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RESPONSE OF *PENSTEMON FRUTICOSUS* TO FERTILIZATION

by

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ABSTRACT

Bush penstemon (*Penstemon fruticosus* (Pursh) Greene), an attractive ground cover on east Cascade slopes, appears to survive under low fertility, xeric conditions. These plant characteristics are desirable for revegetating severely disturbed areas. Seedling response to fertilization was tested to find if growth rates could be increased to provide quicker ground cover with new plantings. Bush penstemon does respond to nitrogen and phosphorus fertilization under greenhouse conditions. It appears that, with adequate soil moisture, 50- to 100-ppm nitrogen is sufficient for nearly maximum growth response.

KEYWORDS: Nitrogen fertilizer response, fertilizer (inorganic) (-nursery beds, growth regulators (applied), erosion -)vegetation.

INTRODUCTION

Bush penstemon (*Penstemon fruticosus* (Pursh) Greene) is an attractive native ground cover frequently found on recently logged areas and new roadbank cuts on the east slopes of the Cascade Range in Washington. It is easily identified by its brilliant blue-lavender to light-purplish flowers[1/] in the early spring. One of bush penstemon's characteristics which makes it useful for stabilization of severely disturbed soils is its apparent ability to survive under low fertility, xeric conditions. The plant reproduces by seed and spreads across open ground by prolific layering. Rate of spreading is relatively unknown, although it appears to be quite slow. Since the most frequent observations of the plant are on poor soils such as roadbanks, it appears fertilization could hasten vegetative growth, which is highly desirable for early soil surface protection to reduce erosion. Although the plant appears to be a pioneering species, it is not known to have the ability to fix nitrogen by the symbiotic process. Therefore, a greenhouse fertilization study was initiated to determine the plant's vegetative response to applied fertilizers.

THE STUDY

To reduce the length of time necessary for the study and to maintain homogeneity of plant material, cuttings were taken in the late fall from a large plant colony on a roadbank cut near Blewett Pass, west of Wenatchee, Washington. These cuttings, approximately 12 cm long with all leaves removed except the upper two, were placed in damp vermiculite and kept in a cool corner of the greenhouse out of direct sunlight. After 1 month, a prolific set of roots up to 5 cm long was observed for about 90 percent of the cuttings. The newly rooted plants were transferred to 16.5-cm plastic pots, where a mixture of 25-percent sand, 25-percent peat, and 50-percent silt was used as the rooting medium.

After planting the newly rooted cuttings, the pots were saturated with distilled water and allowed to drain for 24 hours. After drainage, each pot was weighed. Distilled water was added twice a week to return the pot to its original drained weight. No drainage water which could contain plant nutrients was allowed to escape after the initial watering. Night temperatures in the greenhouse were kept at 18 ^{o}C and daytime, at 23 ^{o}C or above, depending on the ability of the greenhouse air conditioning to meet the summer heat load. Artificial light was used to keep a minimal photoperiod of 15 hours.

After 6 weeks of growth following transplanting, the plants were divided into five groups according to plant size. Each group was used for an experimental replication (blocks). Plant height and leaf area (horizontal surface cover) were measured on each plant. Leaf area was measured with a 6.35-mm grid counter. Similar measurements were made at the completion of the experiment to evaluate vegetative plant response to fertilization.

The fertilizer treatments used in a four-factor (2 x 2 x 2 x 4) experiment in randomized blocks were four levels of nitrogen (0, 75, 150, and 300 ppm),

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1/ Hitchcock, C. L., A. Cronquist, M. Ownbey, and J. W. Thompson. 1959. Vascular plants of the Pacific Northwest. Pt. 4. Univ. Wash. Publ. Biol., Seattle.

two levels of phosphorus (0 to 100 ppm), two levels of potassium (0 and 100 ppm), and two levels of sulfur (0 and 100 ppm). Sources of fertilizer materials were treble-superphosphate, potassium chloride, calcium sulfate, and urea. All fertilizer was broadcast on the soil surface and mixed into the surface soil.

RESULTS

Plant growth response to fertilization in terms of increased height and leaf area was measured after a 90-day test period. Leaf area was not a good indicator of response because of large differences in plant form. Increases in height were also affected by plant form, although not to the extent observed for leaf area. The correlation between increased plant height and leaf area for the test period was 0.61. Plant response as measured by height for the fertilizer treatments is shown in table 1.

Table 1--Height growth response of *Penstemon fruticosus* to 4 levels of nitrogen, 2 levels of phosphorus, 2 levels of potassium, and 2 levels of sulfur fertilizer application (in mm per potted plant)

Nutrient	Level of application	Nitrogen (ppm)				
		0	75	150	300	Mean
	ppm			*mm*		
Phosphorus (P_2O_5)	0	10.3	33.9	31.2	24.5	25.0
	100	15.1	33.7	44.9	33.0	31.7
Potassium (K_2O)	0	16.0	33.5	42.3	34.0	31.5
	100	9.5	34.1	33.7	23.5	25.2
Sulfur (SO_4)	0	15.5	33.4	42.4	28.2	29.9
	100	10.0	34.3	33.7	29.3	26.8
Mean	--	12.7	33.8	38.0	28.8	28.3

Increase in plant height as a response to nitrogen fertilizer was significant at the 1-percent level and to phosphorus at the 5-percent level. No other fertilizer treatments were significant. Plant response to nitrogen increased up to the 150-ppm treatment and then decreased at the 300-ppm level. It appears that high rates of nitrogen fertilization, even with sufficient availability of other plant nutrients, will reduce penstemon growth under greenhouse conditions. The largest treatment response was to the initial 75-ppm nitrogen, which increased plant height 166 percent. Phosphorus at the 100-ppm level increased height by 26.8 percent. Available nutrients in the potting soil may have been sufficient to meet low plant requirements for potassium and sulfur fertilization.

CONCLUSION

Bush penstemon does respond to nitrogen and phosphorus fertilization under greenhouse conditions. It appears that 50- to 100-ppm nitrogen, when soil moisture is adequate, provides near maximum growth response. Plant requirements for potassium and sulfur appear to be quite low. However, on severely disturbed subsoils with extremely low fertility, bush penstemon may be expected to show increased growth response to low levels of potassium and sulfur fertilization. Field testing is necessary to confirm these greenhouse experimental results.

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