

Dickinson College Farm Livestock Program

Integrated Fly Management for Pastured Cattle

Background: Flies love cattle but the relationship is not mutually balanced. Beyond being a constant annoyance, fly parasites can spread diseases such as pink eye. When fly loads are heavy, cattle spend more time working to avoid flies and less time eating – this can result in reduced weight gains or milk production. In response to fly pressure, cows congregate, bite at their backs and swat their tails—behaviors that significantly reduce their feeding and growing efficiencies. This combination of irritation and defensive behaviors



in cows have a significant economic cost. Thus, measures that reduce fly populations in the cattle herd can improve both animal welfare and the farm's bottom line.

While there are many veterinary chemical products that provide effective fly control (pour on oils, ear tags, rubs), parasite resistance is a growing concern, and these options do not apply to farmers selling in the organic and natural markets. Non-chemical fly control in pastured beef cattle can be particularly challenging since they do not return to a barn on a daily basis and are handled much less often than dairy animals. Rather than seeking one silver bullet solution, farmers may find more success with an integrated approach to fly management that incorporates several of the practices discussed below.

The Dickinson College Farm worked with Dr. Jason Smith, a visiting research entomologist, from 2017-2020 to study non-chemical fly reduction methods in our small pastured beef herd. This fact sheet is a summary of that work, interspersed with lessons learned from our experiences in the field. (Note: we use the words cows and cattle interchangeably here – all information below also pertains to steers, heifers, calves and bulls).

Know Your Flies: Many flies are annoying, but not every fly in the field is problematic to cattle. The three fly species responsible for economic losses in the Mid-Atlantic beef industry are described below:

Stable Flies: (*Stomoxys calcitrans*) Stable flies are similar in size and appearance to house flies, but they have a distinctive “beak” of protruding mouthparts that they use to draw blood as they bite cattle, horses, dogs and people. They are also identified by a checkerboard pattern on the abdomen. Stable flies prefer the legs and belly of cows and can be relentlessly aggressive causing painful bites. To monitor for stable flies, count the number of flies on the front legs of cattle (taking a photo can help) – anything over 10 flies per animal is cause for concern. Stable flies breed in rotting organic matter such as spoiled hay and bedding.



Figure 1: Stable Fly - note protruding mouthparts. Photograph by [Lyle Buss](#), University of Florida.

Horn Flies: (*Haematobia irritans*) feed on cow blood 20-30 times per day while resting on backs and sides of cows. Cows may be afflicted by hundreds or even thousands of horn flies at once and are not immune to the annoyance nor to the loss of blood. In the cattle industry nationwide, horn flies account for estimated losses of hundreds of millions of dollars. Horn flies are black or brown and about half the size of common house flies, with no distinctive pattern on the abdomen. Horn flies breed exclusively in fresh manure. The economically important threshold for horn flies is listed as 50 per animal on lactating dairy cows and 200 per beef cow.

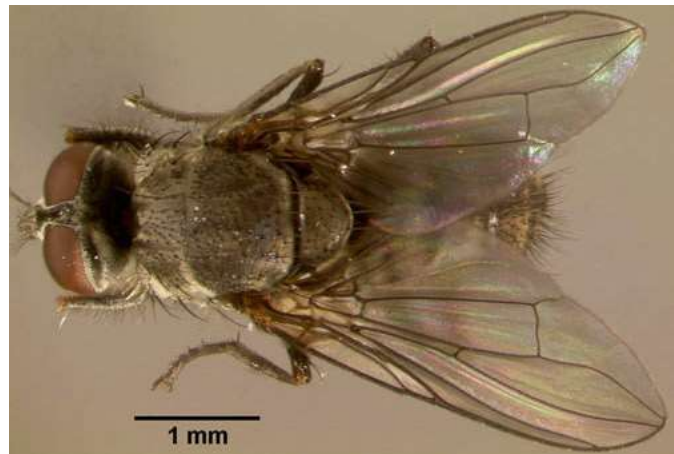


Figure 2: Horn Fly. Photo by [Dan Fitzpatrick](#), University of Florida

Face Flies: (*Musca autumnma*): female face flies feed on the mucus secretions of cow's eyes and noses while males eat manure and nectar. These flies are less directly harmful but problematic because they vector pink eye and cause secondary infections on existing sores. Economic losses are estimated at \$150 million per year due to pink eye and reduced animal productivity. Face flies reproduce exclusively in fresh manure of pastured animals.



Chemical controls: This is not our area of expertise at Dickinson College Farm. Farmers interested in chemical control options including pour on oils, dusts, sprays, and pesticide infused ear tags are encouraged to consult their veterinarian or local feed store for guidance. Heavy reliance on pesticides may result in resistance in the local fly population, so at a minimum, rotation of chemicals is a best practice. As our livestock operation is not certified organic, we have used pour-on pyrethroid insecticide

a handful of times to alleviate fly loads on weak or heavily effected animals. It is not our normal practice but we found the pour on product to be effective at providing relief from excessive flies for a few weeks.

Feed-through insect growth regulators: There are a handful of chemicals (e.g. methoprene (MP) and diflubenzuron (DFB)) that will pass through the animal to resulting manure if included in cattle feed. These compounds have low toxicity to mammals but disrupt the development of fly larvae in manure pads, resulting in reduced populations of mature flies over time. This practice does not affect the adult flies and will be less effective if other untreated cattle herds live nearby. In 2017 Dr. Smith and students conducted an experiment treating fresh manure samples with MP and DFB on two farms. Treated manure was left in a pasture environment, exposed to flies and other organisms for several days. Manure samples were then brought to the lab where all emerging insects were trapped and counted. This unpublished study demonstrated that while feed-through fly controls are effective at reducing fly reproduction (MP is effective against horn flies, DFB reduced all three fly species of concern), they also diminish insect biodiversity and success of non-target species such as ground beetles (MP) and parasitoid wasps that are part of the manure insect community. This result should serve as caution to farmers who are working to enhance biodiversity in their soils and pastures.



Natural fly repellents: There are a handful of natural fly repellents made for the organic livestock market. These are typically concentrated essential oils and are diluted with mineral oil or water before application to cattle. We have added these to terrycloth rubs on our mineral wagon and also applied them directly to animals with a spray bottle or “super soaker” type squirt gun. Our casual observation (no data): While these do seem to provide some alleviation of fly loading, the results are temporary and frequent re-application is necessary.



Cultural Controls:

Sanitation: Stable flies breed in decaying organic matter such as uneaten hay, soiled bedding and fresh cut grass. During the fly season it can be beneficial to minimize piled up muck near the cattle herd. Moving hay feeders and keeping animals moving in a rotational grazing system may also be helpful. At the Dickinson College Farm we’ve focused on reducing water leaks and spills that lead to mud pits. We mounted a self-regulating cattle waterer on heavy skids and haul this from paddock to paddock with a gator as we rotate the animals. This practice also saves labor and reduces water wastage and damage to the pasture. (Water supply is via garden hoses, buried supply lines with field hydrants, and black poly orchard tubing running throughout permanent pastures).

Pasture dragging: Extension professionals recommend dragging pastures to break up manure pies following grazing. The concept at work is reduction of habitat for larvae of face and horn flies (which breed exclusively in fresh manure). Both fly species require appropriate moisture and temperature conditions in the manure pie for larvae to survive, pupate and mature into adults. As this practice is

recommended but not backed by experimental data, we worked with Dr. Jason Smith to conduct field research to assess the effectiveness of pasture dragging at reducing cattle flies at the Dickinson College Farm.

The experiment: To test the effectiveness of pasture dragging, we selected fresh cow pies in the pasture just after the cattle had left a paddock. Some pies were left intact (the control) and some were disturbed by dragging. In 2018 we used a mechanical drag built on the farm from steel bed frames chained together and weighted down with heavy timbers, pulled by a gator (farm utility vehicle).



Figure 3: Mechanical drag smearing cow pies

This drag effectively **smears** cow pies over a large area. In 2020 we used a handheld smearing tool so that we could more precisely control the area of spreading (we tested spreading to double width and triple width of the original pie in 2020, whereas the mechanical smear in 2018 was more random based on the rise and fall of the ground where the pie was laid). After dragging or smearing, all cow pies were left undisturbed for one week to allow adult horn and face flies to lay eggs in the manure. At the end of the week traps were set to collect adult insects coming out of the cow pies and surrounding soil.

Thirty fly emergence traps were built by making cones of aluminum window screen attached to wooden stakes. The large cones have a small (1-2") hole at the top, which was slipped inside a smaller screen cone glued to a wide mouth pint mason jar. These traps were placed over selected manure pies with edges tacked down using ground staples. Adult flies emerging from the soil after pupation naturally fly or walk up the screen to the highest point and become trapped in the jars. Traps were kept in place for two weeks with flies collected from each jar at one-week intervals. Flies were either anesthetized in the field with non-acetone nail polish remover or full jars were placed in the freezer until flies were dead. Dead flies were preserved in alcohol until they could be identified, sorted by species and counted.



Figure 4: Fly emergence trap in pasture with Dr. Smith and C.C. MacPherson



Figure 5: Emerging flies climb into the jar at top of trap and are retained.



Figure 6: Dr. Smith and Stephanie Levin sorting flies to species in the farm lab

The data: To our surprise, analysis of fly emergence trap data from two seasons (five rounds of trapping in 2018 and four rounds in 2020) **does not support** the hypothesis that disturbing cow pies via smearing is effective at reducing reproduction of face and horn flies (stable flies were largely absent from the traps as expected since they don't breed in manure). While some rounds of trapping did show reduced fly success in smeared piles, others show the opposite – face flies were more numerous in cow pies that had been smeared. Dr. Smith analyzed the results in several ways, accounting for variation in rainfall, temperature, daylight and time of year, but could not find a statistically significant correlation that showed a distinct benefit to our smearing technique. Based on these results we cannot support the recommendation that farmers drag their pastures in the Mid-Atlantic to reduce fly populations.

However, the results of our research should be taken with the following caveats: 1. Results may vary from farm to farm based on climate, exposure, timing of dragging, and other organisms present in the pastures. Fly larvae are sensitive to moisture and temperature conditions, so, for example this technique may be more effective in hotter, drier areas (Pennsylvania is typically humid with frequent rainfall in parts of the grazing season). 2. Equipment choice could certainly be a factor – there are commercially available spring tooth dragging tools that might be more effective at breaking manure into discreet particles as opposed to smearing. A youtube search for “pasture dragging equipment” yields several interesting videos. 3. Farmers may find other potential benefits of pasture dragging (distributing manure more evenly, breaking up thatch) worthwhile regardless of fly results. Farmers who use dragging as a fly management strategy are encouraged to contact us to report particulars of their successes and failures – we would be glad to share anecdotal reports of farmer experience with others.

In summary, our data should be a cautionary tale to farmers using dragging as a control method – while it seems like a logically beneficial practice the actual results may be more nuanced based on weather, time of year, timing of drag and equipment choice. Users of this technique are encouraged to record observations to see if they can find a correlation between their actions and fly load on their cattle. Building cone traps is easy and inexpensive – to see trap deployment in action visit this link: <https://www.youtube.com/watch?v=81YRfUsRe60> This research project was generously supported by the Northeast Sustainable Agriculture Research and Education Program. See our full report at: <https://projects.sare.org/project-reports/fne18-911/>

Alternate method of manure disturbance – via pastured chickens: Laying hens reliably scratch at the ground in search of interesting things to eat. Combining pastured hens or other poultry with cattle in mixed species grazing can provide the benefit of fly reduction. We have observed hens scratching up cow manure pies at the Dickinson College Farm and have reason to believe this would be an effective method, especially since the hens will eat larvae if they find them. However, our experience is that the two animal groups are not a perfect match in terms of timing. Cattle move through the landscape fairly quickly – our 20 head of mixed age cattle will graze about half an acre per day on average. Moving cattle paddocks is

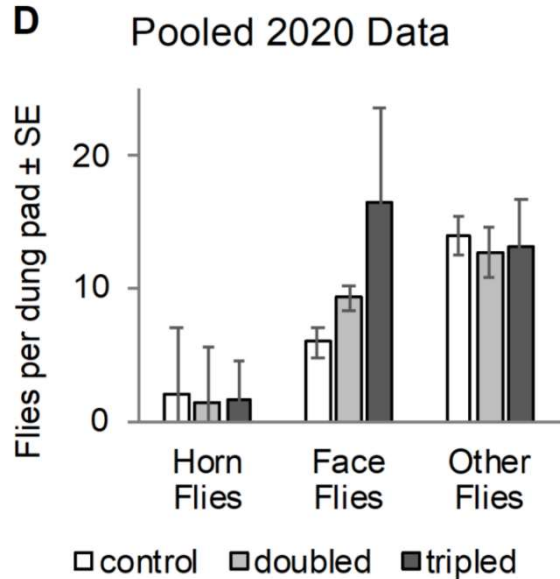


Figure 7: Summary data from four rounds of trapping in 2020. Doubled and tripled indicates the increase in area per smeared cow pie



Figure 8: Laying hens will scratch through manure pies for insects but matching them with cattle grazing is a challenge.

quick and easy using poly-wire on geared reels with step in posts. Moving our 50 hens on the other hand is cumbersome – they require electro-net fencing and a hen house of some kind, so we typically only move them once or twice per week on much smaller paddocks. If left unfenced hens will lay their eggs in the woods, damage surrounding gardens and be more vulnerable to predators. Other farmers do report success with using chickens for fly control so this should be evaluated on a farm by farm basis.

Other Biological Controls:

Dung Beetles gather manure, roll it into balls and take it away to a preferred site for their reproduction. In some parts of the country, a robust population of dung beetles can greatly reduce manure fly success by disassembling and distributing manure pies. Dr. Smith did find dung beetles working the pastures at the Dickinson College Farm but their population was not substantial enough to have a major impact on the success of cattle flies (we commonly see cow pies lingering on the surface for several weeks if undisturbed by human activity). While dung beetles may be available for commercial sale, farmers are advised to be cautious of unintended impacts of importing species from outside their normal bioregion – consultation with local extension officials is recommended.



Parasitic Wasps are small flying insects that reproduce by laying eggs inside the larvae of other species. When the eggs hatch, immature wasps will consume the parasitized insect from the inside out, leaving it unable to mature to adulthood. Several species of wasps will parasitize cattle flies, and at least one is commercially available. Immature wasps arrive in the mail inside parasitized fly pupae – these are either sprinkled on the ground around cattle areas or hung in small mesh pouches from fence posts. After we did not find any obvious success with this method, we consulted with the manufacturer (Spalding Labs) and were advised that fly parasitoids are more effective in barn situations where the manure insect community is more localized – they did not recommend them for effective control in a pasture setting.

Birds: Some birds are pleasant to have around the farm and can provide general control of flying insects. At the Dickinson College Farm we have about 50 nesting boxes designed for tree swallows and bluebirds scattered around the 90 acre property. These boxes do require minor annual maintenance (clearing out mouse nests and invasive sparrows) and protection from curious cattle. While we have no data to report, it is a pleasure to watch swallows and bluebirds swooping around the cattle, presumably consuming flies.



Traps: There are numerous trap designs available for commercial sale as well as on-farm fabrication. Here are a few that we have sampled at the Dickinson College Farm:

Hanging liquid traps: These are filled with water treated with a stinky liquid and hung from a tree or wire near cattle. Flies are drawn to the trap and after entry either drown or die in the heat of a confined sunny space. We used these traps for a number of years, hung near waterers or on mineral wagons moved with the cattle. While it is very satisfying to see a trap packed full of flies (they do indeed catch flies), it is likely that these are not flies of concern to cattle farmers. Since horn and face flies use manure for reproduction and stable flies consume fresh blood, it is more likely that stinky traps are catching non-target flies. Our student fly ID specialist in 2018 (CC Macpherson) examined the flies from a loaded hanging trap and found mostly green bottle flies and house flies. We have since stopped deploying these traps around the pastures but would recommend them for households near trash heaps or other places where garbage flies breed.



Barrel Traps: Several designs for barrel traps can be found online. We built some by cutting a square hole in the top of a plastic drum with removable lid. The hole is covered with plexiglass secured with bolts and silicone caulk to make a seal. Ports are made in the sides of the barrel using 1.5" PVC elbows pointing down into the barrel. The barrel is filled part way with water and stinky material – manure, roadkill, etc. Flies are drawn to the smell, enter through the downward facing port and then are confused by the light coming in the upper window. Flies buzz around the window for a few days and then fall into the liquid below when exhausted. Our experience is that these barrels do trap loads of flies, but they are most likely not the species that are bothering the beef cattle on pasture (since those species seek fresh manure or blood). This barrel trap is depicted in video format here:



<https://www.youtube.com/watch?v=1zuaDI7cR2g> One alternative design for a barrel trap is made by simply wrapping a plastic drum with yellow sticky tape intended for insects – the barrels are placed just outside of cattle fences near waterers or feeders. This sort of trap will catch a broader spectrum of flying insects – those who use them are encouraged to examine what is caught to avoid unintended damage to non-target species.



Walk-Through Traps: If effective, a walk through trap can provide immediate satisfaction – flies are caught as cattle pass through the trap, and farmers can be sure they are catching the right flies. We built a modified version of the Bob's Trap or Buffalo Fly Trap described in this video: <https://www.youtube.com/watch?v=LLv0z1XOdmU>

We built our fly trap from 2x4s and greenhouse plastic for about \$100-200 in 2018. Essentially it is a mini greenhouse big enough for cattle to walk through a lane in the center. The lane is equipped with flaps to disturb flies and a piece of black rubber over the top to create momentary shade. Flies dislike shade so they leave the animal and fly up into the hotter roof of the greenhouse. The upper rafter section has an extra flap of clear plastic hanging loosely inside like a baffle. Once the flies get in between this baffle and the clear roof, they buzz around and tire out in the heat of the sun. Our experience was that flies did leave the cattle when entering the trap, and the trap was effective at killing flies. The challenge was getting the cattle to walk through it. Pastured beef cattle on our farm do not return to a central spot daily and are not in the habit of walking the same lane unless forced to do so. While heifers and steer calves were more curious and would spend time in the trap, mature cows were very skeptical and resistant to entering without coercion. We suspect this inexpensive trap would be more effective in a dairy operation where the cattle follow a daily routine. Sadly our mobile walk through trap was destroyed in a wind storm after only one season of use – if farmers replicate this practice be advised to make the bottom very heavy or otherwise secure it to the ground.

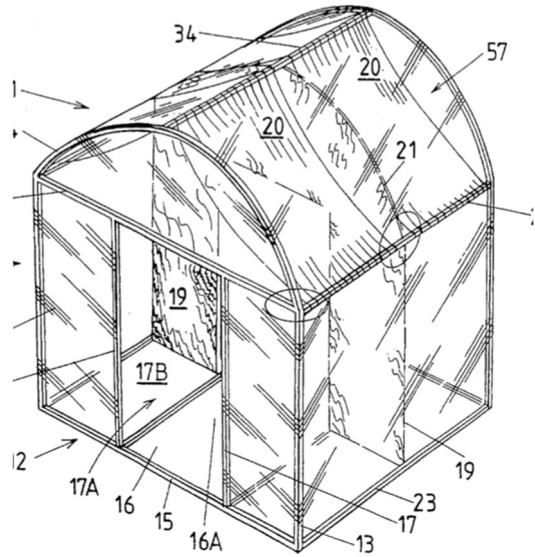
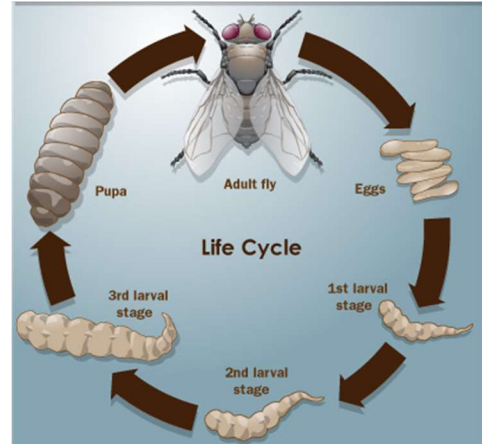


Figure 9: Bob's Trap design. Note extra plastic flaps hanging inside roof area.



Figure 10: Portable walk-through trap at Dickinson College Farm. Plan for wind.

Conclusions: There is no magic bullet control method for flies on pastured beef cattle that will fit all farms. Cattle managers that wish to reduce fly problems without pesticides are encouraged to combine multiple approaches and record observations over time. As always, talking to other farmers in the neighborhood to share experiences can be very valuable. Understanding the fly life cycle depicted at right and knowing which species are bothering your cattle is a great place to start.



Please stay in touch with us if you have any questions about our efforts and to share your success stories so that we can help pass them around.

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Figure 11: CC Macpherson and a new calf get the lowdown on manure flies from Dr. Smith

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