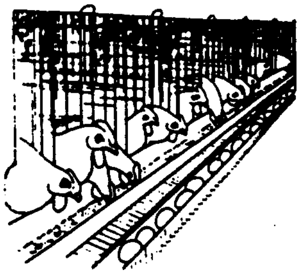

California Poultry Letter

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The Effect of Manure Height and Texture on Manure Drying in Caged-Layer Houses

It is common practice on many farms to leave a 4 to 6 inch pad of dry manure base following a manure clean-out in order to achieve more effective manure drying and fly control. In theory, the dry base would provide a starting population of fly predators and parasites and would aid in the absorption of moisture from the accumulating new manure. In addition, it is theorized that irregularities in the surface of a dry pad provide an increased surface area for drying of fresh manure. Until recently, no experiments had been conducted to study the physical aspects of the manure pad itself, and their effect on newly accumulating manure. Dr. Bradley Mullens, Dr. Nancy Hinkle and Coralie Szijj (University of California, Riverside) conducted a series of experiments on two southern California egg production farms to evaluate the effect of manure height and texture on subsequent drying of newly accumulating manure.

The role of the manure pad in moisture absorption

Two trials were conducted on farms with typical California style open-type housing. The first trial was conducted in March on a farm in Redlands, the second was conducted an a similar farm near Lake Mathews in August.

At each location the wet surface manure was removed leaving a pad that was approximately 8 inches in height and approximately 30%-40% moisture. Two 4"x4" square 16-mesh aluminum window screen pieces were placed on the manure below the cages. One screen was bare, allowing the newly accumulating manure to come in contact with the dry base. The other screen had a plastic backing that prevented water absorption from the new manure to the dry base. Manure was allowed to accumulate for 7 days before the screens were taken to a laboratory for manure moisture determinations. The treatments were replicated 10 times in the March trial, and 20 times in the August trial. Both treatment and seasonal effects were statistically analyzed.

The moisture content of the manure collected during the March trial was 64.6% for the impervious screen (with plastic backing) and 64.1% for the bare screen (tablel).

Table 1. Role of manure pad on moisture absorption

Season	Impervious (% Moisture)	Bare (% Moisture)
spring	64.6	64.1
Summer	55.3	58.7

The manure collected from the August trial had moisture levels of 55.3% for the impervious screen and 58.7% for the bare screen. While seasonal differences did exist, no significant differences resulted from the treatments, indicating that direct contact with dry manure had no absorptive effect on

Table 2. Role of manure surface texture and elevation

Season	Texture: Rough (% moisture)	Texture: Smooth (% moisture)	Elevation: Surface (% moisture)	Elevation: Elevated (% moisture)
Summer	49 ns	49	60**	38
Fall	53ns	56	59**	50

** Differences across columns are highly significant ($P \leq 0.01$)
ns Differences across columns are not statistically significant ($P > 0.10$)

moisture of the accumulating manure after 7 days.

The role of manure surface texture and elevation in drying fresh manure

A second set of trials was conducted following a total manure clean-out (to the soil surface). All residual manure was removed from 10 three foot sections under the cage rows. Hardware cloth (approx. 1/8" mesh, 4"x4") trays fitted with plastic bases were used to collect the manure. One set of trays was placed on wood blocks elevating the trays 4 1/3" off the ground, the second set was placed at ground level. A single layer of marbles (approx. ½ inch diameter) was placed in half of the trays to provide an uneven surface texture similar to a manure pad. The four treatments therefore, were elevation, with and without texture, and no elevation, with and without texture.

Manure was allowed to accumulate on the trays for one week. The trials were conducted in September (summer) and November (fall). Temperature and humidity at ground level in the poultry house were recorded.

Because overall moisture levels differed significantly by season and there was a significant season by elevation interaction, the two trials were analyzed separately.

Elevation had a highly significant effect on manure moisture levels in both seasons, while texture had no effect.

Discussion

These trials demonstrate that the primary beneficial effect of manure drying due to leaving a dry base pad of manure following a clean-out is due to elevation, and not absorption or increased surface area, at least with 7 days of manure accumulation. Moisture loss is assumed to be mainly through evaporation. Air flow is greater as the distance increases above a surface where boundary effects are present. In addition, moisture carrying capacity of air is greater during the summer months due to lower humidity and higher temperatures. The fact that they observed a 37% reduction in moisture by elevation during the summer and only a 15% reduction during the cooler fall weather supports this theory.

For fly control purposes, it is important that poultry manure under the cage row be as dry as possible. These trials suggest that leaving an elevated pad of dry manure after manure clean-out aids in this effort. The beneficial effects on fly control are likely to be greater in controlling *Musca domestica* (house fly) *than* for *Fannia canicularis* (little house fly). This is because *Fannia* is more prominent during the cool seasons when the effects of elevation on drying are least significant. Furthermore, *Fannia* can complete its life cycle in manure that is relatively dry compared with manure that can support *Musca*. Studies on *Fannia canicularis egg* laying preferences and larval survivability in manures of different moisture levels are just beginning at the University of California at Riverside.

D.R. Kuney
Area Poultry Farm Advisor

The Effect of Manure Clean-Out on Pest Fly and Fly Predator Populations in Layer Operations

Many California egg producers use manure drying and coning as a method of manure management to aid in the control of flies. In these systems, most farms encourage the presence of beneficial insects that eat fly eggs and larvae. In open-type housing, the manure is allowed to accumulate for several months beneath the cage rows, while in high-rise houses, the manure usually accumulates for the life of the flock before it is removed. University of California research studies have shown that many of the fly predators are most abundant in the upper levels of the accumulated manure where their prey (fly eggs and larvae) are located. It is assumed that manure removal, either partial or complete, also removes many of these beneficial insects.

Dr. Bradley Mullens, Dr. Nancy Hinkle, Coralie Szijj and Teresa Chin at the University of California at Riverside conducted a 2 year study of 6 open-sided layer houses owned by two southern California egg producers. The main focus of the study was to compare the effects of alternate row clean-out (cleaning every other row followed one month later by cleaning the remaining rows) with normal clean-out (cleaning the entire house at once) on fly and predator populations. In most cases, a 4" to 6" pad of dry manure base was left following the clean-outs. Manure samples were taken at 1, 4 and 8 weeks following the initial removal. Emergence traps and sticky tape counts were used to measure changes in fly and predator populations.

Manure clean-out resulted in a short-term increase in flies. Larvae of house flies were abundant in manure one week following cleaning out but had declined to pre-clean-out levels by 8 weeks. Larvae of the slower developing little house fly were most abundant 4 weeks following cleaning out and also had declined significantly by 8 weeks.

The two most important fly predators, the hister beetle *(Curcinops pumilio)* and the mite, *(Macrocheles)* were severely reduced by nearly 70% and 75%, respectively due to the clean-out. The residual numbers reflect some presence of these predators in the remaining manure pad. In warm weather, the life cycle of hister beetles is 4-6 weeks, compared to flies with cycles of 1.5-3 weeks. By 8 weeks adult beetles had still not achieved pre-clean-out levels, although abundant beetle larvae were observed 4-8 weeks after clean-out. Macrocheles mites have a life cycle of 4-7 days. They regained pre-clean-out levels by 4 weeks. Nevertheless, predator populations lagged behind fly populations. This probably accounts for the increase in fly populations which is commonly observed following manure clean-out.

In general; there was no benefit to alternate row clean-out. After one month, predator numbers were no higher in rows where alternate clean-out was used compared with rows which were cleaned out normally. It appears that neither beetles or mites disperse readily, even a short distance from older to new manure.

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Forced Air Cooling of Shell Eggs

The shell egg industry appears to be moving toward regulations that will require eggs to be marketed at temperatures below 45°F. After packing, eggs are at temperatures well above 70°F and do not cool quickly enough to 45°F when placed in a cold room. Forced air cooling is a fast, relatively inexpensive method used to cool many perishable commodities and may be well suited to **eggs.** Cooling is accomplished by placing **vented** containers next to a low pressure air plenum, forcing refrigerated air to flow through the containers.

The objectives of this test were to determine forced air cooling times and weight loss of shell eggs packed in flats, pulp cartons and foam cartons. (We assumed that eggs packed in wire containers will cool faster than any of the test treatments.)

We simulated cooling of a pallet load of eggs by placing a full case and a half case on a laboratory forced air cooler. Air flowed through a 36"long path through the cases. We cut six 1.5 square inch vent holes in the sides of the cases and divider, resulting in a vent area equal to 5.6% of the side wall area. Pairs of holes were at three heights, selected so that the holes were located between flats.

Egg temperature was monitored with thermocouples (**±0.4°F** accuracy) placed in the center of 24 large sized eggs. On each of six layers, we monitored an egg near where air entered and exited the half case and the full case. Cooling times were based on the average temperature of all sensors. Eggs were considered cool when their temperature dropped to the average cooling air temperature plus 25% of the difference between the egg's initial temperature and average cooling air temperature. The test was done for each packaging method with a high and low air flow through the cases. Weight loss was determined by weighing six eggs **from** each layer before and after cooling. The eggs we used had been oiled during processing. In the last test we compared weight loss of room cooled eggs and forced air cooled eggs. Room cooled eggs were at room temperature when they were packed in pulp cartons and packed in a half case. They were then placed in a 41°F room.

The forced air system cooled eggs in 1.3 to 5.0 hours depending on the air flow rate and packaging method. High air flow rates substantially reduced the cooling time. Cooling times are summarized in Table 1. Foam cartons cooled consistently slower than the other two packaging methods. Processors indicate that they often have 12 to 24 hours between packing and shipping, so even foam cartons had cooling times fast enough for processor's needs. Cooling times for the pulp trays and cartons were both about an hour and a half at high air flow rates. At low air flow, the trays cooled slower than the cartons because air tended to flow directly through the cases without spreading out, leaving some areas with low air flow and thus slow cooling.

Table 1. Forced air cooling characteristics of shell eggs.

Package	Static Pressure (inches)	Air Flow (cfm/lb)*	Cooling Time (hrs)	Weight Loss (%)	Initial Temp. (°F)	Final Temp. (°F)	Air Temp. (°F)
flats	0.63	1.9	1.3	-	73.0	44.8	35.4
pulp	0.05	0.2	3.5	0.03	65.1	42.1	34.3
foam	0.63	0.8	**2.9**	0.03	**64.9**	41.5	33.8
cartons	0.07	0.2	5.0	0.02	63.3	40.6	33.1
pulp	0.64	1.0	1.5	0.02	64.9	41.5	33.6
cartons	0.07	0.2	2.8	0.03	64.0	42.3	35.1

* cubic feet per minute per pound of egg

Table 2. Weight loss of forced air cooled and room cooled shell eggs.

Cooling Method	Weight Loss (%)	Cooling Time(hr)
Forced air cooled	**0.03**	**2.8**
Room cooled *	**0.06**	**26.2**

* **41°** F air temperature and 8 1% relative humidity in the room.

All test eggs lost 0.03% weight or less. In the last test we found that room cooled eggs lost twice as much weight compared with forced air cooled eggs (Table 2). In subsequent storage at **41°F,** eggs cooled either way lost 0.014% weight per day. In this test we also checked eggs before and after cooling and storage for visible cracks. One egg out of 540 was cracked in each cooling method.

Our test showed that shell eggs can be quickly cooled with a forced ‘air cooling system. Weight loss is very small in forced air cooling and appears to be less than the amount that occurs in slow cooling. Forced air cooling appears to be well suited to cooling eggs.

Some processors will be able to use this cooling method on a limited scale by placing a portable fan and tarp system in an existing cooler. However, to cool all of their production they will need to install

additional refiigeration capacity and a permanently installed fan system. Cases and dividers for full cases will need to be manufactured with air vents.

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Upcoming Events:

September 6-10, 1997 International Egg Commission, Toronto, Canada

September 25-26, 1997 California Poultry Industry Federation, Fresno

October 28, 1997 Good Egg Breakfast, Modesto

January 21-23, 1998 International Poultry Exposition, Atlanta

April **28-May** 2, 1998 Pacific Egg and Poultry Association, Monterey

May 13-14, 1998 California Animal Nutrition Conference, Fresno

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