



## **Midterm Status Report 2002 and Application for Continuation in 2003**

For research projects financed by grants from  
The Directorate for Food, Fisheries and Agro Business  
under the Danish Ministry of Food, Agriculture and Fisheries

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### **1. Research program**

Research in organic farming 2000-2005 (DARCOF II)

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### **2. Project title and number**

Project II.1

Title: Organic dairy production systems

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## 6. Project period (month, year)

**Start of project:** 1.7 2000

**End of project:** 31.12.2004

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## 7. Midterm description of the project, its results and progress, and application for continuation in 2003

### A. Project summary

The Danish organic farmers organisation has the declared goal to increase the amount of organic feed in the feeding of the dairy cows and in the latest version of the EU regulations of organic farming it is stated “that the production of organic milk within the next 5 years has to be based entirely on organically produced feed”.

Compared to the present situation on a typical Danish organic dairy farm this will force some changes in feeding and land use. Feeding based entirely on organic feed will force the use of home-grown roughage. Such a changed feeding pattern can have an impact on the production in several ways. It will from a feeding point of view “stress” the cow and possibly influence the production level, milk content and quality as well as animal health and welfare. It will further increase the difference between organic and conventional production conditions and thereby create the need for a breeding program specifically designed for organic dairy cows.

In a situation with feeding based solely on home-grown organic feed, the feed ration and the resulting production will to a larger extent, be a result of the land use. It is therefore important to compare different feed rations based on the crop production from the same area (ha) of land. Feeding experiment, planned from this concept, has been conducted during periods of four months on two private farms.

Prolonged lactation and reduced feeding level for cows are expected to increase the roughage proportion of the cow's diet, and thereby a higher degree of self-sufficiency in feed, and to increase the efficiency and sustainability in the dairy system. A two times two factorial experiment with prolonged or standard calving interval and standard supplementation or no supplementation to clover-grass grazing/silage are carried out at the organic research station Rugballegaard.

The objective is, during modelling, experiments and farm studies, to investigate the effect of different lactation length, feeding regimes and feed rations to dairy cows based on 100% organic Danish grown feed. The more specific tasks are

- to determine the milk production potential and efficiency and the impact on animal health and well-being of different types of organic feed produced at an even area
- to evaluate strategies to minimise excessive energy mobilisation and level of ketoses and reproduction problems
- to investigate the effect of prolonged calving interval and reduced level of supplementation in dairy cows on the biological efficiency of milk production and persistency of milk production
- to investigate mammary tissue proliferation, apoptosis and synthesis capacity, reproduction, health, live weight gain and constitution, and energy balance in dairy cows at different calving interval and level of supplementation
- to investigate the effect of supplement feeding on grass intake and selection of herbage during grazing, and on grazing effectiveness and N-balance in a leader-follower rotational grazing system for dairy cows with heifers as followers

- to explore possible indicators for milk quality in relation to human nutrition and health and their relation to feeding
- to investigate the content of vitamins in organic feed, and evaluate the concentration in milk and blood from animals at different stage of their productive life
- to investigate the genetic ranking of genotypes(individuals) in organic and traditional dairy farming systems.
- to evaluate the effect at farm level in terms of overall biological efficiency, nutrient turn-over, level of production and production economic

**Table 1: Work package list**

No.	Work package title	Partici-pants*	Budget (1.000 DKr)	Start	End	Deliverable No:
WP1	Co-ordination	<u>TKR</u>	0.2	2000	2004	
WP2	Milk production based on home-grown feed	<u>TKR</u>	1.5	2000	2002	
WP3	Prolonged calving interval and reduced supplementation for dairy cows	<u>JAS</u>	3.8	2000	2004	
WP4	Subclinical health and reproduction	<u>KLI</u>	1.0	2000	2004	
WP5	Milk quality	<u>KIS</u>	0.4	2000	2003	
WP6	Grass intake and selection in dairy cows on reduced supplementation.	<u>KAS</u>	0.6	2001	2003	
WP7	Genetic improvement of dairy cows	<u>ILM</u>	0.5	2002	2004	
WP8	Farming systems	<u>TKR</u>	0.45	2003	2004	
WP9	Vitamin status	<u>SKJ</u>	0.60	2001	2001	

\* Responsible participants are underlined

## B. Objectives and expected achievements

The overall perspective of the project is to increase the biological and economical efficiency in organic animal husbandry. The project aims at developing and assessing biologically and economically efficient organic dairy production systems, which are based on a high degree of feed self-sufficiency, and that implicate - under Danish conditions - a high proportion of clover-grass in the feeding ration.

The objective is, by means of modelling, experiments and farm studies, to investigate the effect of different feeding and reproduction regimes and feed rations to dairy cows based on 100% organic Danish grown feed. The more specific tasks are

- to determine the milk production potential and efficiency and the impact on animal health and well-being of different types of organic feed produced on a fixed size of area
- to evaluate strategies to minimise excessive energy mobilisation and level of ketoses and reproduction problems
- to investigate the effect of prolonged calving interval and reduced level of supplementation in dairy cows on the biological efficiency of milk production, milk production and persistency of milk production
- to investigate mammary tissue proliferation, apoptosis and synthesis capacity, reproduction, health, live weight gain and constitution, and energy balance in dairy cows at different calving interval and level of supplementation
- to investigate the effect of supplement feeding on grass intake and selection of herbage during grazing, and on grazing effectiveness and N-balance in a leader-follower rotational grazing system for dairy cows with heifers as followers

- to investigate the influence feed ration used in organic milk production on the milk content of CLA
- to investigate the genetic ranking of genotypes(individuals) in organic and traditional dairy farming systems
- to evaluate the effect at farm level in terms of overall biological efficiency, nutrient turnover, level of production and production economic
- to investigate the content of vitamins in organic feed to dairy cattle, and evaluate the concentration in milk and blood from animals at different stage of their productive life

## C. Midterm results and progress

### C.1 Description (summary) of main results and conclusions

WP1: The project initiated an activity with focus on the vitamin supply to organic feed dairy cattle. The activity was included in the project as WP9, with a budget for 2001 at 600.000 dkr. An application in order to extend this work, did not get support from FØJO II. Based on the present project an application for research funding was submitted to NKJ together with partners in Sweden and Norway. The title of the applied project was "Økologisk mælkeproduktion i Norden - tilpasning under hensyn til bæredygtighed, husdyrsundhed og mælkekvælitet". The aim was to establishing a synergistic internordic corporation on the development of organic milkproduction. Unfortunately the project did not succeed in getting founding. The project will in cooperation with The Department of Animal Product Quality, DIAS, try to establish a masterproject on technological milk quality, as this is an important aspect, which has not been funded so far.

WP2: Feeding experiments were conducted in the period from December 2000 to April 2001, at two private farms belonging to Erik Andersen and Bent Nielsen. The amount of concentrates (barley and rapeseed or rapeseed cakes), were given in amount corresponding to the expected yield, when grown organic in Denmark. The herd belonging to Erik was spilt into three groups, and three treatments was introduced 1) 5 kg barley, 2) 1 kg rapeseed cake 3) 1,4 kg barley and 1,6 kg rapeseed. All cows had ad lib access to the same silage. In the herd belonging to Bent was only treatment 1 and 3 introduced. Main production results are given in table 2.

**Table 2. Feeding experiment with barley and rape (seed or cake) to cows feed ad lib with silage.**

Farm Treatment	Erik Andersen			Bent Nielsen	
	Barley	Rapeseed cake	Barley and rapeseed	Barley	Barley and rapeseed
N	21	21	21	36	36
Milk, kg ECM	24,7	24,3	26,1	25,7	24,9
Fat, g	1047	1013	1085	1055	968
Fat, %	4,24	4,07	3,96	4,09	3,64
Protein, g	776	772	817	854	830
Protein, %	3,14	3,10	2,98	3,31	3,12

The data has to be analysed more into details, both with respect to production response and together with the results given in WP4. The conclusion so far is that rapeseed significant depressed fat and protein content, but not the amount. The milk production was reduced by feeding rapecake from an area corresponding to the area needed to grow barley, but the reduc-

tion was lower than expected, based on the energy intake and amount of protein (AAT/PBV) and fatty acid in the ration.

The potential private farms for experiment during the winter 2001/2002 had already changed to 100 percent organic feeding by the autumn 2001, which from the overall idea with this project is positive, but it gave some restriction on the possibility to make stringent treatments. As the experiment in 2000/2001 showed a large depression of fat content by the used amount of rapeseed, it was decided to look at the response in milk of increasing amounts of rapeseed. The same two farms as in 2000/2001 were used.

**Table 3. Feeding experiment with increasing amount of rapeseed, instead of barley to cows feed silage ad lib.**

Farm Treatment, SFU	Erik Andersen			Bent Nielsen		
	5	4.4	3.8	5	4.4	3.8
- barley	5	4.4	3.8	5	4.4	3.8
- rapeseed	0	0.6	1.2	0	0.6	1.2
N						
Milk, kg ECM	23.0	24.0	25.9	27.6	27.2	27.3
Fat, g	973	1000	1080	1114	1105	1114
Fat, %	4.37	4.15	4.12	3.95	4.03	4.03
Protein, g	712	738	800	899	889	887
Protein, %	3.19	3.04	3.05	3.19	3.24	3.21

WP3: At the organic research station “Rugballegaard” has four different groups been established in the dairy herd; with two levels of feeding (L and N) and two calving intervals (12 and 18). Lactation curves obtained so far from the four groups of cows are presented in figures 1-2, as least square means of daily milk yield from calving to end of lactation. In figure 1 for first calving heifers and for older cows in figure 2. As expected, the milk yield is higher in group N (supplemented with concentrates) than in group L (without supplements). The observed milk yield is higher in group N18 compared with group N12, especially in the older cows (figure 2). At present, we have no explanation for this difference in milk yield. In the young cows on treatment N12 (figure 1), there seems to be a decrease in milk yield during the last part of the gestation period, but due to the limited number of observations it is not yet possible to conclude if this decrease is caused by the increasing energy requirement for foetus production.

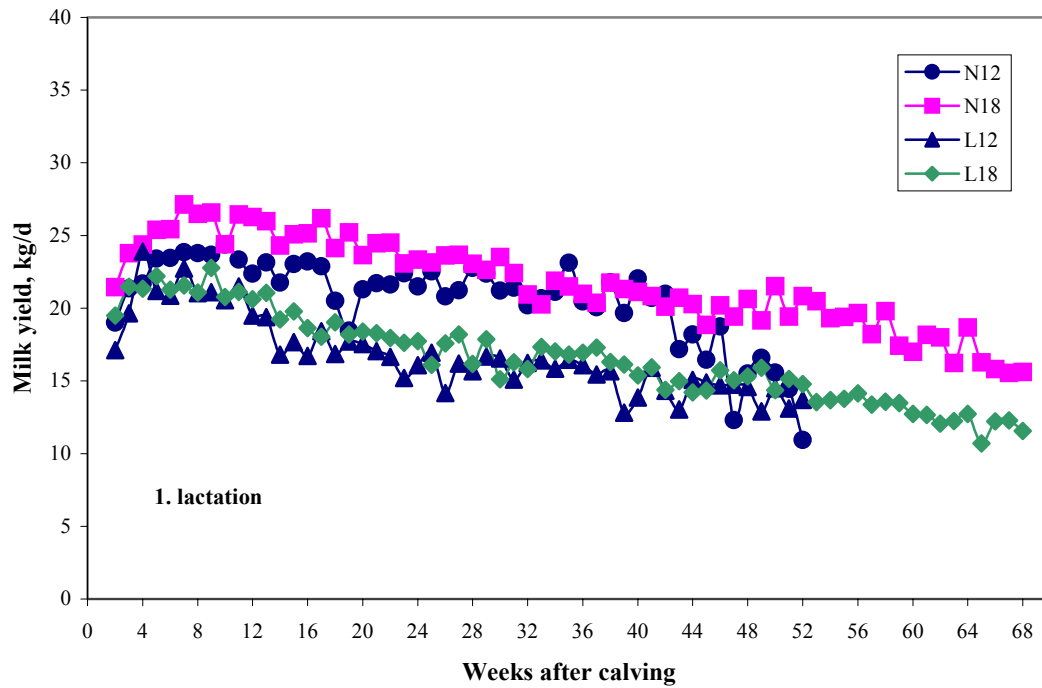


Figure 1. Milk yield in cows at different feeding levels (N or L) and with different calving intervals (12 or 18 months). First lactation cows.

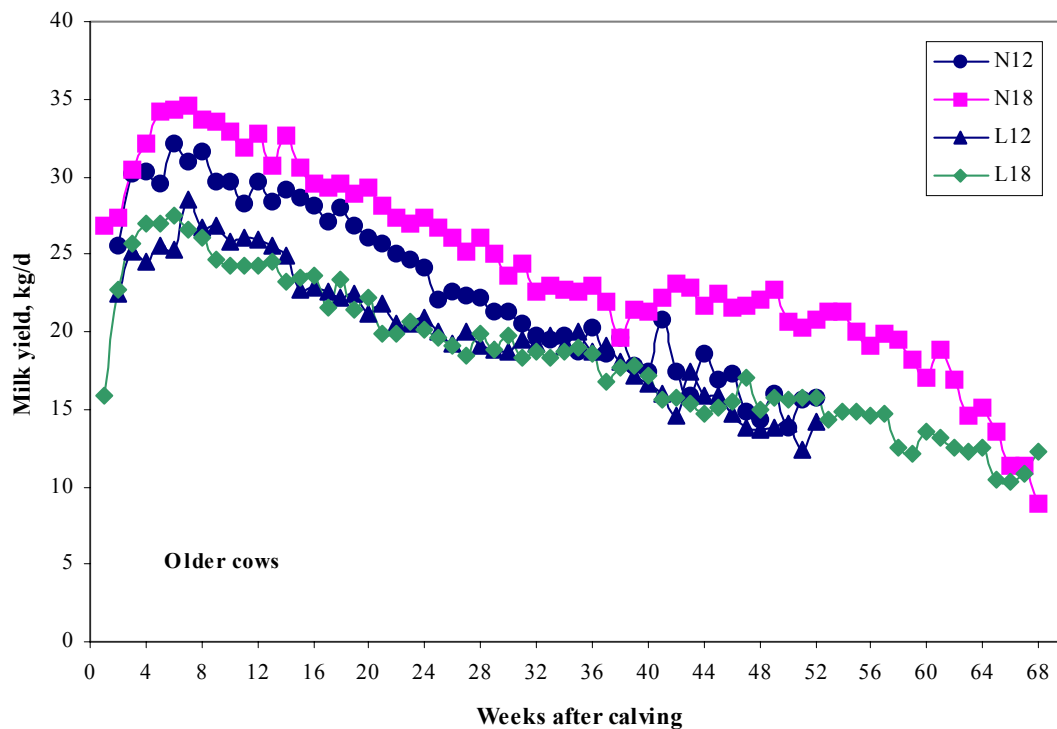


Figure 2. Milk yield in cows at different feeding levels (N or L) and with different calving intervals (12 or 18 months). Older cows.

Some reproduction results are presented in Table 4. There are no significant differences between groups regarding the number of inseminations per pregnancy. The differences from group 12 to group 18 in calving interval and in days to first insemination are a little less than planned, but there is no significant effect of feeding level (group N versus group L) on these parameters. There are no significant interactions between treatment and parity on any of the parameters shown.

**Table 4. Reproduction parameters for cows at different feeding levels and calving intervals.**

Feeding level	Group N		Group L		n
	12	18	12	18	
Calving to 1. insem, days	73 ± 12	229 ± 10	74 ± 12	208 ± 11	81
No. insem. per pregnancy	2.8 ± 0.5	2.3 ± 0.4	2.2 ± 0.5	2.6 ± 0.5	81
Calving interval, days	384 ± 18	511 ± 21	372 ± 18	502 ± 16	40

A literature review on mammary gland physiology and milk production in relation to persistency of lactation has been done by Hans Christian Christiansen and presented in his bachelor thesis “Prolonged lactation in dairy cows”.

WP4: In the herd at Rugballegaard (WP3) has blood been drawn from app. 60 milking cows every second week from calving until 16 weeks after calving if the interval coincided with the winter feeding (Mid December to Mid April). A milk sample has been stripped from one (healthy) teat concomitantly with the blood sample. Both blood and milk samples were instantly measured for its acetone content using a “head space” analyser (year 1). The rest of the samples (blood plasma and milk) were stored on ice until freezing could be practised “home” at the laboratory. A novel procedure for ketone body analyses in whole milk has been developed in our laboratory and analyses of milk samples have been initiated concerning two parameters. Blood samples have not yet been analysed further for its content of metabolites. Nor has the obtained data been analysed statistically.

The two private herds (WP2) of Holstein dairy cows were followed during the period with feeding experiment. The animals (week 0-12 from parturition) were in an average medium score body condition (2.5) and offered good quality roughage. Blood and milk samples were taken every second week, and analysed throughout the period. Blood was analysed for acetone, acetoacetate and  $\beta$ -OH-butyrate (ketone bodies), free fatty acids (FFA), triglycerid, free glycerol, glucose and urea. Milk was analysed for ketone bodies. Routine milk samples were collected in parallel and analysed for e.g. urea.

No risk factors were observed concerning sub clinical *ketosis* when 1 SFU rape seed cake substituted for 5 SFU cereals in an *ad libitum* feeding. Nor did substitution of 5 SFU of cereals with 1.4 SFU cereals and 2.6 SFU rape seed cake affect the energy status of the animals. There was no statistical significant difference in milk production or composition when feeding strategy was altered. Blood urea dropped 1.6 mM and milk urea 0.5 mM when low amounts of rape seed cake was substituted for 5 SFU of cereals, however, it appeared that the animals compensated by in-

creased intake of roughage.

Blood metabolite profiles appeared in the “normal”, physiological range, indicating that the cows, in the chosen time interval, have not been in energy deficiency. Significant effect of rape seed/ barley feeding vs. barley feeding was seen in the triglycerid concentration in blood plasma (0.08 vs. 0.06 mM), presumably reflecting the fat composition of the rape seed itself. Also blood urea was reflected by the feeding strategy: 4.6 vs. 3.3 mM for rape seed containing rations vs. cereal feeding.

It can be concluded that the conditions and parameters under observation did not indicate any signs of low energy status or ketotic conditions in the cows when reducing the feed concentrates towards future legislation for ecological dairy cows.

WP5: In late April, just before turn of on pasture was milk samples from 14-16 cows in 8 herds collected together with WP9. The samples have to be analysed for content of CLA and other fatty acids in order to investigate the variation between organic herds.

Variation during the year is investigated at samples collected individually from all cows (n=60) in the herd at Rugballegård (WP3) and from the cows (n=110) in the private herd belong to Erik Andersen (WP2). The sampling will continue every month until late summer 2002. Based on these samples it will be possible to analyse the content of fatty acids in milk in relation to proportion of pasture, silage and concentrates in the feed, general effect of season and effect of stage in lactation and parity.

Milk samples from a larger number of private farms (Studielandbrug) will be collected and used to illustrate the herd specific variation in CLA.

The effect of more extreme feeding on the content of CLA is investigated based on the feeding experiment in WP2. Milk samples from all cows was collected once during the feeding experiment. The samples are analysed for CLA and other fatty acids.

The preliminary data from the first feeding experiment in WP2 indicate that the content of CLA and t-vaccenic acid is increased when cows are fed rape seed cakes and especially rape seeds. Vaccenic acid is a trans fatty acid that is potential precursor of endogenous production of CLA in humans.

Table 5. Content of CLA and t-vaccenic acid in milk from cows feed different amount and type of concentrate (production data is given in table 2).

	Group 1	Group 2	Group 3
	Barley	Rape seed cakes	Rape seed + Barley
CLA, % of milk fat	0,74	0,92	1,20
t-vaccenic acid, % of milk fat	2,17	2,43	4,02

Analyses and interpretation of the results will be done in corporation with a project founded by the dairy industry. In this project we have observed a dramatic increase in the milk content of CLA and vaccenic acid as the ration content of unsaturated fatty acids is increased. At the highest level of unsaturated fat in the ration the CLA content was as high as 2,5 %. At the highest recommended level of fat in the diet the CLA content was 1.2 % similar to the level as in this experiment. The increases in CLA correspond with the observed drop in milk fat content.

WP6: A leader-follower rotational grazing system was introduced at Rugballegård in 2001 and was adjusted during the season. The leaders, app. 54 dairy cows, grazed separately in paddocks at two levels of supplements (cf. WP 3) and the followers, app. 46 heifers and dry cows, were also split up in two. Both 1<sup>st</sup> and 2<sup>nd</sup> year heifers are included. Routines were developed in 2001 for change of paddocks, irrigation and topping.

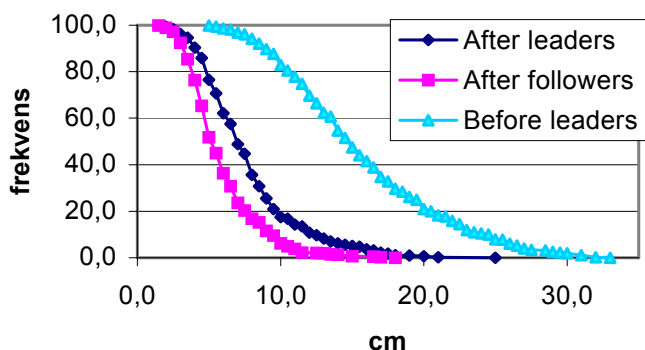
A master student (Per Meinert) analysed intake, performance, and health relations in the two groups of heifers in 2001. He concluded from the registrations that:

- heifers are a good alternative to low yielding cows
- there were no negative effects on health for 1<sup>st</sup> year heifers as followers
- the mean weight performance were 848 and 666 g day<sup>-1</sup> for 1<sup>st</sup> and 2<sup>nd</sup> years heifers respectively
- the daily intake measured by n-alkane were on average 6.6 and 10.6 g DM day<sup>-1</sup> for 1<sup>st</sup> and 2<sup>nd</sup> year heifers.

In 2002 the grazing system was continued with the exception of the grazing length. In 2001 there was three days grazing in each paddock, which was changed to two days in 2002 with the aim to optimise the herbage quality and to a better cleaning up by the followers. In 2002 there were 10 paddocks in spring at turn out and the number increased to 18 during the season. In five of these paddocks the sward height was measured before leaders grazing, after the leaders grazing, and after the followers grazing. Further, the herbage mass and herbage quality was measured by harvesting three plots to 4 cm with a plot-harvester before and after cow grazing. New areas were harvested every time. Five times during the season the botanical composition is measured in two horizontal layers before and after cow grazing.

For the period from start of day and night grazing at mid May and to mid August 2002 the compressed sward height was on average 14.4 cm before leaders grazing, 6.6 cm after leaders grazing, and 5.6 cm after followers grazing. It was calculated, that the goal for herbage mass should be 1400 Scandinavian feed units (SFU) ha<sup>-1</sup> at start of leaders grazing and 300 SFU at start of followers grazing. This correspond app. to a compressed sward height of 14 and 5 cm respectively. This means that in mean the herbage allowance has reached approximately the goal. However, due to no optimal irrigation there have been some fluctuations in herbage production and mass.

The followers seem to clean up satisfactory; which is illustrated in figure 3. They grazed a relatively great amount of rejected areas. Only one topping has been necessary.



**Figure 3: Sward structure in paddocks grazed by cows at treatment N. Results form mid May – mid August. App. 1400 measurements in total.**

Turn in is expected to be in mid October, and therefore results are not all collected and analysed.

WP 7: A literature review with the title: "Genetic Improvement of Livestock for Organic Farming Systems" has been conducted in cooperation with A.F. Groen from Wageningen University. The review has been submitted to a special issue of Livestock Production Science.

An agreement on assistance with extraction of necessary data for this project from the national cattle database has been made with Danish Cattle, Skejby. The first step is to identify all ecological/organic milk producers and to select a matching conventional dairy herd for each ecological/organic herd. This work is ongoing at the moment.

WP9. Samples of blood and milk from cattle as well as feed from 8 organic farms, was collected in April 2001 just before the grazing season. The samples has been frozen (roughage was freeze dried) and subsequent analysed for vitamin A, E and carotenoids. The samples were collected just before the grazing season because it was expected that vitamin content in the roughage would be at a minimum level at that time. Fourteen to sixteen cows and 6-8 of the youngest calves was selected from each farm. The cows were separated in first lactation cows and older cows, due to the fact that off-flavour from the milk and health problems related to deficiencies in vitamin supply most often occur in younger cows in early lactation.

Six of the eight farms used smaller amounts of synthetic vitamins, thus the levels measured in most cows is a result of the dietary vitamins provided by the feed and the dietary vitamins provided by the supplemental mineral mixture.

The sampling was performed in a satisfactory way. All farms had more than 100 cows so it was easy to select the cows, all were of the Holstein-Friesian breed. The selection criteria was:

- First lactation cows 1-3 month post partum,
- older cows in mid lactation,
- the 6-8 youngest calves

Besides a sample of each feed ingredient was taken (5-8 samples/farm).

All samples has been analysed for their content of vitamin A, E and carotenoids.

In connection to our vitamin research, a visiting Ph.D student, Lucia Cortinas from University of Barcelona has established a method, which make it possible to distinguish between natural and synthetic vitamin E. The method is based on chiral column HPLC, and the benefit of this method in relation to quality assessments of organic produced products should not be neglected.

The analysed blood samples showed on average a satisfactory vitamin A and E level, however, around 10% of the investigated cows had a relative low vitamin E level ( $< 3 \mu\text{g } \alpha\text{-tocopherol/ ml plasma}$ ). The majority of these cows were from the two farms, which did not use supplemental vitamins, and most of them was in the beginning of the lactation period.

All investigated calves were low in both vitamin A and E (retinol:  $< 0.12$ ;  $\alpha\text{-tocopherol: } < 1.5 \mu\text{g/ml plasma}$ ), however, at present we do not have reliable reference values, so it is not possible to elucidate the importance of this finding.

All milk samples has been analysed for their vitamin content, but even after they have been standardised for fat content the vitamin content shows too big deviation from normal values. The average content of alfa-tocopherol was  $1.8 \mu\text{g/g milk}$ , but the variation varied from  $0.2\text{-}8 \mu\text{g/g milk}$ . We thus have to conclude that in order to use milk as a parameter it is necessary to take a representative sample of the whole milking or use tank milk on farm level, rather than a hand milked sample.

The concentration of vitamin E and carotenoids in the roughage are shown in Table 6.

**Table 6. Analysed content of vitamin E and A (as  $\beta\text{-carotene}$ ) in feed.**

	E-vitamin		A-vitamin	
	IU/kg dry matter			
	Avg	SD	Avg	SD
Grain/concentrate	41	25	262	338
Clover grass silage	96	43	16169	5806
Grass pellets	58	11	5980	3071
Barley/pea whole crop	84	38	3701	4153

Table 6 shows the average content and standard deviation of vitamin A and E in international units (IU) in the roughage and concentrate used at the investigated farms. From Table 6 it is seen that clover grass silage and whole crop silage are good sources for vitamin A and E. However, from Table 6 it is also seen that the individual variation between different batches/farms of the same feed item is very big. The implication of this result is that it is very difficult to use table values for exact vitamin contents.

Table 7 show the amounts of vitamin A (in the form of  $\beta\text{-carotene}$ ) and E fed to each cow with the feed based on the individual analysed feed samples and the average feeding plan. The table shows that half of the farms meet the requirement for vitamin A and all farms meet the requirement for vitamin E.

**Table 7. Estimated daily intake of  $\beta$ -carotene and vitamin E per lactating cow.**

		$\beta$ -Caroten, mg/cow/day					
farm nr	Grass silage	Whole crop	Grass pellets	Grain	Rape seed		Sum
1	63	69		0	1		<b>132</b>
2	366	8	7	6	1		<b>389</b>
3	164	1	52	1	0		<b>221</b>
4	292	2	54	1			<b>353</b>
5	498		39		1		<b>542</b>
6	146	144	19		2		<b>314</b>
7	599			1	1		<b>607</b>

		E-vitamin IE/day/cow					
farm nr	Grass silage	Whole crop	Grass pellets	Grain	Rape seed	Other	Sum
1	180	774		111	166	60	<b>1232</b>
2	584	67	49	123	111	98	<b>935</b>
3	322	295	201	66	49		<b>935</b>
4	950	395	166	114		38	<b>1628</b>
5	1275		142	45	111		<b>1579</b>
6	366	849	72	55	189		<b>1538</b>
7	1709			105	69		<b>1891</b>

In agreement with the big variation in the content of vitamins in the analysed feed samples a big difference in the vitamin intake between the cows from the different farms was notified. However, the estimated intake and the measured vitamin status of the cows showed on farm level rather good correlation's ( $\beta$ -carotene  $R^2 = 0.75$ ; vitamin E  $R^2 = 0.34$ ).

It can be concluded that the level of both vitamin E and carotenes in the analysed roughage were lower than expected based on the values found in the literature. Likewise, especially the vitamin E content in cows fed without supplemental vitamins was in the lower range of the recommended level, though without showing severe deficiencies.

With respect to the vitamin D situation a more comprehensive study need to be initiated, as the levels of the different metabolites in the blood showed too big fluctuations to allow a clear conclusion.

## C.2 Fulfilment of deliverables and milestones

WP number and title	Time schedule according to application	Deviations, if any*
<b>WP1: Co-ordination</b>		
<i>Milestones</i>		
M1 Project meeting	Sept. 2000, May and Sept. 2001, 2002, 2003, and 2004	
M2 Annual report	Dec. 2000, 2001, 2002, 2003, and 2004	
<i>Deliverables</i>		
D1.1;D1.2: National meeting organic advisors	Oct. 2002 and Oct. 2004	
D1.3: Two general meetings each year		
D1.4: Annual status reports and a final report		
<b>WP2: Milkproduction</b>		
<i>Milestones</i>		
m1 Design of experiments for 2000/2001	July 2000 – August 2000	
m2 Contract with farms	August 2000 and May-June 2001	
m3 Study tour	September 2000	1)
m4 Design of experiments for 2001/2002	April 2001 – May 2001	
<i>Deliverables</i>		
D2.1: Thesis	Dec. 2001	1)
D2.2;D2.4: International papers	Dec. 2001 and Dec. 2002	1)
D1.1: National meeting and proceeding	Oct. 2002	2)
<b>WP3: Prolonged lactation</b>		
<i>Milestones</i>		
m1 Final plan for feeding and reproduction strategies	August 2000	
m2 Final plan for sampling of blood and biopsis etc.	July 2002	
m3 Evaluation of strategies and preliminary results	August 2001, 2002, 2003, and May 2004	
m4 Report	September 2004	
<i>Deliverables</i>		
D3.1;D3.2: International papers	Dec. 2004	
D3.3: National report	Oct. 2004	
D1.2: National meeting and proceeding	Oct. 2004	
<b>WP4: Health</b>		
<i>Milestones</i>		
m1 Sampling and laboratory analysis of samples finished for experiments 1 and 2	July – Sept. 2001	
m2 Sampling and laboratory analysis of samples finished for experiments 3	July – Sept. 2002	
m3 Sampling and laboratory analysis of samples finished for experiments 4	June – August 2004	
m4 Evaluation of different feeding strategies on cow health and reproduction	Oct. – Nov. 2001, Oct. – Nov. 2002, and August – December 2004	
<i>Deliverables</i>		
D4.1: M.Sc. thesis	Sept. 2001	
D4.2;D4.3: International paper	Oct. 2002 and Oct. 2004	
D1.1;D1.2: National meeting and proceeding	Oct. 2002 and Oct. 2004	
<b>WP5: Milk quality</b>		
<i>Milestones</i>		
m1 Start collection of samples	Dec. 2000, May and Dec. 2001	
m2 Start of lab-analysis	May – June 2001 and May – June 2002	
m3 Evaluation of results and preparation of reports	Aug. – Sept. 2001 and Nov. – Dec. 2002	
<i>Deliverables</i>		
D5.1: International publication	May 2003	
D5.2: National report	Oct. 2003	
D1.1: National meeting and proceeding	Oct. 2002	

<b>WP6: Grass intake</b>		
<i>Milestones</i>		
m1 Conclusions on the grazing method	April 2001	
m2 Evaluation of preliminary results	Dec. 2001 and Dec. 2002	
m3 Final report and publication	Dec. 2003	
<i>Deliverables</i>		
D6.1: International paper	April 2004	
D1.2: National meeting and proceeding	Oct. 2004	
D3.3: National report	Oct. 2004	
<b>WP7: Genetic improvement</b>		
<i>Milestones</i>		
m1 Establishment of data sets	Aug. – Sept. 2002 and March – April 2003	
m2 Models developed	March – April 2003	
m3 Models fitted on production data	March – April 2003	
m4 Models fitted on non-production data	Sept. – Oct. 2004	
<i>Deliverables</i>		
D7.1: National report	Oct. 2004	
D7.2: International paper	Oct. 2004	
D1.2: National meeting and proceeding	Oct. 2004	
<b>WP8: Farming systems</b>		
<i>Milestones</i>		
m1 Workshop	April 2003	
m2 Prototype of farmlevel	January 2003	
m3 Evaluation and final report	December 2004	
<i>Deliverables</i>		
D8.1: National report	Nov. 2004	
D1.2: National meeting and proceeding	Oct. 2004	
<b>WP9: Vitamin</b>		
<i>Milestones</i>		
m1 Sampling of feed, blood and milk completed	April 2001	
m2 Analysis for Vitamin A, E and D completed	Sept 2001	
m3 Evaluation and final report	December 2001	
<i>Deliverables</i>		
D9.1: National report	Nov. 2001	
D1.2: National meeting and proceeding	Oct. 2001	2)

\* Deviations are to be further discussed in D

## D. Description of deviations and subsequent adjustments of plans

*Specific comments in relation to notes in the table in C2.*

ad 1)

The study tour planned by Lisbeth Mogensen in WP2 had to be cancelled, due to long-term illness in connection with her pregnancy. The tour will be conducted in autumn 2002. The papers and the final thesis are in preparation, with planned graduation July 2003.

ad 2)

Results from the experiment in WP2 and WP9 were presented at a meeting for advisors and farmers arranged by DJF and FØJO. Material from the meeting is available at [www.fojo.dk](http://www.fojo.dk).

*General comments to adjustment in activities*

WP 6 has been enlarged by grass intake measured by n-alkane in both heifers and cows in 2001. This has been possible as the project co-operated with two master student from KVL.

Karen Søgaard has been on a study tour to Ireland in June 2002 studying rotational grazing

without supplementation. She visited Teagasc (Grange Research, Oak Park research and Dairy Research Centre Moorepark), two dairy farms, and one beef farm.

*Comments to plans remaining part of the project period*

WP3: It is planned to continue and maintain the feeding and reproduction strategies. The project is now coming to a fase where a significant number of cows will be at the prolonged lactation strategy. Especially the reproduction will be closely followed to keep up to the planned strategy. A strategy have been made to increase the available area for grazing and cutting silage in the future, as Rugballegaard have obtained a contract on milk delivery, which demands a 100 % organic feeding ration. As this is a general trend in danish organic dairy production, a pressure is expected on the feed market, and this might cause some restrictions on the supply to this project of especially concentrated and protein rich feeds. Rugballegaard has agreed to try and grow rape seeds to try to ensure the supply of heat treated rape seed cakes.

WP4: A strengthening of the metabolite profiles, analysing for specific liver enzymes in the blood, may be considered, as the present material indicated that it might be a reasonable expansion of the study.

WP 5: Major work will be given to analysing milk samples and publication in 2002.

WP 6: During the grazing season 2002 and 2003 the influence of supplement feeding on herbage intake, selection and grazing behaviour will be determined. Registration of herbage during grazing - herbage mass, botanical composition and frequency measurements of different heights - will be the basis for these determinations. Further the N-balance for the two levels of supplements during the grazing season will be calculated.

WP 7: Data validation and development of editing rules will be carried out in the fourth quarter of 2002. In 2003, models based on "Reaction Norm" will be developed to test for genotype by environment interaction between organic and traditional dairy production systems for production traits. In 2004 this work will be extenuated to cover fertility and health traits.

*Plan for publication*

The plans for publication are not, at the present stage of the project, more specific than given under deliverables in table 1.

*Papers accepted for publication*

Boelling, D., Groen, A. F., Sørensen, P., Madsen, P. and Jensen, J. Genetic Improvement of Livestock for Organic Farming Systems. *Livest. Prod. Sci.*

Sehested, J., Kristensen, T., Søgaard, K. Effect of concentrate supplementation on production, health and efficiency in an organic dairy herd. *Livest. Prod. Sci.*

\*Mogensen, L., Kristensen, T. Effect of barley or rape seed cake as supplement to silage for high-yielding organic dairy cows. *Acta*

## **E. Project publications and other products**

### **1. Articles in international, scientific journals with review procedures**

\*\*Søegaard, K; Sehested, J.; Danielsen, V. (2000): Mixed grazing with heifers and pregnant sows. *Grassland Science in Europe*, 5:359-361.

### **2. Papers presentations at congresses, symposiums etc.**

Jensen, S.K. 2001. Vitaminforsyningen hos økologiske kvæg. Bilag til Temadag om Økologisk Mælkeproduktion, 3. oktober, Forskningscenter Foulum, s. 35-37.

Jensen, S.K. 2001. Kvægets vitaminbehov og -forsyning. Fodringsdag. Temadag om aktuelle fodringsspørgsmål, Herning Kongrescenter den 28. august 2001. Landbrugets rådgivningscenter. Landkontoret for Kvæg, 8200 Århus N, 80-86.

\*\*Kristensen, T., Kristensen, I.S. & Sehested, J., 2002. Malkekøer som dynamo for en alsidig udvikling af økologisk jordbrug. I: Sehested, J. & Kristensen, T., 2002. Økologisk mælkeproduktion. Strategier og foderforsyning ved 100 procent økologisk fodring. FØJO-rapport nr. 17, 43-56

\*\*Kristensen, T. & Sehested, J., 2002. Introduktion - perspektiver ved 100% økologisk fodring. I: Sehested, J. & Kristensen, T., 2002. Økologisk mælkeproduktion. Strategier og foderforsyning ved 100 procent økologisk fodring. FØJO-rapport nr. 17, 9-13.

\*\*Mogensen, L., Kristensen, T. & Sehested, J., 2002. Tilskudsfoder til vinterfodringen af økologiske malkekøer. I: Sehested, J. & Kristensen, T., 2002. Økologisk mælkeproduktion. Strategier og foderforsyning ved 100 procent økologisk fodring. FØJO-rapport nr. 17, 27-42.

\*Mogensen, L; Kristensen, T. 2001. Økologisk mælkeproduktion. Resultater fra forsøg med selvforsyning med økologisk foder. Bilag til Temadag om Økologisk Mælkeproduktion, 3. oktober, Forskningscenter Foulum, s. 9-12.

Sehested, J.; Kristensen, T. (2001): Økologisk mælkeproduktion - reduceret foderniveau og strategisk anvendelse af tilskudsfoder. Bilag til Temadag om Økologisk Mælkeproduktion, 3. oktober, Forskningscenter Foulum, s. 13-16.

\*\*Sehested, J. & Kristensen, T. 2002. Økologisk mælkeproduktion - Strategier og foderforsyning ved 100 procent økologisk fodring. Sehested, J. & Kristensen, T. (eds.), FØJO-Rapport nr. 17, pp 77.

\*\*Sehested, J.; Roepstorff, A.; Monrad, J.; Søegaard, K. Danielsen, V. (2000): Performance and parasitosis in heifers grazing together with sows. Oral presentation and Handout Book at the 51<sup>st</sup> Annual Meeting of the European Association for Animal Production, session M5.

### **3. Reports, articles in agricultural journals etc**

Christiansen, H.C., 2001. Forlænget laktation hos malkekøer. Bachelorprojekt fra KVL.

Jensen, S.K. & Lauridsen, C. 2002. E-vitamin styrker dyrenes immunforsvar. *Landsbladet Agro*, nr. 5, 32.

- Kristensen, T. 2002. Perspektiver ved 100 procents fodring. Økologisk Jordbrug, nr 262, side 6.
- Kristensen, T. 2001. Koen som dynamo. Ændret produktionsstrategi for økologisk mælkeproduktion. Økologisk Jordbrug, nr 246, side 14.
- Kristensen, T.; Sehested, J. (2001): Mange køer æder nu kun økologisk foder. Landsbladet Kvæg, nr 6, 31. maj, s. 34.
- \*Nielsen, P.M. 2002. Systemer til styring af græsoptagelsen hos køer og kvier. M.Sc. Speciale i Kvægproduktion fra KVL.
- Seested, S. 2001. Økologisk mælkeproduktion baseret på 100% økologisk fodring og 100% selvforsyning – konsekvenser på malkekøers fodring, produktion og sundhed i tidlig laktation med fokus på subklinisk ketose. M.Sc. Speciale fra KVL.
- \*\*Sehested, J. (2000): Høj tilvækst med kvier og søer i samme fold. Økologisk Jordbrug nr. 216, 20. årgang, s. 14.
- \*\*Sehested, J.; Kristensen, T. (2000): Køer og svin i samme sædskifte. Økologisk Jordbrug nr. 217, 20. årgang, s. 13.
- Sehested, J.; Kristensen, T.; Søgaard, K.; Nielsen, J.H. (2000): Køerne klarer sig med mindre kraftfoder. Økologisk Jordbrug nr. 217, 20. årgang, s. 13

#### **4. Oral presentations, public meetings, field days etc.**

- Jensen, S.K. 2002. Vitaminforsyningen hos økologiske drøvtyggere. Efteruddannelse for økologiske landmænd. Borris Landbrugsskole/Vestjysk Landboforening 15. januar.
- Kristensen, T. 2002. Fodring med økologisk foder. Efteruddannelse for økologiske landmænd. Hovborg. 5. februar.
- Mogensen, L. 2002. Selvforsyning med foder. Efteruddannelse økologiske rådgivere. Koldkærgård august.
- Sehested J. 2002. Økologisk mælkeproduktion – 100 % økologisk fodring. Efteruddannelse økologiske landmænd. Lemvig 22. januar.

The project has been presented 7. august 2001 at a field day on Rugballegaard.

#### **F. Scientific education**

The activities in WP2 and WP4 has been the back bone of a master project by Susanne Seested, from the Royal Veterinary and Agricultural University, Copenhagen.

The activities and ideas behind WP2 and WP6 has been a major part of master projects by Per Meinert and Sarah Meilbak, and bachelor project by Hans Christian Christiansen

Sinclair Mayne from Agricultural Research Institute of Northern Ireland has visited DJF and participated in a roundtable meeting with discussion about grazing and grazing systems.

## **G. National and international cooperation**

Hanne H. Hansen, KVL has been closely involved in the activities about use of n-alkanes to estimate feedintake (WP3).

A project “Protein feeds to milk and meat production” (2002-2004) founded by the Danish farmers union, will be closely co-ordinated with this project.

The project (WP9) has made contact to Elisabet Nadeau from SLU in Skara, Sweden and it has been agreed that we shall analyse around 150 roughage samples for them in 2002 for their content of vitamin E and carotenoids. These samples show variations with respect to botanical composition, harvest time, harvest conditions and storage.

Also in relation to WP9 contact to Karin Perhsson Waller SVA in Uppsala, Sweden has been made in order to study differences in the effect of natural and synthetic vitamin E on udder health.

## **H. Critical reflection on the project**

The overall idea in the project “feeding 100 % organic”, has showed to be even more realistic than we argued, as the dairy industry during the summer 2001, started making contract with the farmers with this restriction.

The activities in the project so far, has been initiated and conducted in agreement with the plans, and some of the information has been given earlier than planned as a consequence of the demand from extension officers due to the mentioned new situation with contracts based on 100 pct organic.

The introduction of a new grazing system and reproduction strategies at Rugballegaard was more time consuming than expected, but the outcome in terms of the present grazing management, feeding and reproduction results is satisfactory.

The activities at private farms have been useful, both as experimental units and as contact to farmers and local advisor.

The work with milk quality and with vitamin supply has shown the benefit of having a good contact to farmers, which made it possible to extent the project with extra milk samples and the WP with vitamin supply.

The herd at Rugballegård and the two private herds have been heavy used for sampling of data and samples. At present there is analysis and discussion between the WP about how to use these information in order to give information with new dimensions, based on a collaboration between scientist with different working areas, like feeding, health, physiology and milk quality.

We believe that the outcome of this project will be valuable for a more holistic development of organic milk production, as it will give information from quit different perspective, breeding, feeding, reproduction, grazing, farming system ect.

The project works with a large number of agronomical areas, which as mentioned earlier is

very useful, but it also have the consequence that some areas still need to investigated. At present it is clear that the project activities within the area of vitamin status and supply is not power full enough to clarify the problems and possibilities within this important area.

Although the project in WP8 will work with prototyping of new milk production system, there will in the project be generated partial information, which in an extension of this project could be used as input for documentation of future organic milk production systems.

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## 8. Budget

### A. Account for any change in budgets

WP2: 100.000 dkr from 2002 to 2003, due to the delay in data analysis and publishing.

WP6: 84.000 dkr from 2002 to 2003.

### B. Budget for the whole project (1.000 DKR)

Total consumption of funds from DARCOF and expected consumption this year and coming years

Year:	Consumption before 2002	Expected consumption 2002	2003	2004	2005	Total
Man-months						
Scientific personnel	29	21	22,5	14,5		87
Technical personnel	19	12	11	5		47

Year:	Consumption before 2002	Expected consumption 2002	2003	2004	2005	Total
Salaries						
Scientific personnel	1122	895	991	674		3682
Technical personnel	461	317	322	146		1246
Other operational costs	445	213	183	162		1003
Equipment	57	12	24	5		98
Others (please specify)	540	455	300	215		1510
Direct costs	2625	1892	1820	1202		7539
Indirect costs (20% of direct costs)	528	379	364	240		1511
Total	3153	2272	2183	1442		9050

### Comments:

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**9. Signatures and stamps**

Name	Institute	Date	Signature
Head of project			

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## Appendix I. Detailed budget

### A. Budget for each participating institute (1.000 DKr)

Name of Institute: Danish Institute of Agricultural Sciences

Year:	Consumption before 2002	Expected consumption 2002	2003	2004	2005	Total
Man-months						
Scientific personnel	29	21	22,5	14,5		87
Technical personnel	19	12	11	5		48

Year:	Consumption before 2002	Expected consumption 2002	2003	2004	2005	Total
Salaries						
Scientific personnel	1122	895	991	674		3682
Technical personnel	461	317	322	146		1246
Other operational costs	445	213	183	162		1003
Equipment	57	12	24	5		98
Others (please specify)	540	455	300	215		1510
Direct costs	2625	1892	1820	1202		7539
Indirect costs (20% of direct costs)	528	379	364	240		1511
Total	3153	2272	2183	1442		9050

**Comments:**

**B. Budget for each participating department (1.000 DKK)**

Name of Institute and department: DIAS, Dept. of Agricultural Systems

Year:	Consumption before 2002	Expected consumption	2003	2004	2005	Total
Man-months		2002				
Scientific personnel	9	7	4.5	2		22.5
Technical personnel	5	2	2	1		10

Year:	Consumption before 2002	Expected consumption 2002	2003	2004	2005	Total
Salaries						
Scientific personnel	339	305	193	92		929
Technical personnel	145	61	64	34		304
Other operational costs	153	20	17	34		224
Equipment	45	0	20	5		70
Others (please specify)	140	155	0	15		310
Direct costs	822	541	294	180		1837
Indirect costs (20% of direct costs)	165	108	59	36		368
Total	987	649	353	216		2205

**Comments:**

**C. Budget for co-financing from each participating institute (1.000 DKK)**

Name of Institute: DIAS, Dept. of Animal Nutrient and Physiology

Year:	Consumption before 2002	Expected consumption 2002	2003	2004	2005	Total
Man-months						
Scientific personnel	17	7	8	8		35
Technical personnel	7	6	4	3		18

Year:	Consumption before 2002	Expected consumption 2002	2003	2004	2005	Total
Salaries						
Scientific personnel	660	293	354	369		1676
Technical personnel	262	138	103	81		584
Other operational costs	225	119	80	70		494
Equipment	0	0	0	0		0
Others (please specify)	400	300	300	200		1200
Direct costs	1547	850	838	719		3954
Indirect costs (20% of direct costs)	310	170	168	144		791
Total	1857	1020	1005	863		4745

**Comments:**

Name of Institute: DIAS, Dept. of Animal Health and Welfare

Year:	Consumption before 2002	Expected consumption 2002	2003	2004	2005	Total
Man-months						
Scientific personnel	2	3	3	2		10
Technical personnel	2	3	2	1		8

Year:	Consumption before 2002	Expected consumption 2002	2003	2004	2005	Total
Salaries						
Scientific personnel	84	132	139	97		452
Technical personnel	55	85	60	32		232
Other operational costs	47	34	34	19		134
Equipment	8	7	0	0		15
Others (please specify)	0	0	0	0		0
Direct costs	194	259	233	147		833
Indirect costs (20% of direct costs)	39	52	47	29		167
Total	233	310	280	177		1000

**Comments:**

Name of Institute: DIAS, Dept. of Crop Physiology and Soil Science

Year:	Consumption before 2002	Expected consumption 2002	2003	2004	2005	Total
Man-months						
Scientific personnel	1	2	3	0.5		6.5
Technical personnel	0	1	3	0		4

Year:	Consumption before 2002	Expected consumption 2002	2003	2004	2005	Total
Salaries						
Scientific personnel	40	83	129	23		275
Technical personnel	0	31	94	0		125
Other operational costs	20	30	30	7		87
Equipment	4	5	4	0		13
Others (please specify)	0	0	0	0		0
Direct costs	64	149	257	30		500
Indirect costs (20% of direct costs)	13	30	51	6		100
Total	77	179	308	36		600

**Comments:**

Name of Institute: DIAS, Dept. of Animal Breeding and Genetics

Year:	Consumption before 2002	Expected consumption 2002	2003	2004	2005	Total
Man-months						
Scientific personnel	0	2	4	2		8
Technical personnel	0	0	0	0		0

Year:	Consumption before 2002	Expected consumption 2002	2003	2004	2005	Total
Salaries						
Scientific personnel	0	84	176	92		352
Technical personnel	0	0	0	0		0
Other operational costs	0	10	22	33		65
Equipment	0	0	0	0		0
Others (please specify)	0	0	0	0		0
Direct costs	0	94	198	125		417
Indirect costs (20% of direct costs)	0	19	40	25		83
Total	0	113	238	150		500

**Comments:**

