

DR. SURENDER DALAL KEET SAKSHARTA MISSION (REGD.)

INSECT LITERACY BASED IPM

PACKAGE OF PRACTICE

FOR

COTTON



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This book is dedicated to the torch bearer of insect literacy Dr. Surender Dalal and all the insect-master farmers who have worked shoulder to shoulder day and night with him without expecting any rewards to make our platter poison free by doing research on insect literacy. The plant of insect literacy has now turned into a huge tree and providing cool shelter to not only farmers of Haryana state but farmers from other neighbouring states also from the heat of pesticides. Purpose of Our insect literacy mission is to increase productivity by reducing the cost of production by eliminating poisonous pesticides. So that indiscriminate use of pesticides can be stopped to make our platter poison free and thereby increasing farmers' income by reducing expenditure on pesticides. So that farmers can become self-dependent by getting more yields with lesser input expenditure.

FORWARD

In the year 2003, American Bollworm destroyed the cotton crop comprehensively. Farmers were spraying pesticides blindly to protect their crop. They were purchasing costlier and costlier pesticides from market but everything failed to control this two and half inches long insect. And infestation of bollworm increased instead of mitigating. Farmers and agriculture department were in grave fear due to attack of this insect. They did 30-35 sprays to control it but all in vain. Due to increase in cost of production by indiscriminate use of pesticides associated with almost no yield, farmers were in great distress. An editorial in an English daily with title "A Collective Failure" on destruction by American Bollworm rattled the image of agriculture department. The mockery of agriculture department made by this editorial deeply hurt Dr. Surender Dalal, agriculture development officer (ADO) of Nidana, Jind Haryana. After this the attack of Mealybug on cotton forced farmers to shed tears of blood. Mealybug destroyed the crop comprehensively. To understand the reasons of destruction of the crops year after year forced DR. Surender Dalal to work on insect management but with almost no success. Then in 2008, he along with farmers started his experiments to completely stop the usage of pesticides but farmers have to face pressure by the ladies at home to resume sprays. This becomes a point of contention and thus dispute in families. To end this home-war he involved women also and in 2012 first women farmers' class were started which are known as "Mehila Kisan Khet Pathshala". Out of his research that started in 2008, he understood the reasons of insect infestation and concluded that it's impossible to win the war without identification of the enemies. The same way farmers don't know about insect coming in the crop. And it's result of this unawareness that farmers treat them as enemies and spray pesticides to kill these insects. If farmers are to be brought out of this mess, first of all farmers needs to be taught about identification of insects to understand their activities. Then he started educating male and female farmers selflessly on his own expenses. He taught them the relation between insects and plants. In 2012, he involved Khap Panchayats (local caste courts) to make this venture a success. This effort turned into a movement gradually but unfortunately the messiah of farmers succumbed to swine flu on 18th May 2013. Everyone involved in the movement was in grave shock but the brave heart pupils of Dr. Dalal accepted this as will of God and continued working as it was going on. Everyone associated with the movement poured in all their strength and today mission is standing on the verge of success. We are hopeful that this model developed by Dr. Surender Dalal on the soil of Nidana village of district Jind of Haryana be adopted and implemented by the government and department of agriculture for the welfare of farmers.

METHODOLOGY

1. INPUTS

Dr. Dalal Mixture (Dr. Dalal Ghol): Take 2.5 kg urea, 2.5 kg DAP, 500gm zinc (21%). Soak DAP in a plastic or earthen pot one day before spray and stir it 2-3 times. This will help in dissolution of nutrients in water, perfectly. Before spray, urea and zinc shall be dissolved in water in separate pots. Then spray it with 100 ltrs of water in an acre. Care must be taken that no metallic containers shall be used for dissolution and 100 ltrs of water shall be used neither less nor more, otherwise it may damage the leaves. **This will provide all the nutrition required by the plants and there is no need to provide fertilizers in the soil.**

Schedule of Dr. Dalal Mixture:

First spray of the mixture can be started after first irrigation. In the cotton crop, sprays can be done at 10 days interval. Total 6-7 sprays are sufficient for cotton. In case average count of white flies cross ETL, spray of the mixture may be done at 2-3 days' interval. 10 sprays in sugarcane, 4-5 in wheat and not more than 2 in case of fodder.

2. IPM PRACTICE

Material required for identification of Insects:

A good quality magnifying glass (minimum 5X zoom) for identification of insects, a note book and a pen. Note down the count of insects along with their identification.

How to do insect survey in field and calculate average:

Farmers must do survey in the farm once in a week. Survey may be started after the first rain after sowing when crop has developed 5-6 leaves, because infestation increases after the rains. Survey in cotton may be started in last week of June. If possible do the survey in a group. A group may comprise of 4-5 farmers. At least 10 plants shall be surveyed per acre. Choose 9 leaves per plant – 3 each from upper, Middle and lower leaves, to count the insects on them. Then choose the plant at 20 feet distance. This way, count the insects on 10 plants per acre. Major Herbivorous insect viz. White Fly, Jassids and Thrips shall be surveyed. Note down the count of carnivorous present on the plants also. Calculate the average number of insects per leaf. For example, 9 leaves each of 10 plants were surveyed, so total leaves surveyed are 90. Divide total number of insects found by 90, the figure so found will be average count of insects per leaf. In case single farmer is to do the survey, do it on at least 20 plants instead of 10 and 3 leaves per plant can be checked instead of 9.

ETL for various insects:

Entomologists have estimated that ETL per leaf for White Fly is 10, for Jassid is 2 and for Thrips is 10, up to which these insects cannot cause economical damage to the crop. In

case the average is above ETL, we need to think about the reasons of it seriously rather than spraying pesticides. Dr. Dalal Mixture can be sprayed in this case in between at an interval of 3 days to feed the plants so that extra sap is not sucked by the insects.

3. INSECT INFORMATION

White Fly:

White Fly is a herbivorous sucking insect. White Fly nymphs are of the shape of tip of a pen. Due to small size it's not easy to see it with naked eye. This can be seen through microscope only. It survives on leaves by sucking sap. It helps in propagation of Leaf Curl Virus. It can spread virus through its saliva from one plant to the other. If a single leaf is having virus on it, even 10 White Flies are sufficient to spread it throughout the field. This insect is harmful for the crop but carnivorous insects present in the field controls these naturally.

Life Cycle of White Fly:

White fly lays its eggs on lower surface of the leaves. One white fly lays 100 to 125 eggs in its life and it takes one week for the eggs to hatch. Nymphs turn into pupa after 6-7 days and then it turns into the moth. Life period in moth stage is around 20-25 days. Wingless nymphs suck sap from leaves sticking to one place only. Whereas the adults suck sap from here and there. Secretion of white fly contains sugars. Wherever this secretion drops, it creates a fungus like situation on that leaf surface and that leaf stops making food.



Natural Enemies of White Fly:

Ero and Eno (*Encarcia* spp) are two major enemies of White Fly which plays an important role in natural control of White Fly. Both these insects are parasitoids which feeds their children inside white fly nymphs. Nymphs of White Fly are wingless which makes carnivorous insects easy to get rid of them.

<https://www.youtube.com/watch?v=UNaHRG34edA>

<https://www.youtube.com/watch?v=Mf2AZxGYOAw>

Thripps:

Thripps are a tiny sucking pest of cotton. This insect remains on the cotton crop from sprouting to picking. Scientists have fixed its ETL level at 10 per leave. If pesticides are not sprayed on cotton crop, this insect may never cross ETL. Major reason for this is presence of carnivorous insects present in the field. Like White Fly this is also a polyphagus insect which survives on crops like onion, garlic, tobacco etc. This is why we can neither call it a friendly nor enemy insect, because it comes to plants for survival and multiplication only.

Life Cycle of Thripps:

It's a yellowish brown insect with shape like tip of spinning wheel. The female adult lays 50-60 eggs in 4-5 eggs per day basis in its life period. Shape of eggs is like human kidney. Nymphs hatch out of eggs in 3-8 days. This stage lasts for 7-8 days and pupation period is 2-4 days. Larva and nymphs of this insect are found on the lower surface near veins of fully developed leaves. They suck the sap from leaves by scratching lower surface, which turns the surface silver like in colour. The leaves turn upwards when attack of Thripps is severe. And in the end leaves fall after getting dry.



Natural Enemies of Thripps:

Predatory mites and Bindua Bugda (*Perillus bioculatus*), Didar Bugda (Bigeyed Bug) and Enthu Bugda kills them by sucking its blood. Many types of beetles and their children survive by eating Thripps and thereby act as natural predator of Thripps.

<https://www.youtube.com/watch?v=6LpfLSex6X4>

Sucking Pest Jassids:

Jassids are one of the major sucking pest surviving on sucking sap of American cotton. Its colour is parrot green. It's just 3mm long. It loves light. it moves in zigzag manner. It's adult and larva survives by sucking sap from leaves. It leaves a poison in leaves while sucking sap. Leaves turn yellow where Jassids suck the sap and red spots can be seen on the leaves. In case of severe attack entire leaf turns red and turns downwards. This green colour insect does not come to field to harm or benefit the plants but for its survival only.

Life Cycle of Jassids:

Adults of Jassids lays 30-35 eggs near main or thick veins of leaves on lower surface in its life period. Nymphs hatch out in 4-6 days. Nymphs survive by sucking sap from lower surface of leaves. It takes 10-12 days for nymphs to become adults according to weather and availability of food. During this period nymphs remove their skin about 5 times. Afterwards the life period is about 40-50 days.



Natural Enemies of Jassids:

About 15 types of spiders, 3 types of flies, 3 types of Chrysopera and 14 types of beetles etc make nymphs and adults of Jassids their food. Nymphs and adults of Dasyu Bugda (Entocorid Bug), Didar Bugda (Bigeyed Bug), Katil Bugda (Assassin Bug), Kandheru Bugda controls Jassids by sucking its blood. Plants emanate a scent to call different predatory insects, parasitoids etc to save itself from attack of Jassid.

<https://www.youtube.com/watch?v=fPDBSaTCpSU>

Leaf Eating Insect Cotton Leaf Roller:

Cotton Leaf Roller is a leaf eating insect found on cotton. It's a herbivorous insect and eats delicate parts of leaves after scratching it. This insect is found all over India. This tiny insect sometime proves to be really devastating. In infancy these insects starts with lower surface of the leaves but as they grow older they make the leaves turn upwards in the shape of a funnel and keeps on eating leaves by scratching from inside. This is why farmers consider it an enemy.

Life Cycle of Cotton Leaf Roller:

It's of medium size and colour of its wings is yellow. Wings have brown waves like lines on it. Its head and body have black and brown spots on it. Fully developed moth has wings spreading up to 28-40mm. Like other moths they are also night wanderers. Female moths lay 200-300 eggs one by one on lower sides of leaves during night time. Eggs hatches in 4-5 days. These larvas remove their skin 6-7 times. Larval stage is about 15-20 days. The pupation takes place on the plant or inside rolled leaves or under the plant droppings. Pupation stage last for 8-10 days. Moths live for a week long only. Within this period moths have to mate and lay eggs for propagation of their generation.



Natural Enemies of Cotton Leaf Roller:

There are many carnivorous insects available in the farm to control this insect. Katil Bugda, Shail Bugda, Singhu Bugda (Soldier Bug - *Podisus maculiveentris*), Didar Bugda (Big Eyed bug), Dasyu Bugda sucks blood of larva and eats away eggs of the Roller. Various types of Beetles eat away it's eggs and larva. Lopa Flies (Dragon Fly) hunt the moths. Children and adults of Praying Mantis eat it's larva. Cotesia lays eggs inside the larva of these insects.

<https://www.youtube.com/watch?v=Hs1lcRMTmuU>

Leaf Eating Insect Grass Hopper:

Hopper is a herbivorous insect. This insect is found between Kolkata to Peshawar. It is found generally on Akk plants. Akk is its main and favourite food. It survives on more than 200 plant species other than Akk like cotton, wheat, maize, lobia, castor, okra, brinjal etc.

Life Cycle of Grass Hopper:

Female adults are ready for mating within a couple of days after turning into adult stage. Mating lasts for 6-7 hours. Female moths mate for 15-16 time in its life period with different male every time. Female lay one or maimu two egg chains in its life period. Each egg chain comprises around 150 eggs. Nymphs of this insect can be found near Akk plants. It removes its skin 6 times in this stage. It moves on different plants to change its taste despite of availability of Akk.



Natural Enemies of Grass Hopper:

There is huge number of natural enemies of Hopper. Hopper and Bristle beetle lays their eggs in soil. Children of Bristle Beetle are carnivorous. Larvae of Bristle Beetel eat eggs as well as larvae of Hoppers inside the soil. 8-9 types of Praying mantis, Lopa Fly (Dragon Fly) are also predators of the Hopper. Dayan Makkhi (Robber Fly) is its special customer.

Flower eating Insect Bristle Beetle:

Bristle Beetle is a herbivorous insect but its children are carnivorous. Its body contains poisonous chemical named Cantharidin. If its urine falls on human skin, it can cause rashes and cattle can fall sick if this insect is eaten with fodder. Adult of this insect survives by eating flowers petals and pollen nodes. It's a polyphagus insect found on soybeans, tomato, potato, brinjal and ridge gourds etc whereas it's larva are carnivorous. Larva survives on eggs and nymphs of hoppers, wasps and ground beetles and bugs.

Life Cycle of Bristle Beetle:

Life cycle of this beetle is a bit unusual. Adults of Bristle Beetle starts emanating from the soil and turn out in abundance in the month of July. Female moth starts laying eggs after 15-20 days of mating. It lays eggs in clusters at 5-6 different places. Every cluster comprises of 50 to 300 eggs. Number of eggs depends on food availability to female moth, food availability for the larva, and weather conditions. Eggs hatch inside the soil and children are called as grubs.

Immediately after hatching out, the grubs starts hunting for eggs of hoppers and other insects. This way the grubs of Bristle Beetle grow by eating eggs and nymphs of other insects in soil. After removing its skin 5 times, grubs turn into pupa inside soil. This way the larva (grub) spends winter in the soil after removing skin 5 times. The larva lives at 3-4 cm depth under the soil. In adult stage it survives by eating flower petals and pollen nodes.



RELATIONSHIP OF HERBIVOROUS INSECTS WITH THE PLANTS

Sucking Insects: Plants call herbivorous insect for its protection by emanating different scents. One square feet of a plant makes 4.5 gm food in a day. 1.5 gm of it goes to upper part of plant, 1.5 gm to trunk and roots and remaining 15 gm is kept as reserve for contingency. In case the plant doesn't need the reserve food, it emanates particular kind of scent to call herbivorous sucking insects which suck this extra sap. This way herbivorous insects get food and plants also survives.



Leaf Eating Insects: When the plant grows and lower leaves don't get adequate sunlight. Because of this in shortage of sunlight photosynthesis doesn't happen at lower leaves and these leaves are unable to make food. This causes scarcity of food for the plant growth. In order to fulfil this deficiency the plants emanate a scent to call grass hopper like leaf eating insects and these insects makes holes on the upper leaves. Through this eaten parts the sunlight reaches to lower leaves which helps them in making food again and thus the plant gains strength.



Flower Eating Insects: Cross pollination happens in the plants which bear flowers of different colours rather than self pollination. For example, when cotton bears flowers it needs a pollinating agent. Pollen of cotton is heavy and air cannot carry pollen to female part and moreover the female part of pollen is on upper part of flower and male part is on lower part. This necessitates the need of pollinating agents. At this stage flower eating Bristle Beetle comes on the cotton crop to eat flower petals and some pollen carries to female parts by sticking to its wings. This way flower eating insects helps in pollination.



Fruit Eating Insects: Plants keep fruits as per its capacity. Fruits that plants can't bear are dropped by the plant itself or calls fruit eating insects by emanating a scent. Plant allows the insects to eat the extra fruit only. When extra fruits are eaten away or dropped off, it calls carnivorous insects by emanating another smell and these insects eat away herbivorous insects.



This way there is very deep relationship between insects and plants.

CARNIVOROUS INSECTS

Praying Mantis:

It contains 500-600 eggs in its womb. Hatching of eggs and turning to moth from larva takes around 20-25 days. Its life cycle spans over six months. Its children and adults are both carnivorous. It preys on smaller and of same size insects. There are many species of Mantis but till date 8 types have been identified. It eats herbivorous insects and acts as natural pesticide.

Physical Build: Its front feet are like a saw with which it hunts its preys. To save the teeth it keeps its front feet folded. It seems as if it is holding its hands together. The best thing about it is that it can turn its neck in all the four directions.



Food of Praying Mantis: It attacks mainly bigger herbivorous insects, because smaller ones can't fill its tummy. It contains 500-600 eggs in its womb. One mantis eats away about 10 insects in a day. If there are 20 egg-wombs of mantis are available in an acre, farmers need not worry about herbivorous insects because if one egg-pot hatches 500 larva, they can eat 1 lac herbivorous insects in a day.

Lady Bird Beetle:

Children and adults of Lady Bird Beetle both are carnivorous. First stage of its life cycle is eggs. Larva and pupa are next stages and then it turn into adults. Till now 20 species have been identified. It survives by eating herbivorous insects and thus acts as natural pesticide.

Physical Build: its wings are stuck to its body. Wings have large spots on it. A 'W' mark is available on the wings of some species. Some have white and black stripes. It lays 30-40 eggs at a time. It lays eggs at different places instead of laying at one place. Nymphs come out of eggs in 7-8 days and turns into pupa in 15-20 days. Then it turns to adult.



Food of Lady Bird Beetle: it eats insects of smaller and of its size. Mealybugs, Aphids are its favourite food. The most interesting thing about it is that it can die of hunger but liken to eat only insects.

Ero and Eno (Parasitoids of White Fly):

Ero and Eno are both parasitoids (insects that lay eggs inside body of White fly). It helps in controlling population of White Flies. They lay their eggs inside the nymphs (children) of White Flies. Its children survive by eating nymphs of White Fly. Ero, Eno and other parasitoids alone control 99% of White Flies in the crop.

It has 4 stages in its life cycle out of which 3 stages are spent inside the body of nymphs of White Flies and in its fourth stage when these parasitoids turn into an adult and then come out of nymphs after eating it completely. If farmers try to kill White Flies by spraying pesticides, Ero and Eno also gets killed along with White Fly nymphs in first three stages of its life cycle.

Physical Build: Adult of Ero is yellow in colour. Its wings are white and lustrous. Colour of its eyes is red. It has 3 pairs of legs, 1 pair of wings and two antennas on the head. It is hardly 1.5 mm long. Its life span inside the body of White Fly nymph is around 15-20 days.



Food of Ero and Eno: They are parasitoids which lays their eggs inside the body of its prays. White Fly is its favourite food. It plays most important role in controlling white flies. Ero lays it's eggs inside the body of White Fly nymphs. Only one egg in one nymph. The larva coming out of egg grows by eating the White Fly nymphs. This way upbringing of Ero and Eno happens with the death of White Fly nymphs.

This year following Insect Literacy Schools will be held:

- 1. Women's School at village Ridhana, Distt. Jind, Haryana**
- 2. Village Zevra, Distt. Hisar, Haryana**
- 3. Village Jyanakheda, Distt. Hisar, Haryana**
- 4. Village Matti, Distt. Mansa, Punjab**

Important Links:

- 1. <http://drdalajind.blogspot.in/>**
- 2. <http://kitsaksharta.blogspot.in/>**
- 3. <http://chopatchaupal.blogspot.in/>**
- 4. <http://mahilakhetpathshala.blogspot.in/>**
- 5. <https://www.flickr.com/photos/dalalsure>**
- 6. <https://www.youtube.com/user/suredalal/>**
- 7. https://www.youtube.com/watch?v=GnOOuc_FlvM**
- 8. <https://www.youtube.com/watch?v=RvLXA-05iq0>**
- 9. <http://farmer.gov.in/IPMPackageofPractices.aspx>**
- 10. <http://www.ncipm.org.in/NCIPMPDFs/ipmpackages/Cotton%20Bulletin.pdf>**
- 11. <https://www.youtube.com/watch?v=ODz2E9He7ks>**
- 12. https://www.youtube.com/watch?v=pZ8XU_JCZoI**
- 13. <https://www.youtube.com/watch?v=zt5-CV7eOWg>**
- 14. <https://www.youtube.com/watch?v=zt5-CV7eOWg>**