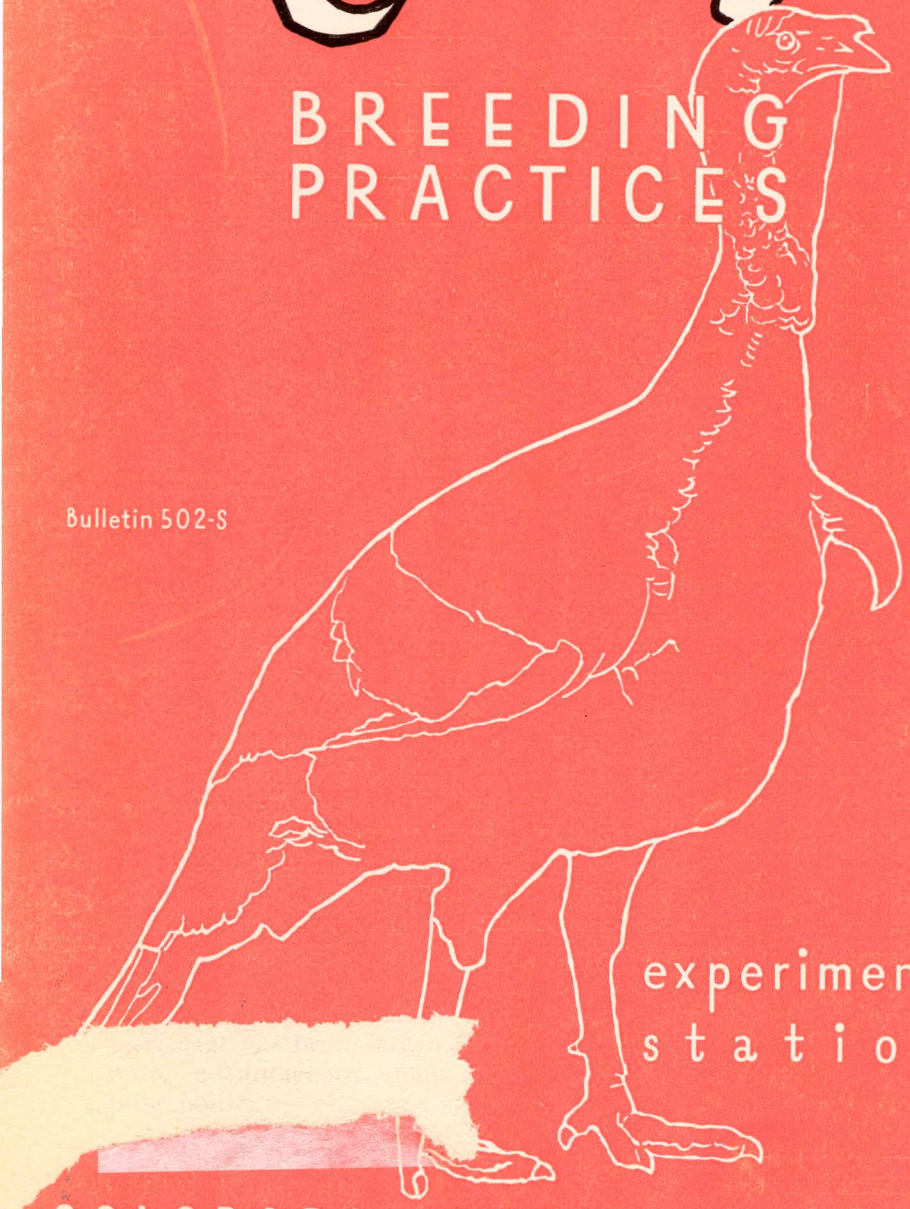
Turkey

BREEDING PRACTICES



Bulletin 502-S

experiment station

COLORADO STATE UNIVERSITY
FORT COLLINS

Contents

This bulletin is designed to bring to the potential turkey breeder in Colorado some of the basic information which will be of help to him. It is not designed to be of highly technical nature but merely to provide a background of information and suggestions from which he may start. A considerable amount of the material used in this bulletin has resulted from research carried out at the Colorado Agricultural Experiment Station under the Western Regional Turkey Breeding project, W-7. Material has been drawn from the results presented by other western states in this project including California, Utah, Oregon, Washington and Wyoming. The project includes the cooperation of the U. S. Department of Agriculture and its associated personnel and facilities at Beltsville, Maryland; Lafayette, Indiana, and Washington, D. C.

FORT COLLINS, COLORADO JANUARY 1959

3M—1-59

Turkey Breeding Practices

R. E. Moreng[1] and T. E. Hartung[2]

Introduction

Colorado's turkey production has increased considerably in the past decade. Modern turkey farms ranging from 2,000 to 3,000 birds up to 75,000 and 100,000 birds are evident throughout the state. The climate of Colorado is conducive to the growth of turkeys, and the location of the state with regard to feed production areas has also made the industry very profitable. Also processing facilities have kept pace with the more efficient production methods and these changes have all added up to place Colorado in a good competitive position.

However, the growing Colorado turkey industry has been dependent upon poults produced outside of the state and shipped in either by air, rail, or truck. This has increased the costs of poults somewhat, through initial costs of the poult, shipping and resulting losses from the stresses encountered in transportation.

Quality poults can be produced within the state at a reasonable cost, and past experience indicates that the job well done will pay many dividends and strengthen Colorado's competitive position.

Difference Between Turkey Breeding and Turkey Reproduction

Experience with turkey breeding at Colorado State University has shown that eggs produced under the climatic conditions here in Colorado have some advantage over those shipped in from out of state, although shipping eggs has been shown to be more advantageous than shipping poults.

At present in Colorado there are very few turkey breeding or reproduction flocks. A breeder flock is more than just one that is used for hatching eggs.

The true breeder flock is under very close scrutiny and control. Information is gathered on growth, reproduction and feed conversion as well as market qualities of the bird produced. Very intensive selection practices

[1] Chief, Poultry Research Section, Experiment Station, Colorado State University.

[2] Poultryman, Colorado State University Extension Service.

are followed with a pedigree program usually involved. A turkey breeder uses a definite science which involves large numbers of birds with a very high capital investment.

The turkey reproducer works very closely with the breeder and usually reproduces the turkeys from a definite line or strain. These birds are usually obtained in one or two ways — through breeding stock direct from the breeders' hatchery, or through eggs from the breeder. Generally the term "breeder flock" is used to cover both the turkey breeding and reproduction phases.

In the immediate future, the turkey reproducer has a definite place in Colorado to eliminate the shipping stresses put on poults coming in from out of state. The breeder also has a place in Colorado, and breeding practices followed in other areas can be used as a pattern for his techniques. However, the breeder program is more of a long range project.

The turkey grower as well as the turkey reproducer should have some knowledge of the breeding practices utilized in the production of turkey stock. This is important so that these people can evaluate the various types of turkeys available on the market.

Breeding Systems

Pure Line

A pure line or strain of turkeys refers to a flock that has been closed mated (no stock brought in from an outside source) for at least five years by a turkey breeder. These birds have usually been selected very intensely by an individual and are quite similar to that breeder's standard or type. The longer the breeder has worked on a particular line, the more uniformity he may have in his birds.

It is quite common in the turkey industry to refer to birds by their strain name rather than by their variety name. There are many top quality pure lines of turkeys in the United States today, and a considerable amount of progress and achievement has been obtained by use of them.

Strain Crossing

The object of strain crossing is to obtain a certain amount of hybrid vigor through crossing two related but different lines of turkeys. This is usually done by the breeder splitting his flock into one or more parts and then selecting various characteristics in these sub-flocks. Sometimes breeders will obtain stock from outside of their own flocks and cross these strains within their same varieties. A number of turkey breeders at the present time are practicing strain crossing and selling strain crossed poults.

Cross Breeding

Cross breeding of turkeys involves the mating of two different varieties such as crossing Broad Breasted Bronze toms on

White Holland hens. To date this has not proven to be very successful in producing commercial turkeys. This method has been used to develop the Broad White. However, it was merely used to develop a large white bird and then pure line breeding was used.

Hybridization Through Inbreeding

Inbreeding and hybridization are techniques that were initially started by the hybrid corn breeder, picked up by the chicken breeder, and at present are under close study by turkey breeders.

Hybridization through inbreeding involves the selection of several families, each for one or two outstanding characteristics, and then intensive inbreeding is obtained through brother-sister matings. After at least four generations of inbreeding, the families are crossed in order to concentrate their favorable characteristics within the resulting poult. This method is still in the experimental stage as far as the commercial turkey industry is concerned.

Setting Up a Breeding Program

The breeding program you set up will depend upon whether the plan is merely to reproduce turkeys from established stock or to venture into the field of "building" a new strain. The "building" of a new strain or, technically speaking, being a turkey breeder, will require a great deal more planning and development than is required in reproducing turkeys.

First of all, you must consider the basic stock which is to be used in the breeding program. The fact that large numbers must be employed and that a high degree of selection is necessary for both market and reproductive economic characteristics must be considered. It is important to try to maintain characteristics according to the variety being bred, but the most important thing to consider is the economic value of the bird and uniformity in the stock produced.

The reproducer of turkeys should consider the use of strong healthy stock and use some degree of selection. However, it is assumed that his stock has been well selected by the breeder for many of the economic characteristics needed.

The cost of producing turkey hatching eggs runs high because of the usually short season and low hatchability of eggs experienced by the turkey breeder in comparison to that of the chicken breeder. The seemingly high price received for eggs and poults is tempered by problems of relatively low reproductive performance compared with chickens. The breeder who is to be successful will be the one who does an efficient job of reproducing and improving turkeys.

Selection of Characteristics

In selecting characteristics the breeder should consider the objectives of his program as well as the market purposes of the bird which he plans to supply.

It is quite reasonable to assume that, the more characteristics for which we try to select, the slower the breeding program is going to progress. Of course, speed is not the most important thing, and you must be resigned to many years of selection in a sound breeding program.

Most breeders select for specific economic characteristics, however, usually there are a number of prime characters which any one particular breeder may emphasize. This type of selection will establish the "breeders choice" and is the main basis for the term **strain.** These characteristics include the following:

1. Fertility
2. Hatchability of fertile eggs
3. Rapid growth
4. Efficient feed conversion
5. Good body conformation
   a. Broad breast
   b. Long keel
   c. Heavy thighs
   d. Broad back
6. Rate of lay of breeder hens
7. Health and vigor
8. Rapid feathering (this is usually associated with rapid growth)

Characteristics a turkey reproducer should look for:

1. Health and vigor
2. Average weight for toms and hens at a given age
3. Elimination of physical defects such as crooked backs and keel bones, weak legs or hocks, pendulous crop, defective beaks, blindness and deformities

Measuring Performance

A breeder must follow a type of pedigree mating and develop records on individual hens and toms for his basic stock. This will involve trap nesting or caging of the hens and the use of individual tom matings. Some standards that the breeder will follow in this pedigree mating period are:

1. Body weight
2. Hatchability
3. Fertility
4. Egg production
5. Feed conversion
6. Individual and family performance
7. Performance of progeny

Fertility

Fertility is important to either the person who is reproducing turkeys or the turkey breeder. Fertility accounts for the greatest factor in the cost of a turkey poult. Poor fertility is one of the turkey breeders' and reproducers' greatest problems.

Fertility many times is either an environmental problem or a physical problem of mating among the turkeys.

Causes of Poor Fertility

1. **Inadequate diet**—nutritional deficiencies

2. **Mating interference of toms**—too many toms or overly agressive toms

3. **Too few toms**—not enough toms to cover all females. The following ratios are recommended: Heavy breeds — 1 tom for each 10 hens. Light breeds—1 tom for each 15 hens.

4. **Preferential mating**, either among males or females—certain females will not mate with certain males or vice versa

5. **Poor conditions** of light, temperature or a combination of both

6. **Season of the year** — the springtime has been shown to be the season of highest fertility, perhaps because it is generally accepted as the natural mating season. Usually fertility will run high at the onset of the season and then taper off toward the end. It is felt that one of the main reasons for this is inactivity of the males in the latter part of the breeding season along with broodiness or molting of early hatched hens and molting of toms.

Many breeders will introduce a second set of toms about halfway through the breeding season in order to maintain fertility. These may be from a later hatch or toms which have been held under restricted light of eight hours a day until three weeks before they are to be introduced into the flocks. Then they may be prelighted with fourteen hours of light a day.

Evaluating Toms and Hens

Toms and hens should be evaluated on the basis of their mating activity as well as on their reproductive performance.

It is a sound program to test toms for their ability to produce semen. You may also examine the vent of a tom and determine whether it is large and moist rather than small and dried.

The hen, too, may be handled to determine egg production performance, and many of the characteristics such as a large moist vent which are similar to those of the high producing laying chicken would apply to the turkey. The best method of evaluating hens as to their reproductive performances is through a pedigree program. This is done more easily with hens than it is with toms.

Usually hens that are high in egg production are also the hens that will give the highest fertility. The overly aggressive tom is not always the one that fertilizes the most eggs, but some aggressiveness is desired among the toms.

Methods of Improving and Retaining Fertility

There is much room for improvement of fertility among turkey breeding stock. Retaining of the fertility is an important point, too, within the flock and after the egg enters storage prior to incubation. It has been

shown that the care of turkey hatching eggs is a very important factor in the maintenance of fertility.

Environmental Conditions of the Flock—The turkey flock can be pretty well controlled as to the onset of egg production and the activity of the males. This is carried out through two techniques, that of preheating (during cold weather) and prelighting of toms and prelighting the hens.

Preheating involves holding the toms at a temperature near 50° F. five weeks prior to entering them into the breeding pens. Naturally any toms one plans to use later would not be preheated with the first group of toms. The prelighting of both the toms and hens begins three weeks ahead of being put into the breeding pens, allowing fourteen hours of light per day.

At present, it appears that the most desirable intensity for lighting turkey breeding stock is about 1 to 1.7 foot candles at bird height, when morning lights are used. This light can be obtained from 25- to 40-watt bulbs, placed 6½ feet above the birds and spaced ten feet apart. Too much light may be detrimental.

Mating Methods — There are three mating methods:

Stud Mating—the mating of one hen with one tom at a time. This is quite successful but takes a great deal of labor. There are many arrangements for the stud method, and it can be carried out on a large flock as well as a small flock.

At the Colorado Experiment Station turkey flock, hens are maintained in cages and rotated to the toms. These cages, shown in Figures 1 and 2, are placed on the floor and are arranged so that the hens can be let out of the cages to spend the day with the toms. Hens are rotated once daily in this system; however, rotation could be more frequent.

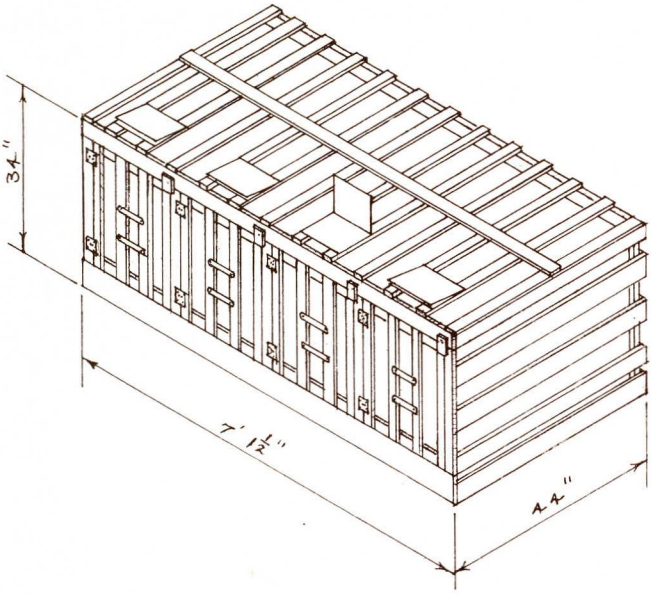
In large flocks the hens are run singularly through a pen of toms, and as soon as mating occurs, the hen is removed. Each hen should be mated once every ten days.

Toms may also be run into a pen of hens one at a time, then when mating occurs the hen is removed and a new tom entered into the pen.

Pen Mating With Tom Rotation—a rotation system where toms are rotated at least weekly or biweekly from pen to pen has been practiced and proven quite satisfactory. In this method, the preferential mating is also controlled and more than one tom is involved.

By rotating toms, one also minimizes any sterility or low fertility problem in any one pen. The pen size will vary with the particular breeder flock. Small pens ranging from 50 to 100 hens are practical. Never have more than 500 hens to a pen (Figure 3).

Artificial Insemination—the practice of artificial insemination is carried out very widely in



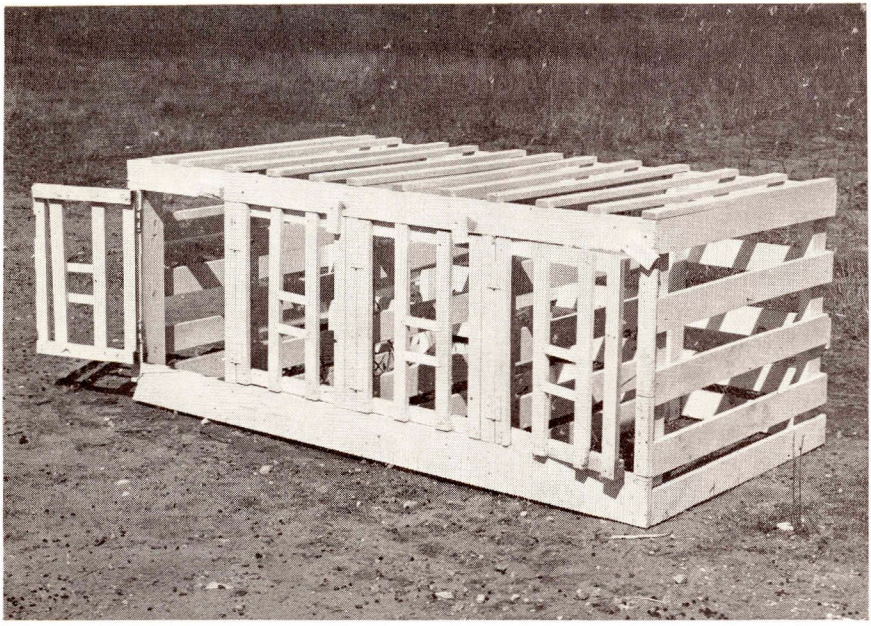


FIGURE 1. Here is a breeder hen cage used for stud mating and automatic trap nesting of turkey hens. Modifications in the overall dimensions of the cage may be considered. The sketch shows how record boards can be attached to the top of each pen. Wire may be tacked to the doors to keep hens from out of each other's troughs. The cage has no bottom and is moved easily.

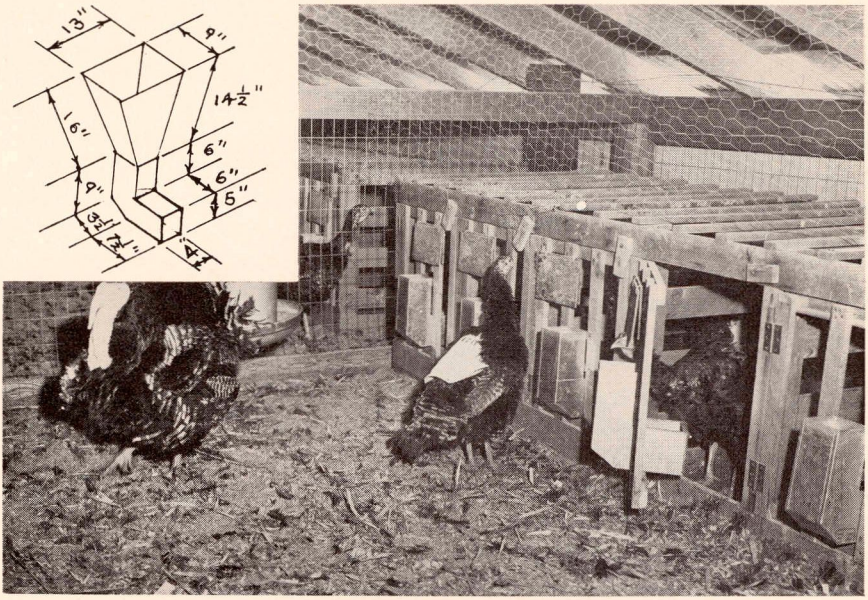


FIGURE 2. Breeder cage in use showing position of hen and feeder. Notice the hoppers attached to the cage doors. In the sketch, an addition has been made to the hopper for more feed capacity.

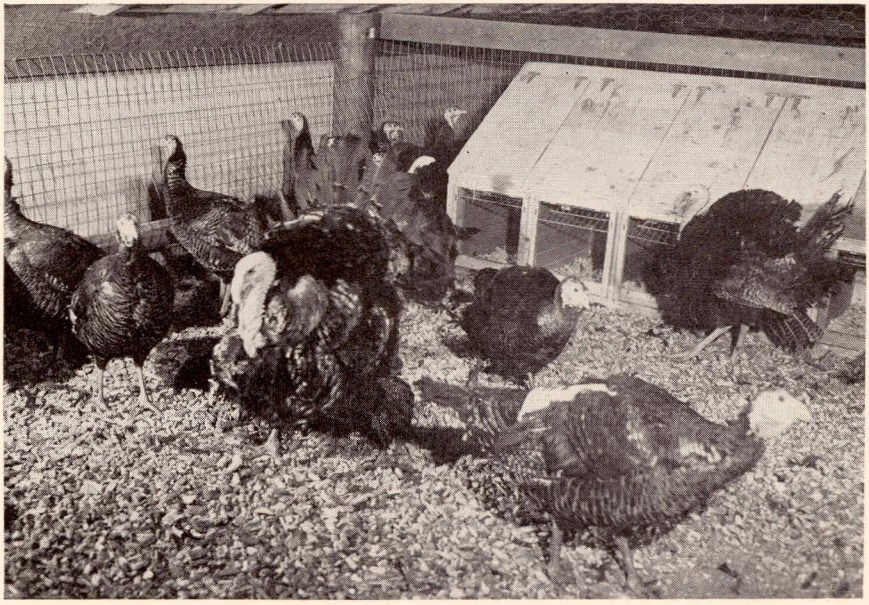


FIGURE 3. Pen of random-mated hens showing trap nest and type of flock mating used where two toms are mated with approximately 15 to 20 hens.

some portions of the country in turkey breeding flocks. It can be used either by itself as the complete method of mating or as a supplementation method to other natural mating systems. When it is used individually, it is carried out by teams of men who contract to artificially inseminate the breeder flock.

Of course, the breeder himself can form a team with his own help and inseminate large numbers of birds in a relatively short period of time.

Turkey semen cannot be stored, diluted successfully or mishandled in any way, and semen samples must be used within 10 to 15 minutes after collection for maximum fertility.

When artificial insemination is carried out as the sole method of breeding, the toms and hens are kept separate and mass insemination practices are carried out. Good quality semen should be creamy white and thick. About 2/10 to 5/10 cc are obtained at each collection and it is recommended that collections do not exceed one per day. It is important that the temperature of the semen be maintained at about 50° F. and that excessive cold be avoided. Females are inseminated once every two to three weeks with 1/20 cc of undiluted semen. Hatching eggs may be saved starting with the second day after the first insemination.

When flocks are inseminated as a supplement to natural mating, insemination is practiced at about the middle of the breeding season. In this case, the toms used for artificial insemination may run with the flock, but it is preferable that they be kept separate and different toms be used for the natural matings. A step by step procedure of artificial insemination is shown in Figures 4, 5, 6 and 7.

Feeding and Care of Breeders

The proper feeding and care of the breeder flock prior to egg production as well as during the reproductive period is of utmost importance. Regardless of the amount of breeding that may go into developing the turkey, the birds will not reproduce successfully without proper feeding and care.

Feeding

In the past, little attention has been given to the feeding of the potential breeder stock other than following the same feeding program as used on market birds until they were selected. Then these breeder birds were many times poorly fed until the breeding season started.

This appears to be a poor practice. Breeder stock should be selected at about 20 weeks of age and placed on a complete feed carrying 16 percent protein and having a fiber level at ten percent. This level of fiber will con-

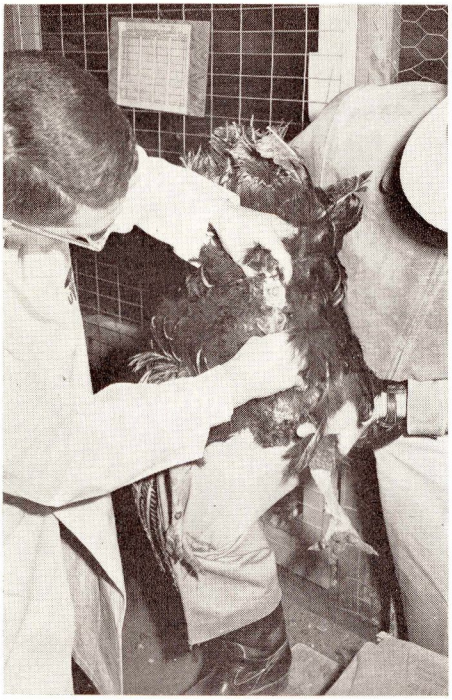


FIGURE 4. Collection of semen from tom turkey is a two-man technique. One man holds the bird while the other squeezes the papilla and collects semen in a glass funnel.

FIGURE 5. Preparation of female for insemination of semen requires a two-man technique for inverting the oviduct. When an oviduct is fully inverted, semen is inserted through the use of a tuberculum syringe.

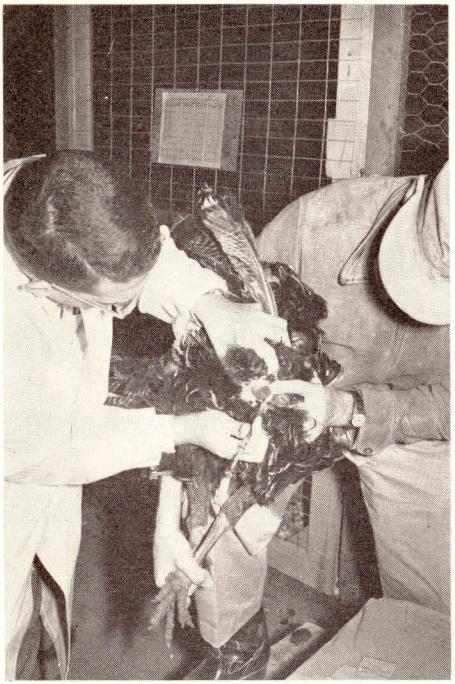


FIGURE 6. Insemination of the hen is done while the opening to the oviduct is inverted through the opening of the cloaca. Syringe is inserted about three-fourths of an inch and the proper amount of semen deposited as the syringe is withdrawn slowly. And pressure is released immediately on the birds.

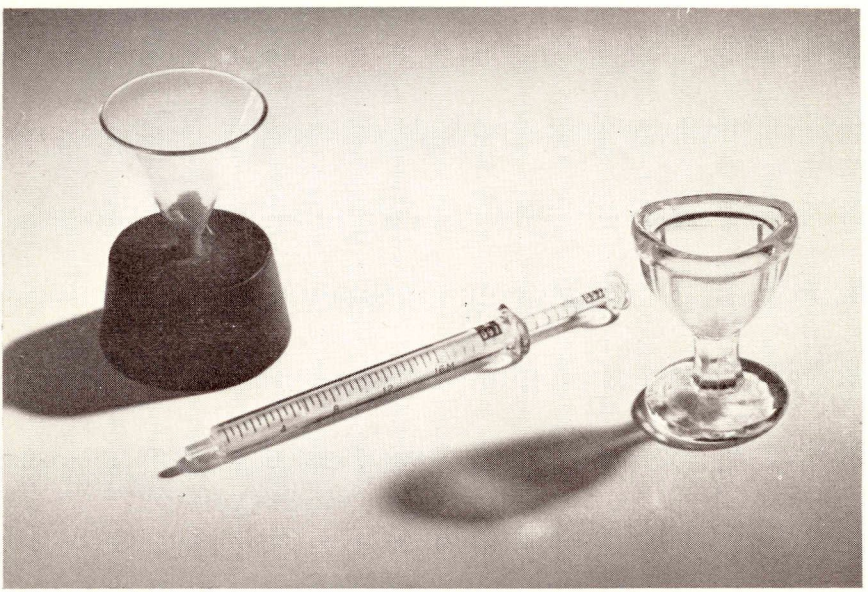


FIGURE 7. Equipment used for artificial insemination. Eye cup (right) or small glass funnel inserted in one-hole rubber stopper base (left). Note 1-cc. tuberculin syringe used for insemination of hen. The marked barrel provides accurate dosages.

trol the tendency for both the hens and toms to become overly fat and have difficulties with fertility. This feed should carry all required levels of vitamins and minerals.

At about the time prelighting starts, change over to a complete breeder feed carrying 16 percent protein and three to four percent fiber along with adequate vitamins and minerals. You may use a breeder feed which requires the free choice of oyster shell to meet the hens' calcium requirements. A formula for such diets may be obtained by contacting the Poultry Department or the Extension Poultryman at Colorado State University at Fort Collins.

Grain intake should be limited because of the tendency of breeder hens and toms to load up on grain during the cold weather and thus become too fat. Excessive fat is usually not conducive to high egg production and fertility, and therefore, when the birds are brought into production, their performance is not as high as you might expect.

The breeder turkey should be allowed to have this diet free choice and it may be fed either in the form of all mash, crumbles or pellets. The type of system for feeding the birds will depend largely upon the breeder and the source of feed supply available.

At the time breeding stock is selected it would be well to separate the hens and toms if they are not already divided. Continue to keep them separated until several weeks before saving hatching eggs.

Broodiness

The onset of broodiness is usually triggered by the advent of the longer day and mild weather of the spring. It tends to show up after the hens have been in production for several months. Broodiness should be broken up as soon as it is detected in the flock.

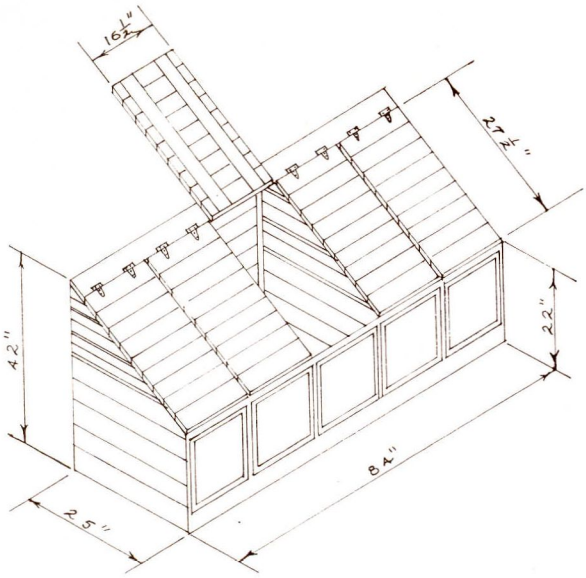
A broody hen can be controlled in a number of ways. One of the most successful is to put the bird in an outdoor pen where there are no nests and keep her on the breeder diet. The broody hen should not be mistreated, but should be treated gently and encouraged to return to production. After egg production commences in the broody hen, she should be held for two or three days before placing her back in the pen.

Many breeders will mark broody hens with a colored band or in some other manner. Those that continue to be broody should be eliminated from the breeder flock.

Broodiness can be controlled and treated in some flocks by the use of hormone injections (diethystilbestrol). This method has not been used commercially to any degree at this time.

Equipment

Nests — The individual nest should be at least two feet high, one and one-half feet wide and



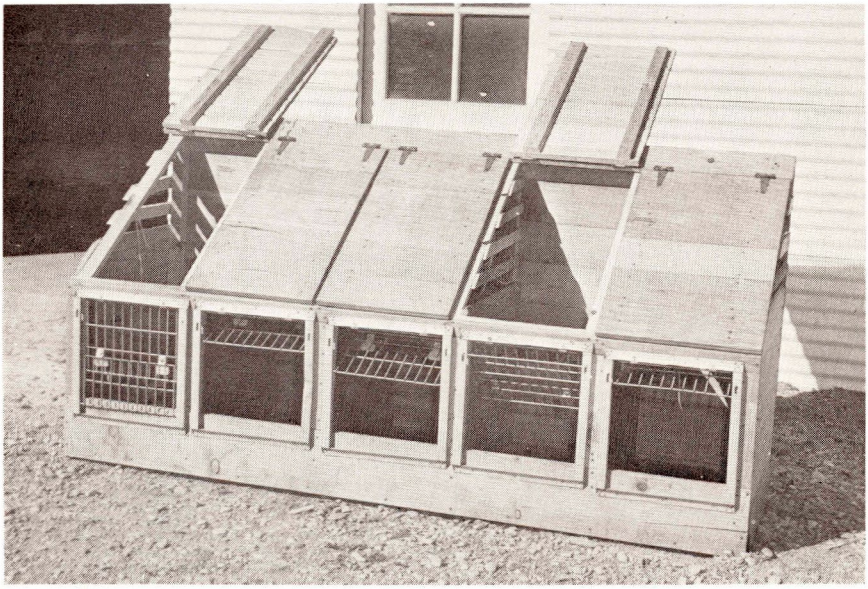
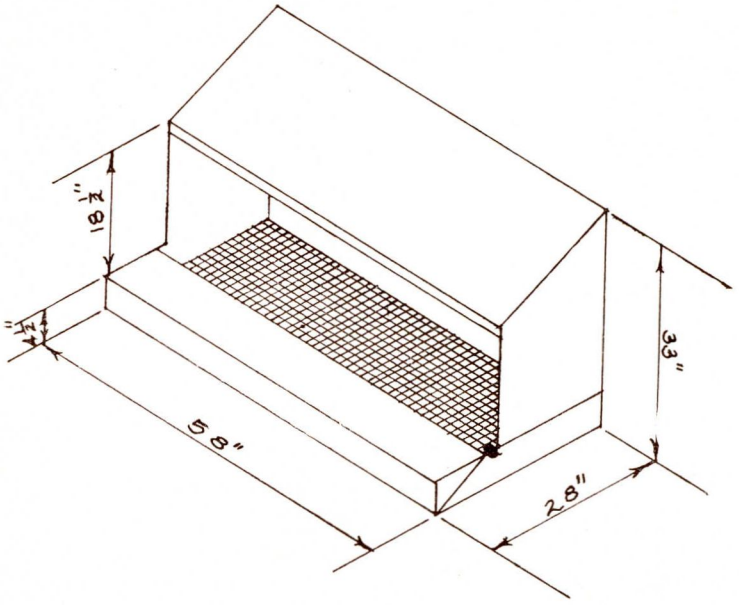


FIGURE 8. Opened nest with trap fronts attached. This is an open type nest with dimensions shown in the drawing. This particular nest has a bottom but it is recommended that the bottom be left out for easy cleaning, if suitable to conditions. Trap fronts are easily installed on the frame. Note the hinged top for easy removal of the hen and the louvered sides for adequate air ventilation and cool conditions within the nest.



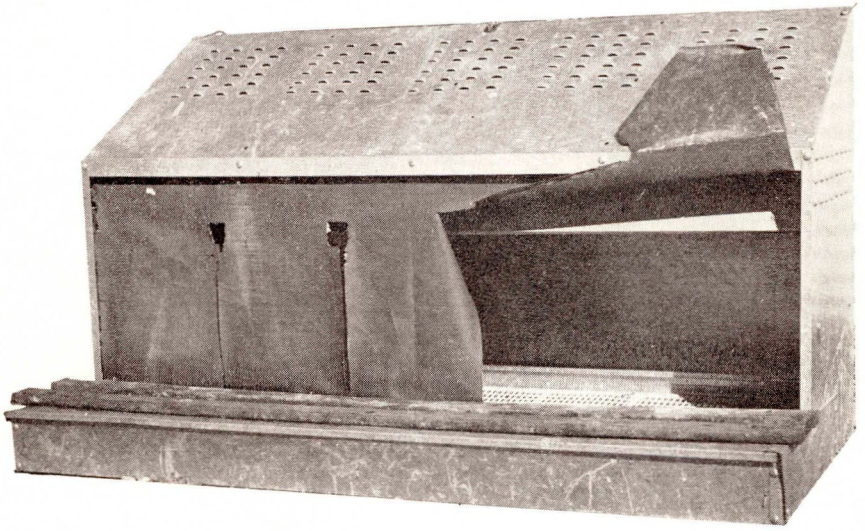


FIGURE 9. A commercially built rollaway type nest with front flap up to show interior portion. This nest has a rubberized wire bottom and the eggs roll forward under the roosting portion. This is advantageous in keeping the eggs clean.

two feet long. If trap nesting, allow one nest for each two to three hens. When traps are not used, one nest to every five hens is considered adequate. Allow enough depth to the nest so that at least four inches of nest bedding can be used. Nests should be placed on the floor or about six inches off of the floor.

There are a number of different types of nests that can be used in the breeder house, and you can see one style in Figure 8.

This open front type nest, or box nest, is very popular. This nest can be adapted for use of trap nest fronts or it can have the semi-trap gate added to it. The trap gate is used many times to keep more than one turkey from occupying a nest at one time, and it minimizes breaking and soiling eggs. The turkeys can move freely in and out of the nest with this trap gate and unless you are pedigreeing your birds, the usual self-locking trap nest front is not necessary.

Cages, as previously shown, or in other forms, may be employed and have the main advantage of accurate egg production records without trapnesting although additional labor is involved in caring for the birds and in mating. A rollaway type community nest (Figure 9) has come into use in recent years and may be obtained commercially.

Feeders—The types of feeders used for the breeder hen will vary from bulk type feeders to porch type feeders as shown in Figures 10, 11 and 12. Allow at least 40 linear feet of feeder space (two ten-foot feeders open on both sides) for each 100 birds. Allow one 700 pound or larger bulk type feeder (diameter of feed pan 40 inches) or four hanging feeders (16 inches in diameter) for each 100 hens.

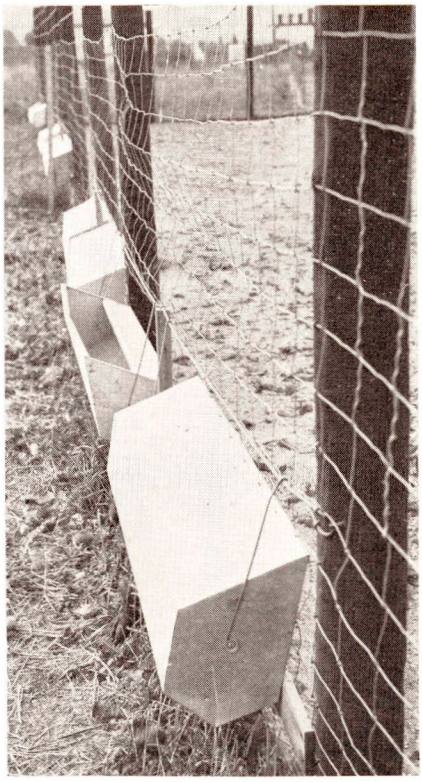


FIGURE 10. A porch-type feeder showing one feeder pulled back for filling.

Waterers—Allow eight linear feet of waterer trough or three five-gallon waterers for each 100 turkeys. The waterers should be placed over wire screen frames to prevent the turkeys from getting into the water that may be spilled.

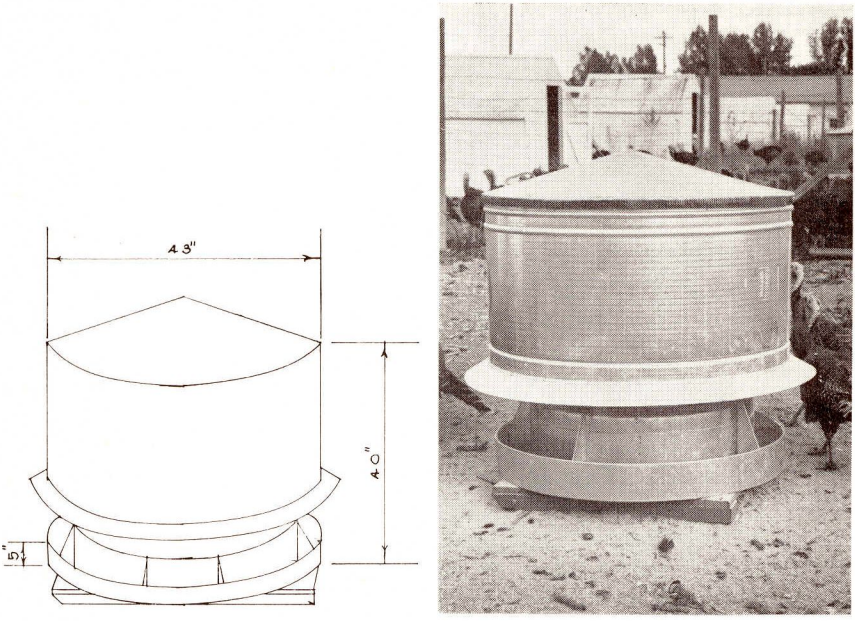


FIGURE 11. This is a bulk-type range feeder with weather shield.

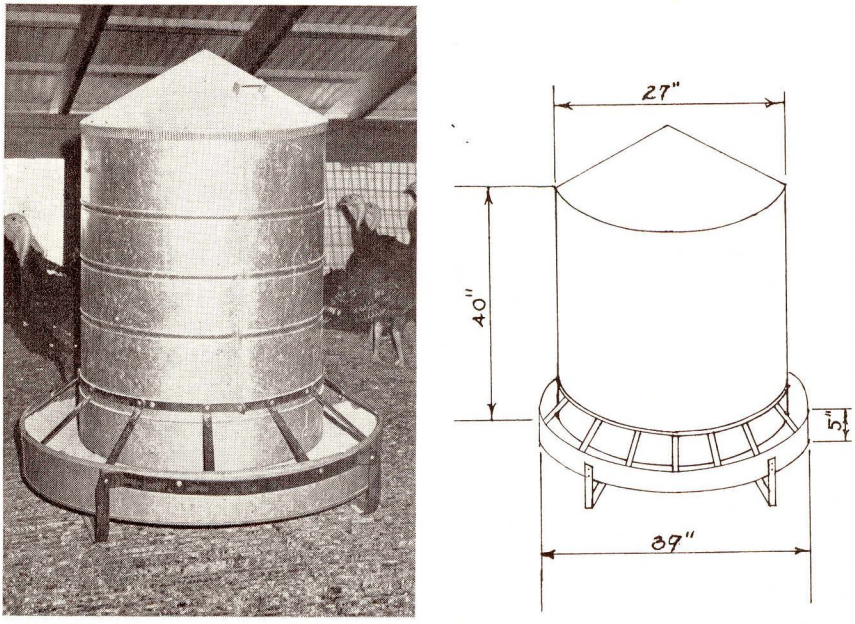


FIGURE 12. A bulk-type feeder used indoors without the rain shield.

One of the great problems with breeder flocks is that of preventing the waterers from freezing up. Arrange to have some means, either electric tape or other waterer heaters, to keep them from freezing. If the water is turned off overnight, be sure to have the water turned on when the lights come on the next morning.

Roosts—Roosts are not absolutely necessary in the turkey flock. The main function of roosts is to keep the birds from crowding or piling up and to allow some of the less agressive birds a place to get away from the main flock. Roosts sometimes will interfere with fertility because some hens will tend to spend a high percentage of their time on the roost and therefore not be available for mating.

When turkeys are out on open range (pen with range shelters), roosts are recommended. However, if the breeder hen is confined, roosts may not be necessary. Allow 16 inches of roost space for each heavy breed turkey and 12 inches for small breed birds and never have the roosts more than two feet above the floor or ground.

Saddles for Breeder Hens—Prior to the combining of the hens and toms forming the breeding pen, put canvas saddles on all hens. The saddle should be of heavy canvas so that it will resist tearing when the toms are mating. Heavy losses from cuts and tears can be expected if saddles are not used on the hens. This will permanently down grade the breeder hen for market and it will result in heavy mortality. Light colored saddles are preferred for birds in open pens to reflect the sun and reduce the heat under the saddles.

Housing

Housing of the breeder turkey is a point that still may be open to a considerable amount of discussion. Since the breeder turkey in the past has been allowed to roam at will in open pens, with range type or open shed shelters, this practice is followed in many parts of the country.

However, a high degree of success has been obtained from the use of pole sheds for breeder turkeys. Apparently the breeder turkey does not need the amount of protection the chicken does during the cold months of the year. Protection should be afforded to keep the bird dry and free from the direct winds and elements of winter weather. An important thing to consider, too, is the proper care of the hatching eggs so that they do not become frozen or excessively chilled in exposed areas.

Breeder turkeys should not be housed in a warm building in that this tends to increase broodiness. Artificial light should be supplied, 14 hours per day, in order to bring the birds into early production. If the birds are confined within a pole shed or other type of building, this lighting is easily accomplished.

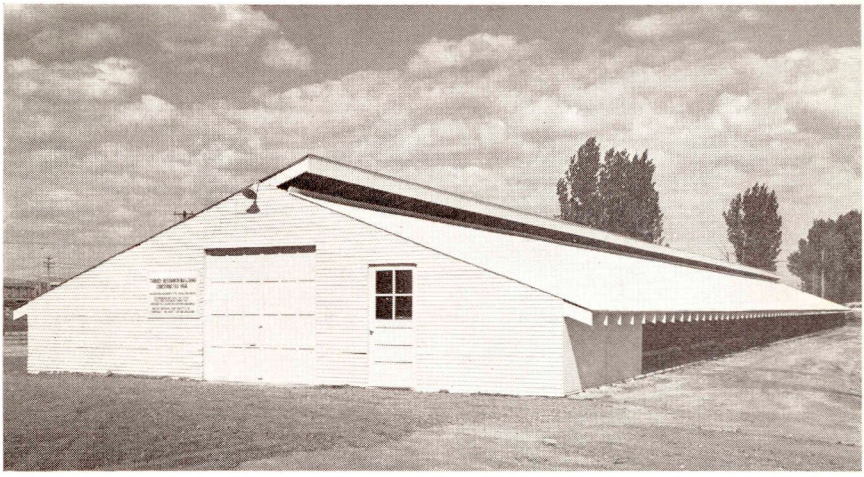


FIGURE 13. Pole shed, showing panelled sides removed for both summer and winter versatility. Note full ridge ventilator and white finish for summer temperature control. Plan available on request from Poultry Research Section, CSU Experiment Station, Fort Collins.

Pole sheds with outdoor runs can be very suitable for breeder turkeys (Figure 13). This affords a certain amount of shed space while it allows the birds to run. In total confinement the breeder turkey should be allowed ten square feet of floor space. Under semi-confinement, allow at least six square feet per bird.

Use deep litter in the pole house. Have six to eight inches of litter material before the breeding season has progressed very far. Remove any wet litter that may accumulate and it may be necessary to stir the litter once each two to three weeks, depending on the litter condition. Good litter management is the key to preventing any build up of worm infestations.

The turkey breeder can utilize his pole house facilities and other equipment quite efficiently during the off-season growing months. Breeder hens should not be allowed to lay their eggs without the use of some type of nesting equipment. In open pens, allow at least 500 square feet of pen area per bird.

Care of Hatching Eggs

Eggs should be collected frequently in cold weather—at least every two hours—and they should be stored in a clean wire basket. The heaviest period of lay is during the early afternoon, but this will depend upon the lighting schedule. About 70 percent of the eggs will be laid after noon.

Currently there is evidence that hatchability can be improved by holding the eggs under warm conditions for a short time after they are gathered and be-

fore placing them in the cooler. This is termed prewarming. This includes the gathering of eggs in wire baskets and then holding at approximately 75 to 80 degrees Fahrenheit for 24 hours before storing them in cold rooms at about 50 to 55 degrees Fahrenheit and 60 to 80 percent relative humidity. The eggs should be packed in precooled cases, small end down, and moisture can be added by sprinkling the fillers and flats prior to packing.

Turkey eggs need not be turned while they are in storage prior to incubation if the storage time does not exceed two weeks. However, if eggs are to be held for a longer period, the eggs should be turned at least three times a day.

We do not recommend holding eggs longer than two weeks since both fertility and hatchability of these eggs declines as the holding period increases. Preincubation or prewarming of the eggs has been shown to increase the possible holding time for the eggs, and may be useful for eggs to be shipped.

Extreme care must be exercised so that the eggs are not overheated, chilled or frozen during shipping. They must be packed small end down in cases with the special turkey size flat and filler or the new filler-flat being used to prevent breakage. Shipping will sometimes result in decreased fertility and hatchability, but under proper conditions (temperature, humidity and handling) this decrease should not be significant.

Hatchability and Incubation

Hatchability of the turkey egg can be preserved through careful handling and proper care (Figure 14). Generally speaking, each incubator has its own "temperament" and only experience and close attention to the directions given by the manufacturer will result in good hatches.

Turkey eggs generally are incubated at 99½° F. and with a relative humidity of 80 to 85 percent. The eggs should be turned at least five times a day and preferably every two hours during the incubation period. The incubation period for turkey eggs is 28 days, although some embryos are known to hatch early, after only 25 and 26 days of incubation.

Only clean eggs with sound shells should be placed in the incubator. Washing is generally not recommended for turkey eggs, as it seems to encourage the entrance of bacteria. Although dirty eggs should never be put in the incubator, washing seems to be more detrimental than setting the dirty eggs. Every attempt should be made to produce clean eggs that are not contaminated. Muddy pens and lack of clean nest bedding can be big factors in contamination.

In Colorado and other western

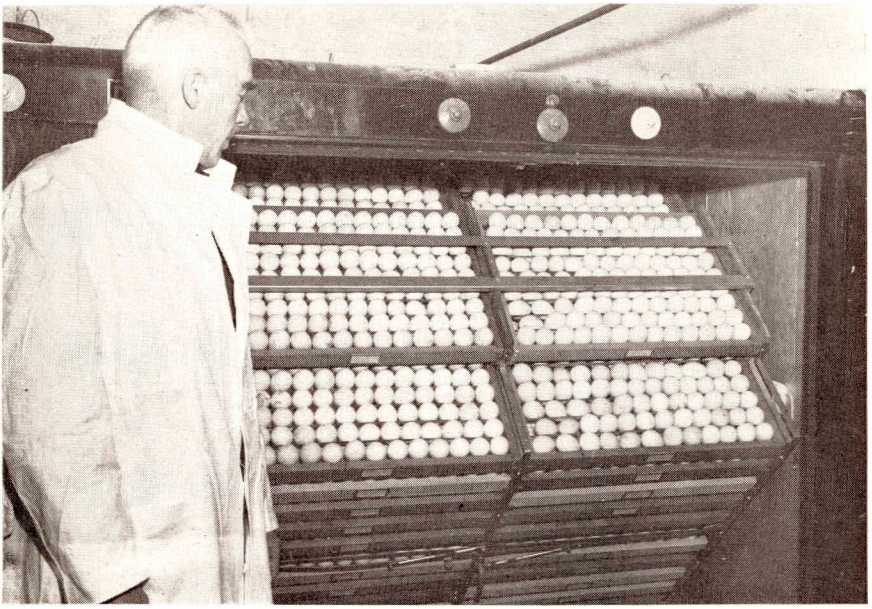


FIGURE 14. Inside view of an incubator with turkey eggs set and ready for incubation. Well proportioned, clean eggs from healthy flocks assure high fertility and hatchability when sound incubation practices are employed.

states, a problem confronts the hatcheryman because of the high altitude. Oxygen has been successfully used in incubators for the hatching of both chicken and turkey eggs. However, it has been shown that it is only economically feasible in turkey hatcheries. Both laboratory and field results show that the addition of oxygen will more than pay for itself by production of additional poults.

Conclusions

A considerable amount of work still must be done on the work of oxygen in the incubation of turkey eggs, but the following conclusions may be drawn from present information:

1. Obtain reliable instruments for analyzing for carbon dioxide and oxygen. Get these before starting the use of oxygen.

2. Overhaul each incubator to be sure all possible air leaks are closed, gaskets around doors are tight and sound, and ventilator intakes and outlets are capable of being closed tightly or adjusted as necessary.

3. Provision for oxygen tanks should be made at a convenient location. Use a manifold to hook up a series of tanks on one pressure-reducing valve and regulator. From the regulator valve, black iron piping can be run along the incubator with a line teed off to each compartment.

Test all joints for leaks, using soap suds.

Precaution: Use no oil or paint for joints and threads. Use only a mixture of glycerine and litharge.

The copper inlet tube into the compartment should be placed through an opening or hole drilled at any convenient location. The stream of oxygen should be readily mixed in the incubator air. Be sure the oxygen flow is not directly on a motor or oily surface.

For example, in the Robbins, it would be in the rear and to one side of the humidifier disc; in the Bundy, it would be through one of the front ventilator holes; in the Smith, it could be in the fresh air intake duct. The tube should be inserted through a rubber or cork stopper in the hole.

An oxygen flowmeter should be placed on each line teed off. Connection from the flowmeter should be located conveniently to read and adjust. The oxygen manufacturer will be glad to sell you regulators, flowmeter and other accessories. He will also advise on the installation and may assist in it.

4. **Precaution:** Keep the concentrated oxygen gas away from any kind of oil, grease, fuel oils and their fumes, or surfaces bearing oil or grease, such as motors, bearings, or oil or grease leakage from them. Such materials in combination with oxygen constitute an **acute fire hazard.** Once the pure oxygen is mixed in the air **at the levels recommended, it is safe.**

5. Adjust the oxygen flow, as recorded on the flowmeter, to maintain the oxygen in the incubator at 23 to 24 percent total oxygen as determined by air analysis. When the incubator is running with normal egg settings, the oxygen flow usually calculates to be about two-thirds of a liter per minute per 1,000 eggs. The flow rate, however, should be adjusted to maintain 23 to 24 percent oxygen in the incubator and in the hatcher at altitudes of 4,500 to 5,500 feet.

6. Start out with all ventilator openings closed tight. Determine the carbon dioxide content of the air every five hours, or oftener if the incubator is full, and open ventilators gradually and only enough to keep the carbon dioxide from exceeding 0.8 percent. A level of 0.6 percent carbon dioxide should be maintained if possible. Too much ventilation reduces the carbon dioxide too much and also greatly increases the amount of oxygen required.

7. Keep a record sheet tacked up by each compartment and record each observation made. The recommended headings for this record sheet are shown at the bottom of this page.

The first few days or even weeks, it will be necessary to take numerous analyses for carbon dioxide and oxygen. But if care-

Incubation Compartments

Date	Hour	Carbon Dioxide	Oxygen	Ventilator Open	Temperatures Dry Bulb	Temperatures Wet Bulb	Eggs Set	Eggs Removed	Notes
				Inches			No.		

Hatcher

Date	Hour	Carbon Dioxide	Oxygen	Ventilator	Temperatures Dry Bulb	Temperatures Wet Bulb	Eggs In	Chicks	Pips	Cripples	Notes
							No.	No. %	No. %	No. %	

FIGURE 15. Sample of recommended headings for record sheets.

ful records are kept from the start, it will be found that analyses may be required only once or twice a week. Care and experience are essential. This is not a job to be delegated to anyone but the hatchery manager or head operator.

8. Be sure of a constant and unfailing supply of oxygen for best results. Figure rough requirements on the basis of one large cylinder per 24 hours per 15,000 eggs. It evidently does no harm, if the oxygen supply fails or is cut off, except to result in failure to get the maximum increase from the oxygen used.

9. Remember that opening doors causes loss of the oxygen and carbon dioxide levels in the machines. This increases the amount of oxygen used. When it is necessary to open the machine, cut off the oxygen about one-half hour in advance, but open the oxygen valve again immediately afterward. This is not detrimental so far as is known.

10. In incubators where hatching is done in the same compartment as incubation, such as the Smith, be sure the exposure to formaldehyde fumigation is limited to about 15 minutes and that at the end of 15 minutes concentrated ammonia is used in sufficient amount to neutralize the formaldehyde. If necessary, open the ventilators and flush the machine with air to get rid of any residual strong fumes. If this is done, cut off the oxygen flow during the flushing. **Reason:** The one- and two-week-old embryos are evidently killed or harmed by excessive exposure to this fumigation.

11. It may be necessary to cut out the humidifiers entirely and to open the ventilators to keep the humidity down at proper levels. This opening may be greater than is necessary to keep the carbon dioxide down. It may also be necessary to use a cooling coil to keep the temperature at proper levels.

12. Be accurate, be careful, be painstaking, record all observations, and study them to acquire experience, confidence and good results. These records are essential, also, in case you need assistance or advice in these matters.

Only with time, research and experience will our production problems be solved.