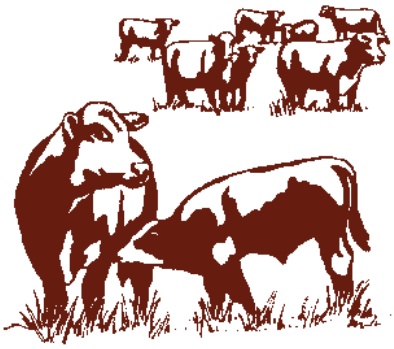
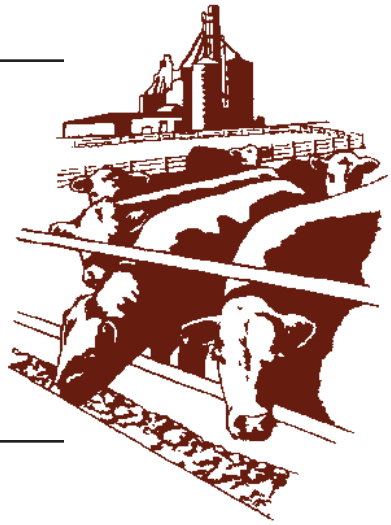


Beef Cattle Handbook



BCH-3810

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Biological Control of Dung-Breeding Flies Affecting Pastured Cattle

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The horn fly, *Haematobia irritans*, and face fly, *Musca autumnalis*, are important pests of pastured cattle in the US. These flies cost livestock producers millions of dollars each year for insecticides, equipment and labor for insecticide applications, and production losses. Both species reproduce in fresh cattle dung (cowpats) dropped on pasture. Most efforts to control these pests have involved the use of insecticides. However, during the last 10–15 years, the horn fly has developed resistance to insecticides commonly used for its control.

Since both species of flies are introduced pests, they lack the natural enemies they had in their native countries. However, a variety of natural enemies (parasites, predators, and competitors) of dung-breeding flies occur in cowpats on pasture in the US. Some of these natural enemies have been shown to play a role in the regulation of horn fly and face fly populations during certains times of the year. During a few weeks each year in some areas of the southern states, 100 percent of the immature horn flies developing in cowpats are destroyed by natural enemies. However, this desired degree of control is not consistent throughout the horn fly season. Studies have revealed the existence of seasonal, habitat, and daily flight-activity "gaps" in the activity of native predators, parasites, and competitors of dung-breeding flies which allows the build-up of pest fly populations. Research in Texas has shown that most adult horn flies originate from cowpats deposited at night when there is little or no flight activity by natural enemies. Foreign exploration has been conducted since the mid-1970s to find exotic species of natural enemies of dung-breeding flies that might be useful in the United States. Several species of natural enemies of dung-breeding flies have been imported to try to fill these non-activity gaps by endemic natural enemies.

Parasites

Several species of parasites (tiny wasps) are known to parasitize immature stages of horn flies and face flies in cowpats. However, the parasitism rate of both species of flies is usually low, and only occasionally is the rate adequate to reduce fly populations. Parasitism rates as high as 43 and 45 percent have been reported for the horn fly in Mississippi and Texas, respectively, and 17–20 percent in Nebraska, but the yearly average is usually less than 5 percent. A seasonal parasitism rate reported for the face fly in Missouri ranged from 3–9 percent and averaged 4.3–4.7 percent in Nebraska. The face fly puparium is calcified, making it difficult for most species of parasites to escape. Twenty-two species of parasitic wasps have been identified from horn fly pupae in the US and six species from face fly pupae. Since the horn fly and face fly are not native, these parasites prefer to parasitize other species of flies that develop in cattle dung. Parasitic wasps of dung-breeding flies do not sting humans and livestock.

Several species of parasites are available from commercial sources to aid in controlling house flies and stable flies near confined livestock facilities. The majority of these parasites are species of *Muscidifurax* and *Spalangia*. Most of these parasites also parasitize horn fly pupae, but very few species parasitize face fly pupae. For pastured cattle, managed parasite releases across wide areas of range and pasture would be cost and labor intensive and probably result in low parasite sur-

vival. Therefore, releases of parasitic wasps to supplement those already present on pasture has little potential value for controlling horn flies and face flies.

Only one species of insect parasite, a staphylinid beetle, has been introduced and released specifically to aid in controlling the face fly. This species, *Aleochara tristis*, was collected from face fly pupae in France and released in Nebraska and California, but it apparently has had little effect on face fly populations. *A. tristis,* an ectoparasite on fly pupae in its larval stage, and a predator of fly eggs in its adult stage, has been reported to be established in California and Minnesota.

Another biological control effort against the face fly used a nematode parasite, *Heterotylenchus autumnalis*. This nematode parasitizes the ovaries of female face flies and makes them sterile. An infected female face fly unknowingly deposits male and female nematode larvae in cowpats instead of fly eggs. The nematodes mature and mate in the dung deposit and infect face fly larvae. In Nebraska, nematode infection levels as high as 80 percent have been achieved in laboratory colonies of face flies, and seasonal infestations as high as 31 percent have been reported in wild face flies. No parasites have been introduced specifically for horn fly control.

Predators

Predaceous insects are important mortality factors of both the horn fly and face fly. The most important predators in cattle dung are beetles (Histeridae and Staphylinidae) that prey as both larvae and adults on eggs and larvae of dung-breeding flies. The staphylinids are the best overall predators, especially *Philonthus* species, because of their diversity and high populations in pastures. Histerids, especially *Hister* species, are excellent predators, but their numbers in cattle dung are usually low. Predation mortality for the horn fly has been reported to be greater than 90 percent in Missouri and Texas. The species of predators that are present in an area will vary from one region of the country to the other.

Seven foreign species of Histeridae have been released in California for horn fly and face fly control. These histerids were imported from southern Africa, Java, and Pakistan. It is not known if any of these beetles have become established. Seven species of predators have been released in Texas to aid in horn fly control. These predators comprise two species of Histeridae (*Atholus rothkirchi* from South Africa and *Hister bruchi* from Argentina) and five species of Staphylinidae *(Philonthus agilis* and *P. concinnus* from Spain, *P. minutus* from Australia, *P. flavocinctus* from southeast Asia, and *P. quadraticeps* from Argentina). At present, it is not known if any of these species have become established because most species were recently released. The general rule is that if a species of beneficial insect is found 3 years after release, then it is considered to be established. There are no commercial sources from which to purchase predators specifically for horn fly and face fly control.

Competitors

Most emphasis on the biological control of dung-breeding flies has been on the use of dung-burying beetles to reduce the breeding habitat of flies. Dung beetles can be found throughout the US, with most species occurring in the southern tier of states. Adults of most species either feed on the liquid portion of dung, or they bury it in the ground as food for their progeny that eat solid dung (Fig. 1). Dung beetles not only compete with the horn fly and face fly for the same food source, they also reduce dung accumulation and improve pastures by increased fertility and improved soil structure. These beetles also have been reported to be effective biological control agents for certain gastrointestinal parasites of livestock.

Although many native species of dung beetles are associated with cattle dung in the US, few species bury significant amounts of dung within a few days after deposit. Competition and habitat destruction by native dung beetles is inadequate for controlling dung-breeding pest flies. Therefore, several species of dung beetles with greater potential to rapidly bury cattle dung dropped on pasture have been imported and released as biological control agents for the horn fly and face fly.

Fifteen species of foreign dung beetles have been released in Texas and several others states by USDA and state university scientists from 1972–1987. Five of these 15 species are known to be established in various states from southern California to South Carolina. Currently, four species (*Onthophagus gazella, Onthophagus taurus, Onitis alexis, Euoniticellus intermedius*) are established in California; three species (*Onthophagus depressus, O. gazella, O. taurus*) in Florida, Georgia, and South Carolina; three species (O. *gazella, O. taurus, E. intermedius*) in Texas; two species (*O. gazella, E. intermedius*) in Arizona and New Mexico; two species (*O. gazella, O. taurus*) in Oklahoma, Louisiana, Arkansas, Mississippi, and Alabama; and one species (*O. taurus*) in Tennessee, North Carolina, Virginia, Maryland, Delaware, and New Jersey. The effect of these introduced dung beetles on dung-breeding flies has yet to be evaluated fully, but a decrease in horn fly populations has been noted on cattle in several states when dung beetle populations are sufficient to bury most cowpats within 24 hours after deposition. Thousands of tons of additional dung are now being buried each day by these beetles. Most species of dung beetles depend on a good rain every 2–3 weeks to maintain large populations.

According to beetle species and soil type, most dung beetles spend the winter at various depths in the soil (10–80 cm deep). The population of dung beetles on pasture in the spring depends on the number of beetles that survive the winter. In the southeastern US, a mild winter with adequate rainfall, and adequate rainfall in the spring usually results in large populations of dung beetles in the spring. In most of the southern tier of states, the introduced species of dung beetles begin to emerge in mid to late April. In southern Florida and Texas, these beetles may bury dung during the entire year.

Successful biological control of dung-breeding pest

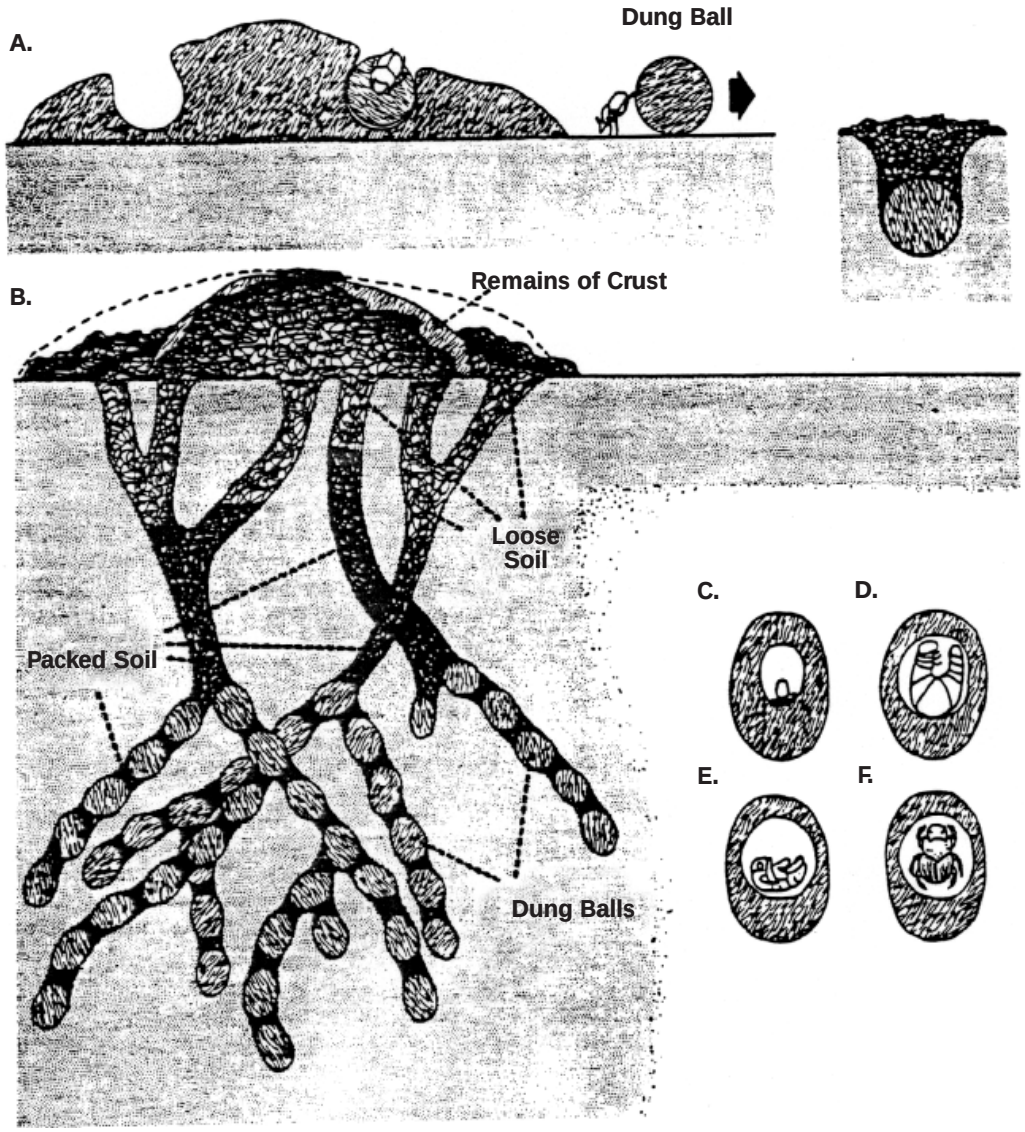

Fig. 1. Cowpats are used in different ways by different species of dung beetles.

(A). One group cuts bits of dung out of the pat, forms them into balls, and rolls them away for burial in a shallow pit.

(B). Most species of dung beetles form their nests in tunnels excavated below the cowpat. A male and female beetle dig the tunnel and carry dung down into it.

(C). The female then forms a ball (as in the case of *Onthophagus gazella* shown at left), lays an egg in it, and closes the ball The tunnels are backfilled with firmly packed soil. Loose soil fills the upper parts of the tunnels and is left on the surface along with some remains of the cowpats.

(D). When the larva hatches it feeds on the dung.

(E). After passing through the pupal stage,

(F) a young adult emerges and makes its way to the surface.

flies depends on several ecological factors, including seasonal distribution, daily flight activity, and habitat preference of natural enemies. In east-central Texas, horn flies begin activity in late February and are most active from June to August; predators are most active from May to October; and competitors are most active from April to October. Because of this lag time, populations of horn flies increase rapidly in the spring before populations of natural enemies increase accordingly.

At present, there are no commercial sources available where dung beetles can be purchased for release by farmers and ranchers. However, dung beetle populations on a farm or ranch can be conserved. When working cattle in the spring, producers should be aware that some pesticides used on cattle for internal and external parasites may affect the reproduction of dung beetles, if the pesticide is excreted in the dung of treated animals. To avoid this problem, cattle should be treated before overwintered populations of dung beetles emerge from the soil in the spring. Information on dung beetles can usually be obtained by contacting veterinary entomologists at most state universities or experiment stations.

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