Inbreeding

This is the twelfth article in a series of brief progress reports on the application of the science of genetics to commercial agriculture.

investigations with dairy cattle indicate inbreeding can lead to desirable or undesirable results

W. C. Rollins

Inbreeding can lead to increased uniformity within the inbred stock, increased prepotency in outcrosses, production of abnormal types, and symptoms of decline in vigor.

Since some of these results are desirable and others undesirable, it would seem appropriate that experiments be conducted to yield reliable information on this subject which could be of help to the dairyman in formulating his breeding plans. With such an aim in mind an inbreeding experiment with Jersey and Holstein cattle was initiated.

This brief summary of some of the findings may be of value to dairymen.

Several types of hereditary defects have been brought to light in the experimental herd. In connection with these defects it should be stressed that the foundation stock consisted of purebred animals of normal type and it was not the program of inbreeding itself that produced these defects, but rather the inbreeding brought them to light thus offering a method with which to purge the stock of the undesirable hidden—recessive—genes that were present in the original stock—and some of which are undoubtedly present in most herds.

It is important for the dairyman to be able to recognize a hereditary defect as such. It saves him from the futile expense and worry of trying to correct it through medication or changes in management procedures. Furthermore, to the extent that he has kept breeding records, he can often devise a plan to eliminate the undesirable gene from his herd.

The commercial dairyman can not afford to use inbreeding for this purpose but he can obtain from the University of California Division of Animal Husbandry a list and description of the known hereditary defects that might occur in his herd.

The effect of inbreeding upon calf mortality prior to four months of age has been studied and the results indicate that the frequency of calf mortality tends to increase with the amount of inbreeding.

An investigation has been made of the effect of inbreeding upon the size and rate of growth of Jersey females. The size of the animal, other things being equal, is related to its vigor and general well being. Many dairymen take size into con-

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Some Hereditary Defects in Dairy Cattle*

Defect	Description
Epitheliogenesis imperfecta (hairless)	Affected calves have defective skin on the lower legs and mucous membranes of the mouth and nostrils, large hairless patches over the body, deformed ears, dew claws, and hoofs. (Found in Jerseys and Holsteins)
Congenital cataract	A defective lens present at birth becomes more pronounced with age. (Found in Jerseys—a similar condition reported in Holsteins by other investigators)
Flexed pasterns	A flexion of the pastern joint during the first few weeks or less of age. In severe cases the hoofs are turned under. (Found in Jerseys)
Strabismus (crosseyed)	Animals had apparently normal eyes at birth. The eyes became crossed in varying degrees from six to twelve months of age. (Found in Jerseys)
Proportionate dwarfism	These animals are of normal size at birth but grow more slowly and from one year of age on they are distinctly smaller than normal. (Found in Jerseys)
Achondroplasia (bulldog condition)	Deforms the head and may also affect other parts of the axial skeleton. (Found in Jerseys)
Congenital spasms	Calves have a palsylike condition at birth and live only a few weeks or less. (Found in Jerseys)
Female sterility	Heifers are sterile. (Found in Jerseys and Holsteins)
Male sterility	Males are sterile for all practical purposes, although one may sire an occasional calf. (Found in Holsteins)
Digital anomaly	Toes are malformed and standing on them causes considerable discomfort as animals advance in age. (Found in Jerseys)
Prolonged gestation	Pregnant females carry calves far beyond term. Resulting large calves cause difficult deliveries which are usually fatal to both the dams and the calves. (Found in Holsteins)

** Approximately thirty known lethals (hereditary defects resulting in death) have been reported for cattle by various investigators.*

Decrease in Size of Jersey Females Due to Inbreeding

Measurement	Age	Herd average	Average loss in heart girth, weight, and height due to the intensity of inbreeding indicated*			
			6¼%	12½%	25%	37½%
Heart girth (in inches)	1 Mo.	26.4	0.3	0.6	1.2	1.8
	½ Yr.	43.2	0.4	0.7	1.5	2.2
	1 Yr.	55.2	0.4	0.8	1.7	2.5
	2½ Yrs.	68.0	0.2	0.3	0.6	0.9
	4½ Yrs.	69.2	0.0	0.1	0.2	0.2
Weight (in pounds)	Birth	55	1	2	4	6
	½ Yr.	280	8	16	33	49
	1 Yr.	528	11	22	45	67
	2½ Yrs.	924	13	27	53	80
	4½ Yrs.	980	6	12	24	37
Height (in inches)	1 Mo.	26.8	0.2	0.5	0.9	1.4
	½ Yr.	37.6	0.4	0.8	1.5	2.3
	1 Yr.	44.0	0.3	0.6	1.1	1.7
	2 Yrs.	48.8	0.1	0.2	0.5	0.7
	4½ Yrs.	50.8	0.0	0.0	0.1	0.2

** Geneticists use a scale of inbreeding that runs from zero to 100 per cent and can be applied to irregular pedigrees. Some landmarks on the scale for the dairyman are: offspring resulting from one generation of first cousin matings are 6¼% inbred; offspring resulting from one generation of half brother and sister matings are 12½% inbred; those from one generation of full brother-sister or parent-offspring matings are 25% inbred; those from two generations of full brother-sister or parent-offspring matings are 37½% inbred.*

NEW PUBLICATIONS

—now ready for distribution—

Each month, new publications of the College of Agriculture are listed in this column as they are received from the press.

Single copies of these publications or a catalogue of Agricultural Publications may be obtained without charge from the local office of the Farm Advisor or by addressing a request to: Publications Office, 22 Giannini Hall, University of California, College of Agriculture, Berkeley 4, California.

TESTING MILK AND CREAM, by E. L. Jack, Circular 340, revised December 1949. A handbook for commercial dairymen. Tells how to test for milk fat in milk, cream and skim milk. Also describes tests for acidity, specific gravity, solids, sediment.

THE CONTOUR-CHECK METHOD OF ORCHARD IRRIGATION, by J. C. Marr, Ext. Cir. 73, revised December 1949. Describes the method and the conditions which make it feasible. Tells how to lay out the contours, mark the trees, and calculate the amount of water to apply.

BREEDING AND TESTING STRAWBERRY VARIETIES, by Richard E. Baker and Victor Voth, Bul. 714, October 1949. Reports on the horticultural value of five varieties of strawberries introduced in 1945, and introduces two new varieties, Campbell and Cupertino, developed by the University.

CONTROL OF FIELD RODENTS IN CALIFORNIA, by Tracy I. Storer, Ext. Cir. 138, revised November 1949. Describes the habits and tells how to control ground squirrels, tree squirrels, pocket gophers, moles, meadow mice, kangaroo rats, muskrats, and rabbits. Does not include control of rats and mice in buildings.

GROWING BEGONIAS IN CALIFORNIA, by H. M. Butterfield, Ext. Circular 162, January 1950. Mainly for the home gardener. Discusses the different begonia classes and their varieties. Contains sections on propagation, care, and control of insects, pests, and diseases.

AGRICULTURAL PUBLICATIONS, 1950. The annual catalogue of popular publications issued by the College of Agriculture.

Previously this publication was mailed to all subscribers of California Agriculture, *but the mailing list of the magazine has grown to the extent that the blanket mailing of the catalogue would be unnecessarily expensive and wasteful. Accordingly, copies of "Agricultural Publications" will not be mailed to subscribers of* California Agriculture, *except upon individual request.*

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sideration in deciding at what age a heifer should be bred. Furthermore, research in nutrition and genetics suggests that size tends to be related to milk yield.

In this study measurements of body weight, heart girth, and height at withers were considered jointly as an indication of muscular and skeletal development.

It was found that inbreeding caused a decrease in all three of the measurements considered. The inbred calves were smaller at birth than the outcrossed calves and grew more slowly up to about six months or a year of age. Subsequent to that period the inbred animals tended to grow more rapidly than the outcrossed. At 4½ years of age the inbred animals were proportionally closer in size to the outcrossed than they were as yearlings.

The effect of inbreeding presented here is an average effect; not every inbred animal is smaller than every outcrosed animal, but the average size of an unselected group of inbred animals is likely to be less than that of an unselected group of outcrossed animals.

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The inbreeding experiment with Jersey and Holstein cattle mentioned in the above article was initiated by W. M. Regan, Professor of Animal Husbandry in the Experiment Station, Berkeley.

DONATIONS FOR AGRICULTURAL RESEARCH

Gifts to the University of California for Research by the College of Agriculture accepted in January, 1950

BERKELEY

American Potash Institute, Inc. $1,200.00
Division of Plant Nutrition

Beet Sugar Development Foundation $5,000.00
Division of Plant Nutrition

The Dow Chemical Company ..... 5# sample DL-Methionine feed grind
Division of Poultry Husbandry

Nopco Chemical Company ..... 1 kilogram cholesterol, U.S.P.
Division of Poultry Husbandry

Producers Cotton Oil Company ..... 5 samples of special cottonseed meal
Division of Poultry Husbandry

U. S. Industrial Chemicals, Inc. ..... 1 lb. DL-ethionine
Division of Poultry Husbandry

The Wilson Laboratories ..... 10 lbs. liver fraction L
Division of Poultry Husbandry

DAVIS

Canners League of California $294.23
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Francis M. Ball ..... 1 rare cactus
Division of Botany

Evans and Reeves ..... 165 standard plants, shrubs and trees; 14 exotic shrubs
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Paul J. Howard ..... 5 plants and shrubs of standard varieties
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Mr. Walter J. Husband, Rochcliffe Nursery ..... 18 exotic plants
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Mr. Ludwig Metzger ..... 6 drug plants
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Keith Patton ..... 1 shrub—Ruscus hypoglossum
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Victor Reiter, Jr. ..... 2 Fuchsia hybrids
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O. M. Scott & Sons Company ..... 1 Scott Fertilizer Spreader
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Division of Botany

Mr. Eric Walthers, Strybing Arboretum ..... 18 exotic cuttings
Division of Botany

Fritz Wassman, Westwood Nursery ..... 1 orchid plant
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Donald P. Woolley ..... 2 plants—Sansiveria procumbens; 1 climbing fern; 1 cymbidium orchid
Division of Botany

Shogo Yamaguchi ..... 2 trees Sapindus ninkurossi
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