole.

Diam. 1964	Year 1968	1966	1974	1973	1972	1971	1964	1969	1967	1965	Sum	Diam. 1974	Net change
	Number of inflorescences												
70	0	6	3	6	6	9	20	6	0	43	99	45	–
74	0	5	8	7	11	8	11	31	3	8	92	164	+
77	0	1	0	0	2	14	11	1	8	7	44	96	+
78	0	3	11	6	13	5	0	29	11	4	82	132	+
84	0	1	2	3	7	6	10	14	1	4	48	133	+
100	0	0	1	0	0	5	6	1	2	16	31	71	–
111	0	2	6	25	30	32	71	47	6	66	285	82	–
116	0	1	0	0	0	3	0	26	12	19	61	102	–
122	0	17	0	0	11	28	20	58	82	75	291	69	–
125	0	0	1	4	1	4	1	50	5	18	84	157	+
125	0	4	4	10	2	3	36	37	79	102	277	57	–
135	0	8	25	55	39	43	52	33	99	44	398	186	+
142	0	1	8	7	11	8	4	31	21	33	124	164	+
161	0	4	12	32	14	14	30	39	22	56	223	201	+
167	0	0	1	3	3	1	3	8	5	25	49	160	–
177	0	1	8	0	8	3	6	8	3	12	49	195	+
202	0	16	54	32	78	55	68	109	180	236	828	222	+
217	0	13	29	48	11	58	10	54	54	16	293	268	+
Sum	0	83	173	238	247	299	359	582	593	784	3358	—	—

There was a small tendency for the plants that increased in diameter through the study to be more productive than those that decreased, yet there were some high producers (277, 285, 291 inflorescences) in the decreasing class, with low production (44, 48, 49 inflorescences) among those plants that increased in diameter.

Inflorescence production showed a small positive correlation with basal diameters. The least productive plant (only 31 infl. in 10 seasons) had a basal diameter of 100 mm declining to 71 mm; the most productive (828 infl. in the same period) was 202 mm, increasing to 222 mm. On the other hand, the largest individual (217 mm initially becoming 268 mm) produced only 293 inflorescences in the same period.

There is no suggestion that fruitfulness in one year so exhausts food reserves so as to depress fruiting the following year. For example, 359 inflorescences were produced in 1964, a value in excess of the annual average of 336; yet the highest crop observed (784 infl.) occurred the next year. Thus conditions which presumably initiate flowering in a given year are those subsequent to the preceding flowering season.

Since inflorescences became distinguishable in late May and frost damage to them was never observed, there would seem to be no necessity to consider weather subsequent to early May. Nor did the exceptional low temperature in the winter of 1969 have an evident depressing effect on the flowering as observed a few months later. With this evidence of the apparent immunity of development to low temperatures of winter and spring, attention was directed to autumnal weather. This period starts the rainy season, subsequent to normally dry summers, and could act as a determinant of vitality the following spring.

The records of the official weather station at Lewiston, Idaho, appear to be adequately indicative of weather conditions at the exclosure. Attempts were made to correlate inflorescence numbers with mean monthly temperatures, monthly precipitation, and mean monthly water balance for individual months and for consecutive series of months. Environmental Water Balance was evaluated by the formula: $EWB = $ Precipitation in mm/ (Temperature in $°C + 10$). The only small correlation discovered was that the spring of zero production had the driest autumn (mean EWB for Sept.-Oct.-Nov. $= 0.7$) and the year of lowest production had the next driest autumn (mean $EWB = 0.8$).

There is little doubt but that fruitfulness is governed by a complex set of master factors, since all plants showed zero fruitfulness in 1968, and most showed maximum fruitfulness in 1965. However, all attempts to correlate this behavior with standard temperature and precipitation data have failed, leaving us with no basis for prediction. This virtual lack of success may be due to interactions between weather conditions stimulating flower initials and subsequent weather nullifying this stimulus. It might be helpful to know the approximate date when flower initials are laid down. In any event, experimental manipulation of microclimate in the field will probably be necessary to discover the nature of weather control over flowering in this grass.

Literature Cited

Daubenmire, R. 1960. An experimental study of variation in the *Agropyron spicatum-A. inerme* complex. Bot. Gaz. 122:104-108.

———. 1970. Steppe Vegetation of Washington. Wash. Agric. Exp. Sta. Tech. Bull. 62. 131 pp.

Received November 16, 1976
Accepted for publication January 10, 1977