

Perfecting the Day-Range Pastured Poultry System Through On-Farm Replicated Research

A How-To Manual for Conducting Statistically Valid Research for Producers of Pastured Poultry

**And a research report on the effect of feedings per day on
broiler weight gain.**

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Pasture Perfect, LLC (dba Pasture Perfect Poultry) is a partnership of three poultry producers near Mason, WI working together to process and market pasture-raised chickens and turkeys. The three producers use the Day-Range production system and work continuously to reduce cost of production.

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I. Introduction

Raising poultry on pasture instead of in a barn or other permanent structure is an increasingly popular enterprise for hobby and small farmers across the country. There are two general systems used by producers. The Salatin system consists of an open-floor enclosed pen or other structure that is moved once or twice a day around the pasture. The birds are kept in the pen 24 hours a day but are provided with fresh pasture by moving the pen. The Day-Range system consists of a mobile pen that is kept within an electrified-fenced area. The birds are free to roam within the fenced-area during the day and are put in the mobile pen at night if predators are a problem. The mobile pen is moved daily to prevent accumulation of manure and the fence is moved as necessary to provide access to fresh pasture.

Both systems have two primary benefits compared to conventional systems: the manure is spread on the pasture as the birds are moved, saving labor and bedding expenses, and the birds have access to plants, bugs, and anything else they can forage in the pasture. Although studies indicate the forage doesn't contribute much to the protein or carbohydrate needs of the birds, the foraging does improve some characteristics of the meat (Ponte et al, 2008a, Ponte et al, 2008b) and is appealing to customers that feel such foraging is a more humane way to raise poultry compared to conventional confinement operations. As such, consumers are willing to pay more for the pastured poultry.

Like confinement poultry systems, the profitability of the pasturing-system is still largely determined by feed conversion efficiency and labor requirements. The challenge, then, for pasture poultry producers is to maintain the benefits of pasturing while maximizing feed conversion efficiency and minimizing labor requirements.

Replicated and statistically valid research on pastured-poultry production is limited. A comparative pasture poultry study conducted in Missouri found that the Day-Range system had better feed conversion ratios than indoor systems (Seipel et al, 2003). In the study, the Day-Range system had a conversion ratio of 2.22lbs of feed per pound of gain. Alternatively, a SARE funded project in Arkansas found that Day-Range birds using the Label Rouge program had poorer feed conversion ratios than the same birds raised indoors, but had less fat than indoor birds (Fanatico, 2005). Research in Portugal found that restricting grain ration to birds in the Salatin system increased pasture intake from 1.6% to 4.9% dry matter and increased polyunsaturated fatty acids, but also reduced carcass yield (Ponte et al, 2008b). The same researchers found that birds raised on pasture had significantly greater carcass weight compared to birds with no access to pasture due to increased grain intake by the pasture-raised birds (Ponte et al, 2008a).

There is considerable interest by pastured-poultry producers to evaluate meat-chicken breeds, feeding strategies, feed supplements, and other production variables that may affect the performance and profitability of their pastured poultry system. Often producers will trial a new approach by trying it on the entire flock. For example, a producer might read about a feed supplement and decide to treat the second batch of birds of the season and compare the performance of that batch to the proceeding batch. Such a comparison is scientifically flawed. There are too many other production differences between the two batches other than the feed supplement that could have caused a difference in how the birds performed. To conduct meaningful and statistically-valid research, it is crucial that a trial be properly designed and replicated.



▲ **Photo 1.** In the Day-Range system, the birds are free to forage within a fenced area during the day, like these chickens about to devour the tasty dandelion leaves.

In order to conduct such research for the Day Range production system, we developed a low-cost research method poultry producers can use on their own farms to test production variables. The Day Range Research System described in this manual will generate statistically-valid and meaningful research results and can be used to profitably produce chickens and turkeys.

II. The Day-Range System

The Day Range System used by the producer-members of Pasture Perfect, LLC (PPP) is a continually evolving system designed to maximize access to pasture, allow for freedom of movement, and reduce labor costs.

A. Production

The Day-Range system used by Pasture Perfect, LLC starts with the brooder. The poultry chicks arrive by mail and are placed in a draft-free brooder equipped with heat lamps. The target ambient air temperature in the brooder is between 75 and 90 degrees, though as long as the heat lamps are at a proper height, the ambient air temperature (above the heat lamps) can be less than 75 degrees. We use 3-6, 250 watt heat lamps per 150 chicks, depending on the season. Beginning at one week, the chicks have access to pasture through a door in the brooder as long as the temperature is greater than 50F. The chicks are kept in the brooder for 3-4 weeks (approximately 23 days), depending upon the weather and are fed a 21% protein broiler ration *ad libitum*. The birds are bed on a mixture of woodchips, sawdust, and wood shavings, depending on availability. For the first week, a vitamin supplement is included in the water.

We currently use the Ross strain of Cornish x Rock meat chickens with a grow-out period of 56 days. Over the last three years, the carcass weight (including heart, neck, liver) has averaged between 5 and 6 pounds, which is the desired weight for PPP customers. However, due to some amino acid deficiencies in the feed ration used in the experiment described in Section IV, the carcass weight was smaller than in previous years.

Around 23 days, the birds are moved outside to pasture (Photo 1). A single, 4' high by 164' long electrified poultry-net fence is used to enclose the pasture area. The fence keeps the birds inside and predators outside. Inside the fenced area is a "hoopie" built of cattle panels as described in Section II-B (Photo 2). At night, if necessary, the birds are herded into the "hoopie" and the doors are closed to provide protection from mammalian and avian predators.

Once on pasture a 19% protein broiler ration is fed in plastic or metal gutters mounted on pieces of 2x4 and the birds are watered with 7-gallon gravity flow waterers. Each bird receives approximately 16lbs of ration during the 8 week grow-out period as shown in Table 1. This feeding schedule was developed based on the industry recommendations for the Cornish x Rock meat chickens and our personal experience. In average conditions, the amount shown in Table 1 is how much a bird will eat in one day, in our experience. Feeding more results in feed sitting in the feeders overnight.

Week	lbs/bird/day
1	free choice
2	free choice
3	free choice
4	0.25
5	0.3
6	0.45
7	0.45
8	0.55
Approx Total:	16 lbs/bird

▲ **Table 1:** Amount of 19% protein broiler ration fed per bird per day for the 8 week grow-out period.



▲ **Photo 2.** The Day Range hoopie is an easy to build and sturdy structure that can be moved by one person and will last for many years. It will comfortably hold up to 150, 8-week chickens overnight.

The amount will vary somewhat based on weather conditions and more will be offered when conditions are below 50 degrees. The feed is provided twice each day, half in the morning and half in the evening.

Predators are probably the biggest problem with the Day Range system, but predator pressure varies considerably from farm-to-farm and season-to-season.

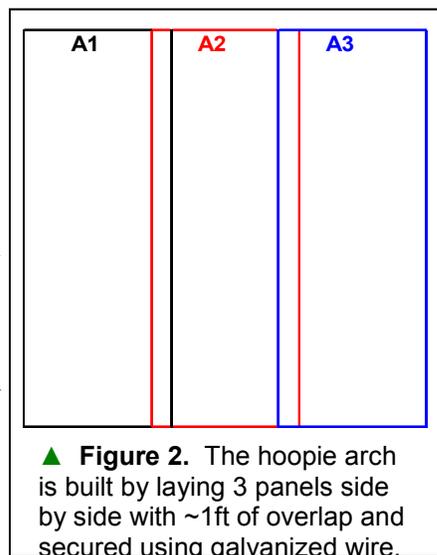
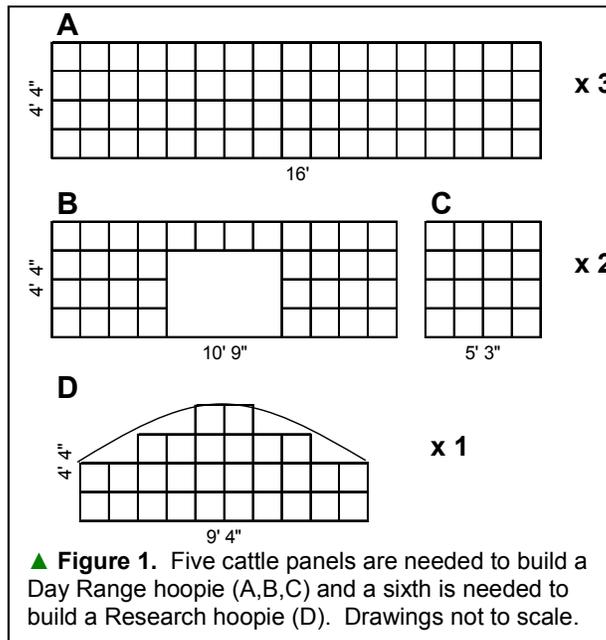
The three producers of PPP are located in agricultural areas with production areas that are far from riparian and forested areas. Each producer has one or more dogs that sleep outside and provide some protection, though, certainly not reliable. Coyotes, fox, owls, and hawks are the primary predators.

To provide maximum protection, the birds are herded into the hoopies each evening and the doors are securely fastened. At first light, the birds are let out of the hoopies and are free to roam the rest of the day. The easiest way to get the birds in or out of the hoopies is to feed them. Thus, we typically feed two times per day. In the morning while the birds are eating the hoopies are moved to prevent manure build-up. When the birds are older we often leave the birds out overnight and most will move into the hoopies on their own. It is also possible to affix a sprinkler to the top of the hoopie and when it's on the birds think it's raining and will move into the hoopie.

If predators aren't a problem (i.e. the electric fence and hoopie (with doors open) provide sufficient protection), it would be possible to only visit the chickens once-per-day or even less. This would considerably reduce labor needs for the system. However, it is unclear how feeding once-per-day instead of twice-per-day would affect the weight gain of the chickens.

B. Production Hoopie Construction and Materials

The Day-Range hoopie is built with 5, 52"x16' cattle panels (Figure 1-A-C), 55' of 1" chicken wire, some galvanized wire, and a 12'x14' tarp (or large). Three of the panels are arranged side-by-side as shown in Figure 2 and tied together at the overlap with galvanized wire. The other two panels are cut to the dimensions shown in Figure 1. The ends of the two panels are used as doors (C) to cover the openings cut into the B panels. The opening cut into the B panels should be no more than 5' wide so the C panels will fully cover them. The bottom wire in the door opening should be left attached to provide stability to the structure when it is moved. The three-panel structure is bent by pulling the short sides toward each other to create a quonset-type arch and fastened on each side to the B panels as shown in Figure 3 with the galvanized wire. This step takes at least two people. Chicken wire is attached to the bottom 3-4 feet of the structure on all four sides using galvanized wire or hog rings. A hog ring pliers makes this job go faster (Photo 3).



▲ **Photo 3.** The bottom 3-4 feet of the entire hoopie is covered with 1" chicken wire and fastened to the panels using wire or hog rings.

Leaving a flange of chicken wire along the bottom of the hoopie can help prevent tunneling by predators, but the flange quickly becomes bent and twisted as the hoopie is moved. The last step is to attach the tarp to the outside of the structure and attach the doors (Photo 2).

Completed, the Day Range hoopie is 10' x 12' and can house between 130-160 full-grown birds at night with room for 1-2 waterers. Not including the time to purchase, transport, and assemble the materials, hoopie construction will take 2 people about 3 hours, or six hours total. Total material cost for the Day Range hoopie is \$192 (Table 2).

C. Research Hoopie

To build a Research Hoopie, a cattle panel is cut to the dimensions shown in Figure 1-D. This is covered with chicken wire and attached inside the middle of the hoopie parallel with the B panels to make two equal spaces. The D panel divides the hoopie in half. With a Research Hoopie, a door must be cut into each of the two B panels.

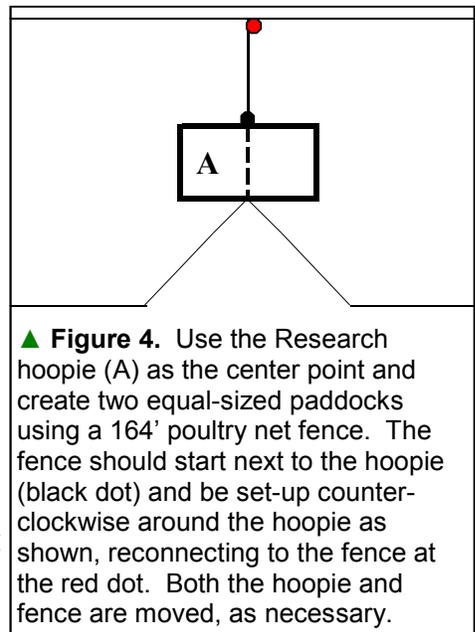
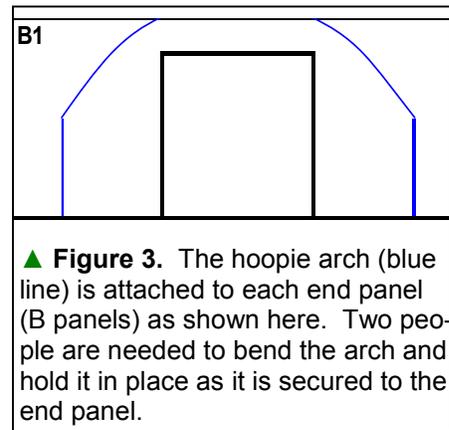
III. Day Range Research System

A. Introduction

The Day Range Research System is a statistically-valid method to compare two treatments, such as two different rations, or two different breeds, or as described later in this manual, two different feeding times. The System uses three replications to allow for statistical analysis and provide some certainty that the treatment effects are real and not due to random chance or some other confounding variable. Each replication requires one Research Hoopie, one 164' length of electrified poultry netting, up to 160 birds, two feeders, and two waterers. For each replication, a group of birds is divided in half with each half raised in one of the sides of the Hoopie. One half receives Treatment A and the other half receives Treatment B. It is important that the conditions within each replication be as similar as possible. For example, the pasture on one side of the Hoopie should always be the same as on the other side of the Hoopie. The basic Day Range Research System is described below:

B. Day Range Trial Protocol With Three Replications

1. Raise all the birds (all cockerels or pullets) in the brooder until ready to go outside. The birds should have full access to water and feed. It is important that all the birds be treated as uniformly as possible while in the brooder.
2. Set up the three Research Hoopies in the pasture. For the 4-5 weeks on pasture, each replication will need an area roughly 50' x 200'.
3. Using the poultry netting, create an equal-sized pasture for each side of each Research Hoopie. Figure 4 shows one possible arrangement using a single, 164' poultry net fence. Photo 4 shows the Research hoopie and a paddock for each side of the hoopie. The important thing is that each replication have roughly an equal-sized paddock divided in half by the Research Hoopie.
4. When ready to go to pasture, randomly divide the birds into 6 groups with each group assigned to one side of one of the three Research Hoopies (Photo 5).



The groups should have the same number of birds but no more than 40 per group. Be as random as possible when dividing the birds. You don't want all the smaller birds in one Hoopie and larger birds in the other, for example.

5. Mark the birds using leg bands or spray-paint on the primary feathers. Mark each bird in each group the same way (Photo 6). The marking makes it possible to sort the birds back into the correct side of the hoopie in the event the birds cross through the pasture fencing into another group of birds.
6. Move the birds to pasture and place each group of birds into one half of the Research Hoopie and close the door. It is best to leave them in the Hoopie for 4-5 hours to acclimate to their new home. Once all the birds are in their Hoopies, the doors can be opened and the fence electrified.
7. With the birds in place, the treatments can be applied. For each Research Hoopie, one side will receive Treatment A and the other side will receive Treatment B. In essence, you are repeating an experiment to compare the two Treatments three times.
8. As necessary to spread the manure and provide fresh pasture, move the Research hoopie and poultry netting. Be sure to maintain roughly equal paddock sizes throughout the grow-out period.
9. This system allows comparison of two treatments, one for each side of the Research Hoopie.
10. The material cost for implementing this protocol with 3 replications is shown in Table 2. For this protocol, no more than 80 birds should be raised in one Research Hoopie (40 per side). Except for the tarps, the materials should last at least 7 years and a single Hoopie can be used to produce roughly 150 birds per 4 week period in a normal non-research production situation. Assuming each Hoopie is used to produce a batch of 150 birds every 4 weeks, June through September, for seven years, the cost of the materials is roughly \$0.11 per bird.



▲ **Photo 4.** One replication of the Day Range Research System. The hoopie is divided in half internally and the birds in each half have access to an equal-sized fenced paddock. The scarecrow keeps the hawks away.



▲ **Photo 5.** A side view of the Research Hoopie showing the group of birds split into two equal-sized groups. Three hoopies and six groups of birds are needed for three replications.



▲ **Photo 6.** All the chickens in each group are marked with spray paint on their primary wing feathers. This allows separation in the event they cross a fence and get mixed-up. The photo shows two groups, one in each half of the hoopie.

Day Range Trial System Material Expenses (3 replications)		
Item	Number	Cost
7 gallon waterer (\$42.99ea)	6	257.94
Gutter feeders (\$4ea)	6	24
Cattle panels (\$23ea)	18	414
12' x 14' tarp (\$12ea)	3	36
1" chicken wire (\$34.79/50ft)	150ft	104.37
galvanized wire (\$23)	1	23
164' of 48" poultry netting (\$165ea)	3	495
Materials Total		\$ 1,354.31

▲ **Table 2.** The material costs for implementing the Day Range Trial System with 3 replications.

C. Statistical Analysis: Knowing if Your Results Are Real

The power of the Day-Range Research System is that it includes true replication, and thus, provides the option for statistical analysis. By comparing the variation between the two treatments, it is possible to determine with some certainty whether the difference between the averages of the two treatments is real. For example, if there were 3 replications for Treatment 1 and Treatment 2 and the average live weights of Treatment 1 were 5, 5, 6 and the average live weights of Treatment 2 were 7, 7, 8 then the averages for 1 and 2 would be 5.3 and 7.3, respectively. The average live weights for Treatment 1 and 2 are clearly different and we can be confident as well because the variation within each of the two treatments is low (5,5,6 and 7,7,8). Alternatively, if the replication averages for 1 and 2 were (3,5,8 and 4,7,11) the Treatment averages would be 5.3 and 7.3 as in the first example, but we would be less confident the Treatment averages are actually different due to the larger variation within each of the treatments.

Thankfully, it isn't necessary to think too hard about the statistical analysis. A basic spreadsheet program, such as Microsoft Excel, can be used to do the analysis. The following explains how to do the analysis using the Analysis ToolPak option with the 2003 edition of Microsoft Excel.

Treatment	Rep	WH 1	WH2	GO1	GO2
1	Rep 1	6.3	6.2	7.43	6.71
1	Rep 2	6.55	5.67	6.94	6.16
1	Rep 3	5.84	4.87	6.5	5.42
2	Rep 1	6.54	6.07	6.43	6.25
2	Rep 2	6.76	5.69	6.78	6.11
2	Rep 3	6.54	5.2	6.2	4.9

▲ **Table 3.** The required arrangement of the data in a spreadsheet for analysis using the Paired-T test in the Analysis ToolPak of Microsoft Excel. The data is arranged in columns with three replications of each treatment. The entire experiment was repeated four different times, twice at each of two locations.

The first step is to arrange your data in an Excel spreadsheet. Table 3 shows the live weight averages for each replication for each of two treatments of each of the four batches of birds raised in the feeding trial described later in this document. The feeding trial experiment was repeated four times, twice at each of two locations. WH1, WH2, GO1, and GO2 are the names of the four experiments. If the experiment was only run one time, there would only be one column. The values shown in the table for each replication of each treatment are themselves the average live weights of all the birds in each replication of each treatment.

Once the data is properly arranged in a spreadsheet, select "Tools" from the Excel menu bar and choose "Data Analysis". If the "Data Analysis" option is not shown, select "Add-Ins" from the "Tools" menu and check the box next to Analysis ToolPak. When "Data Analysis" is chosen the Data Analysis Dialogue box will pop-up. Scroll down and choose: "t-test: Paired Two-Sample For Means".

When "t-test: Paired Two-Sample For Means" is selected, the "t-test: Paired Two-Sample For Means" dialogue box will pop-up. Behind the pop-box, the spreadsheet with the data will still be visible. The next step is to tell the dialogue box where the data for mean 1 (Treatment 1) and mean 2 (Treatment 2) is located. This is done by filling-in the "Variable 1 Range:" (Treatment 1) box and the "Variable 2 Range" (Treatment 2) box. Do so by entering the cell range for the appropriate data. For example, if the three replications for Treatment 1 were in Column B and start at Row 2, you would enter: "B2:B4". Enter the cell range for the replication data for each of the two treatments and click "OK".

Once you click OK, a new worksheet will be created in your spreadsheet listing the statistical information. For the data at WH1 of Table 3, the statistical output should look like Figure 5. The average for the Treatment is shown in the “Mean” row. The other important number is the test statistic “P” as shown in the “P(T<=t) one tail”. When the P value is less than 0.05, the averages of the two treatments are generally regarded as statistically different. However, some consider the means different when the value is less than 0.10. In this example, the treatments were statistically different at the 0.10 level because the P value is 0.068425.

t-Test: Paired Two Sample for Means		
	Variable 1	Variable 2
Mean	6.23	6.613333
Variance	0.1297	0.016133
Observations	3	3
Pearson Correlation	0.769504	
Hypothesized Mean Difference	0	
df	2	
t Stat	-2.41744	
P(T<=t) one-tail	0.068425	
t Critical one-tail	2.919986	
P(T<=t) two-tail	0.13685	
t Critical two-tail	4.302653	

▲ Figure 5. The output format generated by 2003 Microsoft Excel when conducting a “t-test: Paired Two-Sample for Means” as part of the Data Analysis tool. Actual numbers shown are the results of using the tool to compare the treatments of WH1 from Table 3.

IV. Putting the Day Range Research System to Work: Evaluating the Effect of Feedings Per Day on Broiler Weight Gain

Feeding behavior studies have found that broiler chickens raised with the Day Range system tend to do their most active foraging during the early-morning and evening hours (Seipel et al, 2003). This is exactly the same time when most users of the Day Range system feed the grain ration to the chickens—in the morning when they let the chickens out of the hoopie and in the evening when they put them back in. Such a feeding schedule may actually discourage foraging and decrease the benefits of the pasture system.

It was hypothesized that feeding the chickens their entire daily ration at one time between 11AM and 2PM would allow the chickens to exhibit their natural foraging behavior and, therefore, potentially increase their weight gain and feed utilization efficiency. Furthermore, even if there was no difference between once-a-day and twice-a-day feedings, the once-a-day feeding system could potentially reduce labor costs by requiring only one visit of the chickens each day.

To test the hypothesis, the Day Range Research System as described in this manual was used with three replications. The trial was conducted two times at each of two different farms. For each replication, one half of the birds received their total daily ration in one feeding between 11AM and 2PM and the other half received half their total daily ration between 7AM and 8AM and the other half between 7PM and 8PM. Thus, during the summer, we essentially repeated the experiment 12 times (two farms x 2 batches per farm x 3 replications per batch).

All of the birds for each batch were raised together in a brooder for 22 days with water and 19% protein broiler ration fed *ad libitum*. At 23 days, the chicks were randomly divided into 6 equal groups with each group randomly assigned to one of the six hoopie halves. One half of each hoopie received the 1x feeding treatment and the other half received the 2x feeding treatment until the day of processing. At Great Oak Farm, the birds were left outside overnight. At Wild Hollow Farm, the birds were herded into the Hoopie each evening along with their food and water.

	Wild Hollow		Great Oak	
	12-Jul	13-Sep	20-Sep	25-Oct
1 feeding/day	6.23	5.58	6.96	6.10
2 feedings/day	6.61	5.65	6.47	5.75
P(T<t)	0.07	0.32	0.10	0.07

▲ Table 4: The average live weights for each batch of birds in the trial. Each batch consisted of 120-150 chickens divided into three replications of each feeding treatment. Dates shown are the processing dates. P-values less than 0.10 indicate the means are statistically different.

On processing day, each bird was weighed live (Photo 7). For each of the six groups of birds, the average live weight was determined. In some cases, due to market demands, some birds were not processed until a week or two later. Thus, carcass weights were not used.

The effect of the number of feedings per day on live weight was variable. Averaged across all four batches there was no significant difference in live weight between the 1x and 2x feeding treatment (Table 5). However, the 1x feeding treatment resulted in larger birds at Great Oak Farm and for one of the batches at Wild Hollow Farm, smaller birds. (Table 4).

The average live weight varied from 6.96 lbs to 5.75lbs with an average live weight of 6.17 lbs. This translates into an average carcass weight of less than 5 lbs, which is smaller than expected for a 56 day grow-out for the Ross strain of Cornish x Rock broiler chickens. The average carcass weight for birds in 2008 using the 2 feeding/day Day Range system was considerably higher at 5.5 lbs/bird. Analyses of the feed ration used for these batches indicated a slight deficiency in both lysine and methionine, likely causing the slower growth rates. Furthermore, although a 19% starter/grower ration can be sufficient for use in the first 2 weeks, a 21% protein starter would result in better overall performance.

V. Conclusion

Based on the results of this Day Range Research Trial, it appears that feeding the total daily ration between 11AM and 2PM is a viable option and may even result in better feed utilization and higher finish weights. If producers can effectively manage predators so the birds don't have to be put in at night, this research supports visiting the birds only once per day, reducing labor costs. Additional research is needed to determine whether there is increased forage utilization due to the single feeding strategy and whether there is any consequent difference in meat quality.

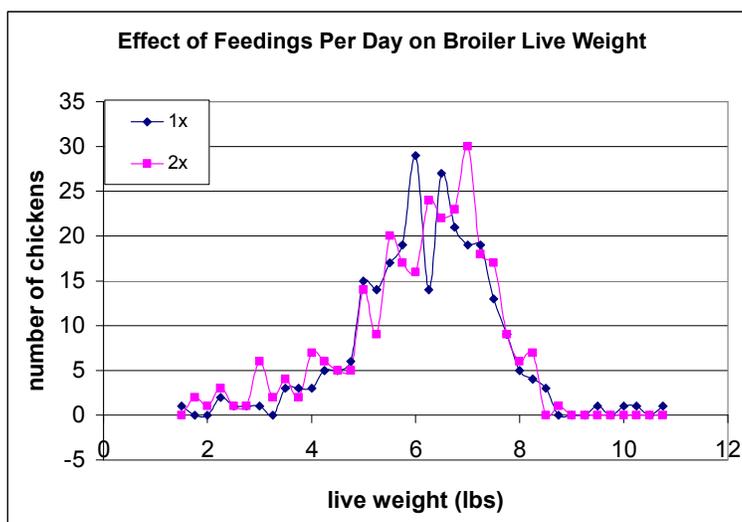
This study also demonstrates the feasibility of on-farm pasture poultry research using the Day Range Research Hoopies and Research System. The System can be used to compare performance of different breeds, rations, or supplements, for example.



▲ **Photo 7.** On processing day, the birds are weighed live and then processed. Some chickens stand calmly in the bucket and others don't!

	Live Weight
1 feeding/day	6.22
2 feedings/day	6.12
LSD(.05)	0.25

▲ **Table 5:** The live weights averaged across all four batches for the two feeding treatments. There was no significant difference between feedings/day.



▲ **Figure 5.** The live weight distribution of broilers at 56 days for the 1 feeding per day treatment and the 2 feedings per day treatment. Data shown is for all four batches (two batches at two different farms). Averaged across all batches, there was no significant difference in live weight between the 1 feeding per day and 2 feedings per day treatments.

VI. Research Cited

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