

## How expensive is vole damage?

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### Abstract

*Vole species, especially *Arvicola terrestris* and *Microtus arvalis* cause significant economical damage in organic pomiculture by gnawing the root system of trees. The importance of voles as pest organisms is well known. Nevertheless, the estimation of financial loss caused by voles is difficult for German fruit growers. We conducted a survey among organic fruit growers to get data on kind and amount of annual damage. Using the available publications and official statistics we calculated economical values of organic apple trees for different types of orchard processing and tree ages. Furthermore we calculated the number of trees lost due to voles in one year.*

**Keywords:** survey, organic farming, pomiculture, economical loss, Germany

### Introduction

Vole species, especially the Water vole (*Arvicola terrestris*) and the Common vole (*Microtus arvalis*) cause significant damage in German orchards (Klemm 1958, 1964; Wieland, 1973; BBA, 1978). Both species gnaw on the root system or trunks of trees. The affected trees mostly die and a persistent crop failure is the consequence. In some organic apple orchards dramatic effects are reported culminating in total losses (Kopp 2002). The knowledge about frequency, distribution and the resulting economical losses caused by voles in German organic pomiculture is poor. In order to get a more precise data basis we started a survey among German organic fruit growers and compared the results with data from Statistisches Bundesamt (2003, 2004) and KTBL collection (2005).

### Material and Methods

Our survey among German organic fruit growers asked for information about farm location and size, kind of apple cultivation, the importance of vole damage and the applied vole management. We focused our analysis on value and economical significance of vole damage. The questionnaire was distributed in February 2003 by consulting services and organic farming associations among their members and also by federal crop protection agencies. 75 questionnaires returned until June 2003 covering 698 ha of fruit growing acreage. This represents 13% of the nationwide organic fruit cultivation (Statistisches Bundesamt, 2004). Nevertheless, returns from the different fruit growing areas in Germany were not evenly distributed. The majority of returns came from the central and south western parts of the country.

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## Results

Vole damage in organic fruit growing is a wide spread phenomenon. 83% of the farms reported damage caused by voles in 2002. In the decade before, 95% of the farms were confronted with vole problems.

Apples were the most important fruit covered by the replies to our survey. They grow on 75% (526 ha) of the surveyed acreage. In 2002 voles caused damage in 230 ha of pomiculture (Tab.1) representing 44%. On 17% of the farms no damage occurred although one or both vole species were present. 55% of the farmers reported a loss of up to 10 % of apple trees/ha. 19% of the farmers lost up to a fourth and 2 farmers suffered from a total loss of trees (Tab. 2). Damage occurred although the vole populations were controlled permanently. 71% of the farms could not specify the total economical losses arising from vole damage. The remaining farmers estimated losses between 50 € and 40.000 €/ha. In the category “up to 10% damaged trees/ha” the losses in 2002 varied between 50 € and 2.000 € per hectare with a mean around 1.000 €/ha (Tab. 2).

Table 1: Returned surveys, covered apple acreage, and occurred vole damage.

| Federal State          | Number of returned surveys | Percentage of returned surveys | Total acreage of apple (ha) | Acreage with vole damage (ha) | Percentage of damaged acreage (%) |
|------------------------|----------------------------|--------------------------------|-----------------------------|-------------------------------|-----------------------------------|
| Baden-Württemberg      | 36                         | 48                             | 314                         | 140                           | 45                                |
| Rhineland-Palatinate   | 12                         | 16                             | 72                          | 31                            | 43                                |
| Hesse                  | 11                         | 15                             | 61                          | 26                            | 43                                |
| Saarland               | 9                          | 12                             | 29                          | 6                             | 21                                |
| Bavaria                | 5                          | 7                              | 32                          | 15                            | 47                                |
| Lower Saxony           | 1                          | 1                              | 3                           | 3                             | 100                               |
| North Rhine-Westphalia | 1                          | 1                              | 15                          | 9                             | 60                                |
| Total                  | 75                         | 100                            | 526                         | 230                           | -                                 |

Table 2: Degree of vole damage and variation of estimated total economical loss (TEL) in organic apple orchards

| Damaged apple trees/ha | Number of farms | Percentage of farms | Range of estimated TEL (€/ha) |
|------------------------|-----------------|---------------------|-------------------------------|
| No damage              | 7               | 9                   | 0                             |
| Uncertain              | 8               | 10                  | 1.000                         |
| -10%                   | 41              | 55                  | 50 - 2.000                    |
| -25%                   | 14              | 19                  | 2.600 - 15.000                |
| -50%                   | 3               | 4                   | 20 - 40.000                   |
| -75%                   | 0               | 0                   | no data                       |
| -100%                  | 2               | 3                   | no data                       |
| Total                  | 75              | 100                 | 50 - 40.000                   |

## Discussion

The results of our survey confirmed the results of Klemm (1958, 1964) and Wieland (1973) and showed the importance of Water voles and Common voles as vertebrate pests in German organic pomiculture. 44% of the reported acreage suffered from vole damage and in most off the affected orchards the farmers lost up to 10% of apple trees/ha. In a survey covering the decades from 1940s to the 1980s, Gemmeke & Pelz (1987) found that the total annual loss of trees was between 10-20% in the apple growing region around Hamburg. The Federal Biological Research Center (BBA, 1978) and Gaudchau (1983) found a damage of 50% and more in conventional pomiculture caused by voles. However, damage of much more than 20% seems to be infrequent. In our survey three farmers had up to 50% damaged trees and two farmers suffered from total loss. Kopp (2002) got similar results comparing 12 organic farms in Southern Germany. Most of these farms lost only about 1% of trees/ha but in one case 80% were damaged.

Estimations of the economical value of tree losses are rare in literature. For the period from 1958 to 1963 Wieland (1973) gave a total estimation of 6.5 Mio Mark losses on territory of the GDR. According to Teutsch (1979) the average of financial losses per hectare was 4.610 DM after a vole peak in conventional apple orchards around Bad Neuenahr-Ahrweiler. In the 1990s Wieland (1997) calculated 21.55 DM as the value of a single tree damaged by voles. To get this value he took the loss of crop yield for one year and the price for a new seedling into account.

Wielands tree value reflects the calculation farmers have in their minds. However, we found that the value of a tree is a function varying in time (Tab. 4). It depends on the costs of orchard plantation, orchard processing, personal costs and expected total crop yields for the whole period of orchards usage (Tab. 3). Therefore, we started our calculation estimating the value for a new tree in its first year. This value based on data published in the KTBL collection (2005). An orchard of one hectare contains 3.000 apple trees and stands for 15 years. We calculated with two different scenarios. The first is a simple orchard with just trees and protection devices excluded. The second scenario, the complex orchard, uses hail-nets, irrigation, anti-freeze protection and deer fences. In both scenarios the crop yield rises for the first five years and reaches 4,63 €/per tree from the 6<sup>th</sup> year of cultivation onward. All costs were added and divided by the number of apple trees (3000/ha). Accordingly the value of one apple tree in the first year is 98 € in simple orchards and 117 € in complex orchards (Tab. 4).

Table 3: Items for the calculation of the tree value in its first year (KTBL, 2005). The data based on a 1 ha orchard with 3.000 apple trees and a life cycle of 15 years. A simple orchard includes just trees. A complex orchard includes hail-net, freeze-protection, irrigation and deer fence.

| Item                 | Simple orchard (€) | Complex orchard (€) |
|----------------------|--------------------|---------------------|
| Expected crop yields | 165.500            | 165.500             |
| Plantation costs     | 23.140             | 47.913              |
| Processing costs     | 27.185             | 61.259              |
| Machinery costs      | 10.510             | 10.510              |
| Personal costs       | 67.028             | 67.028              |
| Total                | 293.363            | 352.210             |

Table 4: Varying value of apple trees and total economical losses during orchard lifetime. Examples given for the 1<sup>st</sup>, 6<sup>th</sup> and 12<sup>th</sup> year of an orchard with a total life span of 15 years.

|                       | Value of a single tree |                 | Range of total economical losses/ha |                  |
|-----------------------|------------------------|-----------------|-------------------------------------|------------------|
|                       | Simple orchard         | Complex orchard | Simple orchard                      | Complex orchard  |
| 1 <sup>st</sup> year  | 98 €                   | 117 €           | 2.058 - 20.188 €                    | 2.457 - 24.102 € |
| 6 <sup>th</sup> year  | 72 €                   | 81 €            | 1.512 - 14.832 €                    | 1.701 - 16.686 € |
| 12 <sup>th</sup> year | 29 €                   | 31 €            | 609 - 5.974 €                       | 651 - 6.386 €    |

According to Kopp (2002) the usual damage of trees per hectare in an orchard is around 1%. Farmers participating in our survey choose at most the category "up to 10% trees/ha damaged". This indicates that an annual damage between 1 and 10% is common in German organic pomiculture. Our calculation of tree values based on the number of 3.000 trees per hectare. This is the number of trees usually planted in a today's orchards. In the nationwide survey "Baumobstanbauerhebung 2002" (Statistisches Bundesamt, 2003) the average number of apple trees per hectare is 2.058. The difference of almost 1.000 trees appears because the "Baumobstanbauerhebung 2002" includes orchards of different ages, structures and degrees of damage. Given an actual number of 2.058 trees/ha and 1 to 10% of damaged trees per year, farmers have to face a loss of 21 to 206 trees/ha each year. In simple orchards the resulting total economical loss is between 2.058 € and 20.188 €/ha in the first year and 609 € and 5.974 € in the 12<sup>th</sup> year. For complex orchards the losses are 2.457 € to 24.102 € in the first and 651 € to 6.386 € in year twelve (Tab. 4).

Our calculated losses per hectare would allow an estimation of the economical importance of voles in organic pomiculture of Germany. However, there is no statistic available that gives the acreage of organic pomiculture. According to the German wide survey "Agrarstrukturhebung 2003" (Statistisches Bundesamt 2004) a total of 5.407 ha is cultivated with organic fruits. Among organic fruit growers in our survey 75% of the total acreage were cultivated with apples. Assuming that this is a plausible ratio for whole Germany, 4.055 ha should be organic apple orchards. Taking the fraction of 44% from our survey, in 2002 a total of 1.784 ha was affected by voles. With an average of 2.058 trees per hectare and 1 to 10% of the trees lost due to vole damage, 36.715 to 367.147 organic apple trees were destroyed by voles in one year.

There is no doubt that the annual economical losses caused by voles count into millions of Euros. Unfortunately, it is impossible to calculate the exact yearly economical losses due to tree values varying with the age and kind of cultivation and the number of damaged trees ranging from 1 to 10%.

We conclude that due to the difficulties of calculation farmers, consultants and officials often underestimate the value of a single organic apple tree and consequently the economical losses caused by voles. A modern ecological and economical management of vole populations is essential.

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