Modelling and Economic Analysis of Hop Production Technologies in Poland

Jacek Hołaj, Andrzej Zaliwski

Abstract: Seven hop production technologies used in Poland were modelled and analysed to determine the influence of mechanisation of operations on the components of direct costs and direct income. The models comprised operations of hop tillage with dissimilar level of mechanisation. The analysis showed that the level of mechanisation, if processes are mechanised in a suitable way, can cause a reduction in direct costs of production. At the same time, the mechanised processes may be carried out more effectively. There is also a notable drop in labour input.


Keywords: hop, production technology, economic analysis

Introduction

A technology decision support system fulfils its purpose when it assists in conducting various technological, organisational and economic analyses within the scope of production activities on the farm [1, 5].

Fig. 1 A diagram of the Agroefekt program major components

With the aid of currently built farm decision support systems it is possible to analyse farm production not only from the productivity point of view but also from the environment perspective. However, they are costly. At the Institute of Soil Science and Plant Cultivation of Pulawy a program has been developed that is not expensive and does not require large sets of data [4]. A small database has also been developed to function together with the program. The database comprises operation sheets and tables with prices and exploitation data of tractors and machinery as well as prices of materials. In fig. 1 a flow diagram of the Agroefekt
program is shown. In the cropping plan the user inputs the production conditions (crops, yields, areas, procedures etc.), operation sheets determine the technological processes and the database with prices and exploitation data is used for economic analysis. With the aid of the program production activities on agricultural farms of any type of specialisation can be modelled and calculation of direct costs, value of production and direct income, among others, can be conducted. A simulation of changes to tillage technology makes it possible to plan more innovative and cost-effective production on the farm [4].

The methodology of economic analysis is incorporated into the Agroefekt program and has been based on the available literature [1, 2, 3, 6] and some other methodology sources.

![Tractor operating costs graph](image)

**Fig. 2** Tractor operating costs

In fig. 2 tractor operating costs of the C-360 tractor are shown in relation to its yearly use. In a model of a farm the use is calculated for each tractor and implement on the basis of operating sheets, which ensures that the operating costs are very close to their real value.

**Materials and methods**

Since 1999 an improvement in economic conditions of hop production has been taking place in Poland. After a deep crisis of 1995-1998 the new situation creates possibilities to invest in new technologies. Innovations may improve profitability of hop production and

<table>
<thead>
<tr>
<th>Variant of tillage</th>
<th>Implements used in a variant</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Hop cone picker, plough, cultivator, harrow, fertiliser distributor, manure spreader, mounted sprayer, trailed sprayer, trailer, forced convection coal furnace, power hop press</td>
</tr>
<tr>
<td>II</td>
<td>As in I + rootstock trimmer</td>
</tr>
<tr>
<td>III</td>
<td>As in II + moistener</td>
</tr>
<tr>
<td>IV</td>
<td>As in III except for the coal furnace, which is replaced by a forced convection oil furnace</td>
</tr>
<tr>
<td>V</td>
<td>As in IV except for the oil furnace, which is replaced by a forced convection direct-heat gas furnace</td>
</tr>
<tr>
<td>VI</td>
<td>As in V + hop plant picker</td>
</tr>
<tr>
<td>VII</td>
<td>As in VI + leaf ripper</td>
</tr>
</tbody>
</table>
reduce production costs [2, 6]. To analyse the question further seven computer models of hop production technologies have been created. The models include seven operation sheets that differ in the level of mechanisation of processes (tab. 1). All the operation sheets for investigating the role of the level of mechanisation of processes have been built for the area of 3 ha. The operation sheets included in the model exemplify real-life hop production practices that are currently in use in Poland. The economic analysis of all these variants of hop tillage was made for the yield of hop cones equal to 15 dt/ha and at 2000 prices.

**Results**

An analysis of cost-effectiveness of hop production in relation to the level of mechanisation was conducted. In the analysis only direct costs of production were analysed.

![Fig. 3. Influence of level of mechanisation on direct costs of hop production](image)

The results of the influence of level of mechanisation on direct costs of hop production are presented in fig. 3. The costs have been broken down into four categories. It follows that the cost of labour goes down with each technical improvement introduced (variant II – machine trimming of rootstock, variant VI – machine plant picking and variant VII – machine leaf ripping). Due to the introduction of a new mechanised process in each consecutive variant of tillage, the cost of machinery raises steadily except in variant IV, when it drops owing to the replacement of the coal furnace with an oil one.

![Fig. 4. Direct costs of production and direct income in relation to the level of mechanisation](image)

Even though the price of the oil furnace is higher, its technical parameters are better (doubled total life – 9.000 hours instead of 4.500 hours) and in consequence the hourly cost of the new furnace is reduced. This is reflected by a drop in the costs of machinery. The costs of
tractors go up in variant II (introduction of rootstock trimmer) and then they are lowered in variant VI (introduction of hop plant picker to replace manual picking of plants from a trailer) to go up again in variant VII (inclusion of leaf ripper). The costs of materials are not influenced much by the change in tillage except for variant V in which a direct-heat gas furnace is used.

In fig. 4 direct costs of hop production and direct income as influenced by the level of mechanisation are shown. Direct income is rather small due to a small area of hop garden, but not only; it also reflects the economy of hop production in Poland in recent years. It follows from the chart that lowering costs of production causes the direct income to go up, which was to be expected [1, 2, 3, 6]. It is apparent that the level of mechanisation, if processes are mechanised in a suitable way, can cause a reduction in direct costs of production (in the analysed variants I-VII it is about 8.5%). At the same time, the mechanised processes may be carried out more effectively. There is also a notable drop in labour input - from 832 man-hours/ha to 630 man-hours/ha, i.e. 24% (not shown graphically).

Conclusion

On the basis of the analyses conducted it can be said that the level of mechanisation, if processes are mechanised in a suitable way, can cause a reduction in direct costs of production (in the analysed variants it was about 8.5%). At the same time, the mechanised processes may be carried out more effectively. There is also a notable drop in labour input (in the analysed variants it was about 24%).

Bibliography


Addresses of authors:

Mgr inż. Jacek Hołaj, Instytut Uprawy Nawożenia i Gleboznawstwa, Zakład Agrometeorologii i Zastosowań Informatyki, 24-100 Puławy, ul. Czartoryskich 8, tel. (081) 886-34-21 ext.202, e-mail holaj@iung.pulawy.pl

Dr inż. Andrzej Zaliwski, Instytut Uprawy Nawożenia i Gleboznawstwa, Zakład Agrometeorologii i Zastosowań Informatyki, 24-100 Puławy, ul. Czartoryskich 8, tel. (081) 886-34-21 ext.202, e-mail boss@iung.pulawy.pl