Review Article

THE IMPACTS OF FLY MENACE ON LIVESTOCK PRODUCTION IN A CHANGING CLIMATE: A REVIEW

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ABSTRACT

Livestock Production in India has been showing a steady and strong growth in recent years; milk production has reached a record high of 247.87 million tonnes in 2025 and total meat production rising to 10.50 million tonnes. However, fly menace has become one of the major constraints for the profitable livestock farming in the face of global warming, particularly in tropical countries like India. The rise in temperature and relative humidity directly influences the bionomics of arthropod pest such as frequency of feeding and life cycle duration. The accelerated life cycle results in high intensity of pest population, eventually the fly menace becomes beyond threshold level, causing huge economic losses in dairy and small ruminant production. The losses associated with flymenace include blood loss, reduced milk and meat production by direct injury, and indirectly the arthropod pests cause economic loss through transmission of dreadful diseases caused by virus, bacteria, rickettsia and parasites. The vector and vector borne diseases have long been controlled through various classes of insecticide, but indiscriminate use has led to insecticide resistance. Hence, in this review the common fly species affecting livestock, associated losses and control strategies.

Keywords: Livestock, fly menace, vector potentiality, economic losses, control strategy

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INTRODUCTION

Fly menace is the major concern for cattle and swine production in recent years in tropical region of the world may be due to influence of climate change. Availability of breeding substrates in animal facilities such as fresh manure, spilled feed, silage, moist animal bedding, and any fresh moist organic matter (moisture content of 50-85% and decomposing) coupled with favourable temperature and humidity favour the proliferation of insect pest at a fast pace, this could be the one of the reasons for high fly menace in livestock farms. Temperature change affects insects directly since they are exothermic; therefore, they

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are more active under increased warmness. When environmental temperature is high, the energy consumption rate of the insects will raise, leading to increased frequency of feeding for e.g. stablefly feeds once per day on cooler days (Berry and Campbell 1985) and twice per day on warmer days (Harris *et al.,* 1974; Müller *et al.,* 2012). Temperature variation of 2^{o}C can increase life cycle of insects up to 1 to 5 times (Nwaerema Peace*,* 2020).

The most common fly species of cattle in stables include houseflies (*Musca domestica*), face fly (*Musca autumnalis*) and stable flies (*Stomoxys calcitrans*), *Haematobia exigua* (Buffalo fly), and Culicoides.Several other flies such as *Tabanus, Haematopota, Chrysops* and *Pangonia* and *Musca crossirostris* also attack cattle while they are on grazing or if they are maintained on open area covered with vegetations. In swine production, house fly menace is considered to be a challenging problem, but *Haematobia exigua* infestation was recorded in Tamil Nadu (Thirunavukkarasu *et al.,* 2023). Cutaneous myiasis in cattle caused by *Hypoderma lineatum* was recorded in Tamil Nadu, although it is very common in northern part of India (Ponnudurai *et al.,* 2010). In sheep and goat, Culicoides and myiasis producing flies *Chrysomyia* and *Oestrus ovis* are the important insects (Senthilvel *et al.,* 2013). Flies annoy livestock and affect their behaviour (Mullens *et al.*, 2006; Taylor *et al.,* 2012). When animals are attacked (biting) by the flies, they attempt to get rid of the flies by specific behaviour including head tossing, skin twitching, ear trembling, tail flicking, leg lifting and kicking into the abdomen and grouping together (Williams, 2010). The energy loss due to fly avoidance activities will have a negative effect on the health (stress) and production. Besides causing direct injuries, the flies are also involved in the transmission of many pathogens to animals and humans. It is estimated that flies are responsible for global livestock production losses in billions of dollars. Hence, economic losses associated with fly menace can be curtailed only through strategic control measures. Identification of fly species and its biology are prerequisite for effective control; because morphological features, life cycle pattern, host preference, feeding behaviour vary between the different species of flies. The common fly species found in dairy, small ruminant and swine farms in India and various control measures are discussed here.

In India, the common fly species attacking cattle, sheep, pig and horse include *Musca domestica*, *Musca autumnalis, Stomoxys calcitrans*, *Haematobia exigua,* Culicoides, *Tabanus, Chrysops, Pangonia* and *Musca crossirostris.*

Musca domestica **(House fly)**

House flies, *Musca domestica* is a very common fly species found in dairy, poultry and piggery farms (Fig.1 and 2), are non-biting insects that breed in manure, decaying silage, spilled feed, soiled bedding, and other decomposing organic matter (Ponnudurai and Harikrishnan, 2011). Adult flies live an average of 2-4 weeks in summer and longer in cooler weather.

Male house flies are attracted by the female produced pheromone called muscalure, (Z)-9-tricosene. Female house flies normally mate only once. Each female can produce 4 to 6 batches of 150 to 200 eggs over her lifetime, which she lays at 3 to 4 day intervals. They can complete their life cycle from egg to adult in 7 to 10 days under the ideal conditions of warm summer months. House fly can travel maximum of 5 km from the breeding site, but it has been recorded it can travel up to 12.5 Km.

Although house flies may cause only minor direct annoyance to animals, their potential for transmitting pathogens (more than 100) mechanically and act as an intermediate host for parasites is considerable, and they have been implicated as vector for *Salmonella, Escherichia coli*, and *Staphylococcus aureus*. Cattle get irritated by the flies and so spend less time resting or eating resulting in reduced daily live weight gain (DLWG) and milk production. It was reported that the fly menace caused reduction of 0.52kg/cow/day in milk production and 0. 28kg/head/day in DLWG in young stock. Narladkar (2018) reported that house flies caused 3.3 per cent decrease in milk production. In addition, house flies wherever rest they leave specks (faeces dark brown and crop fluid light colour), which not only contaminate the environment, and dairy products, but also specks on lights reduce the illumination and specks placed on steel structures of the animal shed cause corrosion and reduce their durability.

Severe house fly infestations may increase bacterial counts in milk. Flies can also become a serious nuisance both around the production facility and in nearby communities. These neighbours are often intolerant of flies, putting greater pressure on producers to keep house fly populations to a minimum.

***Musca autumnalis* (Face fly)**

The fly is 6-10mm long, similar to the house fly, but darker. It is a non-biting fly which feeds on animal secretions (2-3 times a day) and breed in fresh droppings on pasture, the duration of life cycle is 3 weeks. Face flies spend relatively little time on their host (2-5 minutes). These flies are most active during the day and are typically a problem to grazing cattle, as they seldom enter barns or animal shelters. Feeding habits of face flies are annoyance to cattle, 12 to 14 flies per animal are enough to cause greater irritation. The behavioural and physiological responses to irritation may occur in the form of reduced fertility, growth, and lactation (Hansen *et al.,* 2023).

Cows annoyed by flies' exhaust energy in an attempt to dislodge flies, instead of using it for production. Intensity of attacks varies with time of day and weather conditions. Flies are particularly active when winds are low and temperatures are high. Under intense attack, cows often abandon eating and bunch close together. Bunching is a herd response to fly activity where cows attempt to limit surface area exposed to attack. Oftentimes, cows will gather in a tight circle

with heads in the centre. However, cows in such close proximity may increase the risk of heat stress and weight loss. The flies cluster around the eyes, mouth and muzzle and can spread pink eye - Infectious Bovine Keratoconjunctivitis caused by *Moraxella bovis,* Infectious Bovine Rhinotracheitis virus and *Corynebacterium pyogenes* mastitis. It also acts as intermediate host for *Thelazia* sp. and *Parafilaria bovicola.*

Musca crossirostris

Both adult males and females of *M. crossirostris* are haematophagus (10–40 mg per fly); males suck blood as voraciously as females. *Musca crossirostris* is considered as one of the most important pests of cattle in India (Karunamoorthy, 1993). It can attack horses and donkeys, although the species is more usually found on bovines (cattle and buffaloes), and it may occasionally attack humans and dogs. *Musca crossirostris* most often feeds on the legs and belly (Fig.3); cattle typically lie down on their legs to protect themselves from attacks. Because of their nuisance effects, feeding is affected. This leads to reduced weight gain in beef cattle, reduced milk production in dairy cattle (Ponnudurai and Rani, 2018). Rasping of skin with prestomal teeth will be painful that generates stress that contributes to immunosuppression in animals. In addition to direct injuries, it acts as a mechanical carrier for *Escherichia coli*, *Moraxella bovis* (pink eye) and *Staphylococcus aureus.*

***Stomoxys calcitrans* (Stable fly)**

The stable fly, is slightly smaller than a house fly but is dark grey. Its abdomen has seven rounded dark spots on the upper surface. Stable flies breed in wet straw, manure, spilled feeds, silage, grass clippings, poorly managed compost piles, damp round bales, and vegetation washed up on lake shores; in other words, in any damp, decaying organic matter. However, it has also been recorded for the first time stable fly was found to have used poultry litterfor breeding in breeder layer farm in Salem district, Tamil Nadu (Ponnudurai *et al.,* 2022). Each female fly lives about 20 to 30 days and lays 200 to 400 eggs during her lifetime. Stable flies develop slightly slower than house flies, but under warm summer conditions, the life cycle from egg to adult is about 3 weeks. Stable flies are vigorous fliers and may travel long distances to find a host. Both male and females are blood suckers. Stable flies feed one or two times per day (Berry and Campbell, 1985). Usually, intermittent feeding last for 3 -4 minutes, a single fly consumes 11–15 µL of blood per meal (Baldacchino *et al.*, 2013). The preferred site of feeding includes front legs, sides, back and belly of the cattle(Fig.4). The biting mouthparts of the adult protrude like a baton is used to cause extremely painful bites. They aggravate dairy cattle both in the shed and on pasture.

Affected animals will be regularly stomping their legs and bunching together.

That means the animals will spend less time for eating and drinking. The biting of stable fly causes high stress and elevated cortisol levels in host animals, which can affect the health, performance, and welfare of cattle (Vitela-Mendoza *et al*., 2016). Taylor *et al.* (2012) found that high activity of adult stable flies causes lower feed intake, weight loss, increased stress and lower milk production. It has been reported that 5 flies per animal are able to cause economic loss. The reduced feed intake and increased stress or cortisol levels can reduce milk production by 20 to 30 percent (Choudhary *et al.,* 2019) and decrease weight gain by 0.48 pounds per day. The decrease inproduction continues for weeks or months after the end of the fly season. As stable flies mechanically and chemically damage the skin surface due to enzymatic activity, they cause pain in the infested area, local infections and reduce the host's immunity – immunosuppression (Baldacchino *et al.,* 2013). Lesions on theteat may be a predisposing factor for the development of a disease (Bramley *et al.,* 1985).

The indirect effect of stable fly infestation is the mechanical transmission of pathogens which include Equine infectious anaemia, African swine fever, West Nile, and Rift Valley viruses. Rickettsia (*Anaplasma, Coxiella*), other bacteria and parasites (*Trypanosoma spp., Besnoitia spp*.) are also transmitted by *Stomoxys.* It also acts as an intermediate host of the helminth Habronema majus and some *Onchocerca* and *Dirofilaria* species. Being cosmopolite, *Stomoxys calcitrans* might have a worldwide and greater impact than previously thought on animal and human pathogen transmission.

***Haematobia exigua* (Buffalo fly)**

In the genus *Haematobia*, two species have been recorded viz., H. *irritans* (Horn fly) and *H. exigua* (buffalo fly), the latter one is prevalent in Australia and Asia (Onder *et al.*, 2018). *Haematobia exigua* is the smallest blood sucking muscid fly, 4 mm length, thorax has two stripes. The fly feeds on buffaloes and cattle and rarely leaves the host except for laying eggs on freshly voided dung. They generally found in cluster (Fig.5) on the shoulder and sides of animal, but tend to congregate on the underside of the belly when weather is hot or rainy.

The abundance of *Haematobia* flies in cattle is reported to be influenced by abiotic factors such as environmental temperature, relative humidity and precipitation. Together, biology of flies and farm waste management also determines the fly intensity. An average temperature of 22-26°C and relative humidity of 65-90 per cent was found to be ideal for oviposition and development of *Haematobia* flies (Morgan, 1964), however cold temperature may cause diapause in the pupal stage of the fly (Lysk and Moon, 1994). The population of *Haematobia* fly is normally low during hot and dry months, whereas it begins to rise following onset of monsoon. When favourable condition prevails, a single female fly lays about 400 eggs and life cycle

is completed in 9 – 12 days. Due to its short duration of life cycle with a high fecundity enables to produce nearly 3 generations in a month and population reaches a peak quickly.

In addition to influence of abiotic factors on the abundance of *Haematobia* fly on cattle, breed, skin colour, epidermal thickness and skin temperature of the animals are likely to determine the attractiveness to flies. Anbarasi *et al.* (2021) observed high fly intensity in dark coloured animal than medium and light-coloured animal. Similarly, high fly intensity was observed in Jersey cross than HF and native breeds. It has also been reported that accessibility of blood vessels partially determines attractiveness to flies and hence animals with thinner epidermis attracting more flies could be due to easy access to blood vessels (Breijo *et al.*, 2014).

The flies feed 24 – 38 times a day (Harris *et al.,* 1974). Heavy infestation causes irritation and injury due to constant piercing of the skin, leading to development of sores and wounds near median canthus of the eyes in cattle and ventral side of the abdomen in pig (Fig.6 and 7) and sides of the neck region which may attract myiasis producing flies (Mosca *et al*., 2018).

In addition, during the high fly population the cattle exhibit fly avoidance activities including head throw, leg stamping, skin and tail twitching, resulting in disturbed grazing and poor utilization of nutrients (Hart, 1994). The increased frequency of these fly avoidance activities may cause loss of energy, reduction in weight gain and milk production (Boland *et al.*, 2008). It has been estimated that a cow infested with 200 numbers of *H. exigua* adult flies had 520 ml and 28 g reduction in milk production and live weight gain per day respectively in Australia (Jonsson and Mayer, 1999, Anbarasi *et al.*, 2024). In the United States the economic losses associated with *Haematobia* infestations in cattle farms is estimated to be $ 800 million annually (Byford *et al.,* 1992). Besides causing economic losses through direct injuries, *Haematobia* flies have been implicated for spreading of summer mastitis caused by *Staphylococcus aureus* innon-lactating heifers (Owens *et al*., 1998). They can also act as mechanical vector for *Trypanosoma evansi* and *Anaplasma marginale* (Rodrigues *et al.,* 2009) and as intermediate host for *Stephanofilaria stilesi* (Johnson *et al*., 1986).

Tabanid flies

Tabanid flies include *Tabanus* (Horse fly), *Haematopota* (Clegs), *Chrysops* (Deer fly) and *Pangonia*; nearly 4400 species have been recorded (Raju Metri, 2021). Tabanid flies are large, stout bodied. Most species are diurnal, active on warm sunny days with low wind speeds. Both sexes feed on nectar, but in most species the female also feeds on blood. They feed mainly on large mammals (bovine, equine, camel, deer and man) and only rarely on birds. The female after mating seeks blood meal for ovarian development. Adult horse flies are fast, strong fliers one species was estimated to fly over 150 km per hour. Tabanids usually found around streams, marshes, and wooded

areas and in wait in shady areas under bushes and trees for a host. Moving objects, especially if dark coloured is most prone to attack. Attacks occur during day light hours with a peak beginning at sunrise and lasting three hours. A second peak is two hours before sunset and commences shortly after. Attack frequency is low on overcast days or at temperatures below 22ºC and above 32ºC. Horse flies are haematophagus dipterans that cause direct losses to livestock production due to irritation, stress, and blood loss in animals, particularly cattle and horses. It causes reduction in weight gain of 0.1 per day in cattle (Altunsoy, 2012). Economic losses are directly related to the number of horse flies present in the environment.

Tabanids have scissor-like mouth parts, with which they lacerate/slash the skin and lap up the oozing blood (Fig.8). They consume 0.1–0.3 mL (20 – 200mg) of blood at a single feeding, but the blood loss is greater because the wound made by them continues to ooze blood even after mouth parts have been withdrawn, which in turn attracts non – biting muscid flies causing myiasis (Fig.9). At the sight of flies, animals become restless and unmanageable this behaviour is called gadding. Site of preference for feeding includes the underside of the abdomen around the navel, the legs, or the neck and withers. The bites are painful and irritating, give rise to wheals/weals in soft skinned animals (Soulsby, 1982). Flies are often disturbed by the fly avoidance activities of the animal, but flies move to other parts of the body or other animals to feed until they become replete, this is intermittent feeding. This feeding habit facilitates *Tabanus* to act as potential vector for *Trypanosoma evansi*. The probability of transmission of *T. evansi* is high when time interval between successive feeding of fly on an infected animal and a susceptible animal is less than 15 minutes, when parasitaemia is above 10^6 trypanosomes/mL (Desquesnes *et al.,* 2009). These flies may act as mechanical vectors of anthrax, anaplasmosis, tularaemia, bovine leukaemia, and virus of equine infectious anaemia. As *Pangonia sp*. has a long mouth parts (Fig.10), its bite will be more painful to host, resulting in gadding.

Culicoides

Culicoides are very small, blood-feeding midges, approximately 1–3 mm in length, only the females feed on blood. *Culicoides* midges are smaller than mosquitoes, but much more abundant and more than 1400 species of *Culicoides* have been identified (Archana *et al*., 2014). They breed in sites close contact with the host animals such as irrigation pipe leaks, irrigated pasture, cattle trough overflows and even wet dung, the precise type of breeding site being dependent upon the species of vector (Sathiyamoorthy and Ponnudurai 2017). The development of *Culicoides* species takes a few weeks or even months, when egg/ larval stage undergoes dormancy during winter and depends on the ambient temperatures, resulting in a seasonal activity pattern in temperate regions. They are not strong fliers, so they do not fly long distances (female can fly 2 km) and cannot fly against the wind. They prefer still, warm nights, and

fly at dawn and dusk (crepuscular activity) when large swarms may be seen. Midges find suitable animals to bite primarily on the basis of levels of carbon dioxide, and possibly other compounds produced by the host. The females are blood sucker, feeding lasts for 3 to 10 minutes, which facilitates transmission of diseases. Female midges feed every few days. They have strong host preferences so that one animal species in an area may be severely bitten, while another will be more or less ignored. They usually feed on cattle, sheep, horse, wild animals and rarely man. Some species of *Culicoides* are autogenous i.e produce eggs without first taking blood meal. This might play a major role in the maintenance of population in the absence of host.

The bites can be very painful and pruritic and can develop into papules and wheals. The saliva even induces acute allergic reactions such as the "common summer eczema (insect hypersensitivity)" Queensland itchin horses. However, their veterinary or public health importance is their role in the transmission of pathogens, especially viruses, but also protozoans and filarial parasites. More than 50 viruses have been isolated from *Culicoides* spp. worldwide. Most of the viruses belong to the families *Reoviridae* (e.g., African horse sickness virus (AHSV), bluetongue virus (BTV), or epizootic haemorrhagic disease virus (EHDV)), *Rhabdoviridae* (e.g., bovine ephemeral fever virus (BEFV)) and *Peribunyaviridae* (e.g., Akabane virus (AKAV), Schmallenberg virus (SBV), or Oropouche virus (OROV)). *Culicoides* act as intermediate host for *Onchocerca cervicalis* and *O. reticulata* in horse, *O.gibsoni* in cattle and *Dipetalonema perstans* in man, besidesprotozoan parasites *Akiba caulleryi* (Bangkok haemorrhagic disease in chicken).

Control of fly menace

Complete elimination of fly population is not practically possible, but it can be reduced to below threshold level through integrated pest management (IPM). Integrated pest management includes monitoring of fly population, farm management, chemical method and biological method (Ponnudurai *et al*., 2015).

Monitoring of flies

Fly populations should be monitored in barns on a weekly basis. Baited jug traps, spot cards and sticky ribbons are useful for this purpose. Nuisance thresholds are an average of 250 house flies per jug trap per week, 50 fly specks (vomit and excreta) per spot card per week and 100 flies per 300 m total walking distance for two consecutive times gives an indirect estimate of fly populations.

1. House flies can be monitored using sticky ribbons or spot cards (Ponnudurai *et al*., 2015). Spot cards are 3-by-5-inch white file cards that are placed on obvious fly resting surfaces. They reflect the relative population of house flies by showing the number of fly faecal and regurgitation spots left when flies land to rest.

2. Sticky ribbons are 2-inch-wide strips and normally a couple of feet long. The sticky material covering the ribbons immobilizes insects when they land to rest. They provide an easy method to monitor fly populations over time.

3. The number of spot cards, or sticky fly ribbons needed will vary with facility size, it has to be placed at least 5 to 10 locations in each animal housing unit. If possible, mount at equidistantlocations on posts, beams, and walls, or other areas where flies tend torest, making sure to include some wind-free locations. Leave cards or ribbons for 24 hr, and then count number of regurgitation and faecal marks (fly specks)

4. Baited jug traps can be made from 4 litre plastic jugs. Cut four 5-7 cm (1-2") access holes around the upper part of the jug, attach a wire for hanging, and add commercial fly bait made of methomyl (30g) to the trap. Use a minimum of 5 jug traps per average size barn. At each check, count (estimate) the number of house flies in each trap, remove the flies and the old bait and add about 30 grams of fresh bait.

5. Stable flies are monitored weekly by counting flies on all four legs of at least 15 animals in the herd. In general, treatment is warranted when counts reach an average of 10 flies per animal. Snap shot method (Photo) can be adopted to monitor Stable and *Haematobia* fly (Anbarasi *et al*., 2021). Sticky tape can also be used.

6.. Light tarps can be used to monitor Culicoides

Farm Management

Sanitation: Both house and stable flies need moist decomposing organic matter for the immature life stages to survive. Waste management is therefore the first line of defence in developing an effective fly management program.

Clean out calf pens on a regular basis and keep them ventilated. Calf areas are prime spots for fly breeding. Keep animal areas as dry as possible. Scrape out manure regularly, and provide a three to four percent slope to allow drainage of liquid from stalls. Keep areas around feed storage, feed bunks and watering tanks free from moisture and manure. Fix water leaks promptly. Keep flies out of milk rooms by maintaining window screens (use 14-16 mesh) and keeping doors closed whenever possible. Sanitation is an absolute necessity in effectively combating the stable-fly. Manure should be collected and spread on fields thinly at least twice to kill eggs and larvae. Plant material such as hay, citrus pulp, peanut litter, and other waste vegetable matter should not be allowed to accumulate, especially during damp weather. Such materials should be disposed of or thoroughly treated with appropriate insecticides to prevent the flies from using them as breeding media.

Physical Control: sticky tapes, traps, and lights are forms of physical control aimed at attracting and killing the adult fly. These can be very useful as part of

an integrated pest management system. Use traps in areas where the use of chemicals is difficult, ineffective or unacceptable, such as milking parlours, milk holding rooms, and feed holding and mixing areas.

Chemical control: Chemical use around lactating dairy animals is limited. Labels should be read and instructions followed. Use of insecticides for fly control is an important component in an integrated fly control program directed at reducing fly populations to tolerable levels (Sathiyamoorthy *et al.*, 2017)

Adulticide

Surface residual spray applications can also be used for long-term population suppression. They are an effective and economical method to control high infestations of flies and should be applied in the places where the flies rest, including walls, roof, cords, pipes, both inside and outside the buildings. Surface residual spray applications are typically pyrethroids which control the adult flies upon contact with the surface. Pyrethroids will have some repellent activity (Anbarasi *et al*., 2024).

Space sprays or mist sprays are used to quickly knockdown adults. Misting fly resting surfaces with these chemicals is the most common way to suppress overwhelming populations with short residual actions. The low residual activity in turn reduces the possibility of resistance. They should be applied sparingly, maximum twice a week, at regular intervals. Space sprays are applied with ultra-low volume sprayers or foggers resulting in small particles hitting the adult flies. Space sprays are natural pyrethrin based with the synergist piperonyl butoxide or organophosphates.

Baits are effective for maintaining low fly populations (Tamilam *et al.*, 2010). They are scattered, in bait stations or, in some cases, as a spray or paint-on application. Most bait contains the sex attractant (Z)-9-tricosene and a neonicotinoid (chemical class). The bait formulations are very useful in trapping and killing adult flies, but the bait stations should be positioned to avoid food and water contamination.

Whole animal sprays can be made directly on the animals for control of Stable fly; this can provide relief from stable fly bites but the control is short-lived.

Larvicide

a. Larvicide feed-throughs are feed additives that render manure toxic to fly larvae. The great advantage is that this does not require labour.

b. Larvicidal sprays or liquid solutions are applied directly to the manure surface to kill fly larvae. It is recommended to apply only as a spot treatment with high numbers of larvae to reduce the toxic effect on populations of beneficial insects in the manure.

c. Larvicidal granules can be applied to difficult-to reach breeding areas. A small

fertilizer spreader drops granules into the spaces between the slats allowing a consistent application to breeding areas below the slats.

Biological control

Essential oil-based products were found to be effective against fly menace in dairy farms (Rani, 2013). They have certain advantages over the chemical insecticides viz., ecofriendly, no resistance development and no residues in animal products.

CONCLUSION

Integrated pest management (IPM) could be adopted instead of relying on one method. Monitoring of fly intensity is very important first step towards fly control by IPM. It provides a baseline data on the level of fly population, based on which a suitable decision could be made as to whether the current population level requires control measures or not. A strict farm sanitation is essential to discourage fly breeding. Chemical insecticides should be used judiciously to avoid emergence of insecticide resistant population.

Fig.1. House Flies (*Musca domestica*) swarming on dairy cattle

Fig.2. House Flies (*Musca domestica*) menace in piggery unit

Fig.3. *Musca crossirostris* feeding on underside of the neck region of a calf

Fig.4. *Stomoxys calcitrans* flies feeding on grazing cattle

Fig.5. *Haematobia exigua* flies found in cluster on cattle

Fig.6. Wound sore around the eye caused by *Haematobia exigua* flies

Fig.7. Ventral side of abdomen of pigshowing lesion due to *Haematobia exigua* fly bites

Fig. 8. *Tabanus* fly feeding on the leg region of the bullock

Fig. 9. *Musca domestica* feeding on blood oozing from the site of *Tabanus* fly bite

Fig. 10. *Pangonia* sp. of fly

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