

Sexing of Poultry

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

accurate identification at hatching possible by visible effects of heritable characters

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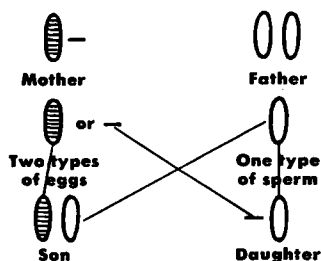
A genetic technique by which the sex of chicks could be determined accurately became available by the discovery of the first sex-linked character in poultry—a white head spot in baby chicks and barred adult plumage.

Since then poultry geneticists have identified a number of other sex-linked genes which also produce visible effects on characters of the baby chick and can be used in identification of the sex of the chick.

Three principal methods are now used in sexing baby chicks: sex-linked crossbred matings, autosexing breeds or varieties, and the cloacal—so-called Japanese—method of examination of the copulatory organ.

Sex-Linked Crosses

The principle of sex-linkage is based on the fact that males have two sex chromosomes and females only one. Chromosomes are the structures on which the genes are situated and the genes are the factors which determine the heritable characters such as color, growth pattern and disease resistance. Any specific gene borne on the sex chromosome—a sex-linked gene—can then be present in both sex chromosomes of the males, but only in the single sex chromosome of the female. If the female carrying a dominant sex-linked gene is mated to a male carrying two corresponding recessive genes, the sons will resemble the mothers in showing the effect of the dominant gene



and the daughters will show the recessive character of the father. The accompanying diagram is a graphic illustration of this condition.

This sex-linked cross gives a typical criss-cross expression of inheritance, since the offspring of one sex resembles the parent of the other sex.

Contrasting characters which are de-

termined by sex-linked genes, and which are often used in crosses to determine sex in baby chicks, include: barring and non-barring, silver and gold color, and rapid and slow feathering.

One deficiency of this method of identifying sexes lies in the failure of some breeds, varieties, or even species of poultry to have sex-linked characters that are expressed in the young at hatching. Another difficulty arises from the necessity of using crossbreeding, which means that two varieties must be maintained to produce the sex-linked crosses.

Autosexing

In 1930 two English geneticists extended the principle of sex linkage to sex identification of baby chicks without resorting to breed crosses. This method, known as autosexing, involves the interaction of a sex-linked gene—the barring gene in every instance reported to date—with certain other genes in a pure-breeding variety or strain of chickens. Two genes for barring, carried by the male, modify the color or pattern expressed in the chick down feathers by the action of other genes in a more severe fashion than would one barring gene carried by the female. This method, therefore, permits the development of a purebreeding variety in which the sexes consistently appear different at hatching. Some inherited characters in chickens with which the barring gene will interact to give autosexing are: parallel penciling, a striped chick down pattern, and the down pattern of mottled breeds like the Ancona.

The creation of a purebreeding autosexing breed or variety is a task that demands a number of generations of careful genetic work on the part of the breeder.

More recent studies of certain purebred varieties—Barred Plymouth Rocks, for example—suggest that sex identification of chicks, with a degree of accuracy which varies with the strain, is possible.

It is probable that accuracy of sexing may be increased in these chickens to more satisfactory levels by genetic selection within the variety.

Cloacal Method

This method depends upon the inspection of a copulatory organ found inside

the vent of the baby chick or other form of poultry. After the twelfth day of incubation of the chick, the copulatory organ of females either fails to develop farther or actually becomes smaller; that of the male increases in size. By hatching time, the female either has a small organ or lacks it. To a certain extent the largest female organs may intergrade with the smallest male organs, so extreme skill is needed by the sexer in order to obtain accuracies in identification that approach 100%.

The sexing operation demands very good eyesight, skill in manipulating the vent to expose the organ, and long training to identify the various shapes found in the organs present. Although principally used in sexing chickens, the method can also be applied to turkeys, waterfowl, pigeons, and certain other species of poultry.

Use of Methods

Certain sex-linked chicken crosses have very desirable characteristics for meat production. In the United States, such crosses are used in several areas for the production of broilers and fryers. Frequently, only the males are raised for meat, and the females are saved for commercial egg production. In Great Britain sex-linked crosses of chickens are much more extensively used for egg production than in America. The commercial use of sex-linked crosses has not been developed for other species of poultry.

Autosexing breeds have not yet been developed to have the high production qualities that are necessary in commercial chicken production. In England particularly, a number of breeders are striving to increase egg production, egg size, and other desirable qualities in autosexing stock, but as yet the results have not equalled the better breeds that have no autosexing characters. Among other species of poultry, one relatively unimportant variety of geese exhibits autosexing.

In all important commercial poultry sections of the world, the cloacal method of sexing has been widely practiced when economic conditions are unfavorable for rearing the male chicks, or when segregating the sexes at hatching for shipment to different poultrymen for rearing.

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TORTRIX

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Two pickings of fruit were made—July 18th and August 9th—from the experimental plots, and a random sampling

Percentage of Tortrix Injured Fruit at Harvest Following Spray Treatments

Plot Section 1				
First spray	Second spray	Fruit counted	Tortrix infested	Infested fruit
DDT	Lead arsenate	3894	452	11.6%
DDT	Methoxychlor	3748	400	10.7
DDT	Cryolite	3514	182	5.2
DDT	DDD	3479	149	4.3
DDT	Parathion	3634	83	2.3
Plot Section 2				
Lead arsenate	Lead arsenate	3876	21	0.5%
Methoxychlor	Methoxychlor	3651	104	2.9
Cryolite	Cryolite	3033	51	1.7
DDD	DDD	3240	4	0.1
Parathion	Parathion	3450	10	0.3
Control Section				
Unsprayed trees		3446	719	21.0%

Significant difference at 1% level in the first plot is 5.7% and in the second plot, 1.3%.

of about 3,500 fruit was carefully inspected for tortrix and other insect injury from each of the treatments. The control obtained is shown above.

When DDT was used in the petal fall

Spray Residue Analysis

Plot Section 1	
ppm (parts per million)	
DDT—lead arsenate	1.25 as arsenic trioxide
DDT—methoxychlor	1.2 as methoxychlor
DDT—cryolite	2.1 as fluorine
DDT—DDD	1.6 as DDD
DDT—parathion	0.07 as parathion 0.51 as DDT
Plot Section 2	
Lead arsenate—lead arsenate	3.5 as arsenic trioxide
methoxychlor—methoxychlor	1.6 as methoxychlor
cryolite—cryolite	3.6 as fluorine
DDD—DDD	1.8 as DDD
parathion—parathion	0.03 as parathion

period and followed by one of the insecticides for the control of the orange tortrix, the results were not so good as when the same materials were used in both sprays. Considering that all of the materials used in the second plot are fairly effective in the control of codling moth as well as orange tortrix, any one of the materials should prove effective against either pest.

The codling moth population in this plot was too low to give significant differences in the control of this pest.

In orchards where spider mites are a problem, the use of a suitable acaricide in combination with these materials may be required.

Fewer woolly apple aphids were found on the fruit and trees sprayed with parathion, cryolite and lead arsenate. Aphids were noticeably heavier on unsprayed, DDD and methoxychlor sprayed trees.

Spray residue analysis of fruit from each of the treated plots at harvest gave the results shown in lower table.

There is apparently no danger from spray residues following these treatments when the last application is made six weeks before harvest.

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See "Orange Tortrix on Deciduous Fruits," page 13, CALIFORNIA AGRICULTURE, August, 1948.

CITRUS

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any given element is deficient, the direction of change of the other elements is fairly well known in many instances. Knowledge of the usual range of values for healthy leaves provides a somewhat broader base for evaluating the leaf analysis.

In another example case, the nitrogen might turn out to be around 2.75%, but phosphorus might be less than 0.08%. Under these conditions it might reasonably be suspected that phosphorus is lacking, and it would be worthwhile to try out phosphorus fertilizer in the orchard.

Data given here—while for orange leaves of a given age range—suggest that these values may be used on similarly aged lemon and grapefruit leaves even though the certainty be somewhat less.

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LIVESTOCK

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evidence is available, however, suggests that the deficit in sheep and lambs came during the World War II period. Although California has been a deficit area for dairy products as a group over the period under review, in recent years it has been a surplus state in the production of evaporated and dried whole milk. In the poultry products group a deficit position in chicken meat production has persisted throughout the period. In egg production a change from a surplus to a deficit state occurred around the middle 1930's. The state has been a surplus area in turkey production since the late 1930's. Commercial turkey production did not really get under way in this state until the early 1930's. Thus turkeys constitute the only product in the entire livestock group in which California has established a surplus position relatively early in its production history and maintained this surplus position continuously throughout the recent period of very rapid population growth.

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POULTRY

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ing of turkey poults is also practiced commercially. Schools teaching the cloacal sexing method have been developed, and associations of trained sexers formed for the promotion of commercial employment of sexers by hatcherymen. Certain problems still remain in the use of this method, since breeds and strains differ in the ease with which the sexes can be identified accurately. Future breeding work may prove that the accuracy of sexing of a strain can be improved by selecting for well-defined copulatory organs in males and their absence in females at hatching.

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CANKER

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as smut and molds, that may be carried by insects to the fruit and there result in spoilage and additional loss. For these reasons all prunings should be removed every year from the orchards and destroyed by burning.

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