NITROGEN FERTILIZER RATE AND TIMING TRIALS IN OREGON

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Nitrogen (N) fertilizer application to cranberries increases growth, tissue N and yield (1,2). Rates producing responses have generally been small (10 to 50 lb/a) compared to rates used on other fruit crops. The low N requirement coupled with a narrow range of N sufficiency and inexpensive N fertilizer creates a situation that lends itself to over fertilization with N. Growers and researchers report decreased yields when this occurs (1).

Most reported N research focuses on N rates, prediction of N sufficiency growth, yield and quality changes produced by the fertilization. Little attention has been given to the time of N application and the impact this has on cranberry growth and yield (3).

Our objectives were to determine appropriate N rate and timing for south coastal Oregon cranberry production. Determination of seasonal N uptake in cranberries was a step in determining appropriate fertilizer timing.

A three year nitrogen rate and timing experiment was initiated in commercial beds of Stevens and Crowley cranberries in south coastal Oregon in 1988. The Stevens' bed was designated N deficient and the Crowley bed N sufficient on the basis of fertilizer history, yield, appearance and a September sample of fruit bearing upright tissue. Nitrogen as ammonium sulfate was applied at 0, 20, 40 and 60 lb/a. The applications were grouped into 5 timings by equally dividing the total fertilizer amount into 3, 4 or 5 doses. These doses were applied at popcorn, hook, fruitset, early bud and late bud growth stages as shown in Table 1.

The popcorn growth stage is a defined as most buds swollen, ready to break. The hook stage is when cranberry pedicels with pink unopened flower blossoms are visible. Fruitset occurs when pea to marble size berries were visible throughout the bed. Flowers are still present under Oregon conditions. Early bud follows fruitset, when new buds begin to show. Late bud is approximately one month before harvest with buds clearly visible for next year's crop.

At harvest, three sections of cranberry bed totaling 1 ft^2 were cut and removed from each 8 ft by 10 ft plot. Berries were removed, counted and weighed.

A second experiment was initiated in the 20 and 40 lb N/a treatments at the Stevens site in 1989. An application of ammonium sulfate, 10.8% ^{15}N (traceable nitrogen), was substituted for commercial fertilizer in l/6 of the plot area (9 ft^2) at popcorn, hook, fruitset, early bud and late bud. One section received no ^{15}N and was used to determine ^{15}N natural abundance.

At harvest, whole plants were removed, sectioned into new growth, old growth, fruit and roots. Total N and ^{15}N or traceable N were determined. Nitrogen from fertilizer (Nff) was calculated for the plant parts at each time of application.

Table 1. Nitrogen application amounts for each timing at the 20 lb N/a rate. To calculate amounts applied for the 40 lb N/a rate, multiply these values by 2. To calculate amounts applied for the 60 lb N/a rate, multiply these values by 3.

Timing					
Growth Stage	1	2	3	4	5
	lb N/a				
popcorn	4		5		6.7
hook	4	5	5		6.7
fruit set	4	5	5	6.7	6.7
early bud	4	5	5	6.7	
late bud	4	5		6.7	

Our results dash the hopes of growers expecting a yield response to N fertilization during the year of application. This research shows current season nitrogen fertilization has little if any influence on cranberry yield even at a site diagnosed a N deficient (Stevens). Data in Table 2 show no yield difference at either site or for any N rate in the first year of the N application trial (1988). This aspect of Cranberry growth is similar to other woody perennials. Nutrients are taken up and translocated to fruit buds or other yield determining areas of the plant before in season fertilizer applications are made. Therefore, changes in fertilizer programs and yield claims from fertilizer programs should be made with caution.

Table 2. Cranberry yield as influenced by N fertilizer rate and year at two Oregon sites'.

		N Rate lb/a			
Site	Year	0	20	40	60
		g/ft^2			
Crowley	1988	126	108[a]	107[a]	110[a]
	1989	137	165[a]	179[a]	164[a]
	1990	85	110[b]	152[a]	141[a]
Stevens	1988	117	122[a]	104[a]	127[a]
	1989	90	174[c]	307[b]	388[a]
	1990	115	201[c]	314[b]	485[a]

[1]yield in g/ft^2 is approximately bbl/a. Within year means followed the same letter are not different p = 0.05.

Cranberry growers approach N fertilization with caution and questions. The research project was initiated in an attempt to answer the common questions of "how much N?," "when to apply N?" and "what source of N to use" Source of N will not be addressed here. Nitrogen rate should be determined for each bed or marsh based on cultivar, past yield and yield potential, tissue N, past fertilization, weather effects and pest problems.

An attempt to address time of N application was made with the initial experiment providing N at 5 timings. Yield data from the third year at the Stevens site was inconclusive as shown in Table 3. The only significant impact of nitrogen at this site, even in the third year was from rate. This outcome is not unexpected as the site was initially nitrogen deficient. Any application of N, regardless of application time, increased yield significantly.

Table 3. Cranberry yield for 1990 as affected by N timing[1].

N Timing	Stevens	Crowley
	. . . . . g/ft^2	
1	322[a]	142[a]
2	296[a]	139[a]
3	351[a]	133[a]
4	331[a]	150[a]
5	370[a]	106[b]

[1]yield in gm ft^2 approximately bbl/a. Within cultivar means followed by the same letter are not different p = 0.05.

The use of traceable N assisted in determining when to apply N. Mean and cumulative Nff data for each N timing are presented in Figure 1. Nff means are low (less than 6%) compared to agronomic and fruit crops, specifically other Vaccinium species (4). Highest Nff was found in new growth and fruit when N was applied at or before fruitset. After fruitset very little fertilizer N entered fruit, new growth or roots. In contrast, Nff in old growth was constant for all times of application.

Even though the Nff was small, the data clearly shows current season fertilizer N is predominantly taken up before early bud. If your goal is to increase N or growth in a N deficient situation, early applications should be considered. However, N applied early in the growing season may promote vegetative growth. Little N applied after fruitset is taken up by the crop.

The idea that early N is detrimental to cranberry yield in N sufficient situations is supported by the response of N timing in the Crowley bed in 1990, Table 3. Cranberry yield from timing 5 where all N was applied by fruitset, was significantly lower than any other application timing.

The interaction of N rate and timing at the Crowley site, even though not significant, provides further insight to fertilization of N sufficient cranberries. In figure 2, note the yield increase with N application to the 40 lb/a rate, and the yield decrease with additional N. Secondly, the detrimental effect of early N application is clearly shown by timing 5. Cranberry yield from timing 5 (bottom line in the figure) was lowest at each N rate.

Conversely, delaying any N until fruitset was detrimental at the 40 lb N/a rate but not at the 60 lb N/a rate, shown by timing 4. This was the only treatment to increase yield with the application of 60 lb N/a.

An approach of moderation in N rate and timing was successful as shown by treatment 1. Treatment 1 tended to produce the highest yield at the 40 lb/a N rate.

In conclusion, this research shows more fertilizer N is taken up when ammonium sulfate is applied at or before fruitset compared to after fruitset. This has implications for N fertilization of cranberries:

N deficient cranberries

N is necessary for new upright growth, therefore apply N as crop begins to grow (popcorn stage), through fruitset.

N sufficient cranberries

Early N applications (popcorn) may promote excess vegetative growth. Apply N during fruitset. Multiple applications are recommended. Apply N when berries become "pea to marble size" until end of bloom. Applications after fruitset may be useful for storage of N in old growth but are of little value for providing fertilizer N to other tissues.

Most growers should fertilize according to timing for N sufficient cranberries because beds or marshes receiving regular fertilization are care should be N sufficient. Tissue tests are excellent for determining cranberry N status.

Literature Cited

1. Eaton, G.W. and C.N. Meehan. 1973. Effects of N, P, and K fertilizer on leaf composition, yield, and fruit quality of bearing 'Ben Lear' cranberries, *J. Amer. Soc. Hort. Sci.* 98(1): 89-93.

2. Eck, Paul. 1976. Relationship of nitrogen nutrition of 'Early Black' cranberry to vegetative growth, fruit yield and quality, *J. Amer. Soc. Hort. Sci.* 10(4):375-377.

3. Eck, Paul, 1990. *The American Cranberry.* New Brunswick, N. J.: Rutgers University Press.

4. Retamales, Jorge B. and E.J. Hanson. 1989. Fate of (15)N-labeled urea applied to mature highbush blueberries, *J. Amer. Soc. Hort. Sci.* 114(6):920-923.

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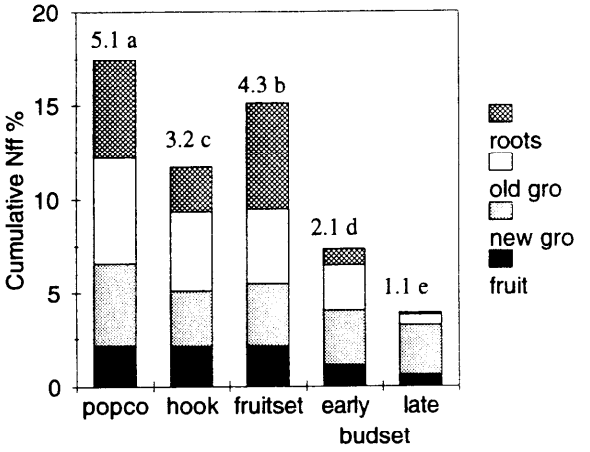

Figure 1. Cranberry tissue N from fertilizer (Nff) of 8 lb ^{15}N/a (40 lb N/a) as influenced by application time. Means followed by the same letter are not significantly different @ P= 0.05.

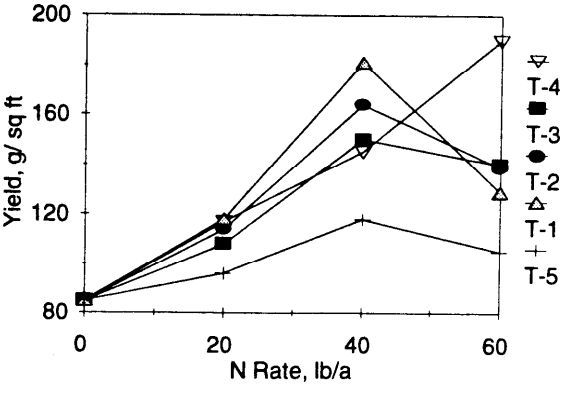

Figure 2. Cranberry yield as influenced by the interaction of N rate and timing at the Crowley site in year 3 (1990).