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# PRODUCTION DIFFERENCES BETWEEN REGISTERED COWS AND THEIR NONREGISTERED HERD-MATES

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## ABSTRACT

Within-herd contemporary comparisons of the first-lactation production of registered and nonregistered cows in herds enrolled in the New York Dairy Herd Improvement Associations suggest only small genetic differences between registered and nonregistered cows. In general, the registered Holsteins exceeded in production their nonregistered herd-mates, whereas the nonregistered cows had a slight advantage over their registered herd-mates for the Ayrshire, Guernsey, and Jersey breeds.

Artificially sired cows had consistently higher production than their naturally sired herd-mates for all breeds. A definite increase in this advantage was noted for Holsteins in more recent years. No trend was apparent in the comparison of artificially sired registered and nonregistered cows for any of the breeds.

The problem of comparing the production of registered and nonregistered cows has not received much attention. Qureshi (1) has reported that the genetic progress of progeny of grade sires was more rapid than the progress of progeny of registered sires for Holstein and Jersey data in Texas. The registered groups, however, had over-all higher genetic merit and average production than the grade groups.

This study was to ascertain the current status of improvement for production of milk and fat of nonregistered cows. Comparisons were made between the first-lactation performance of registered and nonregistered cows within the same herd and year-season of freshening. The influence of artificial insemination (A.I.) was estimated by making further comparisons for these groups of cows: natural service (NS) registered vs. NS nonregistered, A.I. registered vs. A.I. nonregistered, all A.I. vs. all NS, and NS registered vs. A.I. registered. These comparisons were made for five breeds (Ayrshire, Guernsey, Holstein, Jersey, and Brown Swiss) in herds on the New York DHIA program.

## METHODS AND DATA

The contemporary comparison procedure described by Robertson and Rendel (2) in Great Britain and later by Tucker et al. (3) in the United States was used to estimate the genetic difference between any two classes of cows. The comparisons were within herd and year of freshening. Only one season of freshening was considered per year (August through March). Records of cows freshening in other months were ignored. A comparison of registered vs. nonregistered cows for a particular herd-year

was of the form  $(nm) (n + m)^{-1} (x - y)$  where  $x$  was the average of registered cows,  $y$  the average of nonregistered cows,  $n$  the number of registered cows, and  $m$  the number of nonregistered cows. For each year, comparisons were made for all herds having at least one animal in each of the pair of classes being compared. These comparisons were summed over all herds in that year and divided by the sum of the weights over all herds. All cows in the comparisons were less than 35 months of age at first freshening. First-lactation records (305-day,  $2\times$ , mature equivalent) were chosen to minimize effects of selection. All records were from the files of the New York Dairy Records Processing Laboratory.

To be classified as registered, the cow and both her dam and sire had to be coded as registered. This procedure was to reduce errors due to miscoding in the DHIA files. Those classified as nonregistered were coded as nonregistered, but both parents had to be classified as the same breed as the cow. Many cows were excluded because either sire or dam information was missing; this was to eliminate any bias due to including crossbred cows in the non-registered groups.

## RESULTS

The comparisons shown in Table 1 for the Ayrshire, Guernsey, Jersey, and Brown Swiss breeds are for four periods of about 3 yr each. Each value for a time period is a weighted average of the yearly averages. The sums of the yearly sums of weights included in each comparison for each period are given in Table 3 for the non-Holstein breeds. The numbers of herd-year comparisons included in each difference are also given in Table 3.

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TABLE 1  
Contemporary comparisons of registered, nonregistered, A.I., and NS by four time periods for Ayrshire, Guernsey, Jersey, and Brown Swiss

Time period (August-March)	All reg. vs. all nonreg.			NS reg. vs. NS nonreg.			A.I. reg. vs. A.I. nonreg.			All A.I. vs. all NS			A.I. reg. vs. NS reg.			
	Age	Milk	Fat	Age	Milk	Fat	Age	Milk	Fat	Age	Milk	Fat	Age	Milk	Fat	
	(months)	(lb)	(lb)	(months)	(lb)	(lb)	(months)	(lb)	(lb)	(months)	(lb)	(lb)	(months)	(lb)	(lb)	
Ayrshire																
1950-1954	.9	44	.1	.6	-65	-5.1	1.4	776	36.2	-1	-138	-4.9	-.2	-154	-5.8	
1954-1957	.5	6	-7.9	.5	-37	-28.2	1.4	146	2.2	-.7	49	2.6	-.9	50	2.5	
1957-1960	.7	-538	-25.5	1.0	436	16.8	.4	-1,155	-47.5	-.7	109	9.0	-.7	49	6.8	
1960-1963	.9	-24	-4.4	.9	202	2.3	1.1	-220	-12.8	-1	673	30.8	.0	666	30.8	
Average	.8	-79	-6.8	.7	12	-3.9	1.1	-109	-6.1	-.4	258	13.0	-.4	245	12.5	
Guernsey																
1950-1954	.3	-26	4.1	.3	-55	2.8	-1	114	13.2	-.2	397	19.5	-.2	365	21.2	
1954-1957	-.2	-84	-1.8	.0	-151	-3.0	.0	-3	.5	.0	204	8.6	.0	173	6.5	
1957-1960	-.1	-157	-6.0	.1	-24	-2.6	-.5	-179	-4.8	.2	200	10.1	.2	223	11.3	
1960-1963	-.2	-92	-3.2	-.2	-382	-11.3	-1	-72	-4.6	-.2	232	17.1	-.3	251	18.3	
Average	-.0	-85	-1.3	.1	-115	-1.5	-.2	-59	-0.9	-.0	239	13.4	-.1	239	14.0	
Jersey																
1950-1954	.0	-306	-10.2	.0	-292	-8.5	.3	-386	-15.2	-.2	291	15.4	.2	407	-17.2	
1954-1957	.2	-209	-3.4	.3	-260	-3.0	.0	-156	-7.6	-.1	-50	-.4	-.3	-54	-1.3	
1957-1960	.6	-86	-.2	.6	-33	-2.3	.6	-149	2.8	-.3	123	4.1	-.6	183	5.0	
1960-1963	.2	15	8.3	.1	-68	.4	-1	83	13.3	-.2	166	10.4	-.2	144	6.9	
Average	.2	-156	-1.7	.2	-198	-4.1	.1	-90	1.6	-.2	132	7.4	-.3	157	1.0	
Brown Swiss																
1950-1954	.2	-22	-10.9	.2	-271	26.3	-2.0	-2,165	-19.5	-.6	-504	-4.6	-.6	-760	-12.7	
1954-1957	-.3	-1,112	-36.1	-.1	-2,093	-64.2	-1.3	1,194	41.1	-.4	561	30.7	-.5	755	36.0	
1957-1960	.1	-136	2.2	.5	485	28.9	1.8	-1,462	-37.5	.4	123	4.7	.4	37	1.6	
1960-1963	-.4	1,322	47.1	3.1	-714	-27.2	-1.6	1,846	69.7	.0	235	12.7	-.1	238	13.6	
Average	-.1	80	2.3	.3	-712	-27.8	-1.0	1,086	45.5	-.1	205	13.0	-.1	196	12.6	

TABLE 2  
Contemporary comparisons of registered, nonregistered, A.I., and NS annually for Holsteins

Time period (August- March)	All reg. vs. all nonreg.			NS reg. vs. NS nonreg.			A.I. reg. vs. A.I. nonreg.			All A.I. vs. all NS			A.I. reg. vs. NS reg.		
	Age (months)	Milk (lb)	Fat	Age (months)	Milk (lb)	Fat	Age (months)	Milk (lb)	Fat	Age (months)	Milk (lb)	Fat	Age (months)	Milk (lb)	Fat
1950-1951	.4	-67	-4.9	.4	-9	-2.1	1.3	-755	-38.9	-.4	329	13.2	-.4	105	7.8
1951-1952	.6	-61	-4.6	.4	-116	-4.6	.6	705	21.1	-.3	102	5.3	-.3	164	6.0
1952-1953	.4	-8	-.9	.3	4	-.6	.4	16	-2.7	-.3	181	8.8	-.3	153	8.0
1953-1954	.2	212	6.2	.4	262	8.0	-.2	291	9.2	-.1	9	3.5	-.1	-60	.0
1954-1955	.3	89	1.7	.1	181	2.8	.2	54	2.6	-.3	307	12.2	-.3	374	14.7
1955-1956	.2	142	2.3	.3	98	2.8	.0	201	.2	-.2	289	10.4	-.1	271	8.2
1956-1957	-.0	-2	-.0	-.2	-191	-7.8	.7	200	8.2	-.2	264	15.2	-.1	303	17.2
1957-1958	.7	-60	-1.2	.8	9	-.5	-.0	-102	7	-.3	177	10.4	-.3	145	9.9
1958-1959	.1	28	2.6	.2	54	4.8	-.0	127	3.7	-.3	344	16.7	-.4	384	17.1
1959-1960	.3	302	7.9	.3	249	4.2	-.0	410	11.2	-.4	444	21.3	-.4	490	23.5
1960-1961	-.1	50	1.9	-.1	30	-1.3	-.2	46	5.5	-.4	515	19.6	-.4	572	23.3
1961-1962	.3	1	.9	-.0	117	.9	.3	36	3.5	-.4	590	24.8	-.3	631	26.6
1962-1963	-.0	151	5.1	.2	138	4.8	-.1	211	7.6	-.3	504	19.0	-.3	593	22.2
Average	.2	70	1.9	.2	61	.8	.1	136	5.3	-.3	365	15.8	-.3	407	17.5

The values given in Table 2 are for the Holstein breed by year. The corresponding sums of weights and numbers of herd-year comparisons are given in Table 4.

*Non-Holstein breeds.* Nonregistered cows exceed the production of their registered herd-mates for all breeds except the Brown Swiss. The differences were small and showed no trends except for the Jersey comparison, where the registered cows appeared to be gaining consistently on their nonregistered contemporaries. Only for the Ayrshire comparison which had the nonregistered cows calving nearly a month earlier than the registered cows were there any differences in age at first calving between registered and nonregistered cows.

The comparisons of production and age at first calving of naturally sired, registered, and nonregistered cows and of artificially sired, registered, and nonregistered cows followed the same pattern as the comparisons of all registered vs. all nonregistered cows, with the exception of Brown Swiss milk and fat production. The nonregistered Brown Swiss which were sired naturally had a large advantage over their similarly sired, registered mates, whereas the artificially sired, registered animals had a substantial advantage over their artificially sired, nonregistered herd-mates. Note, however, the small number of comparisons and weights in the Brown Swiss.

There was a small, consistent, but nonincreasing (except for the Ayrshire breed) advantage of artificially sired over naturally sired cows, as reported earlier (4). The production advantage of A.I. over NS cows appeared to be increasing rather consistently for the Ayrshire comparisons. Artificially sired cows also freshened slightly earlier than their naturally sired herd-mates for all breeds.

The same pattern for the comparisons of A.I. registered vs. NS registered cows appeared as for the comparison of all A.I. vs. all NS cows. Probably many animals were common to both sets of comparisons.

*Holstein.* Registered Holsteins calved later than their nonregistered herd-mates, although the difference was small and seemed to be decreasing in recent years. The same pattern was evident for the A.I. and NS comparisons of registered vs. nonregistered cows, especially for the NS comparison. A.I. cows consistently calved earlier than NS cows by about a third of a month.

The production of milk and fat was higher for registered than nonregistered Holsteins. The margin was not great and was not consistent from year to year. The same general

TABLE 3  
Sum of weights and number of herd-years for comparisons in Table 1  
(Ayrshire, Guernsey, Jersey, and Brown Swiss breeds)

Time period (August- March)	All reg. vs. all nonreg.		NS reg. vs. NS nonreg.		A.I. reg. vs. A.I. nonreg.		All A.I. vs. all NS		A.I. reg. vs. NS reg.	
	Sum of weights	No. herds	Sum of weights	No. herds	Sum of weights	No. herds	Sum of weights	No. herds	Sum of weights	No. herds
Ayrshire										
1950-1954	72.5	76	50.9	59	14.5	18	130.2	125	114.8	116
1954-1957	31.1	34	11.7	13	15.5	20	154.0	127	139.8	115
1957-1960	32.5	36	11.8	12	12.4	18	139.4	119	124.3	104
1960-1963	60.6	60	15.7	19	34.3	39	252.1	173	231.0	162
Total	196.7		90.1		76.7		675.7		609.9	
Guernsey										
1950-1954	225.7	207	164.6	152	39.9	50	189.8	191	136.4	144
1954-1957	196.4	155	121.3	95	47.1	57	332.0	280	259.1	224
1957-1960	167.7	135	73.3	69	69.5	67	388.6	279	312.3	231
1960-1963	166.6	144	45.1	49	97.1	96	480.1	341	409.6	291
Total	756.4		404.3		253.6		1,390.5		1,117.4	
Jersey										
1950-1954	155.9	123	116.8	98	22.0	21	155.7	145	108.5	108
1954-1957	185.7	123	114.4	80	51.8	46	190.5	156	136.1	119
1957-1960	112.8	89	60.5	54	34.8	36	228.6	176	183.9	146
1960-1963	148.2	115	62.0	54	68.9	64	344.3	234	260.7	174
Total	602.6		353.7		177.5		919.1		689.2	
Brown Swiss										
1950-1954	14.7	20	12.4	17	.7	1	24.1	29	22.5	27
1954-1957	13.6	15	8.2	11	2.8	4	55.8	56	49.9	52
1957-1960	9.9	9	4.9	5	3.1	4	64.8	67	61.0	64
1960-1963	16.0	19	1.2	2	13.0	14	83.2	68	80.4	64
Total	54.2		26.7		19.6		227.9		213.8	

pattern held true for both the NS and A.I. comparisons of registered and nonregistered cows. The A.I. registered advantage over the A.I. non-registered cows was a little greater than the NS registered advantage over the NS non-registered cows.

The advantage of the A.I. above NS cows

was consistent with earlier reports (4, 5), although the upward trend appears to have leveled off. The A.I. advantage over NS for registered cows followed the same pattern, but the advantage was slightly higher than when all A.I. and all NS cows were included in the comparisons.

TABLE 4  
Sum of weights and number of herd-years for comparisons in Table 2  
(Holstein breed)

Time period (August- March)	All reg. vs. all nonreg.		NS reg. vs. NS nonreg.		A.I. reg. vs. A.I. nonreg.		All A.I. vs. all NS		A.I. reg. vs. NS reg.	
	Sum of weights	No. herds	Sum of weights	No. herds	Sum of weights	No. herds	Sum of weights	No. herds	Sum of weights	No. herds
1950-1951	222.5	210	204.9	192	6.0	10	107.1	124	78.0	97
1951-1952	407.9	368	308.8	282	51.0	66	490.8	475	285.0	291
1952-1953	500.7	445	331.7	308	111.8	131	675.2	598	477.0	445
1953-1954	538.6	461	319.8	291	146.7	156	892.0	733	604.9	511
1954-1955	499.2	419	261.3	233	166.6	173	844.3	663	598.0	488
1955-1956	529.4	440	259.4	231	196.7	208	977.0	782	678.9	562
1956-1957	571.9	460	240.4	214	249.4	249	969.9	745	682.2	559
1957-1958	603.9	495	200.7	193	316.8	292	1,076.3	823	897.4	697
1958-1959	507.0	388	179.8	160	246.7	230	1,084.9	839	817.9	655
1959-1960	536.5	422	173.7	167	278.7	257	1,244.0	930	982.5	747
1960-1961	774.8	604	180.7	182	491.9	428	1,723.9	1,257	1,340.4	977
1961-1962	909.5	650	190.6	158	602.5	479	1,723.6	1,143	1,409.7	944
1962-1963	1,134.3	801	220.2	188	766.5	609	2,027.6	1,286	1,704.2	1,063
Total	7,736.2		3,072.0		3,631.3		13,836.6		10,556.1	

## DISCUSSION

One of the functions of registered cattle is often assumed to be the improvement of non-registered cattle or cattle of unknown ancestry through continued upgrading by use of registered sires. Results show that there were only small differences in production of registered and nonregistered cows in herds where both registered and nonregistered cows were herd-mates. Quite likely, though, most of the cows coded as nonregistered had as many qualifications to be registered as their registered herd-mates. For some of these the registration papers may merely have been dropped in this generation or in some past generation. An ancestor might have been disqualified for nothing more than color characteristics. Even those with a nondescript ancestor may have been the result of continued crossing to registered sires so that, for all intents, they were of the same genetic makeup as their registered herd-mates. For these reasons the authors have used the term, nonregistered, in preference to grade, in describing cows not coded as registered.

Differential selection pressure between registered and nonregistered cows on production could make the more strongly selected group appear better than the less strongly selected group. Whatever deliberate selection is practiced for production is probably based primarily on the production of the cow herself or of her dam. The New York DHIA program extends to a complete record basis the records of all cows culled during any lactation including the first. If, however, the extension factors are biased, and if differential culling occurs, some bias could arise in the estimates of differences. If no bias occurs from these factors, any production differences due to selection between registered and nonregistered herd-mates for their first lactations would have to be based on evaluation of records of ancestors (probably the dam), or on precalving evaluation. The intensity and accuracy of this type of selection, actually practiced for production of heifers, is not likely to cause much difference between the production of registered and nonregistered cows for the first lactation. This selection could, however, easily account for the small differences found between the registered and nonregistered groups. For example, consider the following assumptions: Selection of replacement heifers is based on a single record of the dam, heritability equals 0.25, and the genetic standard deviation equals 1,000 lb milk. On this basis if one heifer out of two nonregistered cows, and seven heifers out of ten registered cows, both rather extreme conditions, are selected as re-

placements each year, then the expected difference between the nonregistered heifer and her registered mates is 115 to 140 lb of milk in genetic value. Other selection intensities could easily be imagined, but the general picture is apparent from the example.

The apparent upgrading in herds where only part of the animals are registered might not be true in herds where no animals are registered. The influence of A.I. would, however, suggest that this upgrading would occur or would already have occurred in unregistered herds which use A.I. In herds where registered sires have been used naturally for three or more generations a similar upgrading would have occurred, but perhaps not to the same level as for those herds using superior A.I. proved sires.

## CONCLUSIONS

The genetic difference between registered and nonregistered cows on a within-herd basis is small and probably nonsignificant when all breeds are considered. There were, however, breed differences. The widespread use of the same A.I. sires or registered natural service sires on both groups has resulted in their having essentially the same genetic ability for production.

The fact that registered and nonregistered cows within DHIA herds are so similar in production would indicate that carefully selected sires from nonregistered parentage could be equal to registered sires now being selected. If needed, this could increase the number of potentially superior males for sampling in A.I.

One of the main services of breed associations has been to maintain herd book identification of animals which trace their ancestry to the original importations. Production records that demonstrate superior performance have been emphasized but not made mandatory. Perhaps, in the future, superior production performance should be the principal criterion for permanent registration. The question then would be, "Should ancestral identification beyond the third generation be disregarded?"

Artificially sired cows, both registered and nonregistered, showed a consistent production advantage over naturally sired cows in nearly all breeds. The advantage was similar for both registered and nonregistered animals.

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