



Innovative strategies using organic agricultural waste and lime for housefly control in poultry farms

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ABSTRACT

The intensification of poultry production systems has led to substantial accumulation of poultry waste, creating conducive conditions for housefly proliferation. To address this, a series of controlled trials were conducted at the Poultry Research Farm, Department of Livestock Production Management, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, to evaluate moisture-reducing strategies using organic agricultural residues and calcium oxide (lime powder). Paddy straw, rice husk, and lime powder were tested individually and in combinations at inclusion rates of 4%, 8%, and 12%. Preliminary results identified 8% as the optimal concentration. Subsequently, a four-week trial with weekly applications and an additional post-treatment observation period was conducted. Litter moisture, temperature, adult fly density, and *in vitro* larval counts were recorded on Day 0, Day 1, Day 2, Day 5, and on Days 8, 11, and 14 following the final application. The application of 8% lime powder significantly ($p < 0.05$) reduced litter moisture to 36.38% by the fourth week, compared to 62.51% moisture in the untreated control. A rapid reduction to 29.48% moisture was observed within 24 hours of application. Although litter temperature exhibited minimal variation (32.93°C), larval populations declined markedly post-treatment and remained suppressed up to Day 14. The study concluded that 8% lime powder application effectively reduces litter moisture, thereby disrupting the favorable micro-environment for housefly breeding. This approach offers a practical, economical, and environmentally sustainable strategy for integrated housefly management in poultry housing systems.

Keywords: Feces Moisture, Housefly, Sustainable

Public complaints about fly infestations near poultry farms have increased significantly. The housefly (*Musca domestica* L.) is a major sanitary pest and disease vector affecting both humans and animals (WHO, 2000). Effective litter management, especially maintaining manure moisture below 50%, is vital, as fly breeding rises sharply above 60% (Stafford and Bay, 1987). Chickens excrete about 120–170 g of waste daily (Tanczuk *et al.* 2019), and fly larvae thrive at 50–75% moisture (Fatchurochim *et al.* 1989). Geden and Stoffolano (1987) found wetter manure harbored more larvae and adults.

In Punjab, intensive poultry farming produces large quantities of moist waste, creating ideal breeding sites. Houseflies (Diptera: Muscidae) transmit over 100 diseases (Monyama *et al.* 2023), and 5–15 microbes can survive on or in a fly for up to 35 days (Behrens *et al.* 2023). They spread pathogens through contact with contaminated surfaces (Baker *et al.* 2020; Al-Hasanwi, 2020). Poultry farms spend over \$1.6 million annually on insecticides,

yet overuse leads to resistance and contamination. Integrated House Fly Management (IHFM) focuses on manure drying, ventilation improvement, and eco-friendly agents such as lime powder, paddy straw, and rice husk. Combining cultural, biological, and chemical control ensures sustainable, cost-effective, and environmentally safe fly management. Therefore, the present study aimed to study the effect of organic wastes/lime powder to reduce moisture of poultry fecal material.

MATERIAL AND METHODS

Ethical consideration: The Institutional Ethical Committee of Guru Angad Dev Veterinary and Animal Sciences University Ludhiana has given ethical clearance (Ethics approval number: GADVASU/2023/IAEC/70/10) to conduct this study.

A pilot study was initially conducted in the laboratory using to develop moisture reduction technology, organic waste materials such as paddy straw, rice husk and lime powder. A three-week pilot study conducted in May evaluated paddy straw, rice husk, lime powder, their combinations, and varying application rates (4, 8, 12%). Lime powder, paddy straw, and rice husk at 8% proved most effective.

Methods of application: The study was conducted using

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paddy straw (chopped), rice husk, and lime sourced from Directorate of Livestock farm, weighed on an electronic balance (Essae DS-852), and dusted at 8% (w/w) over poultry litter.

A total of 840 birds were used: 360 in shed 2, 300 in shed 6, and 180 in shed 8. The average body weight was 1.8 kg, with each bird excreting approximately 120.6 g feces daily.

In shed 2, 360 birds were divided into four lanes of 90 birds each, producing total 43,416 g feces (360 × 120.6). Each lane yielded 10,854 g, to which paddy straw, rice husk, and lime powder were applied separately at 8% (868 g), with one control lane.

In shed 6, 300 birds (four lanes of 75) produced 36,180 g feces (300 × 120.6), or 9,045 g per lane. Treatments of paddy straw, rice husk, and lime powder were applied at 8% (723 g), with one control lane.

In shed 8, 180 birds (four lanes of 45) produced 21,708 g feces (180 × 120.6), or 5,427 g per lane. Paddy straw, rice husk, and lime were applied at 8% (434 g) on three lanes, with one lane as control.

Parameter recorded: Moisture, temperature, fly count and *In vitro* fly larvae count on D0 (Day before dusting), D1 (Day of dusting), D2 (Day after dusting), D5 (3rd day after dusting) every week for consecutive four weeks followed by D8, D11 and D14 after fourth week.

Moisture: Moisture measured by AOAC method (2013). Feces moisture was calculated after drying at 100 % overnight.

Fecal sample of around 100g was weighed in duplicate on a dry, known weight aluminum plate dried in an oven at 100 °C overnight. After cooling in the desiccator, the dried sample with the aluminum plate was weighed, and the Fecal moisture % was estimated as follows:

$$\text{Fecal Moisture \%} = \frac{\text{Weight of tray with oven dry sample} - \text{Weight of empty tray}}{\text{Weight of sample before drying}} \times 100$$

Moisture reduction was checked after 2nd day of dusting and after 5th day of dusting of paddy straw, rice husk, lime powder and control.

Fly count: Field level @ Poultry farm GADVASU Ludhiana fly count was conducted by the help of yellow

sticky traps. Dimension of sticky trap is 25 (length) × 11 cm (breadth). Fly count was conducted after 2nd day and 5th day of dusting at control, paddy straw, rice husk and lime till 5 weeks. Old sticky traps were replaced by new sticky traps at 5 days interval.

In-vitro fly larva count: With the help of a trowel, poultry feces is put in aluminum plate of diameter 22 cm as well as in transparent plastic boxes of 22.5 (length) × 12.5 (breadth) × 22.5 cm (height) and placed in B.O.D. cum humidity combined chamber for incubation @ 27 °C temperature & 55 % humidity for 14 days to measure exact fly larva count in per 100g feces *In vitro* in Poultry Science lab @ GADVASU Ludhiana.

Statistical analysis: The collected data from the experiment was subjected to statistical analysis using Proc GLM, SAS (2024) software to test the difference between various treatment, eliminating the effects of the sheds. Treatment means were compared using Tukey's Honestly Significant Difference (HSD) test at the 5% significance level or LSM at 5% level of significance (P≤0.05).

RESULTS AND DISCUSSION

Feces moisture %: Effect of dusting of rice husk, paddy straw and lime powder @8% on fecal material at weekly interval after dusting on feces moisture % are presented in Table 2. Significant difference (P<0.05) were observed in the mean value of moisture % between the treatments (Control, paddy straw, rice husk and lime powder) during week 4. In week 4 the mean value of moisture % was significantly lower in lime (36.38%) as compared to rice husk (52.29%), paddy straw (55.03%) and control (62.51%). Overall mean value of moisture% was significantly low in lime (29.91%) as compared to mean value of rice husk (42.31%) , paddy straw (38.37%) and control (42.35%). However, there was no significant difference in the mean value of moisture % between the treatments (control, paddy straw, rice husk and lime powder) during first 3week: Numerically mean value of moisture % in lime was less in comparison to other treatments (Control,paddy straw and rice husk) during 1st , 2nd and 3rd. week. Significant difference was presented in week 1 to week 4 in different treatments paddy straw, rice husk and lime powder.

Effect of dusting of rice husk, paddy straw and lime

Table 1. Plan of work

	T1: Untreated Control			T2: Paddy Straw			T3: Rice Husk			T4: Lime		
	No. of replication	3			3			3			3	
Shed No	2	6	8	2	6	8	2	6	8	2	6	8
No. of birds	90	75	45	90	75	45	90	75	45	90	75	45
Feces excreted in g	10854	9045	5427	10854	9045	5427	10854	9045	5427	10854	9045	5427
Paddy Straw, Rice husk & Lime ia Sprinkled @ (8 %) in g	-	-	-	868.32	723	434	868.32	723	434	868.32	723	434

Table 2. Effect of dusting of rice husk, paddy straw and Lime powder @8% on fecal material at weekly interval after dusting on feces moisture%.

WEEK S	TREATMENTS (Feces Moisture %)				P VALUE
	CONTROL	PADDY STRAW	RICE HUSK	LIME	
W0	34.50±9.31				NS/ RV
W1	32.96±7.83	23.51±4.20 ^A	23.26±5.21 ^A	22.46±3.97 ^A	0.5678
W2	30.94±6.24	33.58±5.00 ^A	46.60±6.46 ^A	29.15±5.28 ^A	0.1294
W3	43.02±7.35	43.38±8.65 ^A	47.09±6.55 ^A	31.66±5.01 ^A	0.2928
W4	62.51±3.37 ^a	55.03±6.13 ^{ab}	52.29±5.53 ^{ab}	36.38±4.11 ^{bb}	0.002
OVER ALL	42.35±3.97 ^a	38.87±3.78 ^a	42.31±3.63 ^a	29.91±2.40 ^b	0.007
PVALU E	<.0001	0.0021	0.037	0.003	

The mean value with different superscripts in rows differs significantly (P<0.05)

powder @8% on fecal moisture content in days after dusting are presented in Table 3. Following dusting (D2) there is significant (P<0.05) difference in the mean value of feces moisture % between the treatments control, paddy straw, rice husk and lime. The mean value of feces moisture % in lime powder (29.48%) was significantly lower than the mean value of moisture % in control (41.54%), paddy straw (39.09%) and rice husk (47.92%). Overall mean value of moisture % in lime (33.41%) was significantly low as compared to mean value of moisture % in control (49.21%), paddy straw (44.49%) and rice husk (44.12%). However, no significant difference in mean value of moisture % was found in between the treatments control, paddy straw, rice husk and lime powder in Day 5, 8, 11 and 14 post 4th week. Significant difference were presented in mean values of paddy straw treatment among different days D2, D5, D8, D11 and D14 post 4th week were 39.09, 38.66, 49.91, 52.34 and 57.44 in table 3.2. Numerical value of feces moisture % was low in lime on Day 5, 8, 11 and 14 post 4th week i.e. 30.34, 31.38, 38.60 and 39.58% as compared to other treatment group which is highly unfavorable for *Musca domestica* breeding and metamorphosis., Mean value of feces moisture % in day 14 of control reached up-to 60.96% which is highly favorable

for *Musca domestica* breeding as presented in Table 3.

Manure moisture should be below 50%, as over 60% promotes fly breeding (Stafford and Bay, 1987). Chicken produce 120–170 g feces daily (Tanczuk *et al.* 2019), and larvae thrive at 50–75% moisture (Fatchurochim *et al.* 1989). Moist manure favors flies (Geden and Stoffolano, 1987).

Applying 8% lime cuts moisture from 62.51% to 36.38% by week 4 and 29.48% within a day (Ponnudurai and Harikrishnan, 2011). Dry storage (Watson *et al.* 1998) and composting (Abu-Rayyan *et al.* 2010) further limit larval growth.

Fly count: Fly count were significantly lower (P<0.05) in lime powder followed by paddy straw, rice husk and control (Table 4). The dusting of rice husk, paddy straw, and lime powder at 8% on fecal matter presented a significant reduction in fly counts at weekly intervals compared to the control group. In week 1, the mean fly counts were significantly different between treatments., The mean value of fly count in lime powder (8.83) was significantly low as compared to other treatments control (30.33), paddy straw (11.83) and rice husk (22.00), In week 2, the mean fly counts were significantly different between treatments. The mean fly count on lime powder (9.00) was significantly

Table 3. Effect of dusting of rice husk, paddy straw and Lime powder @8% on fecal material in days after dusting on feces moisture%.

DAYS	TREATMENTS (Feces Moisture %)				P VALUE
	CONTROL	PADDY STRAW	RICE HUSK	LIME	
D0	34.54±10.63				NS/RV
D2	41.54±5.31 ^a	39.09±4.74 ^{aA}	47.92±4.75 ^a	29.48±3.25 ^b	0.058
D5	43.17±5.31	38.66±4.74 ^A	36.70±4.75	30.34±3.25	0.484
D8	59.96±10.63	49.91±9.48 ^A	41.51±9.51	31.38±6.51	0.126
D11	62.92±10.63	52.34±9.48 ^A	41.09±9.51	38.60±6.51	0.1132
D14	60.96±10.63	57.44±9.48 ^A	45.60±9.51	39.58±6.51	0.2534
Overall	49.21±2.63 ^{ab}	44.49±3.06 ^{ab}	44.12±3.06 ^{ab}	33.41±3.06 ^a	0.0008
PVALU E	0.173	<.0001	0.61	0.64	

The mean value with different superscripts in rows differs significantly (P<0.05)

Table 4. Effect of dusting of rice husk, paddy straw and Lime powder @8% on feces material at weekly interval after dusting on fly count.

WEEK S	TREATMENTS (Fly Count)				P Value
	CONTROL	PADDY STRAW	RICE HUSK	LIME	
W0	106.00±99.55 ^A				NS/RV
W1	30.33±18.09 ^{ab}	11.83±7.40 ^{aA}	22.00±13.62 ^{aA}	8.83±5.62 ^{ba}	0.0456
W2	40.00±23.76 ^c	14.16±8.80 ^{aA}	16.33±9.71 ^{aA}	9.00±5.38 ^{ba}	0.0478
W3	24.16±11.51 ^{ad}	7.83±4.75 ^{ba}	9.83±5.51 ^{ba}	3.83±2.32 ^{ba}	0.0095
W4	46.33±26.85 ^{ae}	17.33±10.53 ^{ba}	18.50±10.48 ^{abA}	12.33±7.69 ^{ba}	0.0285
Overall	35.70±9.29 ^A	12.79±3.87 ^A	16.66±4.86 ^A	8.50±2.68 ^B	0.003
P Value	<.0001	<.0001	<.0001	<.0001	

The mean value with different superscripts in rows differs significantly (P<0.05)

less as compared to other treatments 40.00 (control), 14.16 (paddy straw) and 16.33 (rice husk). At week 3, the mean fly counts were significantly different between treatments. The mean fly count in lime powder (3.83) was significantly low as compared to other treatments control, paddy straw and rice husk. At week 4, the mean fly counts were significantly different between treatments., The mean fly count in lime powder (12.33) was significantly low as compared to other treatments (46.33) control, (17.33) paddy straw and (18.50) rice husk. Overall, mean value of fly count were significantly different between treatments. The mean fly count in lime powder (8.50) was also significantly low as compared to other treatments.

Next day (D2) following dusting of paddy straw, rice husk and lime powder @8% on fecal material, significant

low mean fly count was found in control, paddy straw, rice husk and lime powder (Table 5). Overall value of mean fly count was significantly low in lime (33.22) as compared to control (73.41), paddy straw (39.95) and rice husk (46.80). Significant difference (P<0.05) was observed in mean fly count in days interval in lime powder after single time dusting on consecutive days (D2) 1.66, (D5) 9.33, (D8) 16.00, (D11) 14.33 and (D14) 18.00. In rice husk also significant difference (P<0.05) in mean fly count was observed on D2, D5, D8, D11 and D14 post 4th week. However, in control significant rise in (P<0.05) in mean fly count was evident in consecutive days (D2) 31.91, (D5) 39.50, (D8) 74.66, (D11) 90.33 and (D14) 107.66. Lime powder significantly (P<0.05) reduced mean fly count up-to 14 days by single time dusting @8%, followed by

Table 5. Effect of dusting of paddy straw, rice husk and Lime powder @8% on feces material in days after dusting on fly count.

DAYS	TREATMENTS (Fly Count)				P VALUE
	CONTROL	PADDY STRAW	RICE HUSK	LIME	
D0	106.00±21.57				N.S./RV
D2	31.91±10.78 ^{ab}	11.41±11.16 ^{abB}	15.33±11.14 ^{abB}	1.66±11.66 ^{ba}	<0.0001
D5	39.50±10.78 ^{ac}	14.16±11.16 ^{abB}	18.00±11.14 ^B	9.33±11.66 ^A	0.1013
D8	74.66±21.57 ^A	21.00±22.32 ^A	23.66±22.29 ^A	16.00±13.32 ^A	0.108
D11	90.33±21.57 ^A	27.66±22.32 ^A	45.66±22.29 ^A	14.33±13.32 ^A	0.127
D14	107.66±21.57 ^A	39.33±22.32 ^A	63.00±22.29 ^A	18.00±13.32 ^A	0.108
Overall	73.41±6.39 ^b	39.95±7.44 ^a	46.80±7.44 ^a	33.22±7.44 ^a	<.0001
P VALUE	0.004	0.02	0.0149	0.023	

The mean value with different superscripts in rows differs significantly (P<0.05)

Table 6. Effect of dusting with rice husk, paddy straw and lime powder @8% on *in vitro* larva count at progressive days interval during and after dusting

Days	Treatments (<i>in vitro</i> larva count)				p value
	Control	Paddy Straw	Rice Husk	Lime	
D0	113.00±27.01				NS/RV
D2	41.00±13.50 ^a	35.00±13.31 ^a	39.12±13.09 ^a	26.62±13.63 ^b	0.0544
D14	80.00±27.01 ^a	NA	86.50±26.18 ^a	28.00±27.26 ^b	0.0107
Overall	87.48±8.98 ^b	79.53±14.02 ^{ab}	87.28±12.12 ^{ab}	65.58±12.12 ^{ab}	0.027

The mean value with different superscripts in rows & differs significantly (P<0.05)

paddy straw, rice husk and control.

Sticky traps, such as the Alsynite biting fly trap, are adhesive-coated devices widely used in livestock areas (Broce, 1988; Gerry, 2020a).

Yellow sticky traps showed reduced fly counts after weekly use of rice husk, paddy straw, and 8% lime: week 0 (106), week 1 (30.33), week 2 (40.00), week 3 (24.16), and week 4 (46.33).

In Vitro fly larva Count: Larvae are commonly collected using Berlese funnels (Axtell, 1970a; Schmidtman, 1988; Stafford and Bay, 1987), sieving (Eastwood and Schoenburg, 1966), or saline flotation (Ladell, 1936; Matthyse and McClain, 1973). Routine monitoring is difficult due to variable larval densities (Schoenburg and Little, 1966). While emergence traps assist in forecasting adults, larval monitoring remains vital for locating breeding sites and assessing substrate productivity (Axtell, 1970a; Gerry et al. 2005). The consistent decline after 8% lime confirms its sustained and economical effectiveness in fly control.

Effect of dusting of rice husk, paddy straw and lime powder @ 8% on feces material in days after dusting on *in vitro* larva count is presented in table 6, Significant difference ($P < 0.05$) in the *In vitro* larva count was found on the next day following dusting in between the control, paddy straw, rice husk and lime powder treated groups. The mean value of *in vitro* larva count in lime powder (26.62) was low as compared to control (41.00), paddy straw (35.00), and rice husk (39.12) However, on day 14 significant difference was seen in between treatments in (control, rice husk and lime powder). The mean value of *in vitro* larva count in lime powder (28.00) was significantly low in comparison to control (80.00) and rice husk (86.50). Overall significant difference was seen in the mean value of *in vitro* larva count in between different treatment and lime powder shows significantly low larva count (65.58) as compared to paddy straw (79.53), rice husk (87.28) and control (87.48). Table 6: Effect of dusting with rice husk, paddy straw and lime powder @8% on *in vitro* larva count at progressive days interval during and after dusting

Monitoring animal waste for larvae helps predict adult fly outbreaks (Gerry, 2020a). After applying 8% lime, larval counts dropped sharply within a day and remained low for 14 days, showing its long-term, cost-effective efficacy.

Application of lime powder, rice husk, and paddy straw at 8% significantly reduced fecal moisture and fly populations. Lime treatment proved most effective, maintaining moisture below the optimal range for fly breeding (60–65%) and significantly ($P < 0.05$) reducing mean fly counts up to 14 days post-application. *In vitro* larval counts also declined markedly following lime dusting.

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