

# Economical and Environmental Aspects of Integrated Fruit Production in Belgium

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## Abstract

In the traditional production of pip fruits a substantial quantity of pesticides are used. As the use of pesticides has a negative impact on the environment, the Belgian government decided to encourage integrated fruit production. A per hectare premium was granted to fruit-growers that used the integrated production method. At the Centre for Agricultural Economics (CAE) the economical and environmental impact of the introduction of integrated fruit production was examined. Based on the data of the farm accountancy data network of the CAE, the use of pesticides was determined on holdings using this integrated production method and on those still using the traditional production method. It was found that the total use of active ingredients of pesticides in the traditional production method of apples was one third higher than in the integrated production method. For pears there were no differences due to the total ban of chlormequat in 1999. Furthermore the profitability of the holdings was examined. No significant difference in profitability could be detected between the holdings of both groups. When the profitability of the two groups was compared in the years before integrated fruit production was introduced, no differences in profitability between the two groups was found. It can be concluded that a more general introduction of integrated pip fruit production can lead to an important reduction of pesticide use, and that this reduction does not affect the income of the fruit holdings.

## INTRODUCTION

Belgian fruit production, almost totally located in Flanders is dominated by apples and pears. According to official figures of the 2000 agricultural census the area in apples amounted to 9160 hectares and the area in pears to 5568 hectares. The total production value of apples and pears was 198 million Euro; this is 13 percent of the total production value of Belgian horticultural crops. In traditional fruit production a lot of pesticides are used which implies a negative impact on the environment. For some years the integrated fruit production method, or IFP, attracted a great deal of attention on the international level. In this method producers give preference to production methods that are environmentally friendly, using a minimum of pesticides and applying integrated pest control methods. This IFP concept has also been introduced in Belgium, and since 1996 a legal regulation of IFP exists.

This paper presents information about the impact of IFP on the use of pesticides in Belgian fruit production. It will be analysed whether or not there are differences in the quantities of pesticides used per hectare between IFP holdings and holdings applying the traditional production methods. Based on these figures the total savings of pesticides will be estimated under the hypothesis that all fruit holdings would apply IFP. In addition to the environmental aspect (reduced pesticide use) of the Integrated Fruit Production concept, this paper will also assess the profitability of integrated fruit production compared to traditional fruit production. Furthermore, it will be analysed whether in the past, before the introduction of IFP, the holdings of the sample, that at the present use IFP, had a different profitability compared to the holdings that at present still produce in the traditional way.

## **INTEGRATED FRUIT PRODUCTION IN BELGIUM**

The application of the integrated production method is framed in the pursuit of a more sustainable agriculture, which implies keeping negative impacts of agricultural production to the environment as small as possible. In the mid-eighties the FAO defined, in an international code of conduct on the distribution and use of pesticides, the integrated production method as follows: 'IPM is a pest management system that, in the context of the associated environment and the population dynamics of the pest species, utilizes all suitable techniques and methods in as compatible a manner as possible and maintains the pest population at levels below those causing economically unacceptable damage or loss' (FAO, 1990).

The fruit producers also adopted IPM, here indicated as IFP (Integrated Fruit Production). In Belgium the integrated fruit production gained a great deal of attention in a early stages. Especially in the production of pears IFP quickly found acceptance. In the production of apples on the other hand, only limited interest was shown for IFP because of the fact that IFP did not always provide acceptable alternatives for some crop protection products (de Schaetzen C. et al., 1993). In 1996 an initiative of legislation was taken by the Belgian government which created a legal protection for IFP and by which IFP became subject to constitutionalized regulations and controls (Moniteur Belge, 1996). These regulations are based on the principles formulated by the International Organisation for Biological and Integrated Control of Noxious Animals and Plants (IOBC). Furthermore, with the aim of stimulating the conversion, in 1999 a premium arrangement was introduced which provided a financial contribution for the first five years a farm converted to IFP (Moniteur Belge, 1999). Currently this subsidy amounts to 247.89 Euro per hectare; this is about 1.5 percent of the production value of a hectare of fruit. This premium arrangement fits within the Federal Plan for Rural Development. IFP is more than the reduction in use of pesticides; nonetheless this study focuses on the comparison of pesticide use between IFP farms and traditional farms. In IFP the pesticides are divided in four groups, according to the severity of their impact on the environment. Different groups are indicated by the colours red, orange, yellow and green. The red list is composed of those with active ingredients which are not allowed in IFP. Active ingredients from the orange list are allowed when their absolute necessity is proven and with the permission of the inspection society. The yellow list includes substances that are only to be used when no other active ingredient from the green list is considered suitable for effective and efficient use, and finally the green list is composed of active ingredients that are allowed. Furthermore the conditions for use of each of the products (such as doses, weather, waiting period, etc.) must be respected. This list gives the farm managers something to refer to in making a rational choice of more environmentally friendly pesticides.

According to official figures for 2000 the Belgian area IFP for apples amounted to 3734 hectares, this accounts for 23 percent of the total area of apples, while 2542 hectares of pears or 33 percent of the total area of pears were grown according to the IFP principles (Filière Horticulture, 2001). It should be noticed however that these percentages are based on the estimated area of apples and pears, which is considerably higher than the official area of the agricultural census. When the IFP areas are expressed in relation to the official total areas, the area IFP apples would be 41 percent of the total area, for pears this would be 46 percent.

## **MATERIALS AND METHODS**

The Centre for Agricultural Economics operates a horticultural farm accountancy data network to observe the profitability of the horticultural sector. As such profitability of the fruit production sector is observed as well. The farm accountancy data network is considered to be representative of professional farms and includes, for fruit production, 55 farms or 7 percent of the total number of professional farms in Belgium. The accountancy mainly includes monetary values of products and costs. Since a few years, the data collecting has expanded with the gathering of data about amounts of used raw materials such as energy, pesticides, minerals, etc. However these supplementary data are not sys-

tematically collected. For the use of pesticides in fruit, data have been collected for apple for the crop year 1998 and for pear in the crop year 2000. In 2001 data on pesticide use were again collected for apple but these data were not yet available for this study. Based on the collected information, pesticide use in the culture of apples and pear could be analysed on integrated fruit production holdings as well as on holdings that are still applying traditional cultivation method.

Financial data, structural data, data on profitability and prices that are available in the accountancy were compared for the two groups of holdings. As the sample farms had already been part of the accountancy data network for several years, it was possible to compare 1995 figures of between these two groups of holdings at a time when IFP had not yet been implemented. In this way it was possible to analyse whether or not the holdings that switched over to IFP had different profitability levels in the period before they changed their production method.

## **RESULTS AND DISCUSSION**

### **Use of Pesticides**

Based on a complementary survey on pesticide use in the culture of apples in 1998 and in the culture of pears in 2000, the use of pesticides in both cultures was analysed for the holdings that apply IFP as well as for the traditional holdings. The fast growth of IFP as seen in the past few years in the farms of the sample is remarkable. In 1998 only 30 percent of the holdings applied IFP while in 2000 IFP farms accounted for more than 60 per cent of sample farms and 70 percent of the total sample area. This is remarkably higher than the percentage of IFP holdings in the population. This phenomenon can be explained by the fact that the sample only consists of farms with a sufficient size to show professional characteristics. Furthermore the phenomenon can also be explained by the presence of holdings that apply IFP, but that haven't applied for the premium and thus do not appear as such in the official statistics.

The amounts of commercial products used at the sample farms were, for this analysis, converted to the amounts of the different active ingredients present in those commercial products. Table 1 indicates the total amount of active ingredients, in kilograms per hectare that were used in the culture of apples and pears for the integrated production as well as for the traditional production methods. It is evident, especially in the cultivation of apples, that the use of active ingredient is one third higher in the traditional production compared to IFP. The use of active ingredients at IFP farms amounts to 28.3 kilograms per hectare, while for the traditional farms it is 38.1 kilograms per hectare. There is remarkably lower use of acaricides in IFP, with 0.06 kilograms per hectare, in comparison to the traditional cultivation method where 0.64 kilograms per hectare was used. The difference in acaricide use can be explained by the effectiveness of the use of predator mites, the natural enemies of the pest mites. In IFP apples acaricides are only used, as a backup, in the conversion period of a holding from traditional to IFP production.

In the culture of pears a different picture emerges. Here, the use of plant protection products in the traditional cultivation shows greater resemblance to that of the IFP method. It can thus be concluded that smaller differences exist between the amount of active ingredients that is used per hectare between both cultivation approaches. Moreover the amount of active ingredients used in the IFP is indicated to be slightly higher than the amount that is used in the traditional method. It must be noted however that until 1999 it was permissible for traditional producers to apply the growth regulator chlormequat in order to slow down the growth of the trees. It was applied in rather large doses (6 to 9 kilograms per hectare). As such it can be concluded that in earlier years the use of pesticides in traditional cultivation was about 25 percent higher than in IFP. Furthermore the use of insecticides, acaricides and growth hormones are considerably lower for IFP holdings. On the other hand, in 2000 there was a considerable higher use of fungicides, on IFP farms.

It can be asked what the potential effect on total pesticide use would be if all fruit holdings converted to the integrated fruit production system. Depending on whether calculations are based on the official area or the estimated area, there would be an estimated 17 to 21 percent reduction in the amount of pesticides used. In the cultivation of pears a full conversion to IFP would no longer have an effect on the amount of pesticides used.

### **Economical and Structural Criteria of Integrated and Traditional Fruit Production**

A lot of research has already been done on integrated fruit production. The technical and environmental aspects of IFP have been especially examined. However little research has been conducted on economical aspects in which the results of IFP holdings are compared with those of traditional fruit producing holdings. Research in the Netherlands compared profitability of IFP and organic fruit growing on the basis of an experiment on a research station that was followed for several years. It was found that the IFP method were more profitable than organic production methods, but there was no comparison with traditional production holdings (Groot M.J., 2000). In the present research of the Centre for Agricultural Economics the economical and structural data of IFP holdings are compared with these of the traditional holdings, and this is done on the basis of a fixed sample. The analysis is done for the data of the accountancy years 2000 and 1995. For 1995 the composition of the two groups is exactly the same as in 2000, so the holdings in the IFP group 1995 are the holdings that in later years switched to IFP. In this way it was verified if there were prior or existing differences in profitability or structure of the fruit holdings before some of them switched to integrated fruit production. In the following tables these two groups will be referred to as the IFP group and the traditional fruit holdings group. The same reference will be used for the data of 1995, although the holdings of the IFP group were not yet practising IFP at that moment.

Table 2 gives a number of structural characteristics of the fruit holdings of the sample. In 2000 there were 33 holdings applying IFP and 22 that still produced in the traditional way. A first conclusion is that the holdings of the IFP group are significantly larger than the traditional holdings. This was already the case in 1995, and it remained unchanged in 2000. The same conclusions were found in other CAE research that was based on the data of the agricultural census of 1999 (Carels K. et al., 2001). In 1995 the area of IFP pears holdings was significantly larger and this was still the case in 2000. During the last five years the total area of the holdings changed little. It is remarkable that the modernity of the IFP holdings is significantly better than that of the traditional holdings, and that they were already like that in 1995 before they switched over to IFP. The modernity of a holding is the ratio between the book value of the means of production (buildings, machinery, trees, etc.) and the purchase price of these assets. The lower the modernity the older the assets. This might indicate that the holdings with a higher modernity are younger, or that they are invested in more frequently. There was no indication that the age of farmers were different between the groups. In both there were farmers in every class of age.

Table 3 compares the level of education of the farmers between both groups; the holdings were classified in three groups on the basis of the level of education of the farm manager. In the first group one can find the farmers with an upper secondary education, in the second group the farmers with a lower secondary education and in the third group the farmers with a vocational education or farmers with only practical experience. A Chi-square test was performed on these data and this test indicated that the managers of IFP holdings had a significantly better education level than the other managers. This corresponds with the conclusions of other CAE research (Carels K. et al., 2001).

Table 4 compares some financial data and criteria on profitability between both groups of holdings for 2000 and 1995. One can see that there were no differences between the average yield per hectare of apples and pears for both groups. This was the case, of the holdings of the first group, in 1995 before the switchover to IFP and also in 2000 after the switchover to IFP. In 2000 one can see that the yield per hectare of apples is higher on the IFP holdings, but these differences are not significant. One can add to this that it is

possible that in other years the average yields of apples are larger on the traditional holdings. There are also no differences found in average prices of apples and pears between the IFP and the traditional production. This means that, until now, the integrated fruit production of apples and pears does not lead to better prices than the prices obtained in the traditional production. However the Belgian auctions make great efforts to promote the environmentally friendly image of IFP fruit. From 2003 on, the Belgian auctions will, under their auction labels, only sell fruit that is produced according to the integrated fruit production method. This will allow them to develop a marketing strategy focusing on environmentally friendly fruit production methods. As all the labelled fruits they sell will be produced according to the regulations of the integrated fruit production, it will be easier to promote the image of the fruits and this will give them a stronger position in the market and hopefully better prices (Filière Horticulture, 2001).

One can also see that there are no significant differences in costs of pesticides per hectare between the IFP holdings and the traditional holdings. As for the profitability there were no significant differences between the family farm income of the two groups. The family farm income is the remuneration for the labour and the invested capital of the family. During the period 1995 through 2000 the farm family incomes fluctuated and for some years the average income was higher for the IFP holdings and in other years they were higher for the traditional holdings. These differences depended on the evolution of the prices of apples and pears which can be different from one year to another but are never significant. In years with good prices for pears the results on the IFP holdings are better, and when prices for pears are lower the profitability of the IFP holdings is not as good as the traditional holdings. Even if the period 1990 through 1994 is studied, no significant differences in profitability between the two groups of holdings are found. However, as some of the holdings were not yet in the accountancy data network for this period, the survey is not a fixed sample and it contains a smaller number of holdings.

Based on these real farm data, one can conclude that it is possible to obtain the same profitability when producing apples and pears using the integrated method as the traditional method. Even if one excludes the subsidies for IFP there is no difference in profitability. These subsidies are rather small and are less than 2 percent of the production value of the fruits. When the profitability of the same holdings in the two groups was compared for the accountancy year 1995, before the switchover to IFP, no differences were found between the two groups. One can conclude that it was not the holdings with better financial standing that were more willing to switch over to integrated fruit production. So profitability was not an indicator of inclination to change production methods. It is remarkable that in 1995, before a number of holdings switched over to integrated fruit production, that there was a significant difference in the solvency of the holdings between the two groups. The solvency is the ratio between the farmer's own capital and the total capital invested in the farm. On the farms that were to switch over to IFP in the next years the solvency was lower than on the traditional holdings. The explanation is that IFP holdings are larger holdings, and that a larger part of their holding were financed with borrowed money. The difference in solvency is still present in 2000, but it is no longer significant.

## CONCLUSIONS

As a result of this analysis it can be concluded that holdings that use the IFP production method use less pesticides than holdings producing in the traditional way and that IFP producers use pesticides that are less harmful for the environment. In the production of apples the use of pesticides on the traditional holdings was one third higher than in the IFP holdings. Fewer differences were found between IFP and traditional production of pears. Since the ban of the growth regulator chlormequat, the total amount of active ingredients used was slightly higher in IFP than in the traditional production.

The holdings that converted to IFP production methods were larger, had a higher modernity and had managers with a higher level of education. This was already true before these holdings converted to IFP. This conforms to the theory of diffusion of innova-

tions that states that among other things, holdings that are larger and more modern and have managers with a higher level of education will be quicker to introduce innovations than will other holdings (Rogers E.M., 1995).

The economical criteria that were studied lead to the conclusion that integrated fruit production does not necessarily affect the yields per hectare, the prices of fruit or the costs for crop protection. No significant differences in profitability were found between IFP and traditional holdings, not even when the subsidies for IFP were excluded, and this was true for the period before some of the holdings switched to IFP as well as after the switchover. Based on these findings it can be concluded that all farmers can apply integrated fruit production without implicating a risk for the profitability. This conclusion is nevertheless only true when the farmers are supported with good and accessible advice and information.

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### Tables

Table 1. Use of active compounds of pesticides in integrated and traditional apple and pear growing in Belgium.

	Apple (year 1998)		Pear (year 2000)	
	IFP	Traditional	IFP	Traditional
	(kg/ha)	(kg/ha)	(kg/ha)	(kg/ha)
Herbicides	3.737	4.127	3.462	3.364
Fungicides	22.671	30.823	25.215	21.367
Insecticides	1.358	2.082	2.472	3.088
Acaricides	0.064	0.639	0.193	0.769
Growth hormones	0.502	0.413	0.104	0.435
Total	28.332	38.084	31.446	29.023

Table 2. Structural criteria of IFP and traditional fruit holdings in 1995 and 2000.

	1995		2000	
	IFP in 2000	Traditional in 2000	IFP	Traditional
Total area (ha)	* 19.18	13.20	* 20.72	13.93
Area apples (ha)	10.29	9.89	10.43	9.44
Area pears (ha)	** 7.69	2.86	** 9.36	3.63
Modernity	* 57%	48%	** 46%	36%

\* T-test significant 0.05

\*\* T-test significant 0.01

Table 3. Educational level of the IFP managers and the traditional managers.

	* IFP	* Traditional
	Number	Number
Higher secondary education	21	6
Lower secondary education	9	11
Vocational education or unqualified	3	5
Total	33	22

\* Chi-square-test significant 0.05

Table 4. Profitability and financial criteria of IFP and traditional fruit holdings in 1995 and 2000.

	1995		2000	
	IFP in 2000	Traditional in 2000	IFP	Traditional
Kg apples/ hectare	43841	44444	49200	42004
Price apples euro/100 kg	35.70	36.99	26.13	27.19
Kg pears/hectare	30052	27858	33089	31809
Price pears euro/100 kg	45.84	45.86	47.57	49.18
Costs pesticides euro/ha	29082	26058	31979	34604
Family farm income in euro	77401	88576	62645	55796
Solvency	* 60%	76%	66%	77%

\* T-test, significant 0.05