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Unleashing Nature's Wisdom: ITK Revolutionizes IPM for Greener Agriculture

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The practice of using pesticides as a tool of the first resort has now drifted the current IPM strategies from its ecological roots. Therefore, the development of new knowledge systems with an emphasis on eco-friendly approaches and new IPM strategies is felt essential to prevent new pests or the intensification of the existing ones. It has already been established that sustainability in crop production and protection can only be achieved by developing technologies that are based on locally available inputs that are easily acceptable and cost-effective. The innovative ideas of farmers in solving technical problems through local resource management are, therefore gaining importance in recent years. Innovations based on traditional knowledge have also been emphasized by the National Innovation Foundation (NIF) and the Department of Science & Technology, Govt. of India. The World Summit on Sustainable Development (WSSD) held Johannesburg in South Africa in 2002 strongly advocated the use of local technical knowledge in crop husbandry packages (Anonymous, 2002).

In general, the ITKs are based on three categories viz., (a) Cultural practices, (b) Physical and mechanical methods, and (c) Use of botanicals.

a) **Cultural practices:** Generally cultural practices enhance the "belowground biodiversity" which concurrently contributes to "aboveground biodiversity" and make the habitat more diverse for the sustenance of natural enemies. The cultural practices (field sanitation; proper seed and variety selection; proper seedbed preparation; planting date; row spacing; seeding rate; fertilization; water management; crop rotation; planting of trap crops and hedge rows; companion planting; and intercropping) contribute to prevent, suppress, or eradicate pest build-up by disrupting the normal relationship between the pest and the host plant and thus make the pest less likely to survive, grow, or reproduce. Most of these practices are well experimented and practiced by the farmers.

(b) Physical or mechanical control: It includes proper land preparation; hoeing; weeding, bagging of fruits; baits and traps; row covers; mulching; handpicking; pruning, etc. Among the above practices traps and baits can be indigenously prepared using locally available resources for better monitoring and control of insect pests. A few examples are cited below;

Trapping rhinoceros beetles (RB) in coconut: a mud pot with three-quarters of it is to be filled with water and to this 250 g of powdered castor cake is added. The pot is then buried in the soil with its mouth level with the soil. The smell of the cake attracts the beetles which fall into the water. Just 2-3 such pots in one hectare of plantation can clear beetles from the area. Slices of pineapple are also used to attract RB. In a cylindrical plastic container, 2 slices of pineapple are taken and an exit hole is made to allow the rainwater to drain. The trap is hung near the crown of the coconut tree. The beetles are attracted to the pineapple and get trapped.

Trapping red palm weevil (RPW) in coconut: The midrib of coconut leaf is cut into small pieces and crushed, placed in an earthen pot either with 1 lit of water 100 g jaggery, and 10 g tobacco powder or with sugarcane molasses 2½ kg or toddy 2½ liters acetic acid 5 ml yeast 5 g. Another pot with a hole at its bottom is placed over it. This arrangement is made at 3-4 corners of the coconut orchard to attract and trap the beetles. The mixture of jaggery, tobacco, and water is to be added once a month in case the former bait is chosen.

Trapping blister beetles: Blue containers, filled with water with little detergent are claimed to attract blister beetles.

Trapping moths: Mix 500ml of aloe extract with 1 kg of castor cake and add latex as an adhesive. Put this mixture in a wide-opened disposable container. Place in strategic locations of the field @12 / ha (Bissdorf, 2008).

Control of Slugs in the Kitchen Garden: Set the rinds of grapes with a little pulp left inside upside down (like an igloo-style) in a kitchen garden. The slugs will hide underneath the grapefruit and die.

Other Mechanical control practices:

Attracting birds: Erection of bird perches @ 25/ha facilitate predation of larval stages of insects.

Bait for Ant: Ants often protect honeydew-producing organisms such as aphids, mealybugs, and scales from attack by natural enemies. Sometimes ants move these honeydew-producing insects from plant to plant. Control of ants often leads to more effective biological control of sucking pests. The bait can be made by dissolving 1 teaspoon powdered boric acid and 10 teaspoons sugar into 2 cups of water; this mixture can then be absorbed into cotton balls which are left near ant trails.

Gundhi bugs in rice: Fix dead crabs, frogs, or even pieces of jackfruit (*Artocarpus heterophyllous*) to bamboo sticks and place them in rice fields before a milky stage. This will attract Gandhi bugs and keep them busy till the dough stage is over.

Fruits of *Mucuna prurienc*e Back (Fam: Papilionaceae) are kept in active rat burrows. When the rodent enters the hole, it collides against the hairy fruits with irritating hairs and leaves the spot with irritation.

A mixture containing 90% sesame or g.nut or niger flour with 5% thick sugar crystals and 5% powdered bulb or tube is placed in a bowl near rat holes and when rats feed this mixture they die within a week.

Inserting 10 – 12 inches long fresh pieces of the stem of the Jatropha plant into active rat holes makes the field rat-free (Kanojia, *et al*.,2005)

(c) Use of botanicals: Botanicals are more readily available than commercial products as they grow in the local environment. Reviving and modernizing age-old farmer practice through the optimization of ethnobotanicals has shown that farmers are more comfortable using plant materials than commercial synthetics and those botanicals can offer a similar level of control when certain guidelines are followed to their use (Belmain, 2002).

Aloe (*Aloe barbadensis*; Fam: Aloeaceae) vitex (*Vitex negundo*; Fam: Verbenaceae) extract: Soak vitex leaves (5kg) in 10 liters of water. After boiling for 30 minutes cool the extract and then strain. Remove the outer part of the aloe leaves (2 kg) and grind in water to get the extract. Mix the two extracts and dilute them in 50-60 liters of water to cover a 0.4 ha area. Add 50-60 ml soap to the mixture and spray early in the morning or late in the afternoon. This Aloe vitex extract is reported to control armyworms, hairy caterpillars, rice leaf folders, rice stem borer, semi-looper, and bacterial and fungal diseases (Bissdorf, 2008).

Coriander (*Coriandrum sativum*) for spider mite control: Coiander acts as a repellent and to prepare the extract to boil 200 grams of crushed seeds in 1 liter of water for 10 minutes. Dilute the extract with 2 liters of water. Spray early in the morning on infested plant parts to control spider mites (Bissdorf, 2008).

Marigold and chilli extract: Chop 500 g of the whole plant and 10 hot chilli pods; Soak them overnight in 15 liters of water. Dilute the filtrate with water at 1:2 ratios and add soap @ 1tsp per liter of extract. This controls most agricultural pests (Bissdorf, 2008).

Turmeric (*Curcuma domestica*): Soak shredded rhizome (20g) in 200ml cow urine. Dilute the mixture with 2-3 liters of water and add soap (8-12 ml) and spray. The extract controls aphids, caterpillars, red spider mites, and powdery mildew (Bissdorf, 2008).

Neem leaf extract: Pound 1kg of neem leaves and place it in a pot with 2 liters of water. Cover the mouth with cloth and leave it as such for 3 days. Dilute the extract at 1:9 with water and add 100 ml of soap before spraying. This controls aphids, grasshoppers, leaf hoppers, plant hoppers, scales, thrips, weevils, and beetles (Bissdorf, 2008).

Calotropis gigantean: Leaves are preserved in a big earthen pot filled with water for two weeks. The water is applied @ 0.5 l / tree to control termites. The leaves are replaced after 2 months.

(d) ther pest control formulations based on ITK:

Fermented curd water – In some parts of central India fermented curd water (buttermilk) is used for the management of white flies, jassids aphids, etc.

Cow milk: Cow's milk was reported to act as an excellent sticker and spreader due to the presence of casein protein has excellent spreader and sticker property. It can be used @ 10% aqueous suspension for effectively controlling powdery mildew. Milk sprays induced systematically acquired resistance in chilli against leaf curl, a viral disease (Arun Kumar *et al.*, 2002).

Cow urine and dung: Cow urine diluted with water in a ratio of 1: 20 is not only effective in the management of pathogens and insects but also acts as a growth promoter of crops.

Cow urine has been found effective against mealy bugs, thrips, and mites (Peries, 1989) and against post-flowering insect pests of cowpea (Oparaeke, 2003).

Crush 5 kg neem leaves in water, add 5lit cow urine and 2 kg cow dung ferment for 24 hrs with intermittent stirring, filter the extract, and dilute it in 100 lit of water for spraying over one acre. This extract is useful against sucking pests and mealy bugs.

In brinjal, the application of cow urine 10% starch 1% (Pradhan, 2011) either alone or redundant with chlorantraniliprole 18.5 SC (Sakhinetipalli, 2012) was found to be cost-effective.

Botanicals fermented in cow urine/cow dung: The cow urine decoctions of botanicals have been reported as effective against various insect pests without noticeable detrimental effects on their natural enemies (Poonam, 2003; Gupta, 2005).

Cow urine 5% with neem seed kernel extract 5% and cow dung 5% showed anti-feeders and anti-ovipositional effects against *Helicoverpa armigera* (Sadawarte and Sarode, 1997; Boomathi *et al.*, 2006).

Among 14 cow urine mixed botanical extracts tested *Lantana camara* Linn. and *Vitex trifolia* were reported effective against aphid, *Lipaphis erysimi* (Shreth, *et al*., 2009).

Crude extract of *Datura alba* (20%) cow urine (20%) was effective against stem borer and leaf folder in Basmati rice (Aswal *et al.*, 2010).

Barapatre and Lingappa (2003) also documented the effectiveness of cow urine along with various botanicals *viz*., NSKE, *Pongamia*, *Vitex*, *Aloe vera* against *S. litura* and *H. armigera* in groundnut and chickpea, respectively

The combination of cow urine with NSKE and *Vitex* reduced the shoot fly infestation in sorghum (Vijayalaxmi, *et al*., 1996; Mudigourdra, *et al*., 2009).

Cow urine fermented karanj leaves (10%) / neem leaves (10%) were ideal in respect of marketable fruit yield (135.5-141.7 q / ha) and benefit: cost ratio (38.20:1 – 42.68:1) despite their ineffectiveness against the shoot and fruit borer in brinjal (Shailaja, *et al*., 2012).

Ash: A thick layer of ash is either spread on the soil around plants or sprinkled on foliage to protect it against a variety of pests. Besides acting as a physical poison ash on crop foliage interferes with the chemical signals emanating from the host plants thus obstructing the initial host location by pests. Ashes from burnt palm fronds and bunches have been traditionally used in the eastern parts of Nigeria to dust the leaves of okra to protect against leaf-eating beetles, *Podagrica* spp. (Oparaeke, *et al*., 2006). Application of ash @50kg/ha kerosene 5% and spinosad 45SC generated maximum benefit-cost ratio of 4.8:1in brinjal (Sakhinetipalli, 2012).

Conclusion

Indian farming, which is going through a transition phase, is slowly but surely adopting the ways and means of pest management for sustainable agriculture (Dhandapani *et al.*, 2003). Adoption of ITK- based crop protection measures as an alternative to pesticides might help in restoring the biodiversity of natural enemies, but as IPM is a knowledge-based and farmer-driven approach, education of farmers on alternatives to pesticides must be given priority.