An Economic Evaluation of Hexazinone Use for Weed Control in Lowbush Blueberry Production

John J. Hanchar¹, Steven P. Skinner², David E. Yarborough, and Amr A. Ismail³

Maine Agricultural Experiment Station, University of Maine, Orono, ME 04469

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Abstract. The economic feasibility of using hexazinone for weed control in lowbush blueberries (Vaccinium angustifolium Ait.) was determined by using the partial budgeting technique. Four rates of hexazinone were evaluated to determine the effect on net income in a blueberry enterprise. Response function analysis also was utilized to ascertain the hexazinone level that would maximize blueberry yield and profitability. Partial budget analysis indicated that hexazinone use at 1.1, 2.2, and 4.5 kg/ha was expected to increase net income, indicating its use was economically feasible. Hexazinone use at 9 kg/ha was judged to be economically infeasible, since it decreased net income. Response function analysis revealed that 2.3 kg/ha of hexazinone maximized profits. Chemical names used: 3-cyclohexyl-6-(dimethylamino)-1-methyl-1,3,5-triazine-2,4(1H,3H)-dione (hexazinone).

The lowbush blueberry is produced in Maine and the Canadian Maritime provinces on fields developed from native stands. It is only one of the many early successional plants occupying land in the process of changing from cleared to forest. Weeds compete with the lowbush blueberry resulting in reduced yields; weeds also interfere with harvesting operations and may reduce the quality of the pack.

Recent testing of hexazinone has indicated that it will control a wide spectrum of weeds found in commercial fields (4, 5). The objective of this study was to determine the economic feasibility of hexazinone use and to find the profit and yield maximizing levels.

An experiment conducted on a commercial lowbush blueberry field in Jonesport, Maine (1980–1981), provided the data utilized in this study (4). The experimental design was a randomized complete block with 5 hexazinone treatments and 10 replications. Each plot measured 2 × 8 m with 2 × 8 m alleys. Hexazinone was applied after pruning and before plant emergence at 1.1, 2.2, 4.5, or 9.0 kg/ha on 6 May 1980. The site also received a 56 kg/ha application of N as urea. Yields were obtained in Aug. 1981.

Partial budget technique. Partial budgeting was used to determine the change in net income expected from a proposed change in the present farm business. The present farm business for lowbush blueberry production was assumed to consist of the 5 following management practices: 1) mechanical or thermal pruning, 2) N fertilizer at 56 kg/ha, 3) pollination with bees, 4) insect and disease control measures when necessary, and 5) harvesting with a hand held rake. The present farm business assumes no hexazinone was being used. The use of hexazinone at 4 rates was examined to determine its effect on net income.

Additions or reductions to income occurred if the yield associated with a level of hexazinone differed from the present farm business. Changes in yields also affected harvesting costs, because growers pay rakers on a per unit basis. The greater the yield, the greater the harvesting costs per hectare, and vice versa. An analysis of variance and F tests were used to determine if significant differences in yields existed among the hexazinone levels. A positive change in net income from hexazinone use at a given level would be considered economically feasible, and the herbicide rate increases net income by the largest amount considered the most profitable.

Response Function Analysis. The following blueberry-hexazinone response function was formulated and estimated, using regression analysis:

\[ y = b_0 + b_1 \sqrt{x_h} - b_2 x_h + b_3 x_p \cdot x_h + e \]

where \( b_0 \) = the intercept, restricted to equal zero; \( y \) = blueberry yield kg/ha; \( x_h \) = level of hexazinone kg/ha; \( x_p \) = percentage of plot covered with blueberry plants; \( x_h \) = 1 if replication ran otherwise; \( e \) = random error term. The intercept was restricted to equal zero so that a yield of zero would be associated with a zero plant stand. The plant stand by replication interaction term, \( x_p \cdot x_h \), was included to account for variations in plant stand and productivity between replications attributed to diversity in genetic characteristics. By accounting for these variations, the reliability of the estimate of the blueberry-hexazinone relationship could be improved.

Once the relationship was estimated, principles of production economics were utilized to determine the yield and profit maximizing levels of hexazinone. These principles have been used to determine optimal input use in agricultural production (2, 3), as well as optimal weed control practices (1).

Partial budget analysis. A significant increase, then decreasing trend in blueberry yield was associated with increases in the rate of hexazinone (Table 1). The change in net income per hectare for each hexazinone rate was calculated (Table 2).

The 1.1, 2.2, and 4.5 kg/ha rates of hexazinone resulted in positive changes to net income, per hectare, of $497.30, $606.30, and $646.32, respectively, indicating use at these levels is economically feasible. The 9 kg/ha hexazinone rate did not increase yields by a large enough amount to compensate for the added cost associated with its use, resulting in a negative change to net income of $145.40/ha, thereby indicating use of this level is not economically feasible.

Although the partial budgeting technique is valuable for determining the economic feasibility of hexazinone use, it is limited in its sensitivity in determining the most profitable rate of hexazinone. Results indicated that the 4.5 kg/ha rate increased net income by the largest amount, $646.32/ha. However, because this technique only examined 4 discrete points, it was not possible to determine if net income was maximized above or below the 4.5 kg/ha rate. Therefore, a blueberry-hexazinone response function was estimated and analyzed to determine the profit maximizing amount of hexazinone to apply.

Response function analysis. Efficacy data on the effect of hexazinone on blueberry injury, number of buds, and weed population were examined prior to the formulation of a blueberry-hexazinone response function (4). Blueberry injury was shown to increase with hexazinone application rate. A quadratic trend in the number of flower buds and yield also was associated with increases in the rate of hexazinone. These observations suggested that an appropriate blueberry-hexazinone response function should be for decreasing yields. Various functional forms including the square root and quadratic, allow for decreasing yields. Further examination for ef-

### Table 1. Blueberry yields and changes in yields by rate of hexazinone.

<table>
<thead>
<tr>
<th>Hexazinone rate (kg/ha)</th>
<th>Blueberry yield (kg/ha)</th>
<th>Change in yields (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>2144</td>
<td>0</td>
</tr>
<tr>
<td>1.1</td>
<td>2919</td>
<td>775</td>
</tr>
<tr>
<td>2.2</td>
<td>3143</td>
<td>999</td>
</tr>
<tr>
<td>4.5</td>
<td>3354</td>
<td>1210</td>
</tr>
<tr>
<td>9.0</td>
<td>2575</td>
<td>431</td>
</tr>
<tr>
<td>F test</td>
<td>**</td>
<td></td>
</tr>
</tbody>
</table>

**Significant at 1% level.
ficacy data indicated that decreases in weed competition and increases in flower buds were greatest at the lower levels of hexazinone and that progressively higher rates of herbicide resulted in blueberry plant injury.

Since the square root function possesses a slope that is steeper than the quadratic’s at low input levels, it better describes the trend indicated by the data. For these reasons, it was chosen over the quadratic to describe the data response. The estimation of a square root response of blueberry yield to hexazinone was chosen over the quadratic to describe the trend at low input levels, depicted by the nearly vertical slope from the 0 to 3 kg/ha as shown in Fig. 1. Also illustrated are the declining blueberry yields from the 3.3 to 9 kg/ha levels of hexazinone. The predicted blueberry yield was maximized at 3195 kg/ha (Fig. 1, point A) at the 3.3 kg/ha rate of hexazinone.

From an economic standpoint, determining the level of hexazinone which will maximize profit is the objective most important to the grower. Profit is expressed as the difference between the total dollar value of the output and the total costs. The total value of output was expressed as net of harvesting costs, because harvesting costs per hectare vary with the level of output. The total value of output net of harvesting costs (TV) equaled the net price of blueberries (price/kg of blueberries less harvesting costs/kg) times the level of output. The profit maximizing application level of hexazinone was utilized.

The square root blueberry-hexazinone response best described the relationship observed on the experimental site. Response function analysis revealed that hexazinone at 3.3 and 2.3 kg/ha maximized yield and profit, respectively. The lowbush blueberry grower would not maximize profit if the yield maximizing level of hexazinone were utilized. These results may be used only as guidelines, since actual yield and profit maximizing levels will vary among fields due to differences among such factors as blueberry plant stand density, clonal variety, weed populations, edaphic factors and climatic conditions.

### Literature Cited