:ial of ectendomycorrhizal fungi in the :ounding land and age of the planting ap- .r to be the most important factors in my- rhizal colonization of rabbiteye blueberry north-central Florida. However, cultural ctices, soil type, and cropping history are o factors which may affect the extent of corrhizal colonization.

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Gibberellic Acid-induced Fruiting of Lingonberries, *Vaccinium vitis-idaea* L. ssp. *minus* (Lodd.) Hult.[1]

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Abstract. **A single application of 50, 100 or 500 mg/liter gibberellic acid (GA) during 75% full bloom induced seedless fruit development in lingonberries growing in their native habitat in Alaska. Fruit set was increased by the 500 ppm GA treatment in the absence of insect pollination. Fruit set was not increased by GA in open-pollinated plants. Berry weight and diameter were unaffected by GA treatments.**

Lingonberries are harvested commercially from their native habitat in Alaska, Canada, and throughout Eurasia. Low fruit set caused by inadequate pollination (4, 6), self pollination (4, 5), and cold temperatures during anthesis (9) limits marketable yields in some years. Fruit set ranging from 0 to 70% of blossom production has been reported (5, 6, 8, 18).

Fruit set has been increased in a diversity of crops by exogenous GA applications even under conditions of unfavorable weather and inadequate pollination (2, 17). Included in this group are *Vaccinium ashei* (16), *V. angustifolium* (1), *V. corymbosum* (7, 10, 12, 13, 14, 15), and *V. macrocarpon* (3, 11). In addition to increased fruit set, GA treatments have been found to decrease fruit size in *V. macrocarpon* (3, 11) and *V. ashei* (16). No experiments studying the response of GA applications on *V. vitis-idaea* have been reported. The purpose of this study was to elucidate the effects of GA on fruit set and fruit development in lingonberries.

In 1979, 4 blocks, 30 × 210 cm in size, were selected at random from a single, uniform population of lingonberries growing in a black spruce-birch forest near Fairbanks, Alaska. Each block was subdivided into four 30 × 30 cm treatment sections with 30 cm separating adjacent treatments. Thirty reproductive stems selected at random comprised each treatment unit. Aqueous solutions of GA (Pro-Gibb, Abbot Laboratories, North Chicago, Ill.) at 50, 100, or 500 mg/liter with 0.05% Tween 20 as a wetting agent were applied with a handsprayer until runoff at a rate of about 80 ml per m^2. Control plots were sprayed with a similar volume of water. The single application occurred on June 10 at 75% full bloom. The experiment consisted of a randomized complete block design with subsampling.

The 1980 experiment contained 4 randomized blocks and 8 treatments per block. A different population of lingonberries in the same locality comprised the experimental unit. GA was applied at the same rates as in 1979. The 30 stems in each treatment section either remained uncovered or were enclosed in individual glassine envelopes to prevent insect pollination. Stems were covered on May 28 prior to anthesis. The envelopes were removed for spray application on June 9 at 75% full bloom, immediately replaced, then permanently removed on June 26 following completion of petal fall.

In both 1979 and 1980, the number of flowers per stem was counted immediately prior to spray applications. Ripe fruit were counted, weighed, and the diameter was measured with calipers. Seed counts per berry and the percent seedless fruit were recorded. In 1979, fruit were harvested on Aug. 28, 30, and Sept. 1. Due to an extremely early snow fall on Sept. 2, 1980, fruit were harvested once on Sept. 5.

Fruit set percentages were not significantly influenced by GA treatments in the 1979 experiment (Table 1). The open-pollinated flowers set between 50 and 60% in all treatments. In 1980, similar results were observed for open-pollinated treatments, although the

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Table 1. Fruit set, berry weight, and berry diatmeter of GA-treated lingonberries.

Treatment		Fruit set (%)		Berry wt (mg)		Berry diam (cm)	
Pollination	GA (mg/liter)	1979	1980	1979	1980	1979	1980
Covered	0	---	1.4a	---	93.3a	---	0.60a
	50	---	2.6a	---	105.0a	---	0.65a
	100	---	7.7a	---	70.0a	---	0.59a
	500	---	41.4b	---	88.3a	---	0.60a
Open-pollinated	0	52.7a[z]	39.3b	162.5a	121.9a	0.69a	0.65a
	50	55.4a	32.5b	158.6a	121.1a	0.70a	0.65a
	100	50.7a	35.7b	142.8a	105.1a	0.66a	0.66a
	500	58.6a	33.9b	160.6a	118.5a	0.68a	0.62a

[z]Mean separation within each column by Duncan's multiple range test, 5% level.

Table 2. Number of seeds per berry and percent seedless fruit set in GA-treated lingonberries.

Treatment		No. seeds per berry		Seedless fruit (%)	
Pollination	GA (mg/liter)	1979	1980	1979	1980
Covered	0	---	0.3a	---	0.0a
	50	---	0.7a	---	66.7b
	100	---	0.2a	---	83.4bc
	500	---	0.1a	---	97.4c
Open-pollinated	0	6.7a[z]	4.2b	10.7a	0.0a
	50	5.8a	3.8b	16.3a	21.6a
	100	6.6a	4.7b	18.7a	19.4a
	500	6.4a	3.5b	15.9a	22.3a

[z]Mean separation within each column by Duncan's multiple range test, 5% level.

overall set was lower. Stems which were covered and treated with 0, 50, or 100 mg/liter GA exhibited lower fruit set percentages than the open-pollinated treatments. Covered stems treated with 500 mg/liter GA did not differ in fruiting percentages from the GA-treated, open-pollinated stems. Average berry weight and diameter were unaffected by GA treatments in either 1979 or 1980 (Table 1).

There was an average of less than 1 seed per berry in all GA-treated, covered stems in 1980 (Table 2). In contrast, open-pollinated flowers had seed counts ranging from 3.5 to 4.7 per berry. Within the covered or open-pollinated groups, the GA treatments did not differ from each other in the number of seeds per berry. Results with open-pollinated, GA-treated stems were similar in both 1979 and 1980 experiments.

In 1980, seedless fruit comprised 97.4% of the total fruit set in the 500 mg/liter GA-treated, covered stems (Table 2). The covered stems treated with 50, 100, or 500 mg/liter GA differed significantly in the amount of seedless fruit set when compared with the covered stems treated with 0 mg/liter GA and all open-pollinated stems. Open-pollinated stems in both 1979 and 1980 experiments produced similar amounts of seedless fruit regardless of GA levels.

This experiment indicated that GA induced seedless fruit development in lingonberries, but fruit set was increased only in the absence of pollination. Concentrations of GA greater than 500 mg/liter may be necessary to increase fruit set under natural conditions, although experiments with related *Vaccinium* species have shown that concentrations as low as 5 mg/liter (14) have been effective. In 1980, the 500 mg/liter GA treatment clearly increased fruit set percentages in the covered stems. The reason for the lack of a similar increase with open-pollination is unknown. Fruit size, as measured by weight and diameter, was unaffected by GA treatments.

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