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Control of Biting Flies with KVAFSU Tabanid Trap (Indigenous Mechanical Device)

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Abstract: ***The study was undertaken to evaluate the efficiency of the modified trap baited with fermented cow urine as olfactory attractant. KVAFSU tabanid trap was designed by using indigenous materials and itwas modified design of Nzi trap. The efficiency of trap was tested by installing in livestock farms and goshalas in Chikhale village, Western Ghats of Belagavi division, Karnataka. The efficiency of traps was synergized by using three weeks fermented cow urine as olfactory attractant. A total of 6780 flies belongs to tabanid and Stomoxys species were collected. KVAFSU tabanid traps baited with fermented cow urine, caught 2.5 times more flies (4779/6780 flies) than those of unbaited traps (2001/6780 flies). During the study, seven species of tabanids and one species of Stomoxys were caught by both baited and unbaited traps.***

Keywords: Cow urine, Olfactory attractant, Tabanid trap, Western ghats

1. Introduction

Horse flies (Diptera: Tabanidae) are facultative hematophagous flies of veterinary and medical importance. Their importance is associated with both the transmission of disease and stress resulting directly from bites, or indirectly from secondary infections, anaemia through blood loss, allergic responses, etc. Host-seeking females are considered to be major pests of ungulates world-wide. Female horse flies feed on domestic and wild animals [1] and are mechanical vectors of different pathogens, such as *Trypanosoma evansi*, *Trypanosoma theileri*, *Bacillus anthracis*, *Clostridium chauvoei* and *Pasteurella multocida* etc. As tabanid larvae are well-dispersed in the environment, control of early life stages is difficult. However, control of horse flies must be based on protective actions against adults, rather than larvae [2]. Instead, most reports have focused on chemical methods of control of adult flies. Butinsecticide resistance is emerging problem due to irrational use of insecticides in field conditions for control of tabanid flies. In view of the severity of tabanid pest problems in the livestock nearby forest area, it's essential to adopt integrated methods for control, such as by placing mechanical traps as alternate method of control. Traps are designed to attract targeted insects using sensory cues and they are practical tools for vector surveillance. However, traps have been only occasionally tested for control measures [3]. Trapping devices for adult horse flies are based on flight interception or attraction using a visual stimulus and/or a natural or synthetic odour. The present study aimed to evaluate trapping efficiency of KVAFSU tabanid trap which was a modified design of Nzi trap by [4]. It was assembled by using locally available materials and three weeks fermented (aged) cow urine as olfactory attractant.

2. Materials and Methods

Materials required for design of KVAFSU tabanidtrap were summarized in (Table 1). The following modification were made to the original NZI trap.

- ***Funnel:*** large funnel is used, which facilitated easy passing of flies from triangular area to collection box and increased the trap collection (Figure 2).
- ***Clamp:*** clamp is fixed between base of stem portion of funnel to collection box cap, so that we can easily detach the collection box, clean it and re-fix.
- ***Collection box:*** easily removable and refixing five kg capacity transparent box was used, which provided more space for collection of flies.
- ***Wooden poles:*** two exterior poles were used to secure wings.
- ***Internal frame:*** triangular MS pipe interior frame was used, which retains the trap in triangular shape and increased the stability of trap (Figure 3). No need of exterior poles to hold the trap, except for wing poles.
- ***Ring plate:*** funnel and triangular dome portion of trap was upholding by interior frame and ring plate. There was no interruption for entry of flies from triangular area to collection box, which increased the trap collection.

Procedure for sewing KVAFSU tabanid trap: Pthalogen blue fabric (50 cm) + Black fabric (50 cm) + Nylon Net (100 cm) + Black fabric (50 cm) + Pthalogen blue fabric (50 cm) stitched vertically, side by side. Pthalogen blue fabric (50

cm) rectangular panel attached horizontally between the wings of previously stitched fabric to give triangular shape to trap at the end. Nylon dome was prepared after cutting out ($1/4^{th}$ portion) a triangular shape of nylon net piece (100 cm^2) and stitching the cut edges to give pyramidal shape as shown in (Figure 2). One angle was stitched to the top front line of horizontal rectangular panel and other two sides stitched to black panel and net, which appears like pyramidal shape. The top of the net cone was cut to insert the funnel stem (funnel diameter 25 cm; stem length 10 cm; stem diameter 2.5 cm) in such a way that that net hangs over the inverted funnel. Collection box was prepared by drilling an aperture (5 cm) on the cap of a five kg capacity box and fixed to the inverted funnel using a clamp nut-bolt assembly. The cap was screwed in to the collection bottle. The front of trap has a blue horizontal rectangular panel with two blue rectangular wings, which were fixed on wooden pole extending out at an angle of about 120° from the front. These wings form an arch which is the trap's entrance. The back of the trap, held upright by a pole was made of mosquito netting for attracting flies towards the bottom and the top of the trap; there was a pyramidal shape made up of mosquito netting on top of the structure (light passing through attracts insects towards the bottom and then upwards), the top of the net was connected into the collection box through funnel stem (the anti-escape device) which guides flies into the last capture cage or collection box. The trap was fixed to interior triangular frame and wings were secured to the ground by two external wooden poles. Inner horizontal shelf (100 cm X 50 cm) was cut in the trapezoidal shape as shown in (Figure 1) and stitched "sew-on hook and lope fastener tape roll" on the three sides of trapezoidal net to attach to the base line of the horizontal blue fabric and other two black fabrics to prevents the flies from escaping.

Table 1: List of materials required for construction of KVAFSU tabanid trap.

S. No.	*Materials*	*Measurements*	*Quantity*	*Total cost (₹)*
1	Pthalogen blue fabric	100 cm height and 50 cm width	3	300
2	Black fabric	100 cm height and 50 cm width	2	200
3	Nylon mosquito net	100 cm height and 100 cm width	2½	300
4	Funnel with wide mouth and upper aperture	12 cm and 2.5 cm diameter	1	100
5	Clamp for secure collection box and funnel with net	5 cm diameter	1	150
6	Transparent plastic box	5 kg capacity	1	50
7	Nylon rope	120 cm	1	50
8	Nut, bolt and washer	1 cm, 2.5 cm and 5 cm	12	50
9	Wooden poles with sharp edge at one end	150 cm	2	100
10	MS pipes for internal frame	100 cm (120₹ X9kg)	9	1080
11	Ring plate to hold wide opening of funnel	12 cm diameter	1	200
12	Stitching cost		1	400
13	Fabrication cost		1	250
	Total cost in INR			3230

Fermented (aged) cow urine: Urine was collected hygienically from adult malnadgidda cow in the morning hour before milking by using funnel and bottle. The urine was left for three weeks (aging) at the ambient temperature (20-25 °C) in 2.5-liter plastic bottles before it was used for experiments.

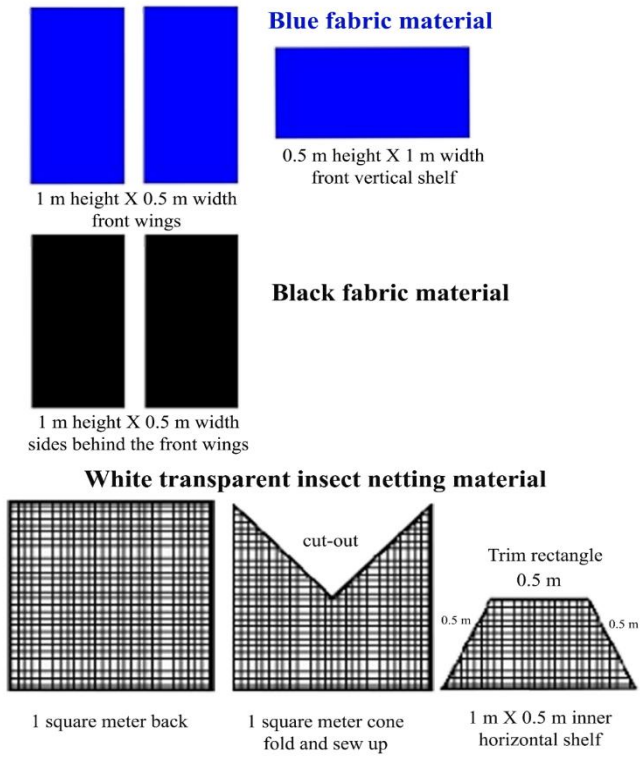

Figure 1: Fabric and netting material with their specification required for sewing KVAFSU tabanidtrap

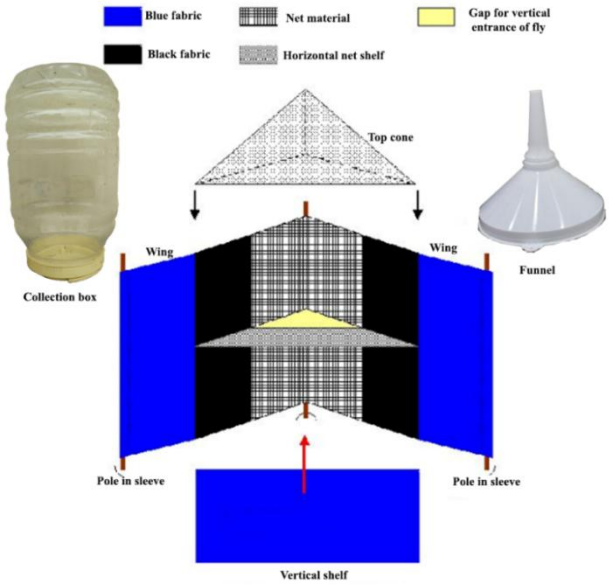

Figure 2: Steps for sewing assembly of KVAFSU tabanid trap

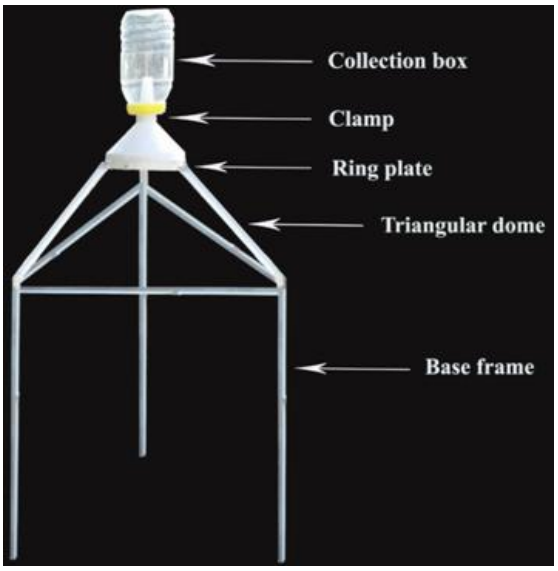

Figure 3: Assembled interior frame

Figure 4: Completely assembled and installed KVAFSU tabanid trap in farms

Installation of traps: The village selected for installation of traps was Chikhale (15° 40' 12.738"N, 74° 17' 12.6996"E). The village situated in Western Ghats of Karnataka, Khanapur taluka Belagavi district with average rainfall 1200 millimeter and semi evergreen and evergreen forest with elevation 651 meters above sea level. The total geographical area in which this village is expanded in 2275.65 hectares /22.7565 square kilometers. Farmers rearing malnadgidda, cross bred cow, bullocks and buffaloes in open paddock system. During day time some farmers leave their animals for grazing in the forest.

The traps were set up in the open facing west at 50 metre intervals along a line running northeast to southwest, perpendicular to the predominant wind. This alignment was chosen firstly because flies approach a host from downwind [5] and secondly because the KVAFSU tabanid trap has a single entrance and thus is dependent on its orientation to the sun. The highest catches of tabanids have been found to occur in traps facing west [6]. Three cattle farms were chosen which were having more than 10 animals and situated 300 to 400 metre distant.

The farms selected for installation of KVAFSU tabanid trap were as follows.

Farm-1: ISKCON goshala having 50 bullocks and six cattle. KVAFSU tabanid trapbaited with fermented (aged) cow urine and without fermented (aged) cow urine was set up 50 metres apart from each other and rotated every 48 hours to avoid the sampling error.

Farm-2: Cattle farm having 12 malnadgidda, five cross bred cattle and two buffaloes. KVAFSU tabanid trap baited with fermented (aged) cow urine and without fermented (aged) cow urine was set up 50 metres apart from each other and rotated every 48 hours to avoid the sampling error.

Farm-3: Cattle farm having 25 local breeds and five cross bred cattle. KVAFSU tabanid trap baited with fermented (aged) cow urine and without fermented cow urine were set up 50 meters apart from each other and rotated every 48 hours to avoid the sampling error.

Collection of flies from sampling stations: All the sampling stations were observed daily for 60 days and recorded total number of flies trapped. Every 48 hours the collection vessels were opened, trapped flies were taken out, counting was done and recorded the number of flies trapped in that particular trap, which was required to know the efficiency of trap, collection vessels were cleaned and re-fixed. Collected flies were segregated grossly by size, colour, and eye pattern into different genera. Flies were pinned and preserved dry for further morphological identification. The collected flies were taken to the laboratory for further identification.

Evaluation of olfactory attractive property of fermented (aged) cow urine against tabanid flies.

An experiment was conducted to assess the duration of olfactory attractive property of fermented (aged) cow urine against tabanid flies in three cattle farms at Chikhale village. KVAFSU tabanid traps was installed in above mentioned cattle farms. On the first day traps were synergized with 500 ml of three-week fermented cow urine in a bottle with 2.5 cm diameter orifice.

All the traps were observed daily for 41 days and recorded trapping of tabanid flies. Every day the collection vessels were opened and trapped flies were taken out, counting was done and recorded the number of flies trapped in that particular trap, collection vessels were cleaned and re-fixed.

3. Results

Total numbers of tabanids and *Stomoxys* flies collected by KVAFSU tabanid trap baited with fermented cow urine and with unbaited control traps shown in (Table 2). A total of 6780 flies belong to tabanid and *Stomoxys* species were trapped. KVAFSU tabanid traps baited with fermented cow urine, trapped 2.5 times more flies (4779/6780 flies) than those of unbaited traps (2001/6780 flies). KVAFSU tabanid trap captured highest number of *Tabanusindianus* Ricardo with 33 per cent (2226 out of 6780 flies), followed by *Tabanusgertrudae* Philip with 15 per cent (1014 out of 6780 flies), *Tabanusbiannularis* Philip with 14 per cent (945 out of 6780 flies), *Tabanusdiversifrons* Ricardo with 11 per cent (723 out of 6780 flies), *Tabanus triceps* Thunberg with 11 per cent (715 out of 6780 flies), *Haematopotamontana* Ricardo 10 per cent (660 out of 6780 flies), *Stomoxyssp*. with 6 per cent (399 out of 6780 flies) and least number of flies captured was *Tabanustenebrosus* Walker with one per cent (98 out of 6780 flies).

Figure 5-A: Tabanid flies trapped in KVAFSU tabanid trap; B: Collection of trapped flies; C: Flies collected in collection box; D: Flies in preservation box.

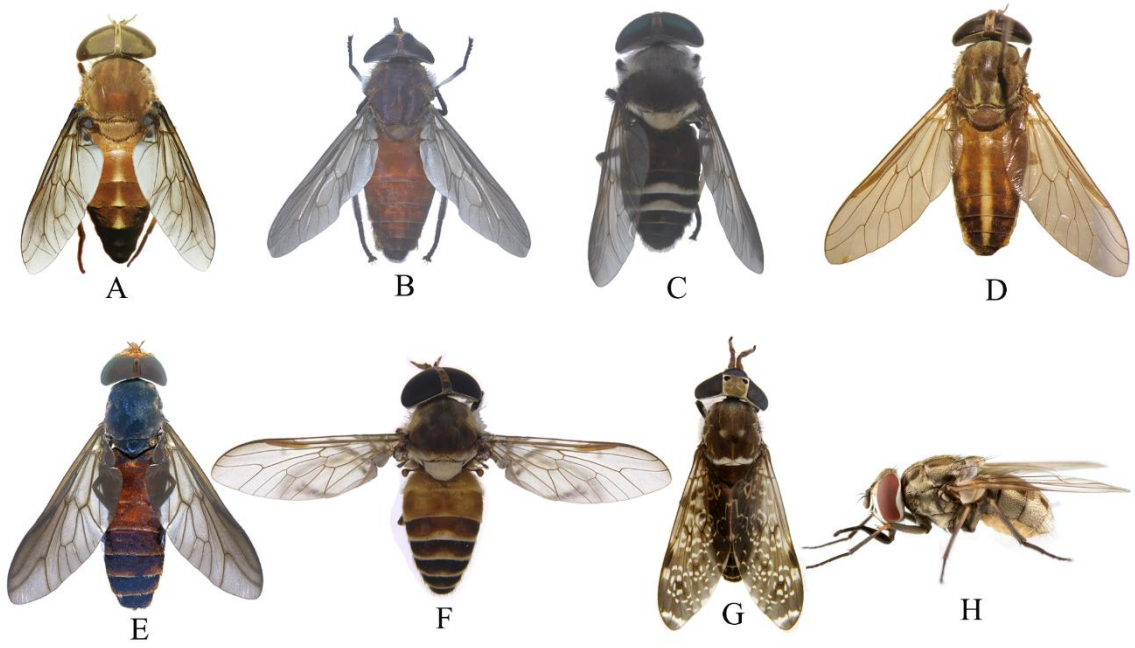

Figure 6- A: *Tabanus indianus*; B: *Tabanus tenebrosus*; C: *Tabanus biannularis*; D: *Tabanus triceps*; E: *Tabanus diversifrons*; F: *Tabanus gertrudae*; G: *Haematopota montana*; H: *Stomoxys sp.*

Table 2: Total numbers of tabanids and *Stomoxys*flies trapped by KVAFSU tabanid trap baitedwith fermented cow urine and unbaited control traps.

Sl. No	Species	Size of fly	KVAFSU tabanid trap		Species total	%
			Baited	Unbaited		
1	*T. indianus*	Large	1497	729	2226	33
2	*T. tenebrosus*	Large	72	26	98	1
3	*T. biannularis*	Small	649	296	945	14
4	*T. triceps*	Medium	553	162	715	11
5	*T. diversifrons*	Medium	523	200	723	11
6	*T. gertrudae*	Small	738	276	1014	15
7	*H. montana*	Small	446	214	660	10
8	*Stomoxyssp.*	Small	301	98	399	6
Trap totals			**4779**	**2001**	**6780**	

4. Discussion

The study was aimed to evaluate the trapping efficiency of traps for the tabanid flies. This was in concurrence with various researchers used Nzi, Box and Canopy trap for catching horse flies in different field studies [7, 8, 9]. [10] used a modified canopy trap for collecting Tabanidae in South Carolina. [1] used the Nzi trap for the collection of tabanid flies in France. [11] compared the tabanid capturing efficiency of classic canopy trap, new polarization liquid trap and combination of the two traps in Hungary. [12] designed polarising sticky black tabanid trap, to catch polarotactic horseflies in Hungary. [9] studied the efficiency of ten differently coloured modified box traps for collecting tabanids at Monjoros forest in eastern Croatia.

For haematophagous flies like tabanids, host mimicking visual cues alone may not be effective, as traps may go unseen if they are set in dense vegetation and only active passer-by flies come across the trap. As a result, genuine host-seeking flies may not be collected. Hence, olfactory attractants are needed to increase the efficiency of the trap. In the present study, the olfactory attractants like three weeks fermented (aged) cow urine was used, which effectively served the purpose and added to the efficiency of the trap. These results are in concurrence with many researchers who used natural and artificial olfactory attractants such as fermented (aged) cow urine, octenol and phenols *etc.,* in fly traps for increasing catches of flies. [13] used aged urine of cow as substitute for pure phenols in Canada. [14] used aged urine of buffalo. [15] used cow and buffalo urine in Nairobi, Kenya. Mixture of three chemicals (1-octen-3-ol, acetone and ammonia solution in the proportions 5: 3: 2), aged urine of donkey, lactic acid and fresh human urine was used by [8] in Croatia. Nzi traps and H-trap with natural attractive odour, urine and stool of camel placed for the flies used by [16] in Sudan. Furthermore [17] used carbon dioxide and ammonia as attractant for host seeking tabanid flies in Hungary. [18] used dry ice and trap tech lure as attractant in their study at Florida and North Carolina [7] used aged urine of cow, horse, sheep and pig for collection of flies in Croatia. [19] used different aged equine urine from a pregnant mare, stallion, gelding and mare in the Croatia. [20] used 1-Octen-3-ol ammonia in canopy traps for attracting tabanid flies in Denmark.

In the present study, KVAFSU tabanid trap baited with fermented cow urine appeared to be the best trap for

capturing for tabanids. This study confirmed the established role of fermented cow urine as a tabanid attractant for tabanids, [14, 21, 7]. Also, the highest number of flies trapped in KVAFSU tabanid traps baited with fermented cow urine *i. e.*, 70 per cent (4779flies out of 6780). Moreover, the present study showed that fermented cow urine is a very effective attractant for collecting six species of genus *Tabanus*, and one species each of genus *Haematopota* and *Stomoxys* in study area.

The most significant aspect of the Nzi trap is its ability to catch Stomoxyinae, while simultaneously catching high numbers of both tsetse and tabanids [4] and [6]. In the present study both baited and unbaited KVAFSU tabanid trap caught *Stomoxys* flies.

In the present study, duration of olfactory attractive property of fermented cow urine was evaluated. It was observed that fermented cow urine was able to attract tabanid flies approximately 12 days. The peak attraction was observed on 7^{th} day of trail. From the present study we suggest that fermented cow urine could be changed after 7^{th} to 8^{th} day of trail to get maximum efficiency of the traps.

5. Conclusion

KVAFSU tabanid trap found effective means of monitoring and trapping tabanid species in Western Ghats of Belagavi division. We recommend their use in future surveys, monitoring, and management programs for tabanid fly pests in that region. From the present study, we can recommend KVAFSU tabanid traps with fermented cow urine as olfactory attractant could result in the reduction of tabanids in Western Ghats of Belagavi division and KVAFSU tabanid trap has following advantages:

1) KVAFSU tabanid trap can be installed in farms, goshala and pasture
2) KVAFSU tabanid trap helps reduce the hematophagous female tabanid flies
3) During trial each KVAFSU tabanid trap caught more than hundred female tabanid flies' daily
4) KVAFSU tabanid trap is very much useful for livestock farmers of Western Ghats region
5) KVAFSU tabanid trap collect female tabanid flies, after two to three year of use there will be decline of tabanid population in the Western Ghats region
6) KVAFSU tabanid trap can also able to collect *Stomoxys* flies
7) The cost of KVAFSU tabanid trap is approximately three thousand rupees
8) KVAFSU tabanid trap is portable, can be installed by farmers and easy maintenance
9) KVAFSU tabanid trap is color based visual attractant, doesn't require electricity to function
10) KVAFSU tabanid trap doesn't require chemical to kill the captured tabanid flies

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