INFLUENCE OF ARTIFICIAL BREEDING ON PRODUCTION IN SELECTED MICHIGAN DAIRY HERDS

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Lyle Harry Wadell

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INFLUENCE OF ARTIFICIAL BREEDING ON PRODUCTION IN SELECTED MICHIGAN DAIRY HERDS

By

LYLE HARRY WADELL

AN ABSTRACT

Submitted to the College of Agriculture
Michigan State University of Agriculture and
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ABSTRACT

LYLE HARRY WADELL

The 6,829 records collected under the D.H.I.A.-I.B.M. program in Michigan from October, 1954, to June, 1956, in herds having both A.I. and non-A.I. daughters were used to analyze the influence of artificial breeding on the genetic progress in production in Michigan D.H.I.A.-I.B.M. dairy herds. How artificial breeding sires have affected herds of different levels of production was also investigated.

The mean difference between the performance of the artificial daughters and the production of the natural daughters in which the difference from each herd was given a weight proportional to the reciprocal of its variance was calculated for Guernsey, Holstein, and Jersey breeds. The Holstein A.I. daughters exceeded the non-A.I. daughters by 124 lb. of milk and 3.7 lb. of fat. The Guernsey A.I. daughters exceeded the non-A.I. daughters by 3.9 lb. of fat but were 6 lb. of milk below the non-A.I. daughters. The Jersey A.I. daughters exceeded the non-A.I. daughters by 16 lb. of milk, and the non-A.I. daughters exceeded the A.I. daughters by 2.7 lb. of fat.

There was no significant trend for A.I. daughters to produce less than or more than contemporary non-A.I. daughters within herds at varying levels of production.

The regressions of the mean weighted differences between A.I. and non-A.I. daughters in mature equivalent butterfat on the M.E. butterfat average of the older herd mates were for Guernseys 16, Holstein 1, and

Jersey -16. Confidence intervals at the 5% level were Guernsey, -4 to 36, Holstein, -6 to 8, and Jersey, -35 to 5.

The herd, sire, herd-sire interaction, and residual components of variance were obtained by equating mean squares to expectations in an analysis of variance of records from herds which had both artificial and natural daughters. No herd-sire interaction was found. In all breeds the component for herd-sire interaction was either negative or nearly zero. The components of variance obtained were similar to those reported previously by other workers.

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TABLE OF CONTENTS

Page

LIST OF TABLES

INTRODUCTION

Twenty-three percent* of Michigan's 925,000* dairy cows were bred artificially in 1954. Each year this percentage increases. In some states it has neared or surpassed the 50 percent level. The increasing importance of artificial breeding in Michigan's Dairy Industry is shown by comparison with five years earlier, 1949, when 91,416* cows or about 10 percent of the total dairy cow population of the state were bred artificially. Of this number Michigan Artificial Breeders Cooperative provided 100 percent of the services. Since that time the total number and percent of cows bred artificially have more than doubled. Seventy-three percent* of the artificial breeding service in Michigan is now provided by Michigan Artificial Breeders Cooperative. Several artificial breeding studs are now providing service in Michigan.

The purpose of this research was to survey and analyze the influence of artificial breeding on the production of Michigan D.H.I.A.-I.B.M. dairy herds to see if the use of artificial breeding has resulted in genetic progress in production. How artificial breeding sires have affected herds of different genetic composition was also investigated.

Salisbury and VanDemark (1952) point out that only a small percent of the cows are on production testing and only a small percent of these are artificially bred. These conditions limit the study of the influence of artificial breeding. Investigation is restricted to those herds which have records. The results of this study apply to this special group of tested herds. How these results relate to the influence of artificial

*Milk Foundation Bulletin and M.A.B.C. Annual Bulletin breeding on untested herds which probably produce less than the tested herds is uncertain.

REVIEW OF LITERATURE

Mean Weighted Differences

Appraising the value of artificial breeding by mean weighted differences between the average production of heifers obtained by artificial insemination and the production of other heifers in the same herd was first used by Robertson and Rendel (1954) in a study of 1423 artificial insemination daughters from 56 sires in 3 breeds. Their results for all breeds showed an advantage for artificial insemination heifers of one gallon with a standard error of five gallons. The largest mean weighted difference, twenty-six gallons, with a standard error of thirteen gallons, appeared in the Friesian breed. In Guernsey and Shorthorn breeds artificial insemination heifers produced less than contemporary heifers. The Shorthorn had a negative five gallons with a standard error of six gallons, and the Guernsey had a negative fourteen gallons with a standard error of ten gallons.

Robertson and Rendel (1954) concluded that the milk yield of A.I. daughters was very little different from that of non-A.I. daughters. They explain these results in that the sires used naturally are either pedigree or have a pedigree sire. This implies that the sires obtained by the breeding studs from the elite herds are genetically little better than the sires used naturally by these herds previously. This is because the sires used naturally were obtained from herds equal in genetic potential to those from which artificial breeding sires were obtained. Robertson and Rendel (1954) concluded by saying, "This suggests that the elite group of herds in each breed is little, if at all, genetically superior to other pedigree herds and that the big differences in performance are due to management."

Contemporary Comparison

Attempts have been made to answer the question, "Do artificial insemination daughters produce significantly different yields in herds with different production levels", by a regression of the production of the artificial insemination daughters on the herd average.

McGilliard (1952) points out that the usefulness of the herd average depends on how much of the difference between averages is due to genetic variation. He adds, "The yearly herd average may be used effectively to correct records for yearly differences in environment by subtracting from each record the herd average for the year in which it was produced. When the ratio of genetic to total variation is about the same in the difference between herd averages as it is within herds, the usefulness of the herd average is negligible".

Lush (1954) found that the natural proofs of sires used artificially varied considerably due to the fact that each sire's proof was made in a different environment. However, there is little environmental variation between sires used artificially because the daughters of each sire represent a sample of many environments, with every sire getting a similar sample.

Rice (1954) believes "The herd level where the young bull is to be used is the greatest determining factor in how much the young bull's daughters will produce." He calls the comparison of artificial insemination daughters with their yearly herd averages the 'new look' in breeding, which makes a correction that has as its aim the lowering or elimination of environmental effects.

Robertson and Rendel (1954) compared the mean weighted superiority of the artificial insemination heifers in herds at different levels of production with contemporary herd averages formed from the average production of the mature cows in the same herd-year. No general trend in the difference appeared as the level increased. They found the regression of the fat percent of artificial insemination heifers on the average of all other animals in the same herd-year to be 0.66 ($\pm$ 0.20) for all breeds. They, therefore, concluded that a fair proportion of the variation in fat percent between herds is genetic in origin. The regression of the milk production of artificial insemination heifers on the production level of the herd for all breeds was 0.96 ($\pm$ 0.09) indicating a smaller genetic difference in milk production between herds.

The regression of the production of individual records on herd production levels on an intra-sire basis should be 0.5 if all differences between herds are genetic and 1.0 if they are due to management. Henderson <u>et al</u> (1954) found the intra-sire regression of daughter on regressed contemporary herd average to be 0.6. For mean weighted differences between artificial insemination daughters and non-artificial insemination daughters the regression should be zero if all differences between herds are due to management and -0.5 if they are all genetic.

Herd-Sire Interaction

Mason and Robertson (1956) in a study of records from 13,000 cows bred by artificial insemination found no evidence of any herd-sire interaction for yield, either within or between management levels.

Legates and Verlinden (1956) in a study of 24,754 daughters of Guernsey, Holstein, and Jersey sires found the herd-sire interaction to be of little importance. In all breeds the herd-sire interaction was zero or nearly so.

Some people think that specific breeding value and herd-sire interaction are one and the same. However, the herd-sire interaction can contain some interaction between heredity and environment. Lush (1949) defines specific breeding value or the process of nicking as the phenomenon whereby on some special sample of cows Bull A will do better than Bull B, while on another genetically different sample of cows Bull B may do better than Bull A. Lush goes on to say that, "...scanty evidence from dairy cattle indicates that nicking is of minor importance. Probably it isn't quite zero, but it is of such small importance that we wouldn't go far wrong if we tossed the specific ability or the 'nicking' out of the window under present conditions." Regardless of whether they are or are not the same, present studies indicate that neither are of major importance.

Often it is useful to know what portion of the total variance can be attributed to herd effects (H^2), sire effects (S^2), herd-sire interaction (HS), and differences between daughters of same sire in same herd due to variation in dams and environmental causes (E^2). Gaunt and Legates (1955) found H^2 to range from 28.1 to 37.6 percent, S^2 from 4.4 to 10.2 percent, and E^2 from 52.2 to 62.2 percent of the total variation between single records of butterfat production in samples from 6,949 daughters of 836 Guernsey and Holstein sires. HS was negligible. Legates and Verlinden (1956) found the components of variance for 24,754 daughters of Guernsey, Holstein, and Jersey sires to be:

	Guernsey		Holstein		Jersey	
	Milk	Fat	Milk	Fat	Milk	Fat
H^2	25.1%	29.3%	30.1%	32.3%	19.9%	34.9%
S^2	6.6%	5.4%	5.9%	6.8%	7.6%	6.3%
HS	0.0%	0.0%	2.1%	1.2%	0.0%	0.0%
E^2	68.3%	65.3%	61.9%	59.7%	72.5%	58.8%

Legates and Verlinden (1956) point out how the variance components can be used where there are _n_ first daughters each in a different herd. The regression of future daughters in different herds on the first tested daughters can be written:

$$\frac{S^2}{S^2 + \frac{H^2 + HS + E^2}{n}} = \frac{n}{n + \frac{H^2 + HS + E^2}{S^2}}$$

SOURCE OF DATA

The records used were part of 16,944 Dairy Herd Improvement Association records collected under the D.H.I.A.-I.B.M. program in Michigan from October, 1954, to June, 1956. Only completed records which were at least 180 days long were included. All records over 305 days were cut off at 305 days. Those herds in which both artificial and natural daughters appeared were used. Only results for Holstein, Guernsey, and Jersey breeds will be reported because the numbers of records in the remaining breeds were insufficient to warrant any comparisons.

Questionnaire

It was decided that the information called for by questions 9-11 of the questionnaire would be helpful in analyzing the results. This information was unobtainable from the available records. Because of this a letter with a questionnaire was prepared and sent to the 240 herd owners whose herds were involved in this problem. Copies of this letter and questionnaire are found in the appendix. Eighty percent return was received and the results are shown on the questionnaire.

METHODS AND RESULTS

Mean Weighted Differences

The herds involved in the mean weighted difference comparison were those herds in which both artificial and natural daughters had first lactation records. Mean weighted differences were computed for actual milk, actual fat, mature equivalent milk, and mature equivalent fat. Where a division was made between grade and registered herds, a herd with any grade animals in it was classified as a grade herd and a registered herd contained only registered animals. Where a herd was composed of several breeds, it was broken into herd-breed groups and each classified as a separate herd. The procedure followed in making the calculations was that set forth by Robertson and Rendel (1954). The mean weighted difference is a difference wherein the average performance of the artificial daughters and the average production of the natural daughters are each given a weight proportional to the reciprocal of their variance.

The mean weighted difference was calculated as shown below:

$$\frac{n_2A_i - n_1S_i}{n_1 + n_2} = \text{Mean Weighted Difference}$$

Where: A_i...is the sum of artificial records in the _i_th herd

S_i...is the sum of natural records in the _i_th herd

n_1...is the number of artificial records in the _i_th herd

n_2...is the number of natural records in the _i_th herd.

One hundred and seventy-six Holstein herds involving 1422 records of artificial and natural daughters gave for all characteristics studied a

positive difference for A.I. heifers. The difference for Holstein milk was 124 lb. and 3.7 lb. for Holstein fat. In Guernsey and Jersey breeds non-A.I. heifers exceeded A.I. heifers in milk and in fat, respectively. Three hundred and thirteen Guernsey records in 33 herds had a mean weighted difference for milk of -6 lb. and 3.9 lb. for fat. One hundred and twenty-seven records in 17 Jersey herds gave a mean weighted difference for milk of 16 lb. and -2.7 lb. for fat. Table 1 shows the mean weighted differences.

TABLE 1

DIFFERENCES IN PRODUCTION BETWEEN A.I. DAUGHTERS AND THEIR NON-A.I. CONTEMPORARIES IN THE SAME HERD

Breed	No. of Herds	No. of Artificial Records	No. of Natural Records	Mean Weighted Differences in lb. Actual Milk	Actual Fat	M. E. Milk	M. E. Fat
All Holstein	176	558	864	96	2.9	124	3.7
Grade Holstein	142	447	678	25	0.6	60	1.7
Reg. Holstein	34	111	186	366	11.8	370	11.4
All Guernsey	33	116	197	-10	2.8	-6	3.9
Grade Guernsey	25	96	114	-21	1.6	-27	2.1
Reg. Guernsey	8	20	83	29	6.9	71	10.5
All Jersey	17	54	73	49	-0.7	16	-2.7
Grade Jersey	12	44	38	113	3.3	45	-0.6
Reg. Jersey	5	10	35	-73	-8.3	-34	-6.6

The registered Holstein and Guernsey herds showed a larger positive difference than did the grade herds. In the case of the Jerseys, however, the grade herds had a larger positive difference for milk with little difference for fat.

These values fall within the range observed by Robertson and Rendel (1954). The values obtained here substantiate the conclusion that there is little difference between the production of artificial and natural daughters. It was found that nearly all the herds under study had been using a registered sire or a sire by a registered sire prior to using artificial breeding.

Contemporary Comparison

An analysis of variance was used to determine whether the mean weighted differences were significantly different at various levels of production of herds. The levels of production in this comparison are based on the mature equivalent fat average of the cows in the herd at the same time but not used in the previous comparison. The herds were divided into ranges of 50 pounds of mature equivalent butterfat, i.e. 250-299, 300-349, etc. Comparisons were then made of differences between A.I. daughters and non-A.I. daughters on actual milk, actual fat, mature equivalent milk, and mature equivalent fat.

The differences in actual milk for the Guernsey breed are significantly different at the 5 percent level. In all other cases no significant difference appeared between the mean weighted differences at different levels of production. The mean weighted differences at different levels of production are shown in Table 2.

These results show no significant trend for A.I. daughters to produce less than or more than contemporary non-A.I. daughters within herds at varying levels of production. In the case of the Holsteins the analysis of variance gave in all cases an F-value of less than one.

A regression analysis of these same data with the independent variable being the mature equivalent butterfat average of the older herd mates

TABLE 2

DIFFERENCES BETWEEN A.I. DAUGHTERS AND THEIR NATURAL CONTEMPORARIES IN HIGH AND LOW PRODUCING HERDS

M. E. Butterfat Range	Number of-	Records		Mean Weighted Differences			
				Actual		M. E.	
	Herds	Natural	Artificial	Milk	Fat	Milk	Fat
Guernsey							
250-299	1	1	1	-4366	-44	-4366	-22
300-349	12	51	48	-169	-6	-195	-7
350-399	9	43	25	-322	-12	-332	-10
400-449	6	51	19	775	38	773	37
450-499	5	51	25	73	3	152	8
Holstein							
250-299	1	4	1	-2465	-111	-2634	-124
300-349	11	28	30	501	28	679	37
350-399	38	207	116	-38	-1	-30	-1
400-449	45	236	165	93	3	144	4
450-499	47	245	136	-164	0	-244	-1
500-549	[illegible]	84	76	658	10	718	8
550-599	8	38	28	124	-5	286	-2
600-649	2	19	2	453	34	1071	63
Jersey							
200-249	1	1	1	1744	96	2144	120
300-349	3	10	12	169	23	148	25
350-399	7	31	17	-321	-26	-451	-35
400-449	4	18	20	430	9	403	-5
450-499	1	6	1	-74	-33	28	-34
500-549	1	7	3	-376	1	-249	14

and the dependent variable being the mean weighted difference for mature equivalent butterfat gave the following regression coefficients; Guernsey 16.17, Holstein 1.05, and Jersey -16.22. Standard errors of estimate observed were Holstein 79, Guernsey 78, and Jersey 54. The regression coefficients were tested by a F-ratio and found not to be significantly different from zero at the 5 percent level. Confidence intervals at the 5 percent level for the regression coefficients are; Guernsey (-4.28 to 36.62), Holstein (-6.40 to 8.50), and Jersey (-35.80 to 5.36). These results were tested for linearity and no evidence was found that the relationship was not linear. There was no significant difference between the regression coefficients found and zero; but, nevertheless, there exists a slight linear relationship. The standard errors are so large that the equations are of little value in estimating possible improvement of A.I. daughters at various herd levels.

Herd-Sire Interaction

The herd-sire interaction and other components of variance were obtained by equating mean squares to expectations in an analysis of variance of records from herds which had both artificial and natural daughters. Each artificial record was expressed as a deviation from the average of all natural cows in the same herd. Repeated records of both artificial and natural daughters were eliminated in a random manner. Computations were completed on mature equivalent milk and mature equivalent fat.

No herd-sire interaction was found in this study in the form as previously defined. The results are shown in Tables 3-5. In all cases the herd-sire interaction was either negative or nearly zero. Negative interaction components are obtained when the herds and sires are found to be more alike than expected. These results compare favorably with those of Mason and Robertson (1956), Legates and Verlinden (1956), and Lush (1949). These results show that sires will be ranked about the same regardless of the group of cows with which they are mated.

The variance components and percent of variance alloted to sires, herds, and error appear in Tables 3-5.

The variance due to herds ranged between 16 and 33 percent, variance

TABLE 3

ANALYSIS OF VARIANCE AND COMPONENTS FOR GUERNSEYS

		M. S.			Variance Components		Percent of Total	
Source of Variance	D.F.	Milk*	Fat		Milk*	Fat	Milk	Fat
Total	257							
Sire	73	3414**	6391**	S^2	330	340	14	6
Herd	58	5054**	10797**	H^2	794	1698	33	30
Registered vs Grade	1	12024**	31177**					
Between Herds wi/class	57	4931**	10439**					
Herd x Sire	67	-117	388	HS	10	-418	0	0
Sire x Registered:Grade	4	826	7408					
Remainder	63	-177	-57					
Error	59	1278	3620	E^2	1278	3620	53	64

TABLE 4

ANALYSIS OF VARIANCE AND COMPONENTS FOR HOLSTEINS

		M. S.			Variance Components		Percent of Total	
Source of Variance	D.F.	Milk*	Fat		Milk*	Fat	Milk	Fat
Total	1496							
Sire	198	6950**	7034**	S^2	244	46	5	1
Herd	281	9568**	11267**	H^2	1058	1161	21	17
Registered vs Grade	1	6028	13422					
Between Herds wi/class	280	9581**	11259**					
Herd x Sire	771	3200	4744	HS	-467	-415	0	0
Sire x Registered:Grade	60	6918**	-21096					
Remainder	711	2887	6784**					
Error	246	4233	5548	E^2	4233	5548	84	82

TABLE 5

ANALYSIS OF VARIANCE AND COMPONENTS FOR JERSEYS

		M. S.			Variance Components		Percent of Total	
Source of Variance	D.F.	Milk*	Fat		Milk*	Fat	Milk	Fat
Total	92							
Sire	24	2801	7478	S^2	464	1234	13	12
Herd	20	3803	10844	H^2	580	1689	17	16
Registered vs Grade	1	1048	143					
Between Herds wi/class	19	3948	11407					
Herd x Sire	17	-1260	-3707	HS	-1260	-4302	0	0
Sire x Registered:Grade	4	1611	7586					
Remainder	13	-2141	-7182					
Error	31	2369	7490	E^2	2369	7490	70	72

*Milk multiplied by 10^{-5}

**Significant at the 1% level

due to sires between 1-14 percent and error variance between 53-84 percent with no herd-sire interaction. In all breeds H^2 falls below the upper bound of these figures obtained by Gaunt and Legates (1956) and Legates and Verlinden (1956). However, the Holstein fat H^2 and Jersey milk and fat H^2 falls below previously found figures. The results for S^2 indicate that the Holstein sires used were of almost equal genetical value, and that the Jersey sires used varied considerably in their genetical value. The variation due to the differences between daughters of the same sire in the same herd due to variation in dams and environmental causes (E^2) accounted for the major portion of the total variance. Except for the Guernsey breed the E^2 found was much greater than reported before. The E^2 for the Guernsey breed is smaller than previously observed.

DISCUSSION

The herds involved in this study are above average herds of Michigan which can be seen by comparing the production levels of these herds shown in Table 6 with the production of the average cow in Michigan, 6500 lb. of milk. The average production of these herds in all instances is well above this figure.

TABLE 6

AVERAGE 305-2x-M.E. PRODUCTION FOR ALL BREEDS

	All D.H.I.A.-I.R.M. Herds			Herds Studied		
Breed	Number	Milk	Fat	Number	Milk	Fat
Holstein	13,899	11,835	435	5,360	12,170	438
Grade	7,401	11,701	420	2,921	11,841	427
Registered	6,498	12,680	453	2,439	12,565	451
Guernsey	3,037	8,240	391	1,001	8,136	389
Grade	1,491	8,137	379	490	7,844	370
Registered	1,546	8,339	402	511	8,400	407
Jersey	1,677	7,559	393	468	7,594	400
Grade	792	7,485	384	208	7,632	401
Registered	885	7,628	401	260	7,564	400

Seventy-five percent of these herds have been using artificial breeding for longer than 5 years and today 53 percent of them are using artificial breeding exclusively, 23 percent are using selective mating, and 14 percent of the herds report they are attempting to follow some form of linebreeding.

Although the resulting numbers from the questionnaire are small, there is some indication that the grade herds are breeding their better cows artificially more frequently than the registered herds. There is also a small portion of the grade herds that breed the registered animals in their herd artificially and the grade animals in their herd naturally.

The grade herds have a greater tendency to breed their heifers naturally than the registered herds. A larger portion of the grade herds claim to be trying to follow a linebreeding program.

The numbers are small, but there seems to be no indication that the herds at a low level of production are breeding their better cows artificially, and the better herds breeding their poorer cows artificially. This is shown by tabulating question 11 of the questionnaire according to level of production.

Seventy-two percent of the herds in this study have more than 20 cows and seventy-seven percent have been on a testing program longer than 4 years.

As shown previously, the overall mean weighted difference between A.I. daughters and non-A.I. daughters is positive. However, nearly 50 percent of the herds in this study have negative mean weighted differences. The differences in production between A.I. daughters and non-A.I. daughters within the same herd seem to support the idea that the sires used by the breeding studs are little if any genetically superior to the sires previously used naturally. Prior to using artificial breeding 83 percent of the herds included under this study were using a registered sire or a sire by a registered sire. Forty-four percent of these herds that today are using artificial and natural sires concurrently are using naturally a registered sire or a sire by a registered sire. The level of production of the herds in this study indicates that the source of the sires used naturally could have been the same as the source of the sires used by the breeding studs.

A few of the breeding bulls for the herds on D.H.I.A.-I.B.M. no doubt came from the best of these herds. The breeding stud however seldom purchases a sire from one of the best D.H.I.A.-I.B.M. herds but would more likely purchase from an 'elite' breeding herd. An 'elite' breeding herd is a popular herd from which the dairyman is making it a business to sell breeding stock. The interesting point is that the better D.H.I.A.-I.B.M. herds may be as good genetically as the 'elite' breeding herds, the major differences falling to environment. Therefore, a portion of the herds on I.B.M. should also be included as the 'elite' herds of the state and would be as good a source for young bulls for the stud as the 'elite' breeding herds.

If the sires used naturally and artificially were actually equal in genetic potential, we would hardly expect a large difference between A.I. and non-A.I. daughters. However, if we assumed the sires used by the studs came from herds at a higher plane of production than those in this study, we can still explain the results. As Robertson and Rendel (1954) pointed out, the so-called 'elite' herds are not necessarily genetically superior to the herds under study since the major differences between herds seem to be due to environmental conditions.

The positive differences of A.I. over non-A.I. are greater for registered than grades in the Guernsey and Holstein breeds. The reverse is true for the Jersey breed. In the Holstein and Guernsey breeds the registered animals have a higher average than the grade animals whether artificial or natural. In the Jersey breed artificial grades however outproduced the registered. The regression of the mean weighted differences on herd averages indicates an increase in mean weighted differences for an increase in herd average for the Holstein and Guernsey breeds. However the Jerseys have a negative regression.

Previous to this study it had been thought perhaps that A.I. daughters would receive an increasing positive mean weighted difference to a certain plane of production and than level off, giving a curvilinear relationship between herd average and mean weighted differences. The study, however, showed a linear relationship with no tendency to become curvilinear. The mean weighted differences tend to get slightly larger as the herd level increases but not significantly so. At a low level of production the benefits of an artificial sire could be cancelled out by the environment giving a greater chance for a smaller or negative mean weighted difference.

The study supported, by showing no herd-sire interaction, that artificial sires can be compared without taking into account the herds in which their daughters appeared. This does not mean, however, that it would not be a good idea to express the daughter's production as a deviation from the herd average in which it appears when comparisons are made. The expression of the daughter's production as a deviation from the herd average aids in eliminating a portion of the variance due to yearly environmental conditions.

The body weight and age at freshening of the first lactation daughters were also handled by the mean weighted difference method. Many times the following are listed as advantages for artificial breeding: 1) the ability to breed heifers at an earlier age and 2) the ability to breed heifers small in size. These two factors, size and age, do affect the production of an animal and were studied to see if they had any affect on the differences observed. There was little difference between A.I. daughters and non-A.I. daughters in any of the breeds in age at first calving. There was no difference between Holstein A.I. daughters and non-A.I. daughters in body weight at first calving. The Jersey A.I. daughters were 50 lb. heavier than the non-A.I. daughters in body weight. The Guernsey non-A.I. daughters were 20 lb. heavier than the A.I. daughters in body weight. These differences are insignificant because of the variation that exists between animals. These results show that A.I. daughters or non-A.I. daughters should not have an advantage over the other because of body weight or age at first calving and, thusly, affect the production mean weighted difference results.

A study to see if these herds using selective mating are actually receiving bettur results than those herds using sires randomly obtained would be a good addition to these results.

These results can not apply directly to herds at a different level of production than those herds in this study. We have seen that the importance of environmental conditions over shadows the importance of the sires, herds, and herd-sire interaction. This explains why there is not a larger advantage for A.I. daughters at the lower levels of production. Along with lower levels of production in many instances goes a poor environment. Assuming that the herds at the lower level of production are not at the same level genetically as the breeding herds, we could expect the A.I. sires to help those herds at a lower level of production to a greater extent if the environment is not such that it will cover up the effects.

If the sires used by these herds are not genetically superior to those previously used naturally as the results tend to indicate, what can these herds do? The results show that the farmers plan on making an increased use of artificial breeding. If they are to make any significant genetic progress, the breeding studs must formulate sire selection programs that will produce superior sires available to all of these herds.

SUMMARY

The records used in this study were part of 16,944 D.H.I.A. records collected under the D.H.I.A.-I.B.M. program in Michigan from October, 1954, to June, 1956.

Comparisons were made between A.I. daughters and non-A.I. daughters for the Guernsey, Holstein, and Jersey breeds. The Holstein A.I. daughters exceeded non-A.I. daughters by 124 lb. milk and 3.7 lb. fat. The Guernsey A.I. daughters exceeded the non-A.I. daughters 3.9 lb. of fat but were 6 lb. of milk below the non-A.I. daughters. The Jersey A.I. daughters exceeded the non-A.I. daughters by 16 lb. of milk and the non-A.I. daughters exceeded the A.I. daughters by 2.7 lb. of fat.

Regressions of the differences between A.I. and non-A.I. daughters on the contemporary herd average were 1, 16, and -16 for Holstein, Guernsey, and Jersey, respectively. For each breed the regression coefficient was found not to differ significantly from zero. These relationships were not curvilinear.

An analysis of variance showed that there was no herd-sire interaction. The variance components obtained were similar to those previously obtained.

APPENDIX

The letter and questionnaire sent to the 240 herd owners involved in this study appear on the following three pages. The results on the questionnaire are expressed as a percentage of the total questionnaires returned. Where the percentages add to more than 100 percent, multiple answers were possible.

MICHIGAN STATE UNIVERSITY

OF AGRICULTURE AND APPLIED SCIENCE • EAST LANSING

COLLEGE OF AGRICULTURE • DEPARTMENT OF DAIRY

December 14, 1956

This summer a study was started to determine what effects artificial breeding has had on Michigan D.H.I.A. herds. At this time we need your help to complete this research. There are certain items of information which can be obtained only from you. We would appreciate it if you would check the appropriate answers to the questions on the enclosed sheet and return the questionnaire in the prepared envelope.

Your herd will not be identified with this information nor will any of the results published mention your herd.

Thank you.

Sincerely yours,

Lyle H. Wadell
Research Assistant

1. What is the breed of your herd?
Ayrshire ___2___ Holstein ___77___ Shorthorn ___0___
Brown Swiss ___5___ Jersey ___11___ No Response ___9___
Guernsey ___18___ Red Dane ___2___

2. Do you have any grade cows in your herd?
Yes ___80___ No ___19___ No Response ___1___

3. How many cows do you have in your herd?
Less than 10 ___1___ 30-40 ___17___ No Response ___2___
10-20 ___26___ 40-50 ___9___
20-30 ___37___ More Than 50 ___9___

4. Which testing programs do you use?
DHIA ___4___ AR ___0___ No Response ___2___
DHIA-IBM ___89___ Owner Sampler ___2___ None ___4___
HIR ___13___ Other ___0___

5. How long have you belonged to a testing association?
Less than 1 year ___1___ 3-4 years ___9___ No Response ___4___
1-2 years ___2___ 4-5 years ___11___
2-3 years ___8___ More than 5 years ___66___

6. From what studs are you receiving your artificial service?
Michigan Artificial Breeders Cooperative ___81___
Curtis Candy Company Farms ___11___
American Breeders Service ___18___
Badger Breeders Cooperative ___0___
Other ___3___
No Response ___4___

7. Approximately what percent of your herd is bred artificially each year?
100% ___53___ 50% ___7___ Less than 10% ___16___
75% ___11___ 25% ___10___ No Response ___4___

8. How long have you been using artificial breeding?
Less than 1 year ___2___ 3-4 years ___4___ No Response ___3___
1-2 years ___2___ 4-5 years ___11___
2-3 years ___3___ Longer than 5 years ___75___

9. Prior to using artificial breeding were you using a registered sire?
Yes ___72___ No ___22___ No Response ___6___
If he was grade, was he by a registered sire?
Yes ___15___ No ___3___ No Response ___0___

10. Are you now using natural service along with artificial service?
Yes ___45___ No ___53___ No Response ___2___
Is the bull used naturally, registered?
Yes ___39___ No ___4___ No Response ___0___
If he is grade, was his sire registered?
Yes ___2___ No ___1___

11. If you are using both artificial and natural sires, what determines which females are mated to each?

12. Are you using selective mating?
Yes 23 No 73 No Response 4

13. Are you following a line breeding program through the use of artificial breeding?
Yes 14 No 82 No Response 4

14. If you have any additional comments, please add them.

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[redacted]

Date Due

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