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PILOT STUDIES IN ORGANIC BROILER PRODUCTION – MANAGEMENT AND CROSS-BREEDS

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Centrum för uthålligt lantbruk

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CONTENT

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SUMMARIES

Two pilot studies were conducted in 1999 and 2000, dealing with management strategies (study A) and alternative cross breeds (study B) in organic broiler production.

Study A: Pastured broilers

280 male chickens were raised in four groups in movable pens on pasture. The pens (3.30 (width) x 4.00 (length) x 0.60 (hight) m) were moved to fresh ground daily. Three groups were conventional broiler-strain chickens ("Ross208") with 50, 70 and 90 birds per group, and one group was a Swedish heavy layer cross breed ("Derco") with 70 birds. The birds had ad libitum (free) access to a proprietary concentrate (11.8 MJ ME/kg, 19 % crude protein) all the time and were offered whole wheat, free choice, from day 42 onwards (table 1).

The production performance of the Ross chickens showed that high performance is possible in the movable pen system.

With the feed given, the modern hybrid used in the experiment grew too fast to be recommended for a 12 weeks growth period: The birds became rather large and showed typical health problems related with rapid growth.

Between 50 and 90 birds per pen (corresponding max. 16 to 26 kg liveweight per m^2), stocking rate did not seem to influence the birds' performance.

The production performance of the Derco chickens did not reach the standards for slow growing table birds, as they are set by French hybrids today. The actual moving of the pens requires simple but adjusted mechanical aid and routine to keep the physical work input acceptable.

Direct measurement of the broilers' effect on the sward would require relatively more detailed investigation. Monitoring of long-term effects would require long term experiments.

Study B: Screening crosses

Derco hens were crossed with Faverolle, Orpington, Modern Game and Indian Game cocks, and four batches with a total of ca. 130 birds were raised to ages between 12 and 15 weeks.

At slaughter day, live and carcass weight were recorded and for three batches, the carcasses were judged, giving scores for the ocular impression of the quantity of meat on breast and legs and feather residues after plucking (table 2).

It is concluded that crosses between Derco hens and cocks from breeds like Modern Game, Faverolle and Orpington does not produce considerably more meat than pure Derco chickens. Crosses with Indian Game cocks gave the impression of higher meat yields and a preferable configuration of muscles, but the fertilization rate between Indian Game cocks and Derco hens was relatively low.

Table 1. Study A, summary of results.

Strain	Age (w)	LW, Mean (kg)	CW, Mean (kg)	Tot. feed consum. (kg)	Wh. wheat total/last w. (%)	Feed conversion	Mortality (%)
Ross	9	3.64	2.72	8.94	13.5/37.6	2.46	10.8
Derco	12	1.20	1.13	5.96	35.7/53.5	3.27	0

CW = Carcass weight
LW = Live weight
Tot. = Total
consum. = consumption
Wh. = Whole

Table 2. Study B, summary of results.

Cross (Derco[1]x)	Batch Nr.	Age (w)	Birds n	LW, Mean (kg)	CW, Mean (kg)	Meat Score Sum (Points)
Fv	1	12.5	13	1.76	1.17	/
MG	1	12.5	31	1.35	0.91	/
IG	2	15	6	1.93	1.33	7.2
IG	3	13.5	14	1.86	1.25	7.1
IG	4	15	39	1.55	1.05	7.9
Orp	4	15	19	1.63	1.07	4.8

IG = Indian Game
Fv = Faverolle
MG = Modern Game
Orp = Orpington
LW = Live weight
CW = Carcass weight
1) Derco = mother

PASTURED BROILERS – STUDY A

The main motivations to do this pilot study with pastured broilers were to learn more about the integration of different animal species in a farming system and to meet a future demand for alternative methods of broiler production.

The designs and experiences of the Virginian farmers Theresa and Joel Salatin (Salatin 1993) were used as starting point and practical guideline. On their 40 hectares, they keep 50 head of beef cattles, produce 6000 broilers per summer, eggs from 150 layers, rabbits and vegetables. The broilers are raised only from April to October and are all pastured in movable pens from around the third week of age (Traupman 1990).

The portable pen system is not the only technique to allow broilers access to pasture. Other systems are briefly described on page 17.

Another driving force for this study is the EU-regulation for organic animal husbandry (EU 1999), which requires a minimum age of 12 weeks for broilers at the day of slaughter.

Aims of the project

- Gathering practical experiences with pastured broilers in portable pens.
- Testing the performance of Derco male chickens as a potential slow growing broiler cross-breed.
- Monitoring the performance of conventional broiler type chickens when raised longer than six weeks.
- Observing the bird's effect on the pasture in order to come up with sward measurement techniques suitable for future experiments.

Material and methods

Animals

At Ekhaga Experimental Farm, Uppsala, 330 day old chicks were started in the beginning of July 1999. Of these 250 were broiler strain male hybrids ("Ross 208") from AB Kronfågel, Kristianstad, and 80 were cocks of the layer cross breed "Derco" from Krutmöllan hatchery, Kävlinge, Skåne. Derco is a heavy Swedish layer cross between Rhode Island Red and White Plymouth Rock.

The Ross chickens were weighed individually at three, five and nine weeks of age, the Derco chickens at three, five, eight and twelve weeks. The Ross chickens were slaughtered at 62 days, and Derco at 86 days of age.

Housing

Until the third week of age, the chicks were raised indoors on deep litter, the Ross chickens in one group and the Derco in another separate group. The chickens were then divided into four groups and moved out to pasture: Three groups with Ross chickens, group size approximately 50 (Ross50), 70 (Ross70) and 90 (Ross90) birds respectively and one group with 71 Derco (Derco70) chickens. Losses of Ross chickens due to health problems were replaced from a reserve group until one week before slaughter day.

On pasture, the chickens were housed in portable, floorless cages (movable pens), 3.30 m wide, 4.00 m long and at least 0.60 m high (see plate 1). The pens each contained feeders, drinkers and ca. ten meters of perches. The framework was made of wood. One end was entirely enclosed, while the other end was of poultry netting. The roof and walls of the enclosed parts were made of wire net, covered with a water repelling paper material ("mjölkpapp"). In Salatins' design, this is aluminium roofing. The top of the non-enclosed end was made of two doors, one of netting and one of roofing (see plate 2). Thus, three quarters of the pen's top were roofed. Half of the walls were made of enclosed material while the other half of the walls and one quarter of the top consisted of poultry netting only.

The pens were moved daily, about four meters, to fresh ground by slipping a dolly (Swedish: "säck-kärra"/"pirra") under one end, fixing it there and pulling at the other.

Plate 1. Portable pen for broilers at Ekhaga Experimental Farm 1999.

Feedstuffs

Three different types of feed were offered in a choice feeding system:

- A concentrate (analysis, table 3), without anticoccidial drugs.
- Whole wheat.
- A mixture of the concentrate named above and flaked wheat, with a ratio of one part concentrate per three parts wheat (only given to Ross, week 9).

Plate 2. Non-enclosed end of a pen, the roofed door opened.

Feeding strategy

The feed was given *ad libitum*, all the time:

- Concentrate only: For all groups, until six weeks of age.
- Concentrate plus whole wheat: In a free choice feeding system for all groups from six weeks of age and onwards.
- Concentrate/wheat flake mix: Given to all Ross chickens in the ninth week of age instead of the concentrate. Whole wheat offered in addition, as earlier.

Grit stones were offered (particle size ca. 2 mm), mainly ad libitum, from week five onwards.

Pasture

The pasture was a first year's ley, the sward partly unsatisfactorily established with bare ground or considerable stands of *Capsella bursa-pastoris* or *Anthemis arvensis*. Beef cattle grazed the pasture ahead of the chickens. They were separated from the pens by a movable electric fence.

Table 3. Feed stuff analysis, concentrates. Note: "Feed B" was only fed in study B.

Per kg feed	**Feed A (Anonymous 1999a)**	**Feed B (Anonymous 1999b)**
Moisture content (%)	12	12
Energy* (MJ ME/kg)	11.8	10.6
Crude protein (%)	19	19
Lysine (g)	10.0	10.0
CYS+MET (g)	7.1	7.0
Crude fat (%)	3.4	3.3
Fiber (%)	3.2	5.5
Calcium (g)	9.6	10
Phosphorus (g)	5.1	6.0
Cu (Coppersulfate) (mg)	22.4	6.0
Selenium (Na-selenite) (mg)	0.3	0.24
Vit. A (IU)	10 000	12 000
Vit. D (IU)	3 000	3 000

* = according to The Swedish Board of Agriculture ("Statens Jordbruksverk")

Results

Animal growth

The average liveweight of the three Ross groups was 3.64 kg (3.67, 3.62, 3.64 kg) at nine weeks of age. An analysis of variance showed no difference ($p > 0.1$) in liveweight between the three Ross groups. The Derco chickens weighed 1.82 kg at twelve weeks. The coefficient of variation (sample standard deviation as a fraction of the sample mean) of the liveweight was between 9.0 and 11.7 percent and between 9.7 and 11.2 percent of the slaughter weight, for both the Ross chickens at nine and the Derco chickens at twelve weeks. It was on average 13.1 percent (12.4 – 14.0 %) for all Ross chickens at five weeks of age.

From the live weight at slaughter day it can be concluded that the stocking rate in kg life weight per squaremeter during the week before slaughter was as shown in table 4.

Feed consumption

All groups directly started to replace more than ten percent of their concentrate consumption with the whole wheat offered from week seven onwards. In the Ross groups, the consumption of concentrate continued to decrease and, in week nine more than 35 percent of the ration was whole wheat. The total amount of feed consumed increased during that time, with a stagnation in week nine.

In the Derco group, concentrate consumption also decreased until week nine, while total feed intake increased. After that, both concentrate and wheat consumption increased. The estimated grit stone consumption was between 20 and 50 g per bird and week. (table 5 and 6)

Feed conversion

Table 7 shows the feed conversion of the Ross chickens after nine, and Derco after twelve weeks. It can be seen that the conversion rates are rather homogenous in the three Ross groups.

Mortality and health

There were neither health problems nor losses from the group of 70 Derco chickens during the 12 weeks between day of arrival and slaughter day.

Table 8 gives an overview over culled birds, mortality and the type of disorder for the Ross chickens.The type of disorder in the two birds found dead in week one is unknown. All culled birds except the one culled in the first week had leg problems: They were not able to follow the daily four meter move of the pen. The two birds culled in week four – the two first cases of leg problems – were sent to the National Veterinary Institute (Statens Veterinärmedicinska Anstalt) for *post mortem* examinations. The diagnosis was acute purulent arthritis with acute inflammations in several joints (ankle joint, knee and ilium) in both birds. The bacteriological test showed *Staphylococcus aureus*. All

following leg problems were assumed to be of the same type.

Cases of coccidiosis were not observed, but no samples were taken.

A test for *Salmonella* in week seven was negative.

Mortality rate from week six to nine was 1.7 times higher than up to week six, including no mortality in week nine.

Breast blisters were not observed on any bird.

Table 4. Actual stocking rate, one week before slaughter day.

	Birds per group	**Live weight kg per m²**
Ross50	53	16.0
Ross70	66	19.9
Ross90	85	25.8

Table 5. Average feed consumption (kg) per bird and week.

	Ross chickens			**Derco chickens**		
Week	Feed A[1]	Wheat[2]	Total	Feed A[1]	Wheat[2]	Total
1	0.12	0	0.12	0.09	0	0.09
2	0.25	0	0.25	0.14	0	0.14
3	0.55	0	0.55	0.23	0	0.23
4	0.84	0	0.84	0.30	0	0.30
5	1.24	0	1.24	0.42	0	0.42
6	1.37	0	1.37	0.40	0	0.40
7	1.29	0.18	1.48	0.41	0.08	0.49
8	1.10	0.45	1.55	0.32	0.26	0.58
9	0.96[3]	0.58	1.54	0.28	0.33	0.61
10				0.30	0.38	0.68
11				0.41	0.47	0.88
12				0.53	0.61	1.14
Sum	7.73	1.21	8.94	3.83	2.13	5.96

[1] concentrate, see table 3

[2] Whole wheat

[3] Blend of 25 % concentrate and 75 % flaked wheat

Table 6. Consumption of whole wheat, per cent of total feed intake.

Week	**Ross**	**Derco**
7	12.4	16.3
8	28.9	44.8
9	37.6	54.1
10		55.9
11		53.4
12		53.5

Table 7. Feed conversion Ross, after nine and Derco, after twelve weeks.

	Live weight (kg)	Feed consumption (Concentrate + wheat, kg)	Feed conversion (kg feed/kg body weight)
Ross50	3.67	9.01	2.45
Ross70	3.62	8.96	2.48
Ross90	3.64	8.90	2.45
Ross, average	3.64	8.94	2.46
Derco70	1.82	5.96	3.27

Table 8. Ross chickens: Culled birds, mortality and the type of disorder, per week.

Age (weeks)	1a Birds culled	1a Reason for cull	2a Birds dead	2b Diagnosis				3 Sum 1a + 2a	4 Cumulative Sum 1a + 2a (%)
				Asc	Sud	Hep	Can		
1	1	Dn	2					3	1.2
2	0		0					0	1.2
3	0		4	1	2		1	4	2.8
4	2	Art	0					2	3.6
5	1	Art	0					1	4.0
6	4	Art	1	1				5	6.0
7	4	Art	4	2	1	1		8	9.2
8	0		4	3	1			4	10.8
9	0		0					0	10.8

Dn = Deformed neck
Art = Arthritis
Asc = Ascites
Sud = Sudden death
Hep = Hepatitis
Can = Cannibalism
1) = Post mortem diagnosis
2) = Assumed, no *post mortem*

Discussion

Animal growth

A typical live weight of intensively raised conventional male broilers after nine weeks is 3.55 kg, according to the National Research Council (NRC 1994). The average live weight of the Ross chickens was 3.64 kg. According to Ross' table values (Ross 1999) these results represent average performance also today but can be exceeded with more than 20 percent.

The expected live weight of slow growing table birds lies between around 2.0 and 2.7 kg after twelve weeks. Fisker (1999) found an average live weight of 2470 g for male ISA "i657" birds of that age on Danish farms. The Derco chickens (male) are lying 26 percent below this value.

No measurements were done on the carcasses, but it may be guessed from the ocular impression that the relative meat yield in the Derco chickens was inferior as well.

According to Salatin's on-farm experiences (Salatin 1993), retarded growth could have been expected in the group "Ross50" due to increased physical exercise and in the group "Ross90" due to stress as compared with group "Ross70". Stocking rate in the Ross groups ranged in the week before slaughter from 16 to 26 kg liveweight per m^2 (table 4). Bessei (1993) reviews findings of increased locomotion of the birds at stocking rates below 10 animals (corresponding 16 kg) per squaremeter. On the other hand, most of the works in his review report growth depression at levels above 30 kg/m^2, and tendencies of a depression already at lower densities. However, he does not conclude that at densities up to 30 kg/m^2 the animals would generally suffer from "social" stress but that temperature, litter- and air quality seem to be prior limiting factors.

There was no statistical difference ($p > 0.1$) of the birds' live weight between the pens. This experiment does not allow safe conclusions regarding the effect of stocking rate on the birds' growth, since each stocking rate was represented by only one pen. But the fact that no significant differences were found between the groups is supported by other studies. However, the results of studies with indoor-raised conventional broilers have only limited value for comparison, because:

- The Ross chickens in this experiment became almost nine weeks old, compared with five to six weeks in conventional production, which changes the relation beween number of birds per surface unit and liveweight per surface unit.
- The effect of high stocking densities on air- and litter quality must be seen different in a system with movable pens on pasture: Air quality is probably relatively unchanged, and the floor is renewed daily by moving the pens to fresh ground. Since only three-quarters of the pen is covered by a roof and only half of the side walls solid, not each squaremeter within the pen offers the same protection in hot as well as rainy weather.

The whole summer 1999 was extraordinary warm and dry, a climate

which probably favoured the broiler chickens' performance.

The Swedish Animal Welfare Act ("Djurskyddslagen") is permitting a maximum stocking density of 20 kg/m^2 (SJV 1998), while Swedish broiler producers who meet the requirements of a livestock care programme of the Swedish Poultry Meat Association ("Svensk Fågel") are allowed stocking rates up to 36 kg/m^2 but max. 25 birds/m^2 (SJV 1995). The EU regulation 1804/1999 on organic agricultural production is permitting:

- max. 10 broilers and 21 kg lifeweight per squaremeter in immobile housing systems and
- max. 16 broilers and 30 kg lifeweight per squaremeter in mobile housing systems (EU 1999).

Feed consumption

The decrease of concentrate consumption after week six can be explained with the parallel increase in consumption of whole wheat. The birds balanced their ration, responding to a decrease of protein requirement in relation to energy (Leeson & Caston 1993, Ciszuk, Charpentier & Hult 1998).

Whole wheat can be offered already at around three weeks of age. Offering whole wheat earlier is judged economically less interesting (Ristic et al. 1994). The amount of wheat chosen by the chickens is within the range of earlier experiences. Leeson and Caston (1993) reported a consumption of 34 percent whole wheat between day 21 and 35, and 41 percent between day 35 and 49 in conventional broiler chickens. Rose et al. (1995) found wheat intakes well below ten percent between week four and seven. Rose (1996) states that birds given whole wheat using choice feeding systems generally have a poorer productive performance than birds given complete single feeds. However, the economic savings achieved when broilers can select cereals in free choice may be substantial (Leeson and Caston 1993).

The untypical average stagnation in feed consumption in week nine could be observed in all three Ross groups. It was due to a decrease in the consumption of concentrate while the consumption of whole wheat continued to increase. This can be explained by the change from concentrate to a mix of concentrate (25 %) and flaked wheat (75 %). The ration was changed as a reaction to the increased health problems typical for rapid growth (see page 8, "Mortality and health"). The impact on the birds' growth due to the change in ration was not monitored, since the birds were not weighed directly before the change.

The Ross chickens' average feed consumption during the experiment was about ten percent higher than typical conventional values (NRC 1994). The higher feed consumption, compared with standard values, can be explained with the higher growth weight and is consistent with the fact that free choice cereal feeding tends to lower the nutrient concentration of the diet. Ristic et al. (1994) found that the feed conversion efficiency was four percent lower with whole wheat feeding. Calculating the energy utiliza-tion of the birds, the Ross birds consumed

29.4 MJ ME per kg live weight gain as compared to 30.2 (NRC 1994), a difference of 2.6 percent in favour of the Ross birds. The study was not conducted on a level that would justify discussion about differences of this dimension.

Comparative data for the Derco chickens could not be found.

Feed conversion

The feed conversion value for Derco can not directly be compared with the values for Ross, as:

- The values for Derco refer to a twelve weeks period, and Ross nine weeks. Feed conversion efficiency changes with age (Lewis et al. 1997, NRC 1994).
- The composition of the feed consumed in the groups is not identical due to the free choice between concentrate (11.8 MJ ME/kg, 19 % crude protein) and whole wheat (13 MJ/kg, 10 % crude protein).
- Compared with Derco, the carcass weight of the Ross chickens was higher in relation to the live weight (Slaughter percentage Ross: 75 %, Derco: 62 %) and in addition it may be assumed that even the meat/bone ratio was higher in the Ross chickens.

However, it can clearly be seen that the Ross chickens need considerably less feed for growth than the Derco chickens. To reach a live weight of 1.8 kg, Ross chickens would need 3.6 kg feed (see table 9), Derco almost 6 kg (see table 7). The difference in feed conversion is less between slow growing hybrids, like for example ISA's "i657", slaughtered at 12 weeks of age at 2.2 kg, and Ross: Compare table 9. The Derco chickens would have to consume more than 6 kg feed in order to reach a live weight of 2.2 kg, beyond the age of twelve weeks.

Mortality and health

A mortality between three and six percent until week six is normal under conventional conditions (Elwinger 1995, Lampkin 1997). Salatin (1993) reports his farm-own mortality to be two to three percent within seven to eight weeks, with most of the losses due to weather or predators. Ascites, sudden death and hepatitis are generally seen as related to rapid growth in broilers. Rapid growth is mainly explained genetically. In addition, male birds grow faster than female and the growth of the Ross chickens during the experiment was accordingly "rapid".

Table 9. Feed conversion standard values for Ross and ISA "i657".

	Live weight (kg)	Feed consumption (Concentrate + wheat, kg)	Feed conversion (kg feed/kg live weight gain)
Ross, 1.8 kg	1.80	ca. 3.6	ca. 2.0
Ross, 2.2 kg	2.20	ca. 5.0	ca. 2.3
ISA i657, 12 weeks*	2.20	6.6	3.0

* Hubbard ISA 1998

However, it might have been possible to reduce growth speed by limitation of the nutrient and energy intake. This was not tried except in week nine, with a changed feed composition.

It is not sure if the birds culled in weeks five, six and seven also were cases of arthritis, since in practice different causes for leg problems are known (FAWC 1992).

The overall mortality apart from the arthritis were, cases of ascites, sudden death and hepatitis, altogether four birds (corresponding 1.6 %): Three in the first week and one in week three (cannibalism). Other (experimental) studies also found leg disorders being responsible for most of the culling, and sudden death and ascites major causes of death (Havenstein et al. 1994, Lewis et al. 1997).

Conclusion

Animal growth

In this pilot study there was no indication of an effect of the different stocking rates (50, 70 and 90 birds per pen) on the growth performance of the Ross chickens. The highest value, 25.8 kg/m^2, although above the Swedish Animal Welfare Acts limit, still is clearly below today's standard of maximum tolerable density in conventional broiler production (> 30 kg/m^2, Bessei 1993). But also at the other end, in the Ross50 group, the birds' weight does not suggest an influence of the lower animal density on the performance, although animal density was (just) below 16 kg/m^2 and clearly below 10 birds per m^2 (< 5 birds/m^2). The stocking rates in the different pens were thus probably within the range of animal densities that provide conditions for generally desired growth rates of this type of bird.

The growth rate of the Ross chickens shows that high performance, well comparable with conventional housing systems, is possible in the movable pen system. The extraordinary warm and dry summer 1999 probably supported this performance.

Feed consumption

The amount of feed consumed in the Ross groups does not necessarily suggest that the exponation to temperature changes and wind increased the birds' energy and nutrient demand beyond of what could be compensated by feed additionally found in the range.

Free choice feeding of cereals appears to be an interesting option even in movable pens, also regarding the aspect that the actual contribution of the pasture to the birds' diet is rather unknown and likely to be of changing quality.

Feed conversion

Compared with the two hybrids "Ross208" (fast growing) and "i657" (slow growing), the Derco chickens had a distinctively lower feed conversion efficiency at comparable feed quality. Together with the relatively low live weight at twelve weeks of age, this would require a special market niche to give this type of chicken a place in commercial table bird production, even with an organic label.

The position of Derco cocks as an organic product would be somewhat strengthened, if it could be shown that they are able to perform as well as they did with feed of lower quality.

Mortality and health

The duration of the experiment and the number of birds involved do not allow to draw safe conclusions on health aspects.

The chicks had to be raised inside until at least two weeks of age, because of their need for permanent access to areas with temperatures between 25 and 32 degrees Celsius and their draft intolerance during

those days. During that period the chicks may grow under environmental conditions comparable to conventional production systems.

Thinkable problem areas on pasture so far are extraordinary bad weather (small birds get wet and cold), predators that succeed to enter the pens or infectious manure left in the pasture by wild animals (e.g. Salmonella). However, none of these problems arose during this study.

Further remarks

Technical aspects

The technical/practical experiences at Ekhaga Experimental Farm in 1999 with the portable pen system were mainly positive. The movement of the pens was still somewhat laborious. This can probably be explained with the difference in construction (e.g. presence of perches in the Ekhaga model), which made the Ekhaga model heavier than the construction described by Salatin. But also the wheel construction necessary to move the pens was not satisfactorily developed during the study.

Salatin states that he needs 1.5 – 2 minutes to move a pen and the same time to service it (feeding). This results in 90 minutes for moving and serving 26 pens (i.e. 2400 chickens) (Traupman 1990, Salatin 1993). During the pilot experiment, more than three times as much time was needed, partly because experimental work takes more time than commercial on-farm routine.

Sward measurements

The broilers' effect on the sward is of interest in order to learn about the quality, quantity and time (-lag) of pasture regrowth after chickens.

It could not be observed that clover was reduced either by selective grazing or the manure. But the high temperatures have probably led to nitrogen losses to the air and the dry conditions might have given clover a general advantage before grass in regrowth.

It seems to be difficult to measure the direct effect of the broilers on the sward: Chickens can "graze" also directly on the ground, an area that is difficult to reach with other equipment than the scalpel. This is aggravated further by a partly considerable spread of manure on the residual sward and probably different grazing behaviour in the different parts of the pen. It appears more practicable to monitor the sward's regrowth as compared with pasture without chickens. Although this requires experiments that exceed one vegetation period.

Other free range systems

According to EU-regulation 1804/1999 (EU 1999), organic broilers must have access to free range.

In France, stables for broilers with access to range (e.g. "Label Rouge") are often built as long stretched buildings with range areas attached to both long sides of the building, facing opposite directions of the heavens. This makes it possible to let one range area "rest" while the other is used (Nichol 1999).

A system practised in England uses wooden houses, ca. 2 m x 5 m and 1.5 m high at the roof top, on skids, that can be pulled by a tractor to fresh ground after each batch (Lampkin 1997). Instead of a wooden, pulled house, this can also be a hoop greenhouse, covered with plastic, as used for broilers for example in the USA (Coleman 1995).

Compared with the systems mentioned above, the movable pen sys-

tem can be judged as follows:
Advantages:

- If there are any apathetic or dead birds they can be found daily, when the pens are moved.
- Fresh ground and pasture can be provided at desired rates, even in rainy weather.
- Full protection against birds of prey.
- Broiler production can be highly integrated in pasture / ruminant production.

Disadvantages:

- Higher daily work input for moving the pens and working with smaller groups.
- Pasturing is restricted to the vegetation period.

Management data and EU regulation

The pens used in the study covered a surface of 4.0 m x 3.3 m. Subtracting the space required for feeders and waterers, some twelve squaremeters remain for the birds. Two thirds of this area (eight square-meters) is under roof. Bringing the birds out on pasture at three weeks of age and moving the pens daily until week twelve requires 830 squaremeters per pen and batch.

Assumed, each pen holds 80 – 100 birds, 1000 birds would require 0.8 – 1.0 hectares (i.e. 1000 – 1200 birds per ha per batch, or 8 – 10 m^2 per bird) respectively.

If 1200 slow growing broilers produced 6.9 t fresh manure on one hectare in nine weeks (week 4 to 12) and 1 t contained 10 kg N and 7.5 kg P_2O_5, this would on an average result in 69 kg N and 52 kg P_2O_5 per hectare per batch. The manure would be distributed unevenly in time, since production increases with age, and in space, due to the movement of the pens. During week twelve, maximum values of 129 kg N and 96 kg P_2O_5 per hectare can be reached, the figures being transformed to "kg/ha", while the actual surface affected would be the surface covered by the pens during that week (92.5 m^2 per pen).

The EU regulation 1804/1999 for organic animal husbandry allows a maximum of 170 kg N deposition per hectare per year on poultry range, so that at least one batch per summer could be run.

If 80 – 100 birds (per pen) weighed 192 - 240 kg, stocking density per pen would be 6.7 – 8.3 birds or 16 – 20 kg per m^2, and the stocking denstiy under the roofed surface of a pen would be 10.0 – 12.5 birds or 24 – 30 kg per m^2.

The EU regulation´s threshold values for broilers in mobile houses are max. 16 birds or 30 kg per m^2 inside the house and min. 2.5 m^2 range per bird. The pen is a house and range in one. The pen system cannot offer 2.5 m^2 range per bird at a time. The birds are restricted to the surface covered by the pen. However, seen in time, the pen system offers 8 – 10 m^2 total range per bird and guarantees that this range area is to a high degree evenly utilized.

SCREENING CROSSES – STUDY B

The animal material tested in study A can be seen as representing two extremes in broiler production today: On the one hand male birds of a commercial broiler strain, fed ad libitum to an age of nine weeks (carcass weight 2,7 kg). On the other hand the male birds of a relatively heavy laying strain, with carcass weights around 1.2 kg at 12 weeks of age.

While the birds of the broiler strain showed typical signs of rapid growth in broilers (leg problems, circulatory disturbances), the laying strain cocks were more vital and healthy but had a meat yield below today's standards.

Knowing that the breast muscles of the chickens have a high heritability, and with a lack of alternative slow growing meat-type chickens on the Swedish market in the year 2000, it appeared worthwhile to test, in how far a meat-type cock could increase the meat yield of the heavy laying strain tested during the summer.

Materials and methods

Derco hens were crossed with Faverolle, Orpington, Modern Game and Indian Game cocks, and four batches with a total of ca. 130 birds were raised to 12 or 15 weeks in the time between October 1999 and May 2000.

Derco is a heavy Swedish layer crossbreed between Rhode Island Red and White Plymouth Rock. Faverolle is a breed from northern France, created for dual-purpose production. Orpington is an English breed, created originally also for dual purpose. Indian Game also is an English breed, with an abundant quantity of breast meat. Modern Game is a relatively light, but upstanding and active breed with long legs.

The birds were raised indoors on the floor, bedded with wood shavings. The floor area was ca. 3 x 5 m and had two perches with a total length of 6 m.

Body weight and carcass weight were measured at slaughter day.

For two batches, the carcass was judged, giving marks from one to five for the ocular impression of the quantity of breast meat, leg meat and feather residues after plucking, as compared to a conventional broiler carcass.

Feed was given ad libitum (free access), a proprietary Starter ("Feed B") during the first three weeks and thereafter a broiler concentrate ("Feed A"), see table 3. Both feeds did not contain anticoccidial drugs. The birds could in addition choose whole wheat and grit stones ad libitum from the second week onwards.

Results

A rather low percentage of the eggs from the group with Derco hens and Indian Game cocks were fertilized, but hatching and performance were normal. However, some feather pecking occured despite the small group size and sufficient floor area (< 4 birds per m^2).

Table 10 shows the body- and carcass weights of all batches October 1999 to May 2000.

In the Faverolle crosses, the carcasses were rather voluminous, but not in proportion with meat accumulation around the breast and shanks. A similiar situation was given with the Orpington crosses, so that the carcasses of the Indian Game crosses in general looked superior to both. This phenomenon can be seen in table 11, were the carcass judgement results are summarized.

Feed consumption per cross could not be recorded because the groups were genetically mixed and partly also of different age. It is estimated that feed conversion was between 3.0 and 3.5 at 12 weeks of age.

Table 10. Body- and carcass weights.

Cross	hatched	Age	Birds	Body weight (kg)		Caracass weight (kg)	
(Derco[1]x)	(day)	(w)	n	Mean	SD	Mean	SD
Fv	13.10.99	12.5	13	1.76	0.29	1.17	0.12
MG	13.10.99	12.5	31	1.35	0.24	0.91	0.17
IG	27.12.99	15	6	1.93	0.31	1.33	0.23
IG	08.01.00	13.5	14	1.86	0.27	1.25	0.18
IG	31.01.00	15	39	1.55	0.27	1.05	0.18
Orp	31.01.00	15	19	1.63	0.24	1.07	0.18

1) Derco = mother IG = Indian Game MG = Modern Game
Fv = Faverolle Orp = Orpington SD = Standard deviation

Table 11. Carcass judgement, scores (1 = low-, 5 = high meat accumulation).

Cross	hatched	Age	Birds	Breast		Shranks		Feathers		Sum
(Derco[1]x)	(day)	(w)	n	Mean	SD	Mean	SD	Mean	SD	Means
IG	27.12	15	6	3.7	0.8	3.5	1.0	4.0	1.3	7.2
IG	08.01	13.5	14	3.7	0.5	3.4	0.5	4.4	0.6	7.1
IG	31.01	15	39	3.9	0.8	4.0	0.8	3.7	0.7	7.9
Orp	31.01	15	19	2.2	0.5	2.6	0.7	3.5	0.5	4.8

1) Derco = mother SD = Standard deviation

Discussion

The test of different cross breeds was a pilot study under simple conditions but good enough to get a first impression of the potential of the different crosses.

The live weights of the crosses at 13 to 15 weeks of age were in general not higher than the male Derco chickens of study A. The crosses were of both sexes and the conditions in the winter stable were probably somewhat inferior to the summer pens (light, temperature).

Indian Game crosses had carcasses with more meat on breast and legs than crosses with Orpington and Faverolle, and had higher body weights, also higher than Derco, at slaughter day. Differences in age must here be taken into account though. Crossing layers with Indian Game will give chickens smaller but of an appearance comparable to conventional, slow growing broilers, and are most likely to be accepted on todays organic market.

The reason for the low fertilization in the cross between Indian Game and Derco is not clear. It might be that the mating was not successful. There were obvious differences in both, anatomy and temperament. Fertilization problems could not be observed in a small group with Indian Game hens and the same Indian Game cock as used for the Derco cross.

It was also noted that slight feather pecking occured in the experimental groups. In earlier experiments this was also observed in crosses between commercial layers and Swedish landrace cocks (Ciszuk 2000). A strong (ethical) point for the use of pure Derco cocks would be that these birds are already being hatched – as a by-product of Derco layers.

Conclusions

This pilot study supports the idea to increase the meat yield in chickens from a heavy laying strain like Derco by crossing the Derco hens with a meat-type father.

While male Derco chickens and crosses between Derco hens and Faverolle and Orpington cocks appear not to meet the market standards as they are established today, crosses between a commercial layer and an Indian Game type father promise to be useful as ”farm-own” broilers. A drawback to this improvement was the observation that purebred, heavy Indian Game cocks seemed to have difficulties to mate with the agile layers which resulted in unsatisfying fertilization rates.

Further research is needed to find a management technique or combination of breeds in order to achieve an increased number of fertilized eggs.

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