HORTSCIENCE 35(4):608–610. 2000.

Is Fall Burning Preferable to Spring Burning for Promoting Growth Characteristics Favorable for Mechanical Harvesting in *Vaccinium myrtilloides* Michaux?

S.P. Vander Kloet
Department of Biology, Acadia University, Wolfville, NS B0P 1X0, Canada

J. Pither[1]
Department of Biology, Queen's University, Kingston, ON K7L 3N6, Canada

Additional index words. lowbush blueberry, yield, stem length, branching

Abstract. **Periodic prescribed burns of lowbush blueberry barrens promote high yield, aid in weed control, and reduce fungal and insect damage. Whether such prescribed fires should be set in the autumn or the spring has been a matter of some dispute. Previous research on *Vaccinium angustifolium* Aiton suggested some advantages to autumnal burning, but few data have been collected on *V. myrtilloides* Michaux. To evaluate whether time of burning affected plant qualities most favorable for mechanical harvesting, such as stem length and lateral branching, a series of experiments was conducted on *V. myrtilloides*. Differences in stem length, numbers of lateral branches, and buds per stem were nonsignificant among plants burned in fall vs. those burned in spring. In three of four experiments, however, fall burns resulted in the growth of fewer lateral branches. Furthermore, among the four experiments, growth responses were more uniform following fall than following spring burns. We therefore suggest that, where possible, fall burns should be prescribed for blueberry plants that will be mechanically harvested.**

Prudent management of blueberry barrens calls for periodic burning so that growers may obtain a high yield, control weeds, and reduce fungal and insect damage (Eck and Childers, 1966). Whether such prescribed fires are to be set in the autumn or the spring has been a matter of some dispute. Eaton and White (1960) found little difference in shoot growth and flower bud production in spring or fall burning, but recommended fall burning "when roads are impassable in the spring and winter erosion is not a danger." Black (1962) recommended spring burning as soon as the last snow patches disappeared. Flinn and Pringle (1983) concluded that, since portions of *V. angustifolium* rhizome exhumed in September produced more shoots (up to 20 sprouts/50 cm of rhizome length) after heat treatment than those exhumed in May (up to 17 sprouts/50 cm of rhizome length), autumnal burning should be pursued. This difference in shoot density was attributed to the accumulation of starches in the rhizomes during the growing season (Flinn et al., 1985). In comparisons of mowing in different seasons instead of burning, Ismail and Yarborough (1981) found no difference in a number of growth measurements, including percentage of branched stems, with fall vs. spring burns, while Ismail and Hanson (1982) reported that fall pruning produced more branching than spring pruning.

To minimize wastage of fruit, mechanical harvesting machines demand tall shoots with few if any lateral branches. Indeed, if mechanical harvesting is contemplated, mowing fields after harvest should also be avoided since this treatment decreases shoot height and increases shoot density (Ismail et al., 1981). Such responses were also observed by Eaton and White (1960) when plants were burned Spring 1956 but not in Spring 1957 and 1958. Their graphs also show that as stem density decreased, not only did the height of stems, but also the number of flower buds per stem, increased. In short, autumnal burning results in taller shoots with flower buds, the *sine qua non* for mechanical harvesting.

We conducted a series of experiments to quantitatively assess whether there is indeed a benefit to autumnal vs. vernal burning. Rather than using *V. angustifolium*, whose response to burning at different times during the year has been documented by others, the subject plant in this burning experiment was *V. myrtilloides*. This species is an important component of blueberry barrens in Maine, New Brunswick, and parts of Nova Scotia (typically comprising 5% to 60% of barrens) (Hall, 1959; Hall et al., 1979; Hilton and Barker, 1962) and is equally tolerant of periodic burning (Vander Kloet, 1994).

Materials and Methods

The experimental population of *V. myrtilloides* was established in 1980 on an experimental plot at the Kentville Agricultural Centre, Kentville, N.S., and was initially used to test the burning tolerance of this taxon (Vander Kloet, 1994). This population of 176 *V. myrtilloides* plants contained genotypes from seven different habitats, encompassing 18 locations distributed among four provinces and two states (for details see Vander Kloet, 1994).

The experimental plot was level, and consisted of uniform sandy-loam soils. Plants were set out 1 m apart in five columns that were 2 m apart. We planted 1-year-old plants from related blueberry taxa (such as *V. boreale* Hall and Aalders, and *V. angustifolium*) between the subject plants to avoid planting genotypes from the same locality adjacent to each other in the rows or columns. These "buffer" plants were randomly selected from a group of 64. This resulted in an experimental plot of five columns of 48 rows for a total of 240 plants. The subsequent fire history of this population has been described in detail (Vander Kloet, 1994) and will not be repeated here.

In 1993, we identified all those plants that had not been burned in the last 3 years and selected 25 to be burned with a propane torch in September and another 25 to be burned in May, with the proviso that the May plants had to be as close as possible to the plants burned in September to minimize the effect of microhabitat differences that are inherent in any field study. (We did not believe that the proximity of selected plants merited "pairing" with the statistical analyses outlined below.) The plants were burned for 2 to 3 min, until all the stems were black. The burned and nonburned plants selected for each experiment were typically 1 m, but never more than 3 m, apart. This entire process of plant selection was repeated for the fall–spring periods of 1993–94, 1994–95, 1995–96, and 1996–97 (total = four experimental combinations of fall and spring).

In early October of each year, when the leaves were red and all the flower buds had developed on the shoots, three stems were harvested from each burned clone using the pin-drop method (Phillips, 1959). For each stem harvested, length was determined to the nearest centimeter, and the numbers of lateral shoots and flower buds were counted. For each sampled plant and each growth variable, mean values were calculated from the three stems (subsamples), providing a sample size of 25 for each season (24 for each season in the 1996–97 experiment). The resulting mean shoot lengths were log-transformed (natural logarithm), and the numbers of lateral shoots and buds per stem were square-root transformed [adding 0.5 to zero values, i.e., $(y + 0.5)^{0.5}$] to satisfy normality assumptions (Sokal and Rohlf,

Received for publication 12 July 1999. Accepted for publication 30 Nov. 1999. Sincere thanks to Gerry Barber for helpful comments on an earlier draft of the manuscript. This study was supported by the Natural Science and Engineering Research Council of Canada (grant # A9559). The cost of publishing this paper was defrayed in part by the payment of page charges. Under postal regulations, this paper therefore must be hereby marked *advertisement* solely to indicate this fact.

[1]To whom reprint requests should be addressed. E-mail address: pitherj@biology.queensu.ca.

Table 1. Effects of fall vs. spring burning of blueberry barrens on stem length, number of lateral shoots, and buds per stem.[z]

	Stem length (cm)			Lateral shoots per stem			Buds per stem		
Expt.	Fall	Spring	$P(t)$[y]	Fall	Spring	$P(t)$[y]	Fall	Spring	$P(t)$[x]
1	18.8 (1.15)	17.9 (1.20)	0.31	0.8 (0.22)	0.8 (0.12)	0.35	4.2 (0.50)	5.5 (0.78)	0.20
2	21.5 (1.36)	22.4 (1.35)	0.72	1.2 (0.33)	1.5 (0.29)	0.13	5.1 (0.77)	5.3 (1.03)	0.89
3	20.3 (1.29)	20.6 (1.02)	0.65	0.6 (0.16)	1.1 (0.21)	0.03	3.7 (0.24)	4.5 (0.27)	0.02
4[w]	19.4 (1.24)	16.9 (0.63)	0.07	0.3 (0.13)	0.5 (0.12)	0.09	4.0 (0.62)	3.2 (0.37)	0.31

[z] Sample size was 24 for both fall and spring.
[y] *P* values resulting from one-tailed *t* tests, sample size was 25 for both fall and spring.
[x] *P* values resulting from two-tailed *t* tests, sample size was 25 for both fall and spring.
[w] Means (standard errors) of nontransformed data, for each experiment (year) and season. Means for the three subsamples per plant were calculated first (not shown), followed by the overall means and standard errors for each cell.

1981). For each growth variable measured we assessed differences between fall and spring burning using univariate *t* tests. For stem lengths, we conducted one-tailed tests with the alternative hypothesis being that stems of plants burned in the fall would be longer than those of plants burned in the spring. For numbers of lateral shoots per stem we conducted one-tailed tests with the alternative hypothesis, viz., plants burned in the fall would produce fewer lateral shoots per stem than those burned in the spring. We conducted a two-tailed test on numbers of buds produced per stem. Within each year's experiment (total of four experiments) we performed three such tests (for each growth response variable) and evaluated their significance at Bonferroni-adjusted alpha levels ($\alpha = 0.05/3 = 0.017$) (Sokal and Rohlf, 1981). In total, twelve *t* tests were performed (three variables per four experiments).

Results

A summary of the data and the *t* test results is provided in Table 1. Differences in growth responses among the two burn strategies were minimal in all four experiments (Fig. 1). None of the twelve *t* tests performed were significant at Bonferroni-adjusted alpha levels. However, some important trends were evident. First, concerning the tests of lateral shoot growth, the latter three of four comparisons were in the predicted direction (*P* values 0.130, 0.027, 0.089, respectively; Table 1), with fall burns resulting in fewer lateral shoots per stem than spring burns (Fig. 1B). Second, a MANOVA performed on all three growth measures (with samples pooled across years) indicated that inter-year variation in growth response was significantly less within the fall-burned plants than within the spring-burned plants, particularly in shoot length and number of buds (significant "year" effect for spring burn trials: Pillai's Trace = 0.2903, $P \leq 0.001$; but not for fall burn trials: Pillai's Trace = 0.1133, $P = 0.27$).

Discussion

Our experiments did not provide compelling evidence to support fall burns over spring burns. The results do, however, suggest *some* advantages to fall burns. First, just as Eaton and White (1960) had observed for *V. angustifolium* in 2 of 3 years, our data show that *V. myrtilloides* in three out of four burn

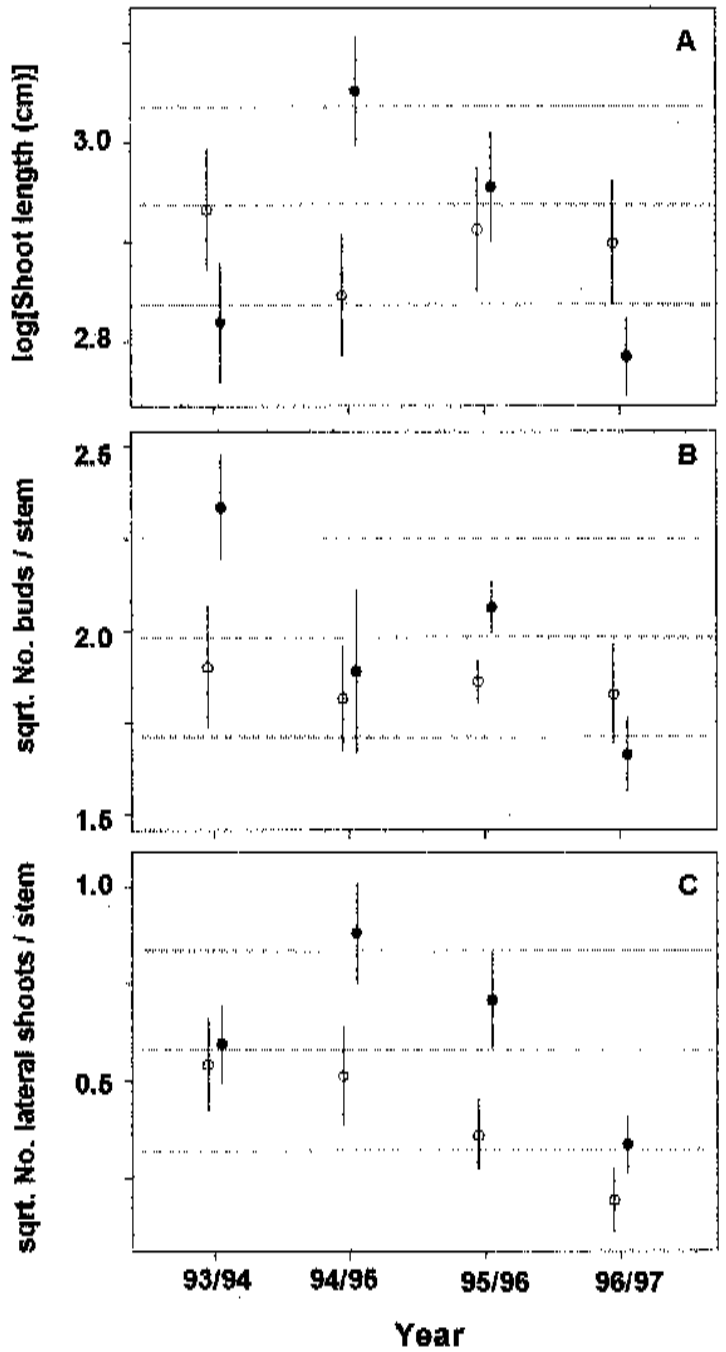

Fig. 1. Effects of year and season on (**A**) mean stem length (natural log-transformed), (**B**) mean number of buds per stem, and (**C**) mean number of lateral shoots per stem (both square-root transformed). ●–Spring, ❍–Fall. Error bars depict one standard error above and below group means. Horizontal gray lines are for visual reference only.

trials produced fewer lateral shoots when plants were burned in the fall (Fig. 1). Second, while stem height and berry production did not differ in a consistent way among treatments or experiments (Fig. 1), supplemental analyses indicated that growth response was *less variable* following fall burns (results of MANOVA).

In short, our recommendation to the grower who wishes to reduce the number of lateral shoots to aid mechanical harvesting and promote a more uniform growth response is to burn barrens in the fall.

Literature Cited

Black, W.N. 1962. The effect of frequency of rotating burning on blueberry production. Can. J. Plant Sci. 43:161–165.

Eaton, E.L. and R.G. White. 1960. The relation between burning dates and the development of sprouts and flower buds in the lowbush blueberry. Proc. Amer. Soc. Hort. Sci. 76:338–342.

Eck, P. and N.F. Childers. 1966. Blueberry culture. Rutgers Univ. Press, New Brunswick, N.J.

Flinn, M.A., S.E. Fisher, E.V. Martin, and I.E. Blum. 1985. Seasonal variation in nonstructural carbohydrate composition of rhizomes of forest understory species. Proc. N.S. Inst. Sci. 35:91–97.

Flinn, M.A. and J.K. Pringle. 1983. Heat tolerance of rhizomes of several understory species. Can. J. Bot. 61:452–457.

Hall, I.V. 1959. Plant populations in blueberry stands developed from abandoned hayfields and woodlots. Ecology 40:742–743.

Hall, I.V., L.E. Aalders, N.L. Nickerson, and S.P. Vander Kloet. 1979. The biological flora of Canada. 1. *Vaccinium angustifolium* Ait., sweet lowbush blueberry. Can. Field-Nat. 93:415–430.

Hilton, S.A. and W.G. Barker. 1962. The research status of the lowbush blueberry (*Vaccinium* spp.), p. 426–432. In: J. Duculot (ed.) Proc. 16th Intl. Hort. Congr., Brussels

Ismail, A.A. and E.J. Hanson. 1982. Interaction of method and date of pruning on growth and productivity of the lowbush blueberry. Can. J. Plant Sci. 62:677–682.

Ismail, A.A., J.M. Smagula, and D.E. Yarborough. 1981. Influence of pruning method, fertilizer and terbacil on the growth and yield of the lowbush blueberry. Can. J. Plant Sci. 61:61–71.

Ismail, A.A. and D.E. Yarborough. 1981. A comparison between flail mowing and burning for pruning lowbush blueberries. HortScience 16:318–319.

Phillips, E.A. 1959. Methods of vegetation study. Henry Holt and Co., New York.

Sokal, R.R. and F.J. Rohlf. 1981. Biometry. W.H. Freeman, New York.

Vander Kloet, S.P. 1994. The burning tolerance of *Vaccinium myrtilloides* Michaux. Can. J. Plant. Sci. 74:577–579.