**Ph. D. THESIS**

# THE RESULTS OF GENETIC PRESERVATION OF HUNGARIAN SPECKLED HEN

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## I. THE BACKGROUND OF THE RESEARCH

Humanity is constantly forming and shaping its environment, including the values created by its own in the animal kingdom. Owing to the changing human need we are creating newer and newer species with better and better qualities, sometimes leaving our older species to be lost. Our old species are not compatible with the modern ones and cannot keep up with the industry-like economical production. For this reason we have to endeavor to preserve our old species and to keep their important characteristics that can be utilized for breeding later on. One of the criteria of the gene preservation of our aboriginal species is to keep our species in an unaltered form with minimal gene loss preserving their original variability.

In the second half of the 20th century the necessity of the endangered species and breeds was recognized. For the sake of saving the old and rare species the FAO started a worldwide initiation at the 1980 Rome Conference. The most significant international endeavor to the recognition of the biological diversity showed in at the 1992 United Nations Conference in Rio De Janeiro where 150 countries signed the Convention on Biological Diversity.

We are the first in the world in preservation of old species, as at the beginning of the 1960s the different state farms, then with the control and the support of the Animal Breeding Authority gene preservation work began.

The Association of Hungarian Small Animal Breeders for Gene Conservation serve the purpose of gene preservation of the old poultry farms that carry out the breed conservation duties and represent the breeders to the state organizations and breeder authorities. The aim of the Association furthermore is to represent and hold together the institutions, enterprises and private breeders as a breeding organization.

In the Pilot Farm of the University of Szeged Faculty of Agriculture we have been dealing with the genetic preservation of two breeds of the aboriginal speckled Hungarian hens – the Speckled Hungarian Hen and the Speckled Transylvanian Naked Neck Hen since 1977.

In my work I examined the quqlity parameters of the two speckled hens looking for answer to the questions whether it was possible to preserve the plummets after twenty generations, whether the original variability is preserved and whether we carried out successful gene preservation activity during the gene preservation work.

## II. THE OBJECTIVES OF THE RESEARCH

I carried out my examinations in the Hódmezővásárhely-located stock of Speckled Hungarian Hen and the Speckled Transylvanian Naked Neck Hen preserved since 1977.

During my work I set the following goals:

- To investigate the differences between physical characteristics of Speckled Hungarian Hen and Speckled Transylvanian Naked Neck Hen by using data from our 20-year-old breeding programme.
- The changes or the lack of changes in characteristics of Speckled Hungarian Hen and Speckled Transylvanian Naked Neck Hen and compare the results with the original variety.
- What is the maximum acceptable standard error to maintain an unvarying hen stock?

## III. THE METHODS OF THE RESEARCH

I carried out my examinations in the Pilot Farm of the University of Szeged Faculty of Agriculture (at present: University of Szeged Pilot Farm Ltd.). The stock of Speckled Hungarian Hen and the Speckled Transylvanian Naked Neck Hen settled in 1977 is the largest elite stock of the country. We carry out species maintaining breeding in the stock and endeavor to preserve the breeds in an unvaried form.

We carry out our breeding program as a continuation of Dr. Ferenc Sófalvy's work both in case of the Speckled Hungarian Hen and the Speckled Transylvanian Naked Neck Hen.

To prevent the deterioration of inbreeding in the case of the feathered neck stock we have been applying the roosters according to a rotating mating system on the certain lines since 2001. The hens of the line stay in their place and the roosters are changed every year in rotation.

Till 1998 the naked neck stock was not homozygote. At the hatching of the naked neck line feathered neck chicks hatched. Homozygote examination was carried out with regard to the naked neck hens as a result of which the feathered-collar neck heterozygote specimens were rejected. Since then we only used the absolutely naked neck and crop area roosters that is the ones that are homozygote in sense of naked neck. We carried out out-crossing in our naked neck stock with roosters brought from Gödöllő in 2004.

In case of the Speckled Transylvanian Naked Neck Hen – as we keep only one line – we endeavor to avoid the relative breeding, therefore we consider the origin of the roosters on settling.

For the preparation of my thesis I use the production data of the Speckled Hungarian Hen and the Speckled Transylvanian Naked Neck Hen stock of the Pilot Farm that is kept as elite stock. the majority of the data was gathered by the workers of the Pilot Farm and the Animal Husbandry Department of the Agricultural Faculty under the supervision of late Dr. Ferenc Sófalvy. After the death of Dr. Ferenc Sófalvy in 2006 we carried out the preservation of species and the related data collection work with my late colleague Lajos Vidács. Within the practical lessons we involved the students of the University of Szeged faculty of Agriculture into the data collection work.

The value measuring qualities of the speckled hen was measured consequently in certain periods. The weight of the one year old hens in the stock was weighed every year till the age of 20 weeks at penning. The weight of the penned hens was measured on 5 g punctuality

Berkel scales in a way that the examined specimen was placed onto the scales and after its settling we read and recorded the value. At the end of the examination we calculated the average, deviation and relative deviation.

To the measuring of the egg production the daily egg production data were used. After the penning the egg production data of the certain lines were recorded daily. During the data collection the time of the laid egg of both the Speckled Hungarian Hen and the Speckled Transylvanian Naked Neck Hen was recorded along with the end date of the laying cycle. From the egg laying data we calculate the production level in the different periods among which the 30% production level and the date of peak production are recorded.

At the end of March we carry out a 7-10 day breeding egg gathering before the hatching. In this period we weigh the weight, length, width of the breeding eggs and record the shell color of the eggs. The egg weigh is weighed on 1 g punctuality scales and the measurement of the length and with is carried out by vernier. The egg shell color is classified in one of the four classes we defined (white, light, beige, brown).

The eggs are stored in an air-conditioned chamber during the breeding egg collection period. The pedigree hatching according to the lines is carried out at private entrepreneurs. On the tenth day of the hatching candling is done as a result of which the proportion of the infertile eggs can be calculated. We calculate hatching percent after the hatching of chicks.

There are detailed and evaluable statistical data since 1992, thus I could assess the results of nearly 20 generations.

I carried out the data procession, analysis and graphic representation with the help of **Microsoft Office Excel 2003** program. **SPSS for Windows 15.0** program was used for the analysis. The data were analyzed by the method of variance. The homogeneity was examined with of the Levene test. The Tamhane test (in case of heterogeneity) and the LSD test (in case of homogeneity) were used to compare the group-pairs.

The biometric calculations and notations required for data procession were used according the guidelines set by ANTAL et al. (1978), SVÁB, (1981) and (HUZSVAI, 2004-2010).

The results obtained during the tests are presented in tables or in graphical form. On the graphs I illustrated the average values, the standard deviations and the coefficiens of variation values. The formal establishment of the graphics was carried out using **Microsoft Photo Editor 3.0.2.3**. and **GIMP 2.6.11** editing programs.

## IV. THE MAIN OBSERVATIONS IN THE PAPER

### The body weights of one year old hens at colonization

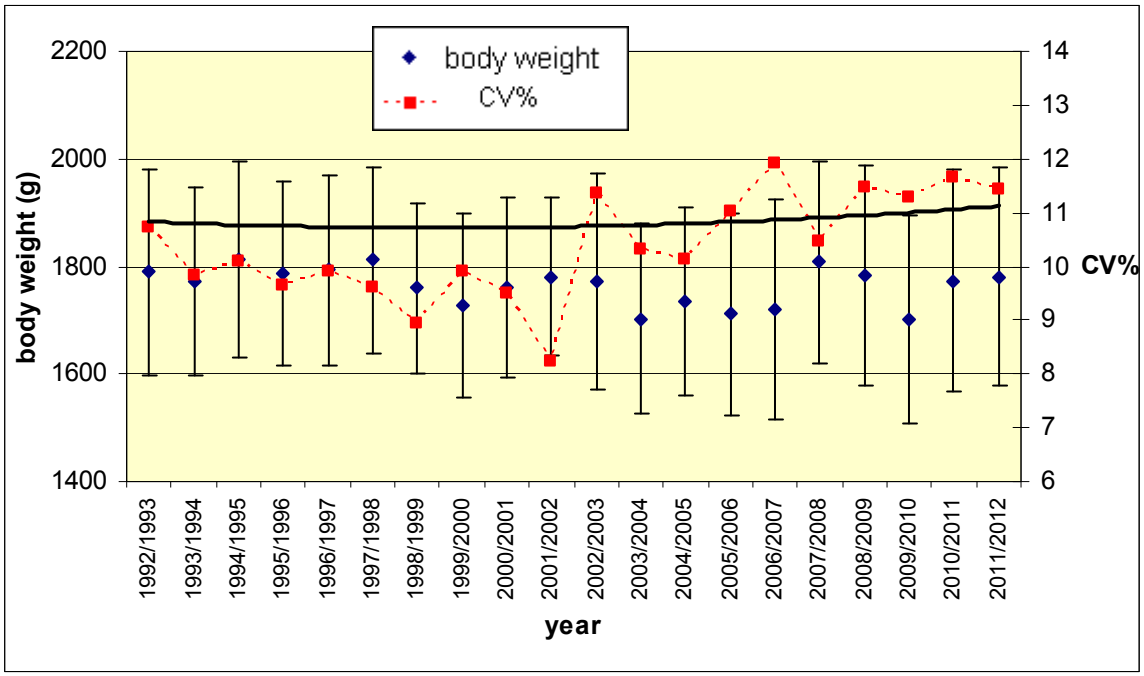


**Figure 1: The body weights of one year old hens of 21st line at colonization**

Studying the live weights (Figure 1), I concluded that the body weight of the 21st-line through the initial eleven generation said to be stable as a result of crosses between the lines started in 2001 was significantly ($p<5\%$) reduced until the second generation period. This value of the lower body weight has been preserved through four generations. The stabilization selection regarding to the body weight can be said successful as the body weight remained within the standard deviation values and at the end of the test period the body weight values for the 21st-line show similar values like the values of those twenty generations before.The initial downward trend of the standard deviation values were stopped by the rotation pairing with the cocks because the standard deviation values have increased. Since then the deviation values of the 21st-line are similar to those of the initial period. From the beginning of the test the variance of the body weight at the colonization showed a downward trend. The variance has been increased to a moderate level by the breeding started in 2001.

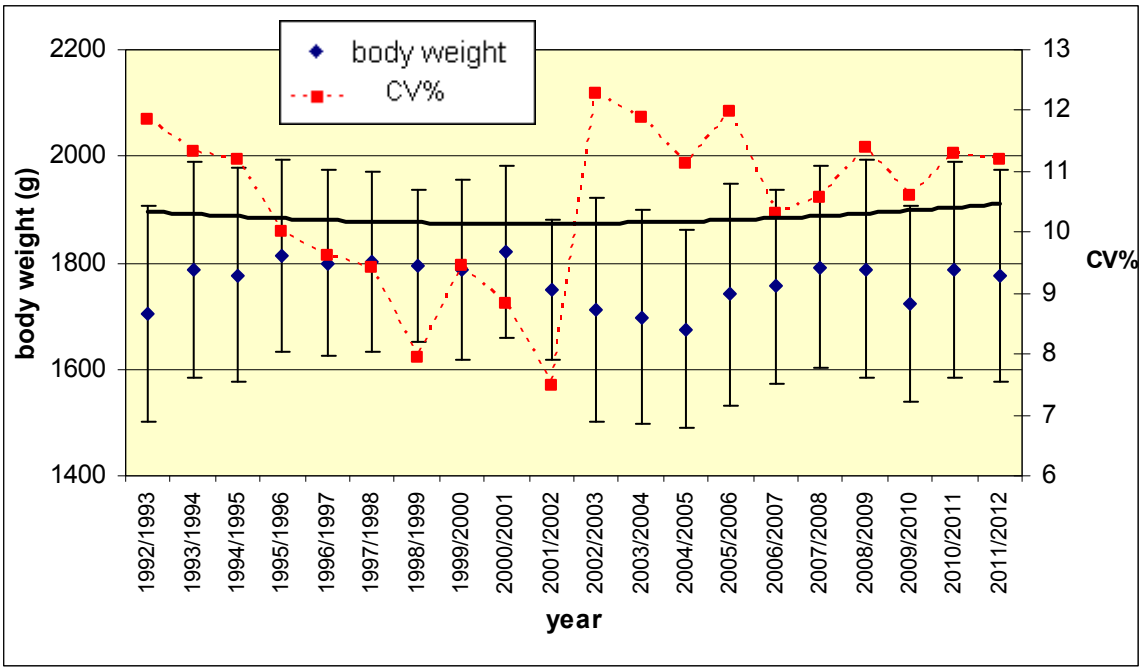


**Figure 2: The body weights of one year old hens of 22nd line at colonization**

Examining the body weight of the one years old hens of the 22nd-line at the time of the colonization (Figure 2) we can say that the average body weight, comparing to the initial values, had increased during the second year of the study period, which was stabilized at close to 1800 grams through eight generations. In the third generation after the crossing between the lines we can experience a significant decrease ($p<5\%$) measured with the pre-crossing values. Similarly to the previous line, the body weight of the recent period show almost the same values compared with the values measured at the beginning of the test. As well as at this line the trend of the value of the standard deviation was influenced by the line crosses between the lines. Similarly to the previous line the decreasing standard deviation values of the initial period have high value since the introducing the breeding process till today. Examining the variance we can conclude that the decreasing low variance has been raised to a medium level by the crossing procedure. In case of the 22nd-line the race preservation proved suitable for the development of the weight and the values of the standard deviation, because the similar values measured at the end of the test are similar to those ones measured at the beginning of the test.

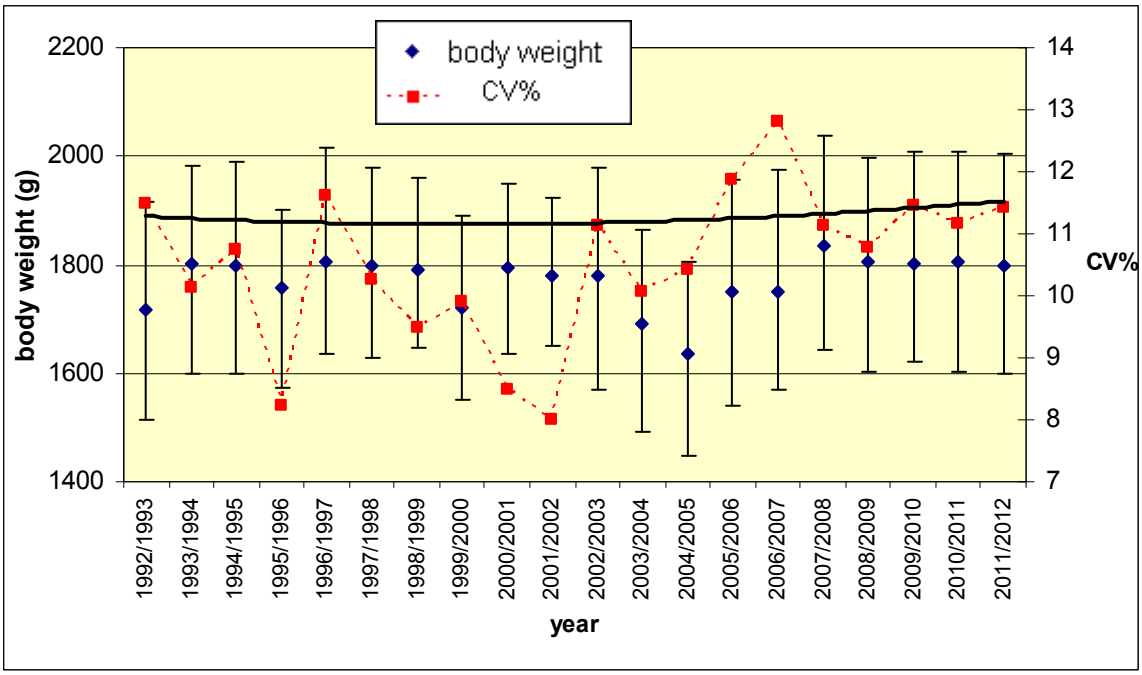


**Figure 3: The body weights of one year old hens of 24th line at colonization**

The body weight of the one-year old hens (Figure 3) of the 24th-line at the time of colonization was stabilized from the initial value over 1700 grams to under 1800 grams by the early 2000s. After starting the crossing between the lines in the second generation a significant ($p < 5\%$) decrease can be observed in body weight, which increased in the fourth generation, and later on it was stabilized over the value of 1800 grams. The decreasing trend of the standard deviation values - similarly to the two previous lines – disappeared after the effects of the 2001 line-crossing. Since then, the stock has higher standard of deviation values. The trend of the decreasing relative standard deviation also disappeared after the starting of the crossing procedure and since then it has been moving at a moderate level. The values of the body weight of the 24th-line were stabilized during the last four years and show similar values measured at the beginning of the test period, and therefore the stabiliy of the selection at this code also proved successful.

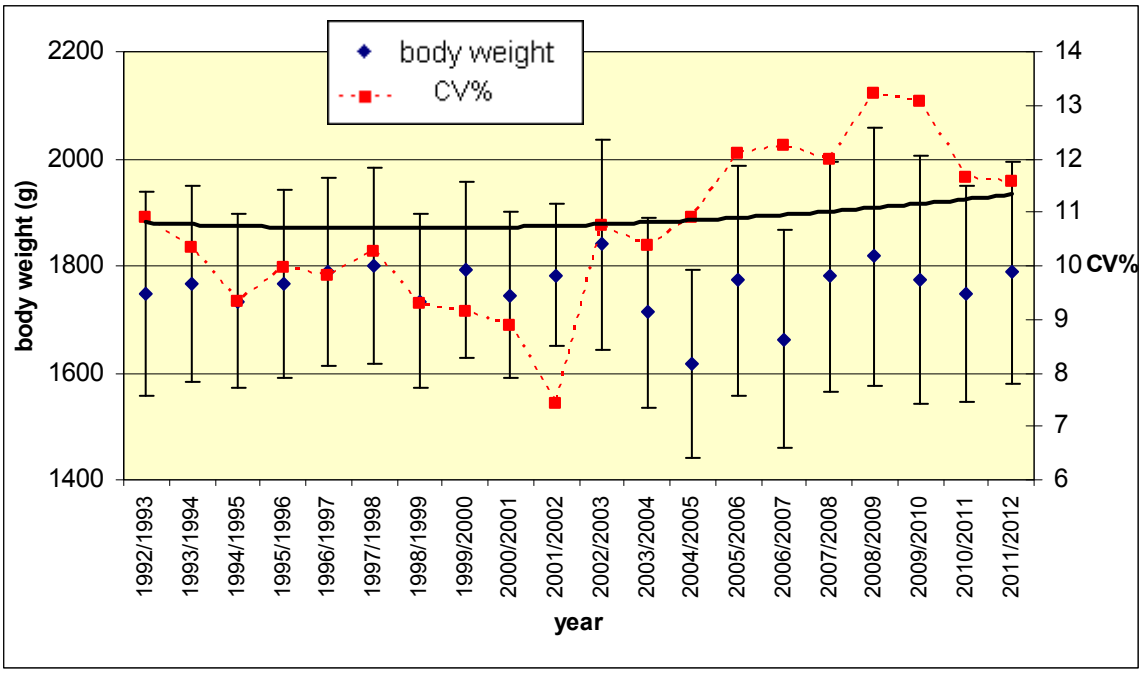


**Figure 4: The body weights of one year old hens of 28th line at colonization**

The trend of the body weight of the 28th-line (Figure 4) is similar to the ones in the previous lines. The values of the body weight in the first half of the test period show values close to the values of 1800 grams. After starting the crossing process in the second generation we observed a significant ($p<5\%$) weight loss. The body weight of the subsequent generation decreased close to 1600 grams. We can observe significant ($p<5\%$) fluctuation among the values of weight of the subsequent third generation. The values of weight of the latter three generation are similar to values measured during the initial time of the investigation, which proves the correctness of our breeding process. The development of the standard deviation values was similar to the previous three lines. The downward trend of the initial values was stopped by the crossing programme introduced in 2001. Since then the 28th line has higher standard deviation values than the initial values, which refers to the imperfection of the stabilizing selection. The initial medium variance during nine generations decreased to low level (CV% below 8%), which increased to 10 % relative standard deviation value after introducing the crossing programme among the lines and currently it is still at a medium level.

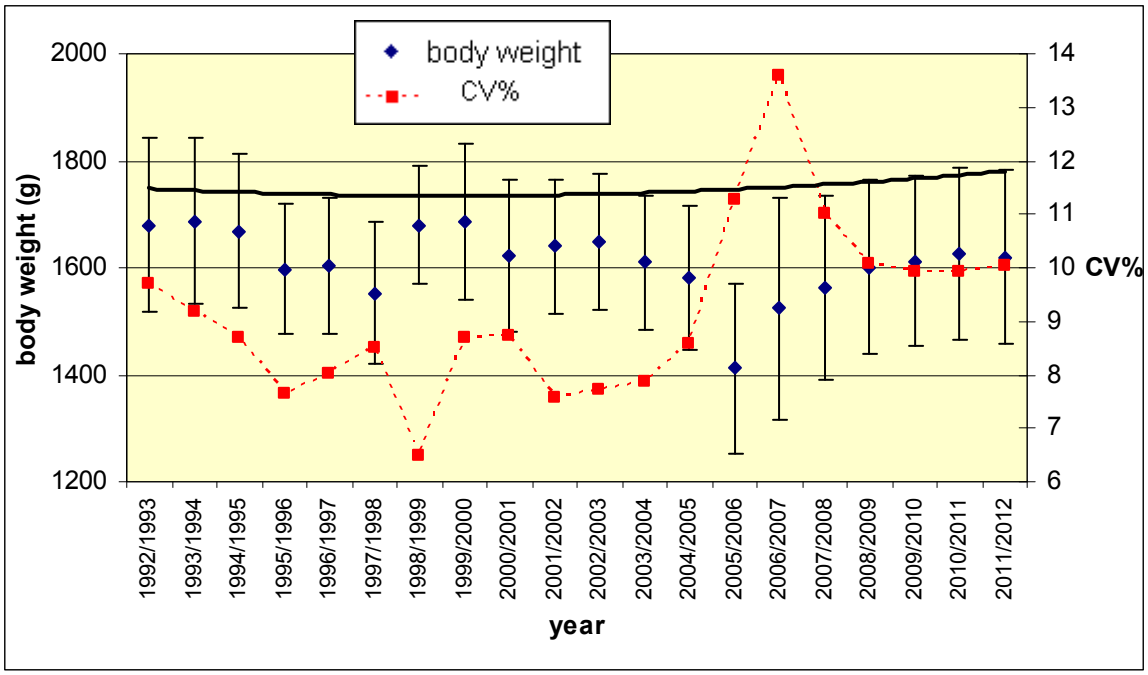


**Figure 5: The body weights of one year old hens of 26th line at colonization**

The average weight of the nacked-neck breed signed with 26 number (Figure 5) dropped to below-1600 grams through five generations, which is significantly less ($p<5\%$) than the initial value. The hatching of the 1988th year was already carried out by using eggs coming from breeding with homozygous naked-neck cocks. At the colonization carried out in 1998 regarding to the body weights there was significant ($p<5\%$) growth compared to the body weights of the previous year. By the introduction of outcrossing with cocks from Gödöllő carried out in 2004 the significatly ($p<5\%$) lower weighed stock was colonized in the following year. After the growing trend of the body weight of the stock, the weight of the one year old hens with naked- neck stabilized. In 1988 the standard deviation values decreased at the beginning of the breeding by homozygous cocks, probably because of the strong selection effects, then they increased and showed higher values compared to the values of the previous period after the introduction of blood-freshing.

The less than 10% level of the relative standard deviation values were raised above 10 % by the blood-freshing, which has been stabilized around 10 % with decreasing tendency.

The failure of our race preserving breeding at the 26th line can be blamed for the fact that the value of the average body weight is below the initial values; but the standard deviation values are greater than their baseline values.

The weight of the naked neck stock showed significantly ($p<5\%$) lower values compared to the weight of the lines with feathered necks. Significant differences can be found among the

body weight of some lines with feathered necks in particular years of the test period, but unequivocal conclusions can be drawn only from the different body weights at the colonization in the year 2002. This year, between the body weights of the 21st and 24nd lines there were no significant (p<5%) differences. The body weights of the other lines were significantly (p<5%) different from each other.

**The egg production of speckled hen stock**

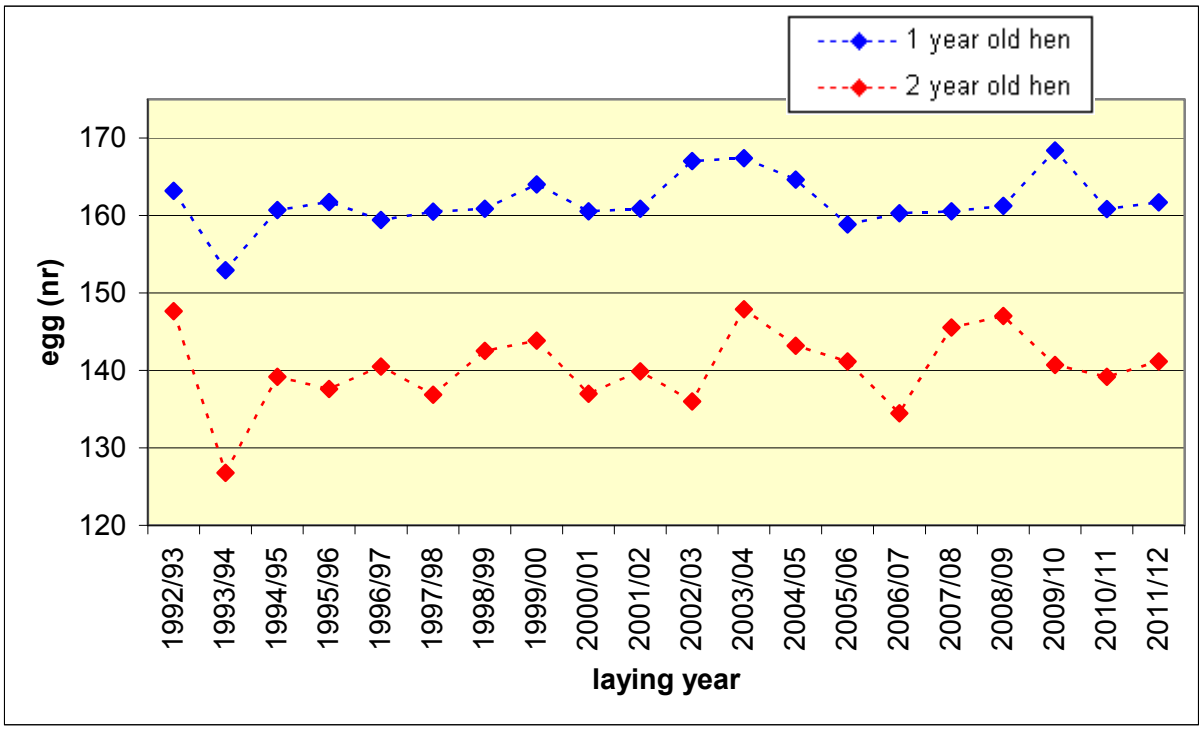


**Figure 6: The egg production of 21st line corrected to 365 days**

Studying the egg production of the 21st line (Figure 6), we can say that in the last twenty years the one-year old hens have performed well-balanced egg production. During the first ten years of the investigational period the egg production was around 160 pieces of eggs. No increasing or decreasing tendency can be experienced. The less, close to 153 pieces of egg production of the 1993/1994 laying years was caused by feed-toxication, which hit the stock. (Source: Breeders' Final Report 1994.) In the 2002/2003 laying years the number of layed eggs increased (to 167 pieces), which was the result of the crossing between the lines programme. The stock was able to produce this level through the next generation as well, however following it they ran down back to the level of around 160 pieces of eggs by ever decreasing egg production through two generations. During the last seven years the flock

produced eggs at this level, except the 2009/2010 laying years, when the egg production reached the 168 pieces of egg quantity. It is the stable production level measured at the 21st line, which has hardly changed through twenty generation. It be tokens about excellent stabilizing selection.

The two-year old hens of the 21st line, considering average of the twenty years, laid 13.23% less eggs. At the beginning of the test period the same trend can be observed, which has been experienced in one year old hen stock, with the difference that a slow growing tendency through five generation can be observed from the third test year in the egg producing. In the 2000/2001 laying years the egg production declined. The impact of the crossing between the lines on the egg production is proved by the fact that the egg production of the two-year old hens prominently increased in the 2003/2004 laying years correlating with the previous laying year. ( In the 2002/2003 laying years, this stock produced the most egg quantity at their age of one.) Through three generations following the 2003/2004 laying years, a continuous decreasing tendency can be observed and as a result of this the annual egg production decreased with 13.14 pieces of eggs. In the following two laying years the quantity of egg production significantly increased, then following it during the latter three years the annual egg production of the two year-old hens of the 21st line was stabilized at around 140 pieces.

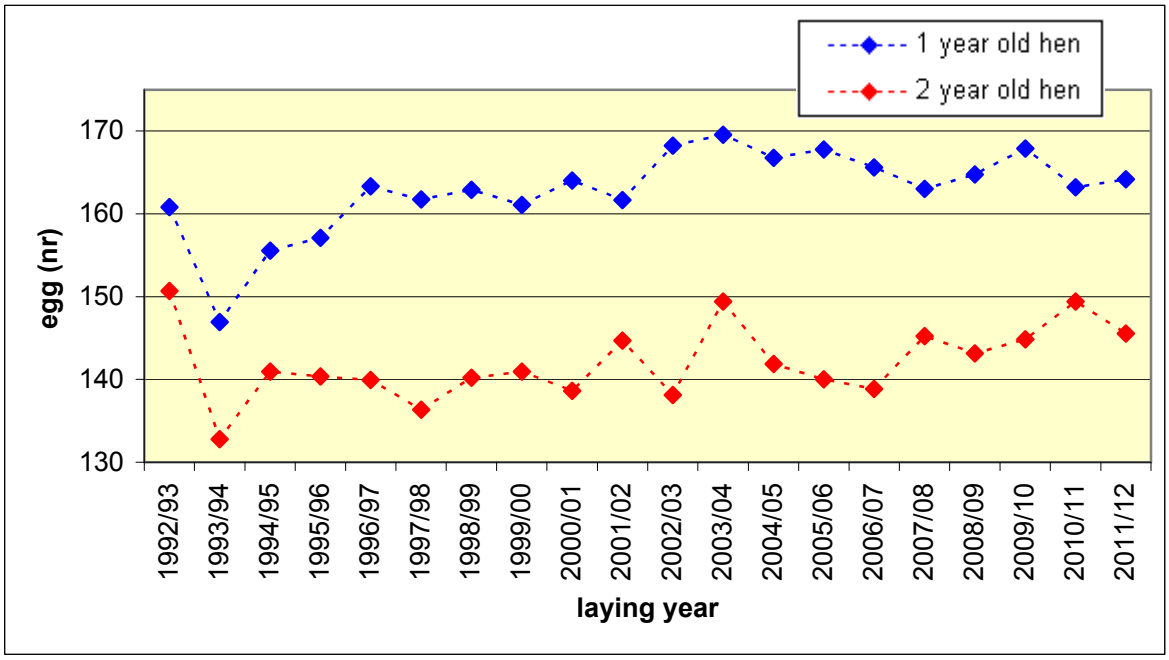


**Figure 7: The egg production of 22nd line corrected to 365 days**

The egg production of the one-year old hens of the 22nd line (Figure 7) significantly decreased because of the above described feed-toxication in the second year of the study period, then after had been increasing through three generations it was being stabilizied through six generations at around the level of 162 pieces. Following the aforementioned crossing between the lines in the 2002/2003 laying year the balanced egg production was followed by a higher level of production, and we can see from the data that the level of egg production in the 2003/2004 laying year was hardly under the 170 piece-production level (169.55 pieces). After the 2003/2004 laying year a downward tendency was observed in the egg production lasting through four generations, then following it, growth lasting two years was seen. During the last two years of the study period we could experience a lower growth of the an annual production of 163 piece compared to the previous year. The egg production of the 22nd line is higher in the last ten years than it was at the beginning of the investigation, which can be regarded as a failure from the point of view of the genetic preservation.

Studying the egg production of the two-year old hens of the 22nd line, it reveals that similarly to the 21st line the number of the layed eggs significantly decreased in the second investigational year, then from the third laying year of the study period through seven generations the egg production stabilized at around 140 pieces (excluding the 1997/1998 laying years). Remarkable changes were experienced according to the egg production similarly to the 21st line in the 2003/2004 laying year, during which period the average egg production reached the level of 149.39 pieces. Similarly to the egg production of the 21st line, following this line through three generations, a decreasing trend can be observed, then beginning from the 2007/2008 laying years the flock reached the 149.40 piece-production level regarding to the 2010/2011 laying years by an increasing tendency.

The production level of the two-year old hens of the 22nd line in the latter five years is higher than those of the previous periods, however it does not reach the initial level of the study period (150.69 pieces).

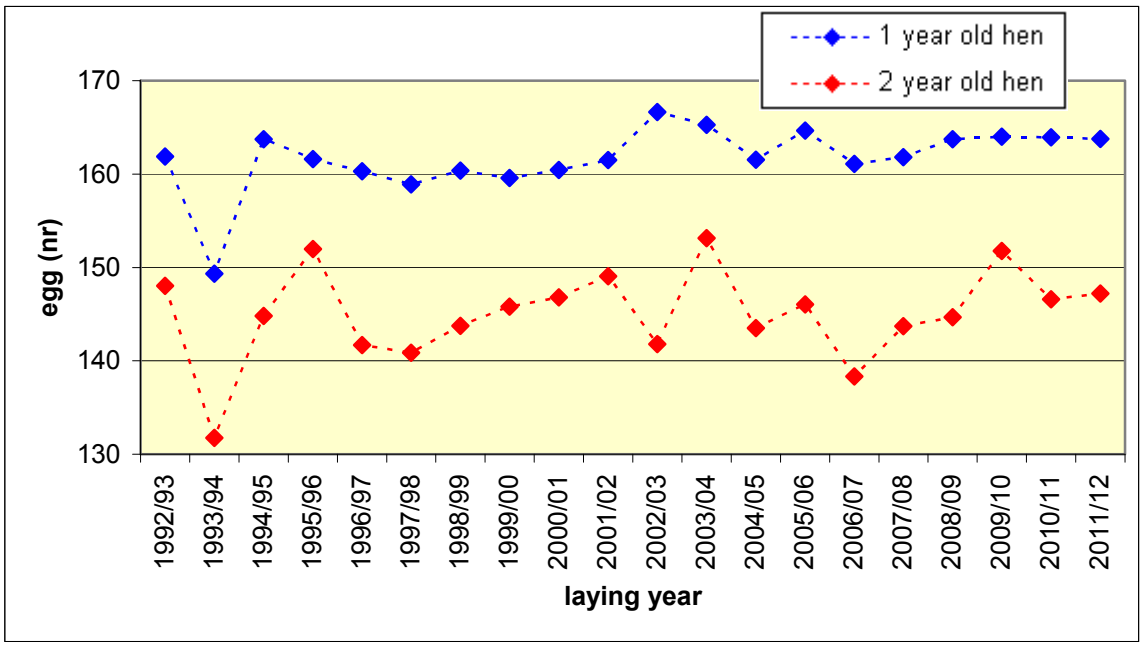


**Figure 8: The egg production of 24th line corrected to 365 days**

The same tendency can be observed in connection with the egg production of the one-year old hens of the 24th line (Figure 8) at the initial stage of the investigational years as the one has already been written down about the two previous lines. The egg production during the second year of the study period significantly decreased. Then in the subsequent year it increased over 160 pieces. The egg production during the subsequent period through seven generation was stabilized at around 160 piece-production level. Likewise the 2002/2003 laying year brought more significant changes for this line, namely the egg production increased to 166.65 pieces in this laying year. During the following four years the production dropped to 161 pieces, then the level of the egg production from the beginning of the 2006/2007 laying year with a slow growing tendency – during the latter laying years – was stabilized at around 164 pieces. This production level is higher than the one during the period before the crossings between the lines, however the stock has similar production at the beginning of the study. Considering that, the stabilizing selection at this line can be said suitable.

The two-year old hens laid 10.30% fewer eggs during the studied period than the one-year old ones. Similarly to the egg production of the two-year old hens of the previous line, the egg production of the stock significantly decreased during the second investigational year, although in the following years it proved to be increasing and as a result of this the number of the laid eggs was raised by 152 pieces during the 1995/1996 laying year.

After a significant decrease, you can experience an increasing tendency of the egg production of the two-year old hens of the 24th line starting from the 1997/1998 laying year. Though there was a significant drop in the egg production during the 2002/2003 laying year, but in the next laying year – similarly to the egg production of the previous two-year old hens - the egg production of the 24th line also increased the number of the laid eggs. There was decrease in the egg production of the three generations following this, then a growing tendency can be observed during three years following the 2006/2007 laying year, subsequent upon this, the number of the laid eggs increased to 151.75 pieces in the 2009/2010 laying year. During the last two years the number of eggs dropped, the stock produced around 147 pieces of eggs. This number is at the same level as the number of eggs produced twenty generation earlier (148 pieces).

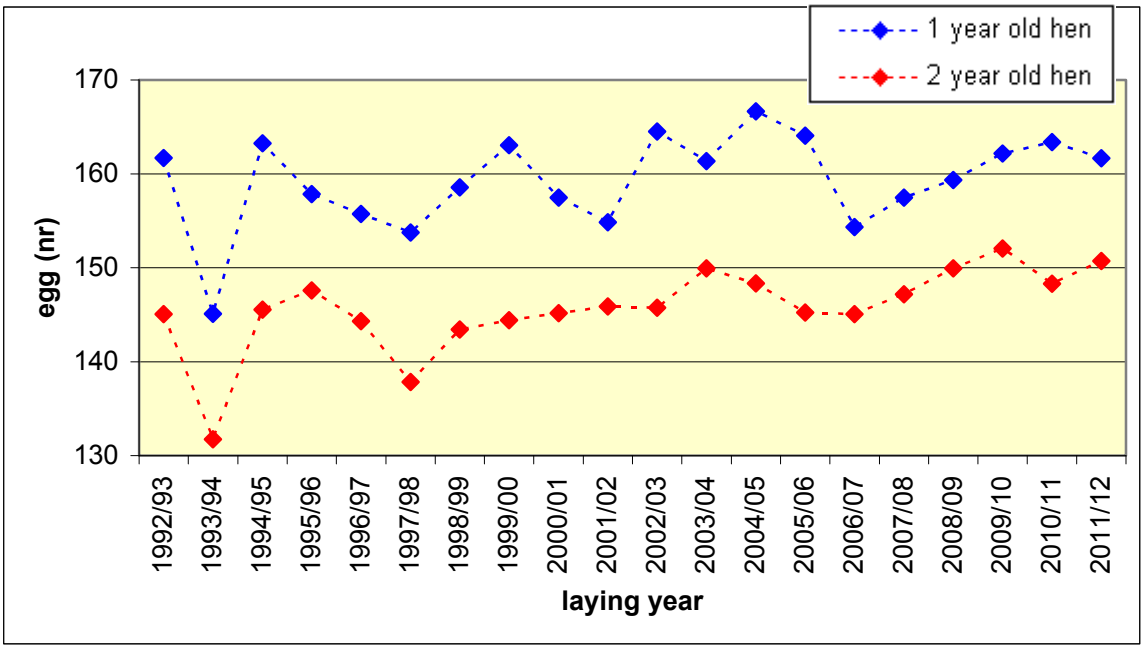


**Figure 9: The egg production of 28th line corrected to 365 days**

The same tendency predominated in connection with the one year old hens of the 28th line during the first three laying years of the investigational period (Figure 9), as I have already written down above at the previous three lines. However we could experience different trends in connection with the next period, namely a strong decreasing tendency can be observed in the egg production of this line from the third investigational year, which lasted during through three generations. Significant increase can be experienced in the egg production in two laying years after that, which was followed by a two-year long downward period. However the

2002/2003 layer year can be characterized by a strong growth similarly to the other three lines with feathered necks, thanks to the aforementioned breeding programme. The stock produced the most eggs (166.66 pieces) in the 2004/2005 laying year, following that during two years, the egg production decreased to 154.34 pieces. From the 2006/2007 laying year an increasing trend can be seen in connection with the egg production of the one-year old hens of the 28th line, which shows an egg production over 160 pieces during the latter three years.

This production level corresponds to the level of production twenty generation ago. However the stabilizing selection cannot be considered successful, because the egg production was uneven, large fluctiations can be observed in the egg production of the 28th line through twenty generations.

In case of the two-year old hens the tendencies of the first investigational years correspond to the ones experienced in connection with the previous lines. In connection with the egg production of the two-year old hens of the 28th line we experienced reduction through two generations from 1995/1996, then following that a five-generation long upward trend can be observed. Following the crossing between the lines in 2003/2004 laying year a stronger growth can be experienced in connection with the egg production, which was followed by a production loss through two generation because of the disappearing of the heterosis. An increasing trend was experienced in the egg production through three years after the 2006/2007 laying year. The egg production decreased during the latter two years compared to this production level, though it is beyond the production level of the one twenty generations ago anyhow. There is 8.65 % difference between the production levels of the hens of the 28th line in favour of the one-year old hens considering the production of twenty generations.

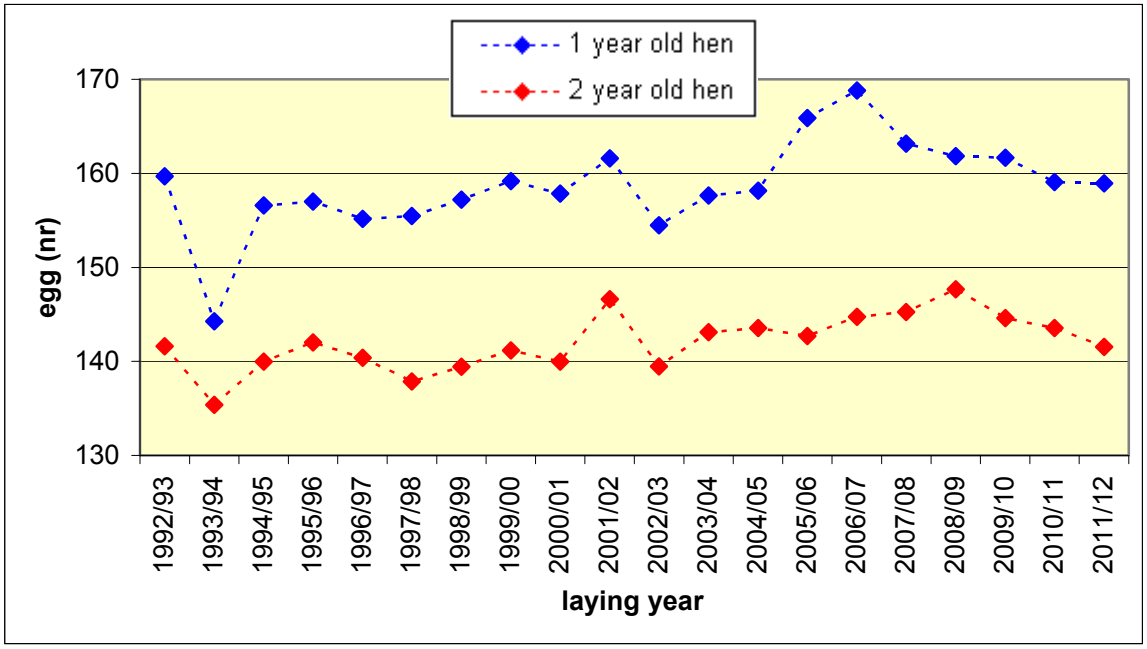


**Figure 10: The egg production of 26th line corrected to 365 days**

The tendency of the first three investigational years of the 26th naked-neck line corresponds to tendencies of the feathered-neck lines. Analyzing the egg production of the one-year old hens (Figure 10) we can state that the level of the egg production slightly increased by 5 pieces through seven generations, which reached 161.61 pieces by the 2001/2002 laying years. During the following three generation the production level dropped to 160 pieces, then the level of the egg production significantly increased as a result of the blood-freshing of the naked-neck stock by the cocks from Gödöllő in the 2005/2006 laying year and in the following year. Our race preserving breeding can be blamed for this. Showing ever since decreasing tendency, the egg production now reached the production level measured at the beginning of the study.

The production level of the two-year old hens dropped 8.65 % behind the production level of the one-year old hens considering the egg production of twenty generations. The egg production, after the third laying year, was fluctuating around 140 pieces – initially by decreasing and then increasing tendency. In the 2001/2002 laying year compared to the previous years, similarly to the one-year old hens, we experienced by far higher egg production in connection with the two-year old hens. After the 2003/2004 laying years the production level increased over 140 pieces. As a result of the blood-freshing in the year 2004, the effect of the breeding process can be felt among the two-year old hens as well, since an increasing tendency lasting three years can be observed from the 2006/2007 laying year. We

can experience a downward tendency in the egg production of the two-year old hens of the 26th line during the last four years of the investigational year. The production level of the last year is similar to that one twenty generations earlier.

**The sexual maturity of speckled hen stock**

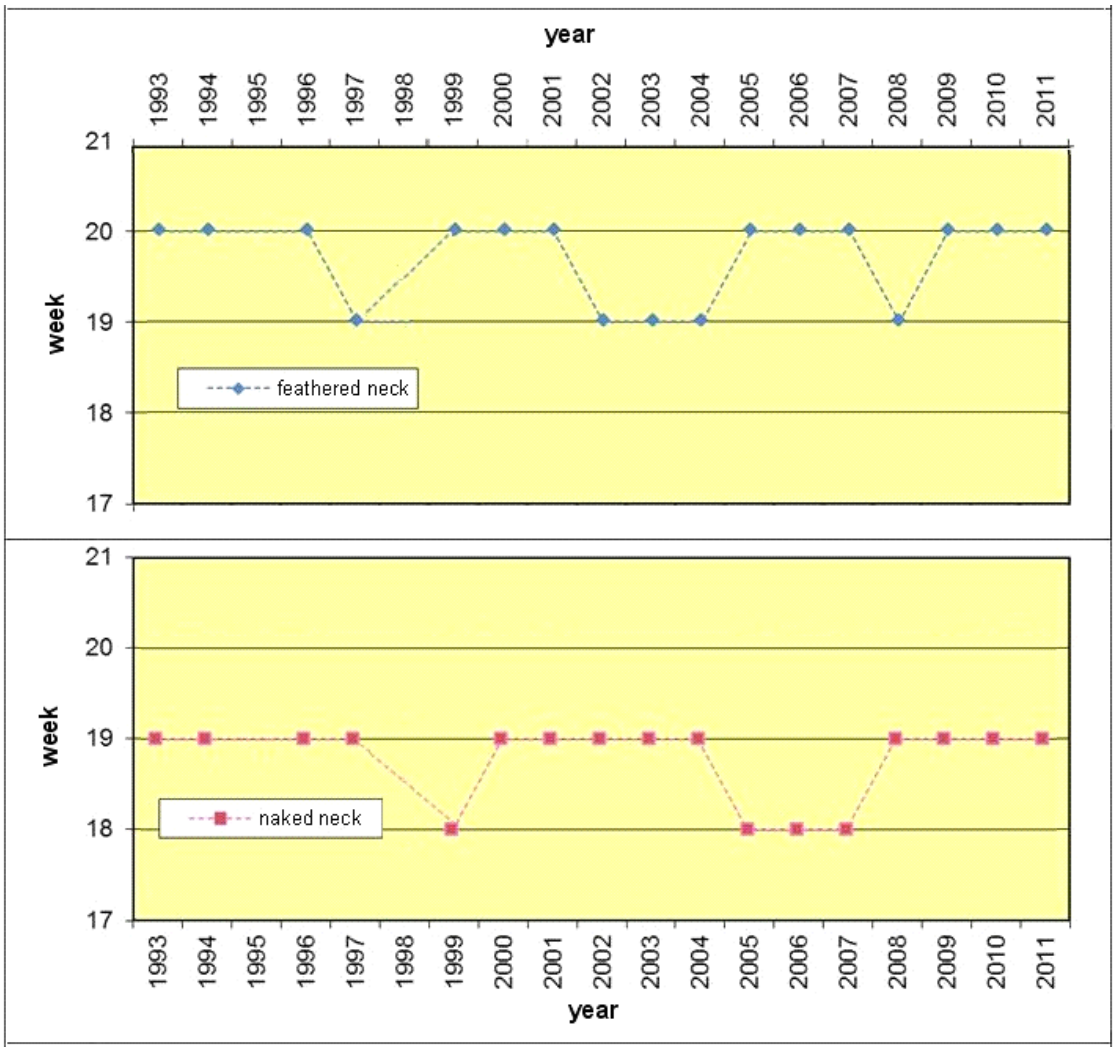


**Figure 11: The age of hens at the time of the laying the first egg**

The speckled hens in our stock already lay their first eggs before colonization. Since the two kinds of breed are separately raised up, we can put down the date of the first-layed eggs according to the species. The lines of the feathered-neck stock are raised together until colonization that is why it is not possible to fix the date of the first egg according to separate lines. Data of the time of the laying the first eggs were not available for two years during the

investigational period (1995, 1996). On Figure 11 we can see in the first half of the study period the feathered-neck stock lay their first eggs at the age of twenty weeks, then from the year of 2002 onwards through three generations the time of sexual maturity decreased by the age of 19 weeks. In the year of 2002 the maturity happened earlier and it checks up with the launching of our breeding programme in 2001, so we can say that because of the crossing between the lines the sexual maturity happened earlier through three generations in the feathered neck stock. The original twenty-week age was restored in the fourth generation, which remained until the end of the study, except the year of 2008.

We can experience a similar tendency in connection with the naked-neck stock. Comparing to the feathered-neck hens, the one week earlier average 19-week maturity time of the naked-neck hens dropped to the age of 18 weeks in 2005 because of the blood-freshing in 2004, then following this it was again restored to the original 19-week period. Examining the time of the maturity it can be summarized that the feathered-neck stock lay their first eggs at average age of 20 weeks, while the naked-neck stock at average age of 19.

**The analysis of the egg weight of one year old hens**

When tested in the weights of the eggs we can claim that we can experience significant ($p<5\%$) differences in connection with the one-year old hens of the feathered-neck lines during the first few years of the investigational period.

The annual egg weight-fluctuation of the one-year old hens of the 21st line (Figure 12) experienced during the first period changed into decreasing tendency in the six generation. This trend ceased in the second generation after the crossing between the lines. Then the egg weight stabilized over 55 grams through four generation, then after a decrease it stabilized at around 53 grams in the latter four generation.

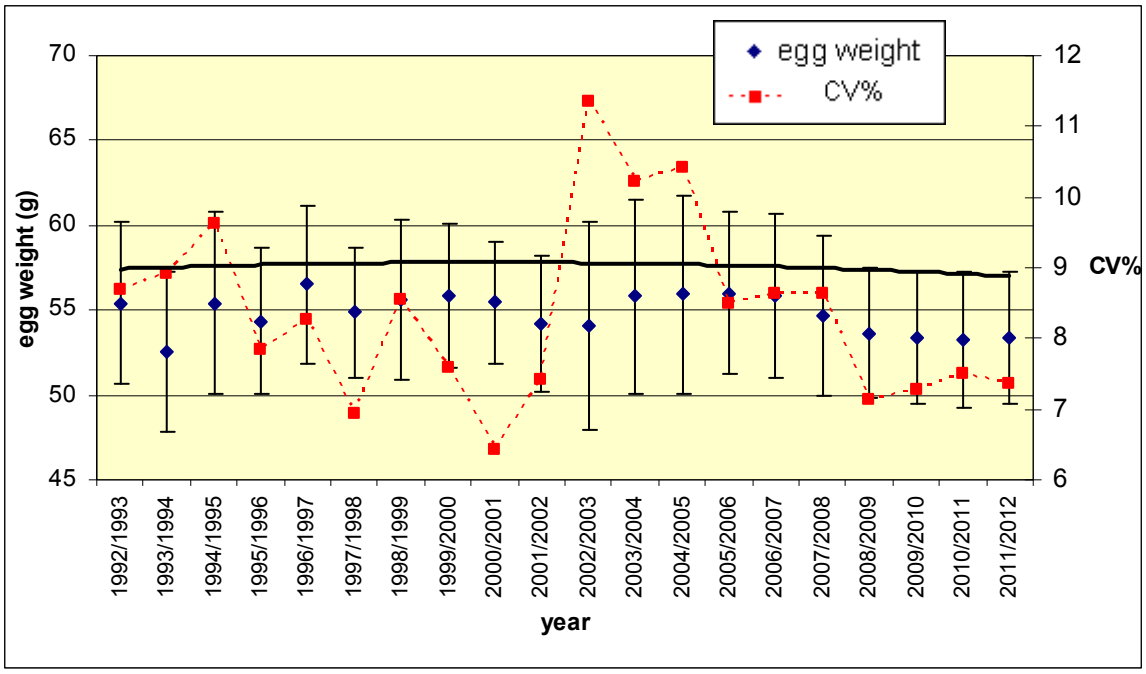


**Figure 12: The egg weights of one year old hens of 21st line**

They show downward tendency compering to the initial relative deviation until the end of the year 2001. After launching the crossing between lines the relative deviation increased, then it stabilized at around 3.9 grams in the latter four generations. The variance of the egg weight of the 21st line shows decrease after the initial years. Because of the crossing between the lines it increased to a medium level of variance, but during the subsequent period the coefficient of variation stabilized significantly decreasing at around 7%.

The stabilization selection cannot be said successful in connection with the 21st line, because the egg weights and their standard deviation lag behind the values measured at the beginning of the study.

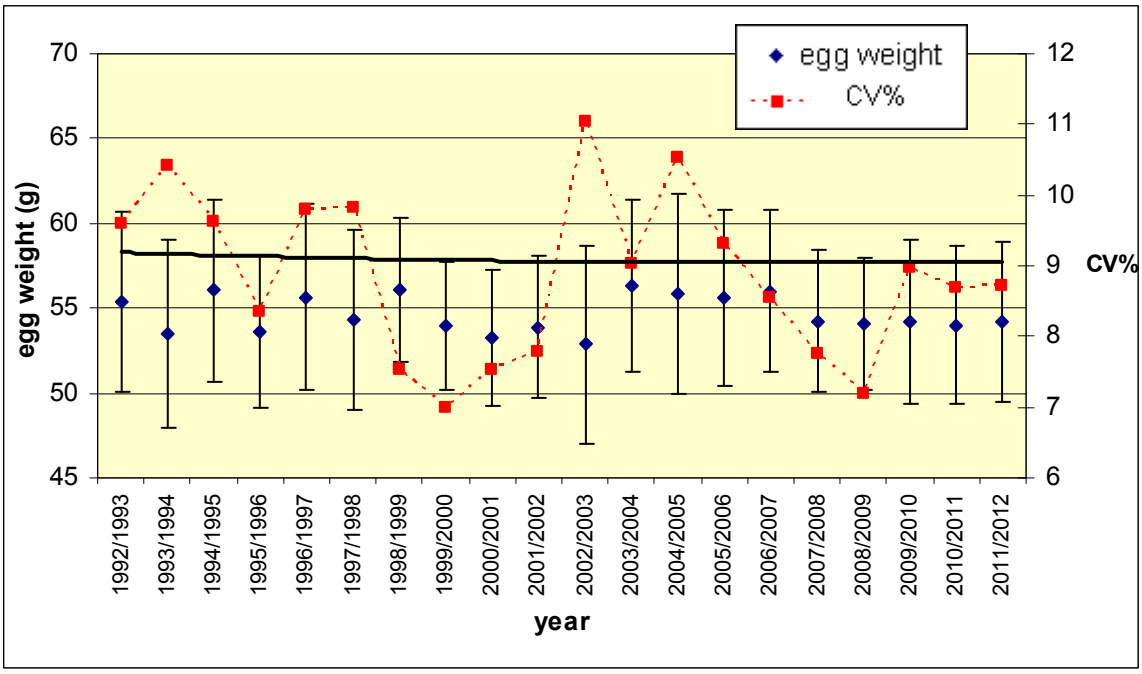


**Figure 13: The egg weights of one year old hens of 22nd line**

The changing of the egg weights of the 22nd line (Figure 13) was similar to the those of the 21st line. The initially fluctuating values ranged around 53 grams, then as a result of the crossings of the lines they were stabilized around 56 grams through four generation, owning to a failure in the view of the gene conservation. During the latter five years the weight of the eggs stabilized at around 54 grams. The initial values of standard deviation tended to decrease through ten generation. After applying the rotational mating system the values of the standard deviation increased. Following that after a decreasing tendency they stabilized at around 4.7 grams during the latter three years. The relative deviation had decreasing tendency from the beginnings, then after the crossing we can observe a medium variance, as the CV% raised over 10%. During the period after this, the variance decreased again in the 22nd line. The value of the relative deviation settled not much below 9%.

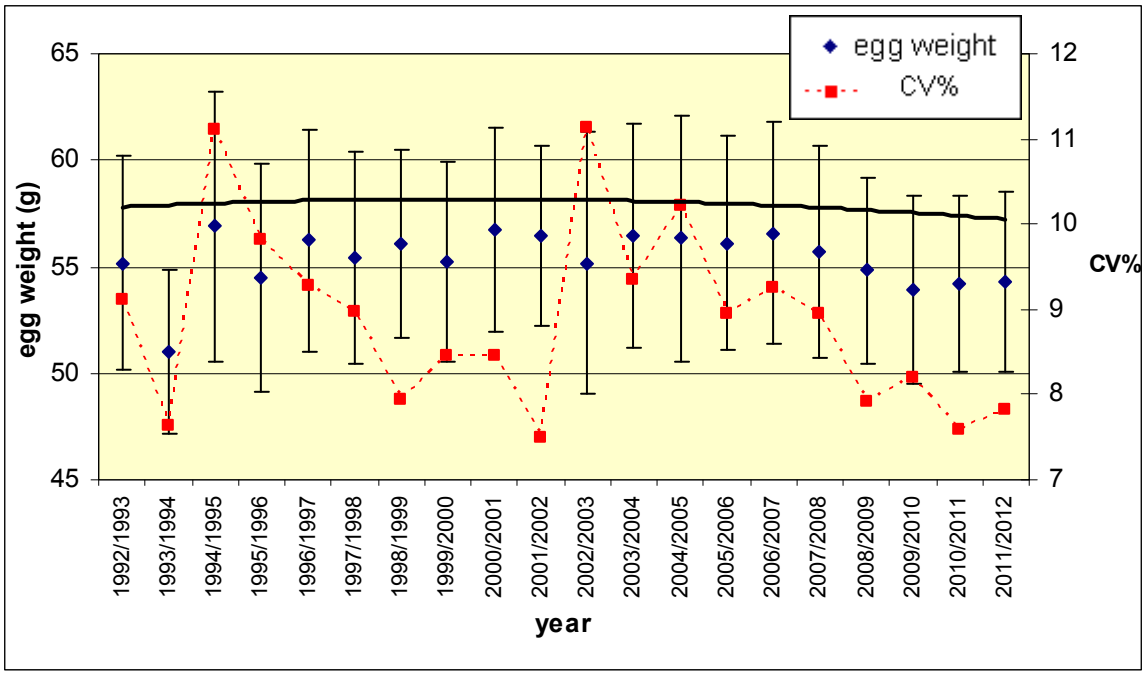


**Figure 14: The egg weights of one year old hens of 24th line**

The initial egg weight fluctuations of the 24th line (Figure 14) stabilized at around 56 grams from the fifth year of the investigational period. The tendency of the weight of the eggs is characterized by a decreasing trend from 2006, which turned to be increasing after the fourth generation. The decreasing tendency of the standard deviation was stopped by the crossing between the lines, namely the generation in 2000 had already higher standard deviation values than the generation one year earlier. After this period the changes of the standard deviation values are marked with reduction. The relative standard deviation of the egg weights in the 24th line has declining tendency in the first ten generation. As in the previous lines, the variance was increased to a moderate level by the crosses between the lines. After this period, the coefficient of the variation shows a downward tendency. The low values of the final years lag behind the initial values of the investigational period. Comparing to the initial values, the smaller weights of the eggs, and the changing of the relative and coefficient deviation shows the failure of the stabilizing selection in the 24th line.

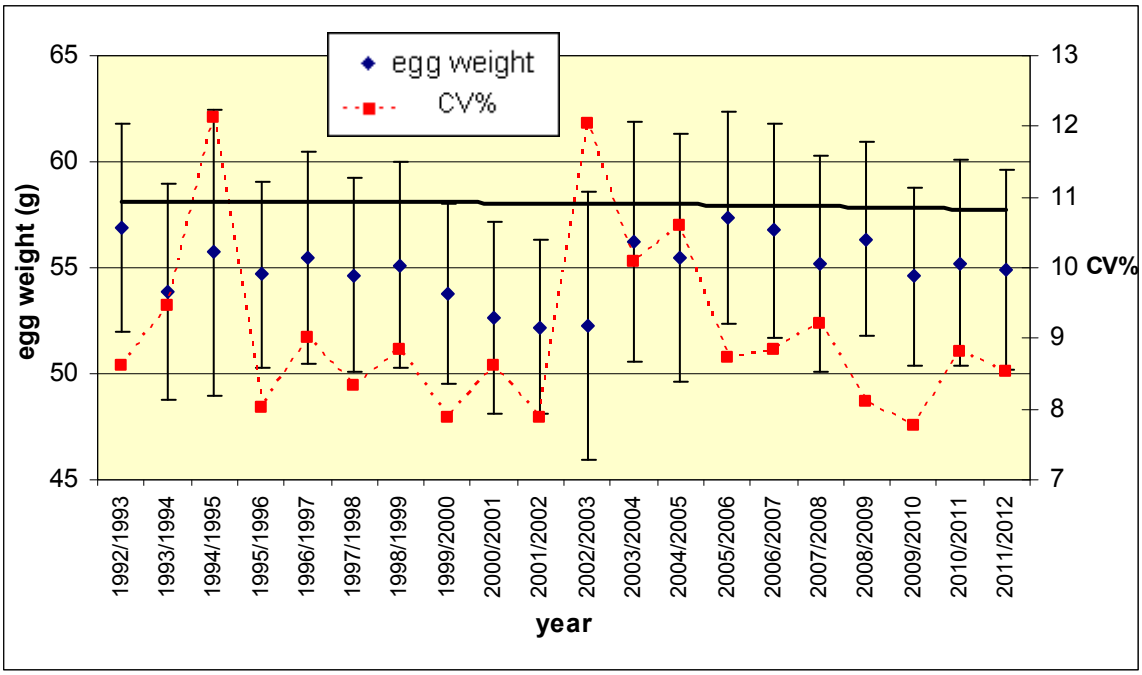


**Figure 15: The egg weights of one year old hens of 28th line**

The egg weights of the 28th line (Figure 15) show declining trend during the first ten years of the study. As a result of the crossing between the lines we could experience significant ($p<5\%$) weight gain, which difference still remains significant for six generations. During the last three years the values of the egg weights of the 28th line stabilized at around 55 grams, which is less than the initial values. The standard deviation values show a similar declining tendency until 2001 to those of the previous lines. Due to the changing of the above mentioned breeding process the standard deviation values increased from 2002. During this period the changing of the standard deviation values is characterized by a decreasing tendency, which stabilized at around 4.5 grams during the latter four years. The variance of the egg weights ranged between 8-9% from the fourth year of the study period, then by rising to above 12% in 2002 it caused average variability. After this period the coefficient deviation declined, which ranged between 8-9% during the latter two years.

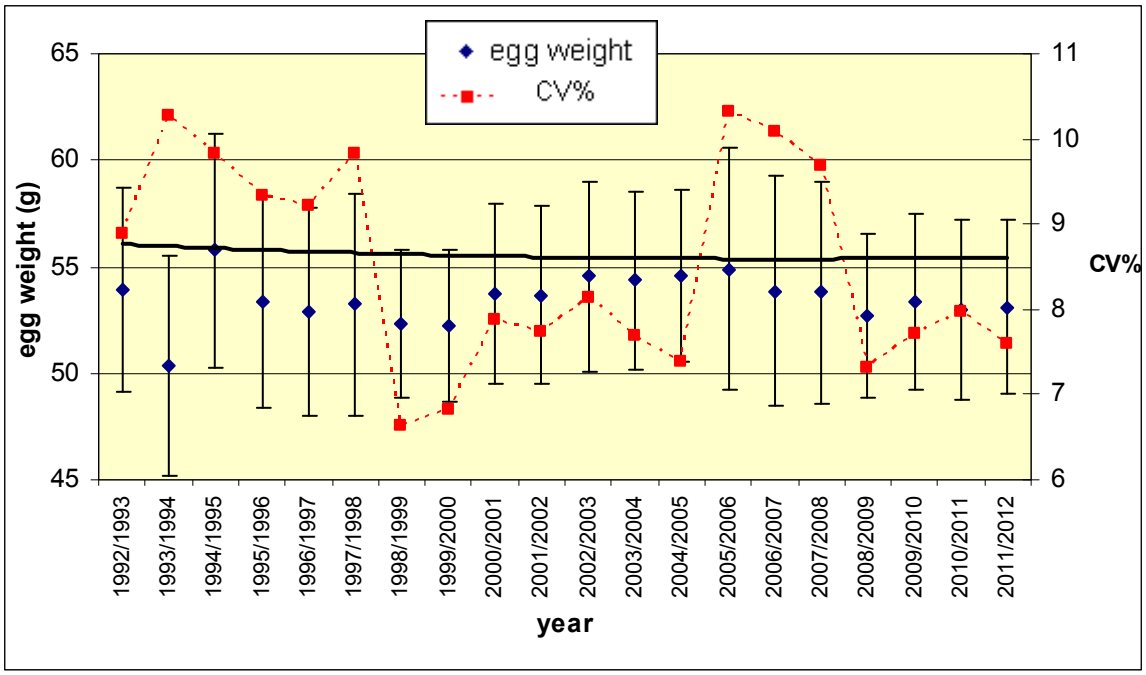


**Figure 16: The egg weights of one year old hens of 26th line**

The initial fluctuating egg weights of the 26th line (Figure 16) had been stablizing for three years after the third generation. The offsprings of the homozygous naked neck cocks, that were colonized in 1998, were producing lighter weight-eggs on average.

Then, until 2005 an increasing trend can be observed in regards to the change of the egg weights. Egg weight loss occurs in the second generation after the blood-freshing in 2004, which even remains through two generations. During the last three years, the egg weights of the 26th line stabilized at around 53 grams. The initial standard deviation values were reduced by the effect of selection in 1998. The blood-freshing in 2004 resulted a greater change in the standard deviation values. After 2005, the change of the standard deviation values shows decreasing tendency, which was stabilized over 4 grams during the latter three years.

The variance of the body weights of the naked-neck stock greatly decreased due to the cock selection in 1997 after the initial years. After an increasing tendency, a significant increase can be experienced as regards to the variance of the egg weights due to the blood-freshing. At that time the value over 10% of CV% referred to an average variance. During the following period, the variance decreased, and the value of relative standard deviation ranged between 7-8% in the latter four generation.

The stabilizing selection, applied for the Transylvanian speckled naked-neck hens, cannot be said successful, since both the egg weights and the standard deviation and coefficient of variation values lag behind the values measured at the beginning of the test.

**The examination of hatching results**

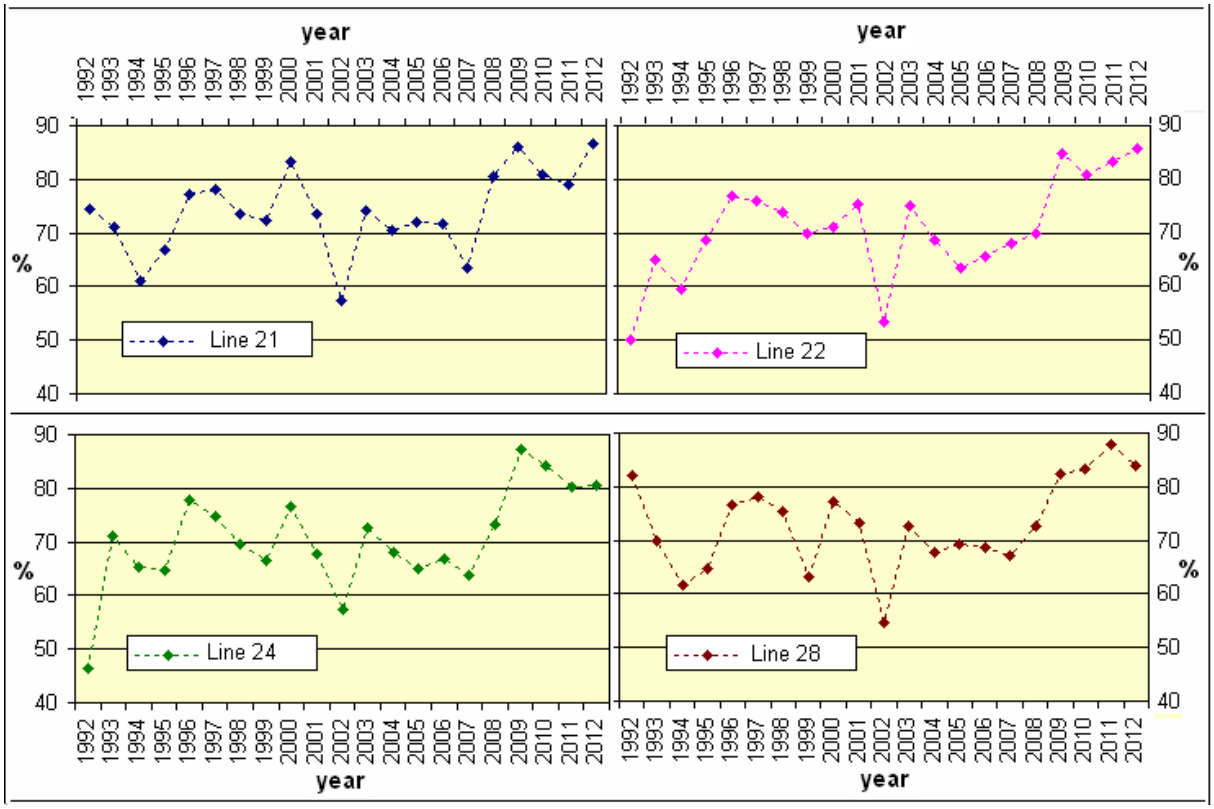


**Figure 17: The hatching results of speckled feathered-neck stock**

The data of the hatching in the feathered-neck stock (Figure 17) show results in the case of the four lines. The hatching percentage of our stock in the fourth year after the initial years increased to 70 %, then after eleven generation this value following a slow downward trend dropped below 70%. The crossing between the lines did not cause any change having regard to the hatching results of the feathered-neck stock after this period. Hatching results could have been expected to improve. The change of incubators in 2008 caused outstanding improvement in the hatching results. Over 80% hatching perctenges were produced by the feathered-neck stock during the last four years.

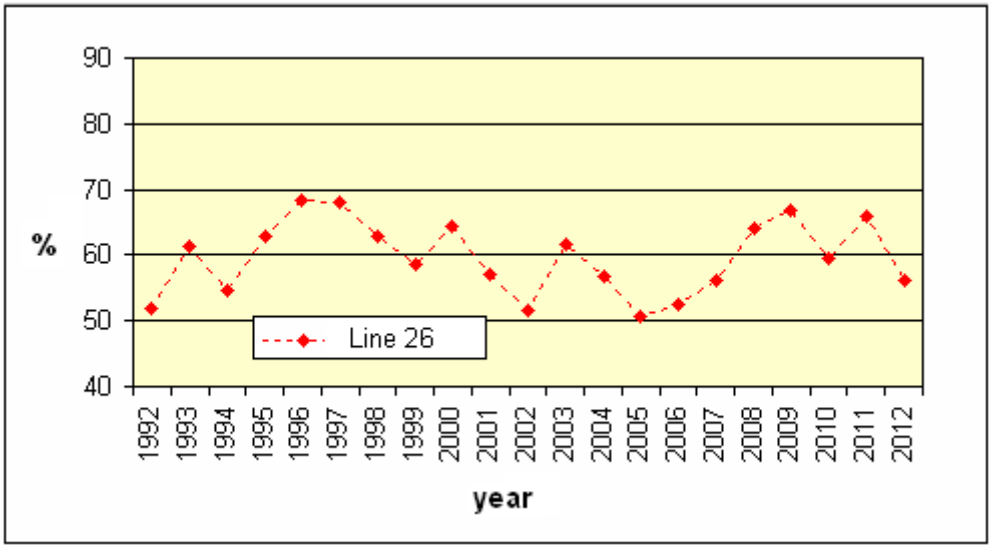


**Figure 18: The hatching results of speckled naked-neck stock**

During the last twenty years, the naked-neck stock (Figure 18) produced lower hatching results than the feathered one supposedly because of a high degree of inbreeding. During the first five years of the study period, the hatching percentage showed an improving tendency, but in the year of 2005, the naked-neck stock produced only around 50% hatching results. From the second year after the blood-freshing through four generation we can experience a growing trend having regard to the hatching results. During the latter three years decrease can be seen in the hatching results of the naked-neck stock.

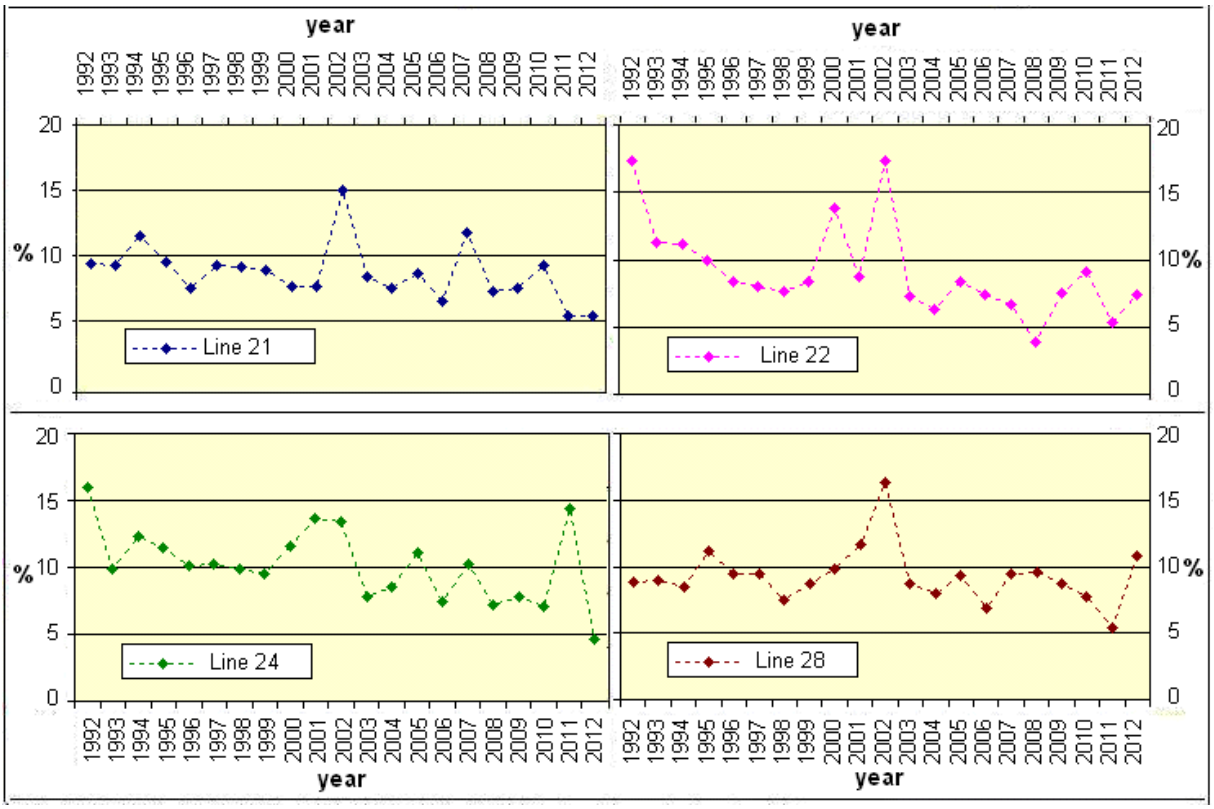


**Figure 19: The infertile egg ratio of feathered-neck stock**

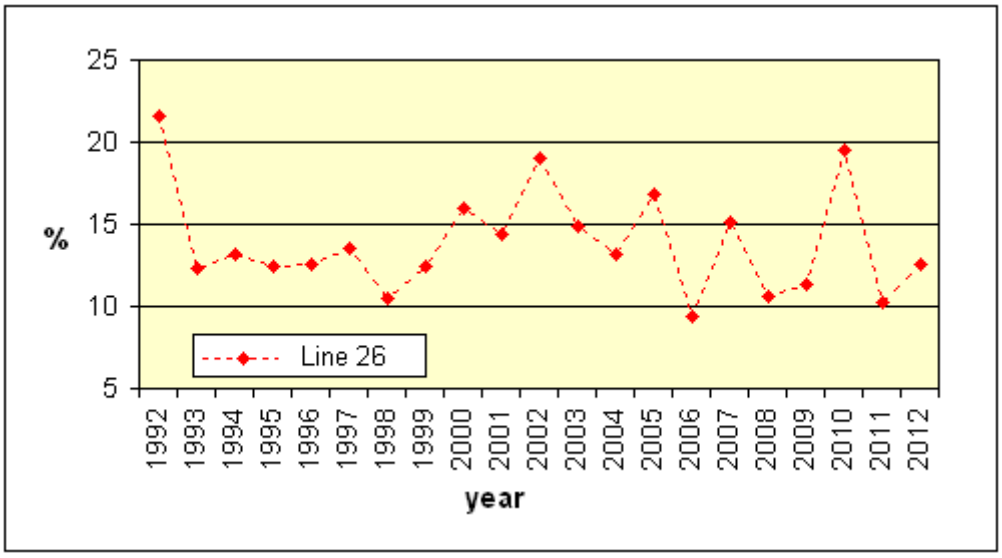


**Figure 20: The infertile egg ratio of naked-neck stock**

By examining the hatching results of twenty generations, we can see (Figure 19) that the infertile egg ratio of around 10% initial values decreased to under 10% of values. The annual rate of the infertile eggs in 2002 is so high due to the failures of the hatching technology. During that year a lot of eggs became addled at the first candling because of the malfunction

of the hatchery, which increased the precentage of the infertile eggs. The „improvement" of the infertile egg rate may be the result of the crossing between the lines.

By examining the proportion of infertile eggs, it can be seen that the 26th line (Figure 20) can be characterized by greater degree of infertility, than the others (only one generation is an exeptional from the tested 20 generation). The infertility among the naked-neck stock, compared to the stable results of the mid90s (12%), significantly decreased by the early 2000s (15%). During the period following this, the infertility of the Transylvanian naked-neck hens shows a rather fluctuating status. Not taking into consideration the initial year, between 2006 and 2007 was the difference the maximum (some 10.1%) measuring it by the percentage of the infertile eggs. After the year when the blood-freshing was applied to the naked-neck lines in 2004, the proportion of the infertile eggs declined by 3.63%. Since it can be seen by examining the results of the other lines in this particular year that the proportion of infertile eggs declined, it is presumable that the lower hatching proportion can be the result of some kinds of technological problems.

By examining the hatching outcomes of twenty years, we can conclude that the race preserving breeding can be considered successful in the feather-neck stock, since the major changes occured in the hatching results can be attributed to technological malfunctions and changes. The major fluctuations, experienced in the hatching results of the naked-neck stock, are supposedly due to hatching technological faults, changes, and of course because of a greater degree of inbreeding.

**Investigation of mortality data during the rearing period**

During the study period data of 20 hen generations were investigated (Figure 21 and 22). The mortality was similar in all studied Speckled Hungarian Hen stocks. The mortality ratio was around 7-8 %, which is acceptable.

The mortality was measured in Speckled Transylvanian Naked Neck Hen stocks from 2006. The percentage of the mortality was higher than in Speckled Hungarian Hen stocks, which can be the sign of higher rate of inbreeding in this variant.

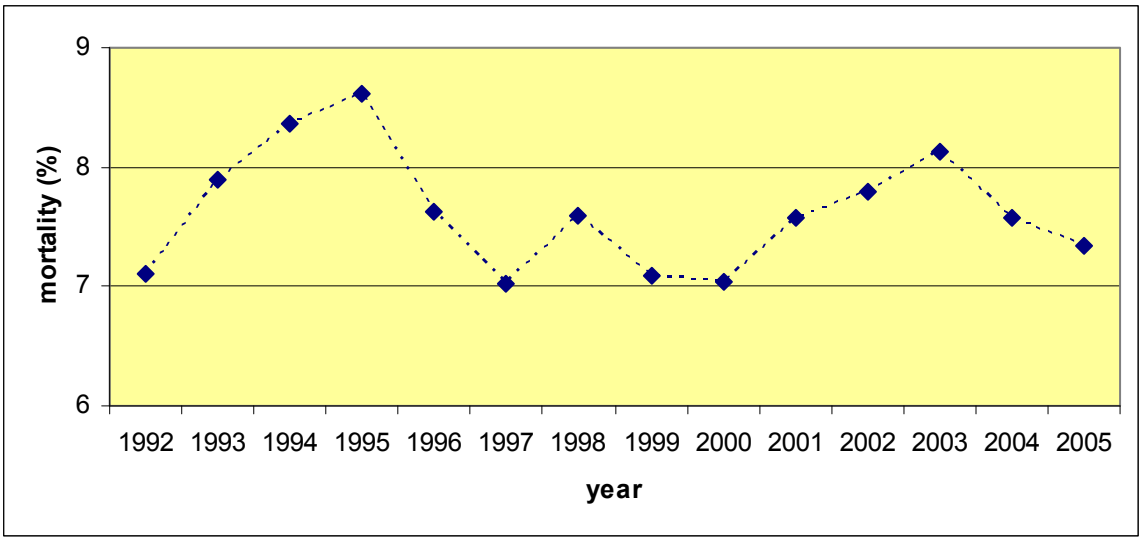


**Figure 21: The mortality rate during the rearing period in speckled stock**

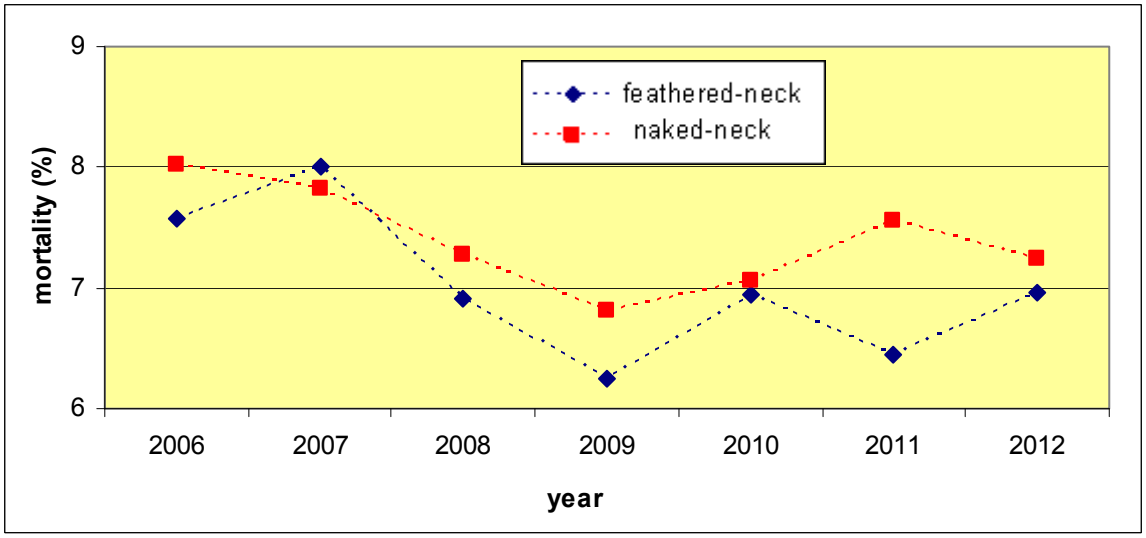


**Figure 22: The mortality rate of speckled species during the rearing period**

**Correlations between the main physical characteristics of hen stocks**

Contrary to the general observations, we found a weak negative correlation between the body weight and egg weight, the increase in body weight cause reduction in egg weight in both hen variants. From the studied five lines the line 26 has the highest correlation coefficient (r= -0,39).

We found positive correlation between egg production and egg weight in both studied hen variants. We found weak correlation in three feathered-neck variant stocks, lines 21, 22 and

28 (r=0,17; r=0,25; r=0,31). One feathered-neck variant stock (line 24) and one naked neck variant stock (line 26) show modest correlation (r=0,61 and r=0,53).

In all five hen stocks we found that the body weight affects negatively the egg weight. The line 22 shows modest correlation (r=-0,52), the other four stocks shows weak correlation (line 21: r=-0,29; line 24: r=-0,15; line 28: r=-0,25; line 26: r=-0,38).

**The efficiency of our breeding programme**

Our gene preserving programme proved to be suitable to preserve the feathered-neck variant because after 20 generations colonisation weight, egg production and date of sexual maturation did not differ significantly from the initial measurements. The hutching result is now higher than it was in beginning of the study period, probably due the improved breeding technology. Unfortunately, despite of direct stabilizing selection this gene preservation programme failed to preserve the same the egg weight as it was 20 generations before.

To sum up the results of our 20-year-old gene preservation work, we can declare that the gene preservation of Speckled Hungarian Hen and Speckled Transylvanian Naked Neck Hen was successful in Hódmezővásárhely. We were able to preserve the physical characteristics of these variants during the last 20 years.

## V. THE NEW SCIENTIFIC RESULTS OF THE PAPER

Based on the examinations during my research I concluded:

- The rotation breeding process between lines applied in the feathered neck stock at present is suitable for maintaining the variability of live weight on a medium level.
- There was a significant decrease in the average body weight in the naked neck stock in comparison with that of the one 20 years before. Considering this, the breed maintenance breeding in case of the naked neck stock needs to be adjusted
- With the species preservation selection applied in the stock of the Speckled Hungarian Hen it was possible to preserve the body weight value at colonization and egg production capacity to a level near to the one recorded twenty years ago. In the perspective of these two quality parameters we can declare our program to be successful.
- Over the last 20 generations the egg weights of the feathered-neck and naked-neck stocks have become more balanced, as shown by the values of the standard deviation and coefficient of variation
- The unchanged preservation of the Speckled Hungarian Hen whith suitable variance can be accepted in case of colonization body weight with 9-10% relative standard deviation values while in case of egg weights the relative standard deviation values are about 8-9%.
- The preservation of the Speckled Transylvanian Naked Neck Hen in unchanged form in case of colonization body weights at and egg weights can be accepted with 8-9% relative standard deviation values.

## VI. THE APPLICATION OF THE RESULTS IN PRACTICE:

Nowadays the hybrids play an important role in the animal product preparation. Our farm animals reached the peak of their production capacity, for this reason no growth in he production yield can be expected. As a result, today's breeders focus on the quality characteristics. The new usage of old species can be timely on his basis, as our almost forgotten breeds have such valuable characteristics that can be used in modern animal husbandry. Thus the role of the gene preservation plants is very important as they provide a basis to the new utilization of these old breeds.

The aim of the gene preservation activity is to keep our old species in a way that their plummets should not change during the years, but the variance within the breeds should remain.

The analysis in my thesis point out the correctness and faults of the breeds preservation program of the speckled hen elite stock in Hódmezővásárhely. At the examination of the different quality parameters it turned out how the breeding methods we have been using in the last twenty years influenced the production of our speckled hen stock, how certain average values, deviances and variances of plummets changed. On the basis of these we can change our work in the future in a way that by observing the principles of gene preservation we work out better and better breeding programs for the unaltered preservation of the breeds.

## VII. PUBLICATIONS IN THE THEME OF THE DISSERTATION:

**Reviewed scientific publications:**

- BENK Á. – VIDÁCS L. – SZALAY I. – SZENTES K. (2008): The evaluation of egg production of Hungarian Speckled Hen. A magyar kendermagos tyúk tojástermelésének értékelése. Agrár- és Vidékfejlesztési Szemle, Vol. 3 (1),, Hódmezővásárhely, 15 p. + CD supplement, ISSN 1788-5345
- BENK Á. – VIDÁCS L. – SZALAY I. – SZENTES K. (2008): The slaughter value of Hungarian Speckled Hen. A magyar kendermagos tyúk vágóértéke. Agrár- és Vidékfejlesztési Szemle, Vol. 3 (1), Hódmezővásárhely, 16 p. + CD supplement, ISSN 1788-5345
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- BENK Á. – VIDÁCS L. (2010): A magyar kendermagos tyúk és a kendermagos erdélyi kopasznyakú tyúk küllemi tulajdonságainak vizsgálata a hódmezővásárhelyi tenyészetben. Agrár- és Vidékfejlesztési Szemle, Vol. 4 (1), Hódmezővásárhely, 112-117 p. + CD supplement, ISSN 1788-5345
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- BENK Á. – VIDÁCS L. (2011): The genetic preservation of Hungarian Speckled Hen and and the Speckled Transylvanian Naked Neck Hen in Hódmezővásárhely, Agrár- és Vidékfejlesztési Szemle, Scientific Journal of University of Szeged, Faculty of Agriculture, Vol. 6. (1), Hódmezővásárhely, 112-117 p. CD supplement, ISSN 1788-5345
- BENK Á. (2011): The breeding system of Speckled Hungarian Chicken and Speckled Transylvanian Naked Neck Chicken in Hódmezővásárhely. Lucrari Stiintifice, Management Agricol, Scientific Papers: agricultural management, Seria I. Vol. XIII, Timisoara, 127-134 p. ISSN 1453-1410, E-ISSN: 2069-2307

- BENK Á. (2011): The genetic reservation of Hungarian Speckled Hen and and the Speckled Transilvanian Naked Neck Hen in Hódmezővásárhely. Scientific papers: Animal Science and Biotechnologies, Vol. 44 (1), Publisher: Agroprint, Timisoara,166-171 p. ISSN 1221-5287, E-ISSN 1841-9364
- GRÁFF M. – BENK Á. (2012): Live weight change examinations of indigenous speckled hens on a farm in Hódmezővásárhely. Review on Agriculture and Rural Development, Vol. 1. (2), Hódmezővásárhely, 541-547 p. ISSN 2063-4803.
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