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NVBDCP

GUIDELINES
ON
VECTOR CONTROL
IN
KALA-AZAR ELIMINATION

Government of India

Dte. of National Vector Borne Disease Control Progamme
22-Sham Nath Marg, Delhi – 110 054
Ph. No. 011-23967745/23967780, Fax No. 011-23968329/23972884
Website: www.namp.gov.in

Dte. of National Vector Borne Diseases Control Programme

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Introduction:

Kala -azar or Visceral leishmaniasis is a parasitic disease caused by ***Leishmania donovani*** and transmitted by the sandfly ***Phlebotomus argentipes.***

The disease has been endemic in India for a long time and the earliest outbreaks occurred in the early nineteenth century. Kala-azar used to occur in cyclical epidemics at the intervals of 10-15 years. With the launching of insecticidal spraying under National Malaria Control Programme/ National Malaria Eradication Programme in 1953 and 1958 respectively, the disease declined to negligible proportions as a result of the reduction of densities of the vector, *Phlebotomus argentipes.* Withdrawal of insecticidal spraying from erstwhile malaria endemic areas following successful malaria control resulted in a gradual build up of vector populations and renewed transmission of the disease. A resurgence of Kala-azar during 1970's, initially in four district of Bihar followed and eventually engulfed the entire north Bihar, parts of south Bihar and several districts of West Bengal. The Kala-azar also began to be reported from erstwhile endemic districts of eastern Uttar Pradesh.

Concerned with the increasing problem of Kala-azar in the country, Govt. of India launched a centrally sponsored Kala-azar Control Programme in 1990-91. The programme implementation was intensified during 1991 which brought about a reduction of morbidity and mortality due to kala-azar in Bihar and West Bengal. The programme implementation was not however, sustained by the concerned State governments resulting in a slower pace of decline in kala-azar incidence in the years following.

The Expert Committee on Kala-azar under the chairmanship of Director General of Health Services, Government of India reviewed Kala-azar Control Programme in the year 2000 and recommended feasibility of its elimination from the country. The National Health Policy – 2002 also endorsed the feasibility of elimination and envisaged Kala-azar Elimination by 2010.

The Kala-azar Control Programme operates with a mix of strategies which include diagnosis and treatment, active and passive case detection, vector control, behavioural change communication, capacity building and monitoring and evaluation.

As may be evident from the post experience, insecticide spraying is an extremely important intervention in achieving kala-azar elimination. To get optimum benefits of this strategy, it is essential to properly plan spray operations, supervise them and provide timely feedback for future planning. The guidelines on vector control have been prepared to guide peripheral workers in undertaking vector control for kala-azar, in particular good quality, effective indoor residual spraying.

1.0 Vector Bionomics

The bionomics of *Phlebotomine* sandflies are presented in so far as they are relevant to the control of kala-azar.

1.1 Distribution

P. argentipes is a small, dark brown, hairy insect about 2.5 mms. from the tip of mouth parts to the last abdominal segment. It belongs to the sub-family Phlebotominae which comprises of more than 600 species. Of about 50 species of sandflies present in India, ***P. argentipes*** is the only species that transmits kala-azar to man.

P. argentipes has a very wide distribution range, stretching from Iran to Indonesia. But the core area of its distribution range lies in the, eastern & south eastern India, where because of availability of the alluvial soil, high humidities, relatively equable temperatures, abundance of cattle population, it is able to build up enormous population densities and transmit kala-azar.

In the Assam state, and adjoining plains of the north-eastern India, P.argentipes, has apparently been eliminated by continuous anti-malaria spraying. In these states no indigenous Kala-azar has been reported since the 1950's except in year 2005 when one case has been reported from state of Assam.

1.2 Life cycle

Breeding places

The life cycle of sandflies resembles that of mosquitoes in the basic pattern i.e, as comprising four stages, the eggs, four larval stages, the non-feeding pupal stage and the adult stage.

However, sandflies including the vector ***P. argentipes*** breed in moist soil unlike mosquitoes which breed in water. The larvae after hatching out from the eggs, penetrate some inches below the surface of the substrate. The larval feed on decaying organic matters. The four larval stage, lead to progressive growth and last about 10 days. The larval stage is followed by the non-feeding pupal stage which lasts about 7-10 days under optimum conditions. The larvae are very small with body covered with numerous chaetae which glue substrate particles and mask them. That is the reason only older larvae and pupae can be found in soil samples after most careful searches. **No eggs or younger larvae of sandflies have ever been found in nature.**

Eggs and larvae of ***P.argentipes*** can withstand immersion in water for considerable time. First stage larvae can survive immersion for 5 days, and larvae of the 4^{th} stage for 14 days. These findings possibly explain the survival of larvae in the soil during the heavy monsoon rains when their breeding places may be flooded.

Breeding places of *P.argentipes* are found within a radius of about 20 yards of a dwelling house, in dark, humid soil protected from sunlight. In the cattle sheds the favorite breeding place is the floor underneath the earthenware trough. *P. argentipes* does not breed in rodent burrows, outside or in the dwellings.

Feeding

After emergence the adults feed and mate within about **24-48 hours**. The males often form swarms on buffaloes seeking mating females. Female sandflies require a blood meal for egg development and maintenance of water balance. They also imbibe plant juices, a fact of considerable epidemiological importance as the capacity of *Phlebotomus argentipes* to transmit *L.donovani* is enhanced by feeding plant juices.

Only the female sandflies are haematophagous, i.e., take a blood meal. *Phlebotomus argentipes* prefers cattle blood to human. But during the transmission season from June to October, when there is tremendous build up of *P.argentipes* densities there is a spill over of population into human dwellings, enhancing man-vector contact.

During feeding, saliva is introduced into the host, one component of which **is a peptide considered to be one of the most potent vasodilators ever discovered. Sandfly saliva to enhances the growth of Leishmania in the host.**

In addition to blood, sandflies also ingest cells lying in the dermis outside the blood circulation and thus infected macrophages may be picked up.

Resting places

Adult sandflies are active after the dusk hours. During daytime they escape into their resting shelters. These shelters are protected from sunlight, excessive temperature.

In the Kala-azar endemic areas of India, *P.argentipes* is entirely endophilic (indoor resting and feeding). Among thousand of *P.argentipes* collected, from Bihar and Jharkhand, only one male specimen was collected from an outdoor rodent burrow. This fact is very important from the point of view of Kala-azar elimination. A vector species with little variation in resting places can be easily targeted for residual insecticidal spraying. The presence of large numbers of *P.argentipes* on the lower margins of walls of mud houses is attributable to lot of moisture on the lower side of the dwellings.

High humidities are a decisive factor in the life history of sandflies. *P.argentipes* is active in humidity range of 75-85%. This is the main reason why it is abundant during monsoon and post-monsoon seasons.

Dispersal of sandflies

The dispersal range of *P.argentipes* is restricted to about 25 metres. It is a poor flier, moving in short hopping flights.

Seasonal Dynamics

High densities of *P.argentipes* are a pre-requisite for Kala-azar **transmission. Transmission season of Kala-azar in India is coincident with the season** of the **highest *P.argentipes* densities, and which is from June to October.** In the north-east India, *P.argentipes* vanishes in the cold months of December and January and reappears in small numbers in March. The numbers shoot up dramatically after the onset of monsoon and remain high till the end of October

Age composition

Development of mature eggs, after taking a blood (gonotrophic cycle) is completed in about 3-4 days time. Sandflies must take at least two blood meals to transmit leishmania to man. Thus the presence of parous sandflies (which has laid at least one batch of eggs) in a population of sandflies is important to know the potentially infective flies. Determination of the age of the sandflies is also important in assessing the effectiveness of treatment with insecticides.

Ovaries of nulliparous (not laid eggs) females resemble a compact bunch of grapes. The follicles (precursors of eggs) are very compact and do not move far from each other when pressed under a cover slip. ***The ovaries of parous females when pressed under a microscope cannot contract for a long time and remain in an extended form.*** They appear loose and covered with a light net. ***A small number of mature eggs with undeveloped follicles and an empty stomach indicates that this female had laid at least one batch of eggs.***

The **accessory glands** of the oviducts produce a secretion containing numerous granules. In the newly hatched female, the glands are nearly empty with no granules. The granules appear only after the first blood meal. **Females with no or few granules in the glands are newly hatched individuals, *while females without a trace of blood in the stomach, with eggs in the early stage of development, but with granules in the accessory glands, are individuals which have digested a blood meals and laid a batch of eggs.***

Development of Leishmania in the sandflies

Amastigote, i.e., aflagellate form of *L.donovani* found in the macrophages, are taken up with the blood meal. Amastigotes penetrate into the midgut of sandflies with blood meal taken from an infected vertebrate host. Most parasites perish in the midgut during the first hours after blood sucking due to possibly the action of substances similar to lysozymes. In the midgut the surviving amastigotes change into promastigotes (i.e., flagellate stage) and begin intensive multiplication, within the blood clot. At the 4^{th} day, when digestion of blood comes to an end, slender, and long forms of promastigotes called ***Nectomonads***, appear in large numbers in the midgut. They attach themselves to epithelium of the midgut by penetration of the flagellum between the membranes of two adjacent cells.

The last stage of the life cycle of leishmaniasis in sandflies is connected with their penetration into buccal cavity, from where they move into vertebrate host during blood sucking by the sandlfy.

Susceptibility to Insecticides

The susceptibility to insecticides is determined by the WHO test kit Tests carried out since the 1970's have shown that *P. argentipes* is susceptible to all insecticides, including DDT.

Control of Kala-azar

Indoor Residual Spraying

Indoor residual spraying is most important intervention in achieving the interruption of transmission of diseases transmitted by Phlebotomine sandlfies. In the 1950s anti malaria spraying under the National Malaria Control Programme (NMCP) and National Malaria Eradication Programme (1958) brought about a virtual cessation of Kala-azar transmission in India. Indoor Residual spraying has virtually eliminated Kala-azar from north-eastern states of Assam, Meghalaya and Tripura, and smaller foci in Orissa and Tamil Nadu.

2. PRE-SPRAY ACTIVITIES

2.1 Pre-spray operations include the following

- Selection of the areas to be sprayed
- Development of the required quantities of insecticides & equipment
- Hiring and training of spray squads
- Informing the community

2.2 Criteria of Spraying

The target of Kala-azar elimination programme, is the interruption of Kala-azar transmission by the year 2008. Thus it is imperative that all Kala-azar villages,weather affected those affected now and in the past, are treated with insecticide sprays.

- All villages within a PHC which reported kala-azar cases in the past five years.
- All villages which reported cases during the year of spraying.
- Villages which are free of kala-azar, but on search are found to contain cases conforming to the kala-azar case definition.

2.3 Dosage

The dosage of DDT application is the same as that for anti-malarial spraying, i.e. 1g/m^2 of the wall surface. The inside walls of huts and cattle shed are to be treated with the insecticide. Spraying is to be restricted to the 6 feet of the wall surface. Cattle sheds, and kala-azar positive and suspected houses are to be treated on priority.

2.4 Spray Timing

Spraying is usually started to coincide with the build up of vector populations and before onset of kala-azar transmission. The transmission season of kala-azar in India is from June to October. The build up in the population of the vector ***P. argentipes*** starts in March. The effectiveness of DDT deposits lasts for about 10 weeks. Thus two rounds of spraying to control ***P. argentipes*** population are undertaken, Ist in February/March and 2nd in June/ July. Two rounds of sprays are given for DDT to provide protection during the entire transmission season.

2.5 Insecticide Requirement

When the insecticide spraying is restricted to 6 feet of the wall surface, in the cattle sheds and human dwellings, the requirement of the insecticide will be approximately one half of that required for anti-malarial spraying. The average surface area in a rural household in so far kala-azar spraying is concerned would be about 75 sq.m.

Insecticide	Dosage per sq. m. (a.i.) #	Insecticide required per house (75 sq.m.) per round	Average per 5000 popn. Per round	Total per annum
DDT 50%	1 gm	150 gm	187.5 kg	375 kg

a.i. = active ingredient

2.6 Manpower Requirement

The Expert Committee 1995 on Malaria recommended 26 squads for 75 days spray period to cover one million populations with DDT and synthetic pyrethroids for control of malaria. With one round of spraying on an average a spray squad of 5 persons can cover 100 houses per day for anti-malaria spraying.

Each spray squad consists of 5 field workers plus one superior field worker working with two stirrup pumps and one superior field worker. In the case of anti-kala-azar spraying, in view of the restriction of spraying to about half the area, only about half the number of personnel are likely to be engaged, and can be decided on the basis of experience and spray targets.

2.7 Equipments

Each squad will require the following equipment, which must be available well in time before the spray operations:

- Stirrup pumps-(2)
- Spray nozzle tips for spray pumps-(2)
- Bucket 15 liters-(4)
- Bucket 5/10 liters-(1)
- Asbestos thread-(3 metres)
- Measuring mug-(1)
- Straining cloth-(1 metre)
- Pump washers-(2)
- Plastic sheet (3x3 metres)-(1)

- Register (1)
- Gheru for stenciling

Squad supervisor must have extra spray pumps, nozzle tips, washers, and asbestos threads. A set of tools for minor repairs should also be available which should include a pipe wrench, pliers, screwdrivers and a set of spanners. A good quality nozzle should be used.

Each squad must also be provided with personal protection gear including masks and soap to wash.

2.8 Training

Hiring of squads should be done well in time so that training of spray squads is completed prior to the due date of spray operations. The training of the MPWs and the supervisors should be completed two weeks prior to the start of the spray operations. Training should cover each aspect of the spray operations. The following topics should be covered:

- Preparation of suspension
- Various parts and operation of the pump
- Regulation of the flow from the nozzle tip
- Regulation of the speed of application including movements of the lance and the spray men
- Care and maintenance of the spray equipment
- Safety precautions in spraying and handling of insecticides
- Disposal of insecticide suspension remnants and containers

Training schedule must be ready at the district and PHC levels by January end and should be part of the work plan for the next year.

Report of the Training of Supervisors and Spray Squads				
	Total Number	**Training Sessions (No)**	**Dates**	**Venue**
MPWs and other Supervisors				
Spray Squads				

2.9 Spray Programme

A spray programme in a given PHC area must be drawn up village-wise so that the entire area to be sprayed is covered within the recommended period. The schedule of village-wise visits by date must be communicated to the Gram Panchayat and other village leaders 7 to 10 days prior to the expected date of visit so that the community is well informed. They should be reminded a day before the commencement of the spray operations.

	PHC Spray Programme		
Sub-centre	**Village**	**Date of spray**	**Squad No.**

In addition to the date of the spray, the following information should be provided, to the community leader:

- Reason for the spray, i.e., a deadly and an economically crippling disease kala-azar will be controlled by spraying houses with DDT. If all areas are not sprayed, sandflies will rest on these surfaces without any harm to them.
- Food items should be protected from contact with insecticides.
- Outer walls and eaves of dwellings need not be sprayed.
- Mud plastering of walls should be avoided for 6-10 weeks after each spray cycle, as plastering will reduce the effectiveness of the insecticides.

Each squad must have a village wise beat drawn up well in advance. While drawing up the programme, the size of the villages and distances between villages should be taken into account.

Village wise Beat of Spray Squads				
Squad No.	**Village**	**Population**	**Date of Spray - II**	
			I Round	**II Round**

3. SPRAY OPERATIONS

3.1 Preparation of Spray Suspension

The requirements of various insecticides can be calculated as per formula given below. The required quantities should be issued to the squads each day by the supervisor after checking balance stocks available from previous day's supplies. DDT used under the NVBDCP is available as a wettable powder.

3.2 The preparation of the spray suspension is made just before the start of the spray operations every day. It is important that the suspension is made correctly so that the correct dosage is applied on the sprayed surfaces. **As in anti-malarial spraying 1kg of DDT 50%, powder (500 gms DDT in 1 kg. of powder) is mixed with 10 litres of water and total suspension sprayed on 500 meters of wall surface to achieve a dosage of 1gm/m^2. The 10 litres suspension will be sufficient to cover 6-8 houses in case of anti-kala-azar spraying as against 3-4 houses in anti-malarial spraying.**

3.3 The required quantity of the insecticide is measured with a plastic mug and poured into a 15-litre bucket. A paste is made with a small quantity of water. The remainder of the 10 litres of water is then poured slowly into the bucket, and the insecticide-water mixture is stirred vigorously to obtain a uniform suspension. The suspension is then poured into another bucket through a cloth sieve to remove any particulate matter that might clog the nozzle of the spray pump.

1000 sq meter's can be sprayed with 10 liters of the suspension. The average surface area of a rural house is 150 sq. meters; the 10 liters will be sufficient for more than 6 houses.

3.4 **Spray Technique**

3.4.1 The barrel of the stirrup pump is put in the bucket containing the spray suspension. One man operates the pump and the other man sprays. The spray lance is kept 45 cms (18 inches) away from the wall surface. The swath should be parallel. Spray is applied in vertical swath of 53 cm (21 inches) wide. Successive swaths should overlap by 7.5 cm (3 inches). Spray is done from top of the wall to the floor, using downward motion, to complete one swath; then stepping sideways and spraying upwards from floor to top. Spray should not be allowed to drip to the floor.

3.4.2 The discharge rate should be 740 to 850 ml per minute. To obtain the above discharge rate, the pump man should give 20 to 26 strokes per minute with 10-15 cms plunger movement at a pressure of 10 pounds per square inch (PSI) (0.7kg/sq.cm) at the nozzle tip. Spraying into a bucket for one minute and measuring the quantity of the suspension in a graduated mug enables check of the correct discharge rate (740 to 850 ml/minute). The nozzle tip should be discarded if the discharge rate exceeds 850 ml per minute.

3.4.3 If the spray stops due to a blockage in the nozzle, the nozzle cap be unscrewed to remove the blockage and replaced with a new one. The blocked nozzle should be put in a container with water for a few hours before the blockage is removed with a fine wire.

3.4.4 A good quality spray should lead to uniform deposits on walls and other sprayable surfaces. This is easy to verify in case of DDT as the deposits of DDT are clearly visible. The supervisor through physical verification should check the quality and coverage of spray.

3.4.5 It takes about 3 minutes to spray area of 150 sq. metres. This is the average surface area of a dwelling unit in rural areas of India.

3.4.6 Mopping up team to cover the locked/refusal houses.

3.4.7 **Daily Summary**

A daily summary of spray operations should be maintained, showing the areas covered, +percentage room coverage and insecticide consumption in the tables as shown below:

Spray Operations At Subcentre on _____ on _____

Village	Targeted		Sprayed		
	Houses	Rooms	Houses	Rooms	Locked/ Refused

Daily Consumption Record of Insecticide

Spray Operations At Sub-center _____/ on/ _____			
Insecticide Issued (Qty. wp)	**Balance insecticide available from previous day**	**Number of buckets (10 litres)**	
		Prepared	**Consumed**

4. POST-SPRAY ACTIVITIES

Post spray activities include stock taking of the daily spray operations, maintenance of equipment and disposal of insecticide remnants, and safety measures. This is essential for assessing the actual coverage of spray operations, consumption and requirement of insecticides.

5. ROUTINE MAINTENANCE OF EQUIPMENT AND MINOR REPAIRS

5.1 The pumps and other equipments are subject to wear and tear, because of the corrosive action of the insecticide. Hence it is very essential that spray equipments are maintained with due care. Following actions should be ensured, every day in the evening.

- The discharge line should be disconnected at the delivery outlet at the end of the spraying
- The bucket and the discharge line should be emptied.
- The spray pump should be thoroughly rinsed with clean water.
- Filter assembly should be rinsed and cleaned. Filter should be removed from the valve by grasping it at its screen and slightly twisted on pulling it out.
- Reassemble all clean parts except the nozzle. Put clean water in the tank, seal the tank and pump air into it. Open the control valve and let the water flow from the lance to flush the hose, filters, control valve and lance. Remove the tank cover and dry the inside of the tank.
- Clean the nozzle tip by washing thoroughly with water. Remove any dirt from the orifice with a fine bristle/ a brush. **Never use metal wire or nail**.

5.2 Repairs of sprayers

At field level the following minor repairs can be attended to:

- Nozzle tip cleaning
- Strainer cleaning (in discharge line)
- Hose clamp tightening
- Gasket tightening
- Cut off valve compression and nut tightening
- Nozzle tip replacement

6. REPORTS AND RECORDS

Records are to be maintained for supervision purposes, and for day-to-day planning. All reports, as given in the annexure IV to VII should be forwarded in time to the concerned officers.

7. TRANSPORTATION, SAFE HANDLING AND STORAGE OF INSECTICIDES

Exposure to insecticides may occur during transportation, handling, storage and spraying. To ensure safety, precautions as detailed in following sections need be taken.

7.1 Transportation

Insecticides should be transported in well-sealed and labeled containers, boxes or bags. Insecticides should preferably be transported separately. These should NOT be transported in the vehicle carrying food items.

7.2 Disposal of remains of insecticides and empty packaging

- At the end of the day's work, the washing from the sprayers may be emptied into pit latrines or into pits dug especially for this purpose and away from the sources of drinking water.
- To avoid wastage iIt is advisable to prepare only as much insecticide suspension as can be used same day.
- Never pour the insecticide into rivers, pools or drinking water sources.
- All empty packaging should be returned to the supervisor for safe disposal.
- Empty insecticide containers should never be used for any purpose.

7.3 Storage

- Container must be labeled as per the standard procedures laid down by the Central insecticide Board indicating clearly the name of chemical, the name of manufactures, date of manufacture and date of expiry and the mark of poison. The label should be in English and a local language and should also indicate the possible measures in the event of contamination.

- Insecticides should be stored in well-ventilated rooms at ambient temperatures away from direct sunlight. These should be kept out of reach of children and animals. No food items should be kept in the same store.

- Containers, bags or boxes should be well stacked to avoid possibility of spillage. The principle of 'first in first out' should be followed and care should be taken to ensure that stocks do not date expire.

- Stock and issue registers should be kept upto date. Access to the insecticides should be limited to authorized personnel only.

- The storeroom should have a prominently displayed mark of caution used for poisonous or hazardous substances. It should be kept locked.

- Eating, drinking or smoking etc. during sprays should not be permitted.

7.4 **Handling and Spraying**

- Hands should be washed thoroughly after making preparation of insecticide suspension and after spray operations. Personal protective gear such as goggles, gloves and apron should be used.

- Direct contact with insecticide should be avoided. In case of accidental exposure of the eyes or skin, the eyes should be flushed with clean water for about five minutes and skin washed with clean water and soap. Medical attention should be sought if irritation persists.

7.5 **Health Monitoring**

- In case of accidental exposure or appearances of symptoms of poisoning medical advice must be sought immediately.

8. **SUPERVISION, PROCESS AND PERFORMANCE INDICATOR**

Supervision of spray operations is a very important activity, to ensure that spray operations are carried out according to correct technical procedures, which is essential for taking corrective action, and achieving the programme goals. Supervision is carried out at all levels of programme implementation. It can be concurrent or consecutive. A stratified sample should be taken up for supervision.

8.1 **Concurrent Supervision**

The following should be checked during such inspections:

- Date of advance notification and the maintenance of timetable for spray operations.
- Turn out of spray crew
- Nozzle tip discharge rate
- Conditions of spray pumps
- Preparation of insecticide suspension
- Actual spraying operation including the technique, speed and coverage etc.
- Extent of refusal to accept spray and the numbers and percentage of locked houses.
- Maintenance of spray records.
- Consumption of insecticide as determined by the quantity issued and stock in hand.
- Date and time of checking of the squad by inspectors/supervisors and other supervisory personnel and their remarks, if any.
- Arrangements for mopping up
- Future programme and time schedule.

8.2 **Consecutive Supervision**

The following is to be checked in consecutive supervision:

- Evidence of insecticide deposit on sprayable surfaces.
- Dispersal of the insecticide deposits on the walls to verify uniformity of deposits.
- Number of rooms in each house sprayed satisfactorily, partially and not at all
- Percentage of refusals and locked houses
- Reasons for not spraying any area as elicited through enquiries from the residents
- Reasons for high refusal rates, if any and action taken
- Attempts made for mopping up operation in the event of high refusal
- Extent of mud plastering on the walls, if any and other relevant matters.

Annexure-III

SPRAY EQUIPMENT

Two types of hand operated sprayers are used for indoor residual spraying;: i) Hand Compression pumps; ii) Stirrup pumps.

HAND COMPRESSION SPRAYER PUMP

A hand-compression sprayer consists of a tank for holding a liquid insecticide formulation, which can be pressurized by means of a hand pump attached to it. The compressed air forces the liquid from the tank via a hose with a cut-off valve, a lance and a nozzle.

The barrel of the sprayer should be capable of withstanding an internal pressure of 14 kg/cm^2 and for this purpose the metal walls should not be less than 0.63 mm thick. The diameter of the plunger shaft should not be less than 12 mm. The plunger bucket of the pump should be made from nitrile rubber or chrome-tanned leather. The plunger assembly should be easily removable for cleaning and repair in the field. The handle may be shaped D or T. The handle grip should be about 30 mm in diameter. Further, the length in the case of T-type handle should not be less than 20 cm.

Following actions may be ensured by the operators/supervisors:

- The compression sprayer is pressurized before commencing spraying, and not continuously pumped. The pump is filled to levels usually at about ¾ liquid to ¼ air. A smaller air volume in relation to liquid volume would not retain sufficient pressure for long periods.

- When the tank is not in use, the spray lance is held in a bracket and nozzle cup, which protects the nozzle form damage.

- The nozzle tip is the most important part of the sprayer. It should deliver a precise amount of spray suspension per minute (740-850 ml) at a certain pressure (40 PSI or 2.8 kg/cm^2) in the tank, and maintain a uniform spray pattern and swath width (53 cm or 21”).

- **The flat-fan spray (Flat Fan) nozzle delivers a fan-shaped spray, and is used for residual wall spraying.**

- The flat-fan spray nozzle used for indoor residual spraying which produces a spray with an angle of 60 and 750-840 ml. per minute output at a standard tank pressure of 40 PSI (2.8 kg/m). It is usually made of especially hardened stainless steel. The nozzle tip is designed with flat surfaces on either side of the orifice so that it can be removed easily. The pressure at nozzle tip is calibrated at 10 PSI (0.7 kg/cm).

- The inside tank should be thoroughly cleaned.

- The distribution hose and accessories should be securely attached to the delivery outlet. The cut-off valve should be tightly closed.

- Full strokes to be pumped till the pressure gauge registers 2.8 kg/cm (40 PSI).

- The sprayer must be suspended on the shoulder or carried in hands.

STIRRUP PUMP

The stirrup spray pumps are used in anti-malaria or anti-kala-azar spraying in India, because they are less costly than compression sprayer. The pump mounted on a footrest or stirrup is inserted in the spray liquid in a bucket. A hose attached to the pump leads to the spray lance. Two persons are needed, one to pump and one to direct the spray. The pressure varies with the speed of pumping which has to be uniform to allow uniform spray applications.

The stirrup pump sprayer consists of a brass pump, a foot rest (stirrup), a hose, a lance and a nozzle. The pump is lowered into the liquid in a bucket and held in position during operation by placing the foot on the flat stirrup provided for the purpose. The stirrup is attached to the pump with bracket. It should preferably be attached to the pump by a clamp so that adjustment can be made for buckets of different depths.

The principle of working with the stirrup pump and all other sprayers working on the pump system is the same. With the suction stroke (upward stroke) of the piston, the suction valve opens and the liquid enters the barrel. During the pressure stroke, the suction valve closes and the delivery valve opens to permit the entry of the liquid into the pressure chamber or directly into the spray lance, as the case may be. In the former case, a few pump strokes to build up air-cushion in the pressure chamber before starting the spraying are required. Two persons are employed for working the sprayer – one to operate the pump and the other to direct the spray from the nozzle at the end of the spray lance The length of the hose normally supplied with these sprayers is approximately 5 m, which can be varied according to the requirement of the user.

- The stirrup pump sprayer bucket should be filled about 2/3 of strained prepared insecticide suspension and the pump laced in the liquid. The liquid may be agitated by inserting the nozzle in the bucket and pumping at least ten times.

- The pump plunger may be operated through a stroke approximately 4-6 inches in length and at the rate of 24-26 cycles per minute.

- The supply worker will replenish insecticides as needed, assist spray operator to keep hose line from kinking and assist pump worker to move stirrup pump and bucket as spray operations proceed.

- The tip may be subject to occasional clogging. When clogging occurs, the tip may be taken out and the obstruction cleared by a fine brush.

- The nozzle should be replaced whenever it gives an uneven spray pattern or shows signs of damage, or discharges excessive insecticide.

Evaluation of anti-sandlfy measures

The effect of control measures on sandflies can be assessed by comparing the target population with either a neighbouring population that has not been attacked or the population of sandflies in the place of intervention in previous years. The first of these comparisons is preferable because the population size of sandflies are known to vary from year to year.

There are no practicable means of estimating the total size of a sandfly population reliably. Standardized sampling methods recommended for measuring population densities include the following:

Man landing rates: Technical personnel working in pairs may collect sandflies coming to humans to bite. The results are expressed as *number of sandflies per person per hour* this method. This

method was exploited extensively in the study of Sudanese Kala-azar, but has been little tried in India and generally with disappointing results.

Standardized active catches: Skilled Insect Collectors actively search habitations during the day and catch all resting sandflies. This must be done on the same days of the week as the efficiency of Insect Collectors varies widely each week, in the same buildings and preferably by the same Insect Collectors. This method is appropriate only for endophilic sandflies and almost universally employed in India. Catches must be identified. The results are expressed as *number of sandlfies per man hour*. This method yields information on the following aspects:

- Sandlfy fauna of the area, with the limitation that only those species will be recorded which are caught at the time of collection
- Comparative densities, in a quantifiable manner
- Material for age grading of sandflies
- Susceptibility of sandflies to insecticides

Knock down catches : At fixed intervals – weekly or fortnightly – sandflies are collected in previously selected rooms after spraying with a knock-down insecticide like pyrethrum. All sandflies falling on to the sheets are collected. This method is appropriate only for endophilic sandflies. The catch is identified, and results are expressed as *number of sandlfies per room per night.*

Light trapping : Miniature light traps designed by the Communicable Disease Centre, USA(CDC traps) are installed at fixed sites and are run from before nightfall until just after dawn. In order to collect sufficient data, it is preferable to run the traps nightly. This method can be used for both exophilic and endophilic sandflies provided that they are attracted to the light trap. Species of sandflies differ in their response to light. If the traps are installed outside (primarily for exophilic species), the catch will be greatly affected by variations in the weather. In protected places (eg. Stables, chicken sheds, houses), the effect of the weather is less marked, and collections can be made at longer intervals. All sandflies should be killed and identified. The catch results are expressed as *number of sandflies per trap per night.*

Quantitative sticky paper traps

Light traps have been extensively employed with considerable success in South America. They have been seldom used in India. There is little information on phototropism in *P.argentipes*, whether this species is attracted to light, as *S.squamipleuris, or P.hindustamicus* are.

The use of sticky papers for sandfly collection ahs been extensively employed for various species. It was the only method used in the ex-USSR and France. Standardized pieces of paper or cards (e.g. 25x20cm) soaked in castor oil and placed in sandfly resting places overnight. In order to obtain quantitative results, either one or both sides of the paper must be completely exposed. The papers can be fixed on a bamboo support or applied to a wall. The number of papers used at each sampling is normally constant. Sandflies are removed from the oiled paper (e.g. with a small brush), washed in saline with a trace of detergent and then identified. The catch results are expressed as *number of sandflies per m^2 of sticky paper per night.* The sticky trap method is the most objective method of collection when properly placed, i.e., near their likely resting places they are likely to provide an objective picture.

Environmental management

Modification of the physical environment can have a dramatic effect on the relative abundance of vectors and on levels of transmission in certain situations particularly where feral (forest) dwelling sandflies transmit the disease. Cleanliness of houses and cattle sheds are measures potentially useful, but have never been scientifically evaluated.

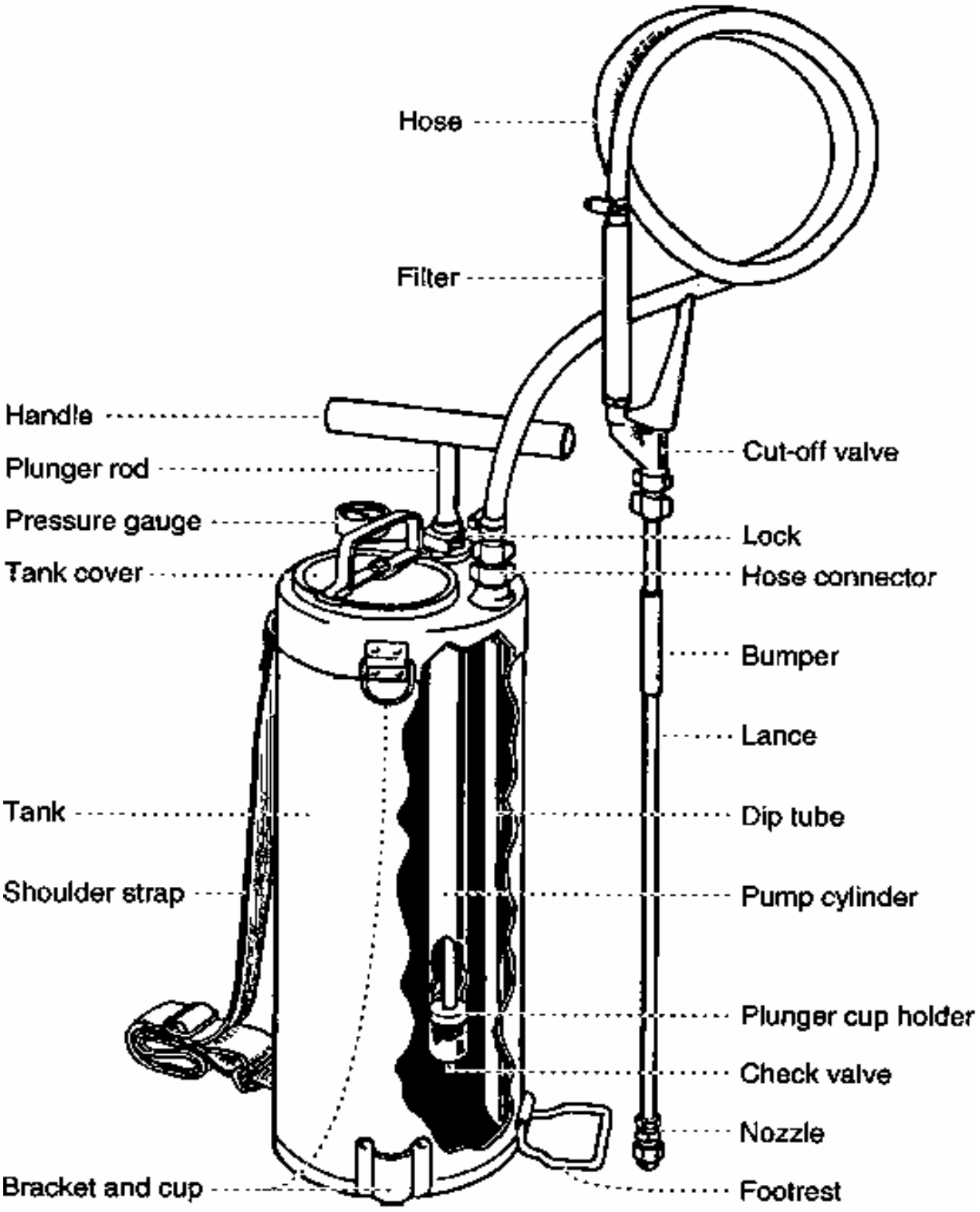
Recently, Kumar et al. used mud plastering and painting with lime, to lower densities of *P.argentipes* in one village in Bihar. The experiment was confined to one village only. This approach needs to be evaluated with a sufficient sample of villages. P.argentipes does rest on mud-plastered walls including those smeared with lime.

Self-protection

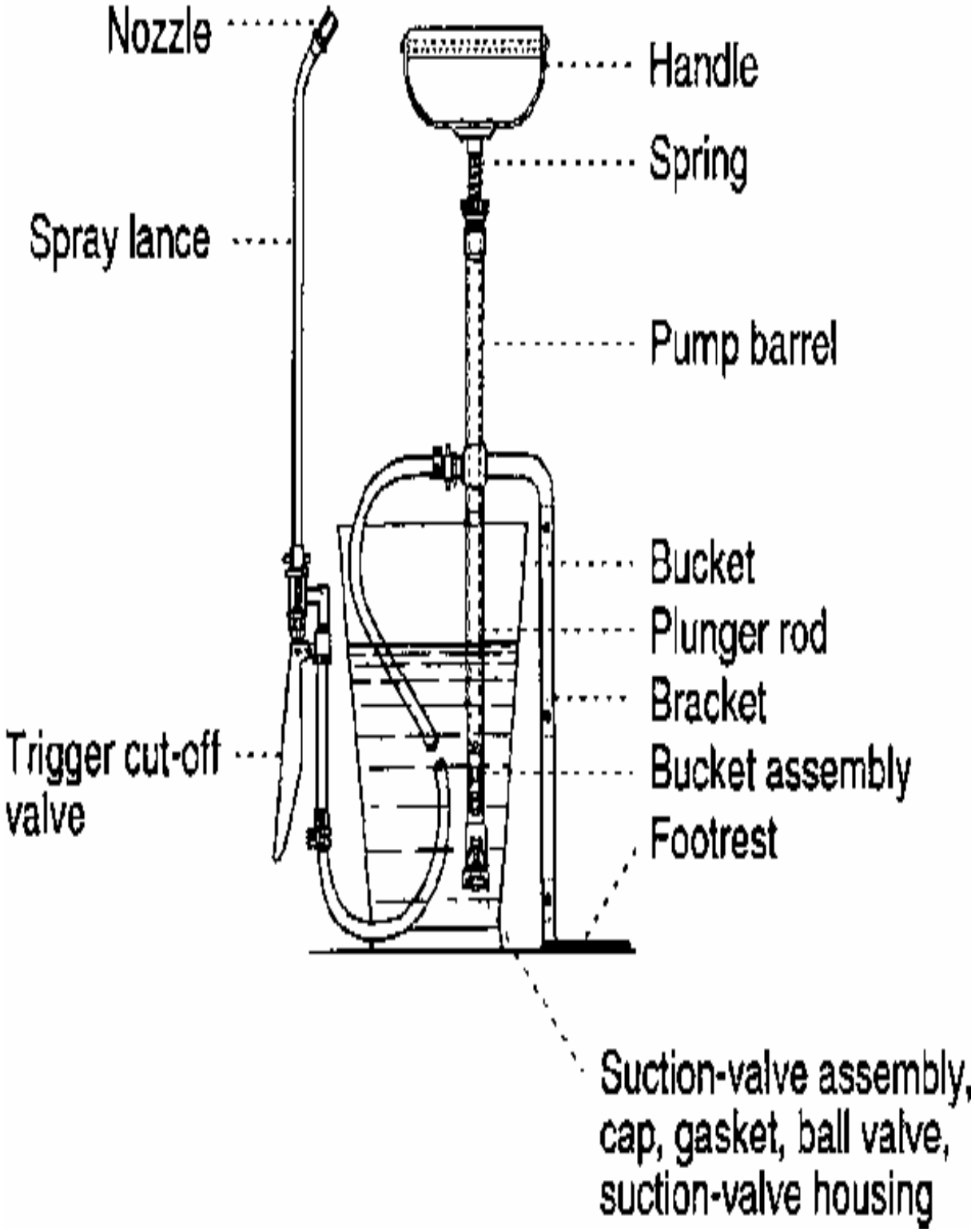
Individual protective measures in outside areas include application of repellents, such as diethyltoluamide, to the skin or clothing to reduce man-vector contact. Portable **mosquito coils could be effective but have not been evaluated for use against sandflies.** Indoor protection from sandfly bites can be obtained by the use of fine-mesh screens on windows and doors, insecticide treated curtains, mosquito coils, electrically heated fumigation mats and fumigant canisters.

Annexure III ….Contd/-

HAND COMPRESSION SPRAYER



STIRRUP PUMP SPRAYER



Annexure - IV

STOCK REPORT ON DDT 50%

State _____ PHC selected of spray _____

District _____ No. of sub-centres _____

Sl. No.		Balance from previous year			Quantity received in (MTs) during the year			Total quantity (MT)	Qty. used in (M.Tons)		Qty. Balance (MT)
		Qty. MT	Date. of Manufacture	Date of Expiry	Qty. (MT)	Manufacture date	Expiry date		1st round	2nd round	
1.	DDT 50% w.p.										

Annexure-V

STOCK REPORT ON SPRAY EQUIPMENT

State _____ PHC selected for spray _____

District _____ No. of sub-centres _____

Name of Supervisor _____ Population _____

Sr. No.	Type of Sprayers	Balance in the beginning of the year	Received during the year	In working Order	Repairable	Unrepairable	Remarks

Annexure-VI

SPRAY OPERATIONS

District …… (To be completed at District Level) State ……

Population of District…… No. of PHCs…… No. of villages ……

No. of Hamlets ……

S. No.	Name of the PHC	Population of PHC at Col. 2	No. of villages reporting cases in last five years
1	**2**	**3**	**4**
1. 2. 3. 4. 5. 6. Contd.			
Total			

Summary Population Selected _____ Spray pumps Required _____ Available _____ on _____ insecticide required _____. Remarks on availability of other spray equipments.

Chief Medical Officer

District :

ANNEXURE-VII

MONTHLY REPORT OF KALA-AZAR PROGRAMME

(PROGRESS & ASSESSMENT OF SPRAYING)

State _____ Name of PHC selected for spray _____

District _____ Total sub-centres _____

Name of Kala-azar Inspector _____ Population _____

Headquarters _____

Sr. No.	Name of Sub-centre	Population	Insecticide used	Period of spraying rounds	Targeted Rooms	Targeted cattlesheds	Achievements		
							No Sprayed	Coverage In % (Rooms)	DDT 50% wp (cattlesheds)
1	**2**	**3**	**4**	**5**	**6**		**7**	**8**	**9**
A		Sprayed Subcentres							
1.		1st Round 2nd Round							
2.		1st Round 2nd Round							
3.		1st Round 2nd Round							
B.		Non-Sprayed Sub-Centres							
Total									

Chief Medical Officer