GENETIC IMPROVEMENT IN MILK YIELD
IN EGYPTIAN BUFFALOES

By

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ABSTRACT

Records of 538 & 290 buffalo cows and 54 & 50 buffalo bulls kept at Sakha and Sids Experimental Stations respectively over a period of twenty years were the source of this data. In these two herds of buffaloes, the genetic gain in 305 day milk yield due to selection was estimated.

Results obtained can be summerized as follows :

1. There was continuous selection for 305 day milk yield up to the sixth lactation in the case of both herds.

2. Genetic improvement in 305 day milk yield calculated by the culling differential obtained through selection of dams of heifers was 199 and 255 pounds at Sakha per generation, while it was 335 and 17 pounds at Sids.

3. Genetic improvement tnrough selection of bulls were 990 and 75 pounds in both herds, respectively.

4. Annual genetic gain in 305 day milk yield at Sakha calculated by the culling differential or by the superiority of dams of heifers gave similar results i.e. 40.97 and 42.87 lbs. respectively. This result is higher than in the case of the Sids herd i e. 3.5 and 15.5 lbs.

5. The genetic improvement per year for the Sakha herd was equal to 1.8% of the average of the first 305 day milk yield (2362 lbs.) while at Sids it ranged from 0.11 to 0.47% of the herd's average (3298 lbs.).

INTRODUCTION

An important aspect of a breeding program is the amount of genetic gain achieved. It is known that the milk yield varies somewhat from year to year due to changes in management, feeding and climatic conditions. The rigidity of culling among the individuals also affects the average milk yield.

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The rate of genetic improvement in a particular trait is a function of three factors, i.e. selection intensity or reach (i), heritability (h^2) and the interval between generations (t). The effect of selection per unit of time can be expressed as :

$$\Delta \; gt \;=\; \frac{i \;\times\; h^2}{t}$$

This study was carried out to estimate the genetic gain in 305 days milk yield due to selection in two herds of buffaloes located at Sakha and Sids experiment stations. The progress per unit of time is usually more important in practice than the progress per generation and therefore the interval between generations is an important factor in reckoning the response to selection.

MATERIAL AND METHOD

Records of 538 & 290 buffalo cows and 54 & 50 buffalo bulls kept at Sakha and Sids Experiment Stations over a period of twenty years were the source of our measurement to the generation interval in buffaloes. The total generation length is the sum of time intervals along the four paths by which genes are passed from one generation to the next. The mean generation interval is the sum of these paths divided by four.

The probable annual genetic improvement in the 305 day milk yield was calculated using data drawn from the records of the first six lactations for the two herds of buffaloes studied.

The method applied by Dickerson and Hazel (1944) in estimating the genetic gain was used in this study. The formula was as follows :

$$\text{Annual genetic gain} = \frac{\text{Genetic superiority of dams} + \text{Genetic superiority of sires}}{\text{Average of dams when progeny was born} + \text{Average of sires when progeny was born}}$$

The genetic superiority of dams was estimated by multiplying the improvement in 305 day milk yield reached through selection from lactation to lactation by the heritability of that trait. The improvement in 305 day milk yield in life time was calculated by estimating the improvement in 305 day milk yield in each lactation by culling and adding this for the six lactations in consideration.

The improvement in 305 day milk yield in a lactation was calculated by finding the difference in milk yield from all the buffaloes that completed the lactation and those which were selected for subsequent lactation and multiplying this difference by the percentage of buffaloes selected for the subsequent lactation.

For instance in this study at Sids, the percentage of buffaloes retained from the first to the second lactation was 76%. This gave an improvement in the first lactation of 82.8 lbs. Such estimate obtained from subsequent lactations were added to give advantage in milk yield in the life time referred to as the phenotypic superiority (1240.06 lbs.). The sum of the phenotypic superiority was multiplied by the heritability estimate of 305 day milk yield (0.27) to give the genetic superiority of dams which was 335 lbs.

At Sakha the phenotypic superiority came to 738.70 lbs, multiplied by the heritability of 305 day milk yield to give the genetic superiority of dams which was 199 lbs. The estimates of selection pressure from lactation to lactation are given in Tables 1 and 2.

TABLE 1.—Selection of Buffaloes for Milk Yield " SIDS "

Lactation	No. of buffaloes			Milk Yield		
	Before culling	After culling	% surv.	Before culling	After culling	M.Y. Imp,
1st lact.	220	168	76	3298	3407	109
2nd ,, ...	168	119	71	4305	4432	127
3rd ,, ...	119	78	66	4480	4951	471
4th ,, ...	78	49	63	4775	5186	411
5th ,, ...	49	34	69	4854	5028	174
6th ,, ...	34	28	82	4747	5207	460

TABLE 2.—Selection of Buffaloes for Milk Yield " SAKHA "

Lactation	No. of buffaloes			Milk Yield		
	Before culling	After culling	% surv.	Before culling	After culling	M.Y. Imp,
1st lact.	368	246	67	2362	2384	22
2nd ,, ...	246	144	59	3426	3738	312
3rd ,, ...	144	86	60	3847	4160	313
4th ,, ...	86	57	66	4269	4375	106
5th ,, ...	57	41	72	4362	4496	134
6th ,, ...	41	32	78	4389	4627	238

Effect of Culling on 305 day Milk Yield

The selection of the dams of future heifers is the result of continuous culling that is practised in the herd. As a result of culling, the buffaloes surviving in the herd for another lactations usually have a higher average milk yield than the population from which they were saved. This difference, is referred to as the culling differential which is the phenotypic superiority of animals kept in the herd over their contemporaries during a given lactation. The results given in Tables, 1, 2 for both Sids and Sakha indicated that there was a continuous

selection for milk yield up to the sixth lactation in both herds. However, the selection pressure reached its maximum in the third lactation. Culling percentage decreased with advance in lactation till the fourth and third lactations at Sids and Sakha respectively, after which the proportion of animals culled increased with age. It is expected, however, that the proportion of animals culled increased with age because of the increase in infertility and disease in senility.

Genetic Improvement through Selection of Dams of Heifers

Results in Table 3 indicate that the genetic improvement obtained from selection of dams of heifers at Sids is lower than that from buffaloes at Sakha. However, when the genetic superiority was estimated in terms of herd's average for both herds it was found to be 10.8% and 0.51% respectively. This difference may be due to the fact that the average 305 day milk yield at Sids is higher than that at Sakha, the former being 3298 lbs. as compared to 2362 lbs. for the latter. It may be due also to the fact that selection at Sakha is more intensive than at the other station.

TABLE 3.—Genetic Improvement through Selection of Dams of Heifers

Herd	No. of dams	No. of heifers	Genetic superiority of dams (lbs.)	Herd aver. lbs.	Superiority as % of herd aver.
Sids	122	229	17	3298	0.5%
Sakha . . .	129	246	255	2362	10.8%

Results obtained from analysing records from the Sakha herd showed that selection of dams of heifers was responsible for a genetic increase of 255 lbs. per generation which is twice that obtained by Asker et al (1955) who reported 133 lbs. per generation in the herd of buffalo studied. Alim (1953) analysing the records of a herd of buffaloes near Alexandria estimated the genetic gain to be 13 lbs. of milk per generation through selection of dams of heifers which agree with that obtained from Sids herd.

Genetic Improvement through Selection of Dams of Bulls

Unfortunately, information available on dams of bulls was limited, only 17 sires at Sakha having 500 daughters, and 30 sires at Sids having 278 daughters have been used for this purpose. The genetic superiority of sires was estimated by multiplying the phenotypic superiority of the average production of dam's sire over the average production of the herd in the first lactation by the heritability of milk yield. The genetic superiority of dams of bulls was 990 lbs. at Sakha and 75 lbs. at Sids.

Comparing the genetic improvement obtained through selection of dams of bulls with that obtained through selection of dams of heifers showed that the latter was higher than the former. This is expected since the number of bulls used is smaller than that of the heifers, especially in the Sakha herd. Also, the number of heifers per sires in both herds showed a sire preference, which in turn lead to a bias. It was found that one bull from an outstanding dam had 209 daughters at Sakha, another with 81 daughters was at the Sids herd.

Our findings, however, are in close agreement with those reported by other investigators on dairy cattle. Asker *et al* (1955) in this country and Alim (1962) analysing data of Butana cattle in Sudan, found that the genetic improvement through selection of dams of bulls was higher than the improvement obtained through dams of heifers.

Estimated Annual Genetic Gain in 305 day Milk Yield

In the present study the total generation interval for buffaloes was found to be 26.4 and 29.0 years respectively for the two herds at Sakha and Sids. The genetic superiority of dams and sires were added in Dickerson and Hazel (1944) formula to give total estimated annual gain in 305 day milk yield per year. The annual genetic gain in milk yield per year for the herd at Sids calculated by the culling differential is 3.49 lbs. and 15.54 lbs. by using the superiority of dams of heifers. In terms of the herd's average of first lactation (3298 lbs) the genetic improvement range from 0.11% to 0.47%.

In the case of Sakha the annual genetic gain in 305 day milk yield calculated by the culling differential or by the superiority of dams of heifers gave almost the same results namely 40.97 and 42.87 lbs. respectively. The genetic improvement per year for the Sakha herd was 1.8% of the average of the first 305 lactation yield. In conclusion, the annual genetic gain per year as percentage of the average first milk yield at Sakha was 1.8%, higher than the 0.47% obtained at Sids.

It might be interesting to note that this estimate is similar to the estimates reported by Robertson (1950) in Nigeria for Fulani cattle (1.7%) while it is higher than the results obtained by Mahadevan (1951) for Sinhala cattle (0.64%) and Asker *et al* (1955) for Egyptian cattle (0.8%).

Concerning the herd of buffaloes at Sids the genetic improvement per year range from 0.11 to 0.47% of the herd's average. Estimates for cattle reported by Rendel and Robertson (1950), Stonaker (1953), Mahadevan and Marples (1961) compare favourable well with our findings. Results obtained by Alim (1953) in this country on the genetic improvement per year in a herd of buffaloes, was 1.5 lbs. of milk which was 0.04% of the herd's average. This is very low compared to our estimates for buffaloes in both herds. It should be noted that records collected on the commercial herd used in the previous work did not include the milk produced during the first thirty days of the lactation. It can be concluded that our estimates of the annual genetic improvement of the average herd is around the maximum of 1.0% that one might expect.

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التحسين الوراثى لانتاج اللبن فى الجاموس

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الملخص

حللت السجلات الخاصة بقطيع الجاموس الموجـود فى كل مـن محطتى التربية بسخا وسدس لدراسة التحسين الوراثى لانتاج اللبن فى ٣٠٥ يوم ٠ وقد استخدم فى هذه الدراسة السجلات التى تجمعت فى خلال العشرين سنة الاخيرة وكانت لـ ٥٣٨ و ٢٩٠ جاموسة انثى و ٥٤ ، ٥٠ فحل جاموس فىمحطة سخا وسدس ــ وقد ادى هذا التحليل الى النتائج الآتية الى :

١ ــ لوحظ تحسين مستمر فى اتاج ٣٠٥ يوم الى الموسم السـادس فى كلا القطيعين ٠

٢ ــ عند حساب التحسين الوراثى لانتاج ٣٠٥ يوم عن طريق الفارق الانتخابى أو امهات البنات فى فترة الجيل وجد أنه ١٩٩ و ٢٢٥ رطلا فى سخا بينما كان فى سدس ٣٣٥ و ١٧ رطلا ٠

٣ ــ بلغ التحسين الوراثى الناتج من انتخاب امهات الطلائق ٩٩٠ رطلا فى سخا و ٧٥ رطلا فى سدس ٠

٤ ــ عند حساب التحسين الوراثى السنوى لاتاج ٣٠٥ يوم فى سخا عن طريق الفارق الانتخابى أو تفوق البنات على الامهات اعطى نفس النتيجة (٤ر٠٩٧ و ٨٧ر٤٢ رطلا على الترتيب) وتعتبر هذه النتيجة أعلى من مثيلاتها فى سدس حيث بلغت ٣ر٥ و ١٥ر٥ رطل على التوالى ٠

٥ ــ بلغ التحسين الوراثى السنوى منسوبا الى متوسـط الاتـاج فى ٣٠٥ يوم لأول موسم ١٨ ٪ فى سخا بينمـا كان يتراوح ما بين ١١ر الى ٤٧ر ٪ من متوسط القطيع فى سدس ٠