Summary

With the aid of the Agroefekt program the influence of mechanisation of operations and the area under the crop on the components of direct costs and direct income was analysed. To this purpose a model of hop farm was created comprising seven variants 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 an evident drop in labour input. The expansion of hop garden from 3 ha to 10 ha can result in a significant reduction of direct costs of production and a significant reduction in labour input. Nevertheless, expansion of hop garden in the present situation on the hop market in Poland would not be justified.

1. INTRODUCTION

An advisory computer program fulfils its purpose when it assists in conducting various technological, organisational and economic analyses within the scope of production activities on the farm [Lorencowicz 1992]. With the aid of 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 [DSSAT 1997, Pl@nteInfo 1996]. However, they are costly. At the Institute of Soil Science and Plant Cultivation of Puławy a program has been developed that is not expensive and does not require large sets of data. 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.

Fig. 1 A diagram of the Agroefekt program major components

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.
The Agroefekt program had been developed from 1988 to 1994 and operates under MS DOS. The database has been updated on a yearly basis. With the aid of the program production activities on agricultural farms of any type of specialisation can be modelled and calculation of direct cost, 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 [Zaliwski et al., 1991].

The methodology of economic analysis is incorporated into the Agroefekt program and has been based on the available literature [Lorencowicz 1987, Manteuffel 1984, Witney 1984, Zaremba 1987] and some other methodology sources.

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 and this way the operating costs are very close to their real value.

2. MATERIALS AND PROCEDURES

Since 1995 a crisis in hop production has been taking place in Poland. The crisis is caused by a continuous rise in the price of means of production on the one hand and a steady drop of prices of purchase of hop produce. In the present study it was assumed that the best way of improving profitability of hop production would be a reduction in production costs [Manteuffel 1984, Zaremba 1987]. To analyse the question further a computer model of a hop farm was created. The model included seven operation sheets that differed in the level of mechanisation of processes and eight operation sheets for hop garden area from 3 ha to 10 ha. All the operation sheets for investigating the role of the level of mechanisation of processes were built for the area of 3 ha. The operation sheets included in the model represent 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 1998 prices.
### Table 1. List of hop tillage variants

<table>
<thead>
<tr>
<th>Variant of tillage</th>
<th>List of implements used in a variant</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Hop cone picker, tractor, 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 oil 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>

### 3. RESULTS AND DISCUSSION

Two separate objectives have been sought in the analysis. First, an analysis of cost-effectiveness of hop production in relation to the level of mechanisation was conducted. Second, an analysis of relation of hop production cost-effectiveness to the area of hop garden was done.

#### 3.1 The level of mechanisation

In the analysis of cost-effectiveness of hop production in relation to the level of mechanisation only direct costs of production were analysed [Lorencowicz 1990].

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

In fig. 3 influence of level of mechanisation on direct costs of hop production is presented. In order to make the picture clearer the costs have been broken down into four categories. It follows from fig. 3 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. 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 lower. This is reflected by a drop in machinery cost. The cost of tractors goes up in variant II (introduction of rootstock trimmer) and then it is 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 cost of materials is not influenced much by the change in tillage except for variant V in which a direct-heat oil furnace is used.

![Fig. 4. Direct costs of production and direct income as influenced by the level of mechanisation](image)

In fig. 4 direct costs of hop production and direct income as influenced by the level of mechanisation are shown. Direct income is negative 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 is to be expected [Lorencowicz 1987, Manteuffel 1984, Witney 1984, Zaremba 1987].

### 3.2 Area of hop garden

In the analysis of cost-effectiveness of hop production in relation to the area of hop garden eight variants of tillage were used. Variant for the 3 ha area was variant VII for the level of mechanisation analysis in which the throughput was increased from 100 plants per hour to 140 plants per hour. Consecutive variants differ in area by one hectare from variant to variant. Hop tillage processes used in them are very similar; nevertheless they reflect the influence of hop garden area on mechanisation, especially in regard to harvest.

In fig. 5 direct costs of tractors and machinery as influenced by the area of hop garden and in fig. 6 direct costs of production and direct income are presented.
The expansion of hop garden from 3 ha to 6 ha results in reduction of costs of tractors (fig. 5). This causes direct costs of production to go down (fig. 6), as all changes in costs of tractors and machinery are reflected in direct costs of production. At 7 ha another tractor is required and this brings about a small growth in costs of tractors in comparison with a 6 ha garden; then costs of tractors begin to drop steadily again. At 9 ha another drier is needed together with a furnace and this causes the costs of machinery to shoot upward; then they start to drop again (fig. 5). Since direct income is a difference of value of production and direct costs of production, the direct income grows when the direct costs go down and vice versa (fig. 6).

The differences in costs of labour are small; neither costs of materials change much with extension of hop garden area.
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%). At the same time, the mechanised processes may be carried out more effectively. There is also an evident drop in labour input (from 832 man-hours/ha to 630 man-hours/ha, i.e. 24%). The expansion of hop garden from 3 ha to 10 ha can result in a significant reduction of direct costs of production (by about 10%) and a significant reduction in labour input (from 615 man-hours/ha to 536 man-hours/ha, i.e. 15%). Nevertheless, expansion of hop garden in the present situation on the hop market in Poland does not seem justified. However, hop farms in Poland are diversified in respect to the area under hops. It may be expected that after Poland has joined the European Union, the situation on the hop market might stabilise. Hop farmers who will persevere might regain the profitability of hop production.

4. 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%). At the same time, the mechanised processes may be carried out more effectively. There is also an evident drop in labour input (in the analysed variants it was about 24%). The expansion of hop garden from 3 ha to 10 ha can result in a significant reduction of direct costs of production (by about 10%) and a significant reduction in labour input (15%). Nevertheless, expansion of hop garden in the present situation on the hop market in Poland would not be justified.

5. REFERENCES

Books

Periodicals
Internet Sources
