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REMOTE SENSING AND INFORMATION TECHNOLOGY IN INTEGRATED PEST MANAGEMENT

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The present popular review article provides a perspective on remote sensing and information techniques and its applications, especially for insect pest management. Presently, remote sensing technology is used as an effective tool for the detection, forecasting, and management of insect pests. The main objectives of these applications were to collate data that help in decision-making for insect pest management and decreasing the environmental pollution of chemical pesticides. Furthermore, remote sensing using aerial CIR photography used to detect the presence of sooty mold due to citrus blackfly in citrus foliage and aerial multispectral videography, GPS, and GIS technologies used to detect and map whitefly infestations in cottons while, satellite information proved to be a promising tool in forecasting and monitoring the distribution of locust species. Remote sensing can provide fast and accurate forecasting of targeted insect pests and subsequently minimizing pest damage and the management costs.

The term "remote sensing" has come to be strongly associated with techniques of observation from earth-orbiting satellites, and in this guise would seem to have relatively little to offer entomologists. However, the subject more properly includes all methods of "observation of a target by a device some distance from it" and this broader definition encompasses large number of techniques that have been of benefit in entomological studies. There have been three distinct areas of application: the observation of insects themselves, the detection of the effects that insects produce (usually plant damage), and the monitoring of environmental factors likely to influence insect behaviour. Internet has become the great potential to impact research, extension and teaching in entomology. Scientists can communicate with their counterparts in other universities and research institutions. (Riley, 1989) They can access a large database of information available on the net. Research literature is migrating very fast from paper to the web most of which can be accessed free of

cost. It permits easy and efficient access of information thus saving a researcher's valuable time. Extension entomologist's can access the latest information on pest control which can be disseminated to the farmers. Farmers can communicate directly with the expert for solution of their specific problem. Internet based communication is becoming more popular than making phone calls both among farmers and extension workers as it permits broader choice for the farmers and allows sufficient time for the expert to answer a query.

Need of Remote sensing and information technology in IPM

Information is indispensable in the socio-economic and agricultural sectors of both developing and developed countries. Agro-Information System (AIS) can be used to provide information of major pests and diseases for crops and advice on crop protection. The public, government and agricultural decision-makers can obtain essential information and services provided by the AIS for use in areas such as agricultural disaster assessment, national vegetation monitoring, national crop yield forecasts and agro-advisories. To enhance agricultural productivity among rural farmers, it is often necessary to increase farmer's access to agricultural information and effective utilization of this information. The information provided must be in user-friendly form, easy to access, cost effective and well protected from unauthorized accesses. Agricultural knowledge and information system for farmers can justify the need for farmers to understand the technological principles of integrated pest management. Aerial imaging systems have been used extensively for detecting and monitoring insect infestations in both agricultural and non cultivated environments. These systems allow rapid acquisition of data with short turn-around time, overhead imaging of entire areas at one time, and a procedure that is considerably less costly than ground surveys. Aerial photography is often used for detecting insect infestations because of its high spatial resolution and aerial videography has potential for entomological applications.

Information technology in IPM

Internet and the world wide web (www). The internet is a network system in which different computers are connected together by phone lines, fibre optic networks and Ethernet using the Transmission Control Protocol/ Internet Protocol (TCP/IP) suite.

Entomology and Internet - The use of internet in entomology research, teaching and extension is still in its infancy. Entomologists are now-a-days becoming increasingly aware

of the impact of internet to accelerate their research. Internet tools help them communicate easily, find and access information faster than the traditional ways of finding the journals and taking photocopies of the articles.

The Internet and Research - The entomological research has witnessed a profound effect by the use of internet. Scientists are frequently using electronic mail (e-mail) and web as a faster means of communication than the traditional means.

Retrieval of information from internet - The worldwide web is becoming an important component of information acquisition and exchange. There are a number of ways for retrieval of internet-based information.

Search engines - The use of search engines is the most common and easy ways to find information on the web. A search-engine allows the user to enter keywords related to a topic and retrieve information about websites containing those keywords. There are a number of search engines available on the web such as Google, Yahoo, Direct Hit, Northern Light, Meta Crawler, Excite, Magellan, Alta Vista, Ix quick Meta search and Dogpile etc.

Remote sensing in IPM- Detection and discrimination of objects or surface features means detecting and recording of radiant energy reflected or emitted by objects or surface material. Different objects return different amount of energy in different bands of the electromagnetic spectrum, incident upon it. This depends on the property of material (structural, chemical, and physical), surface roughness, angle of incidence, intensity, and wavelength of radiant energy.

Remote sensing techniques used in entomology.

- ✓ Photography and video grapy from aircraft and from the ground
- ✓ Satellite-borne photography
- ✓ Multispectral scanning
- ✓ Thermal imaging
- ✓ Ground-based and airborne radar
- ✓ Acoustic sounding and
- ✓ Low-light optical methods.

Acoustical remote sensing

The insects are detected by the low-intensity incidental sounds (in the range c. 0.5–150 kHz), that they make while moving and feeding in the medium. Stored grain; Wheat, *Sitophilus oryzae, Tribolium castaneum, Ryzopertha dominica, Cryptolestes ferrugineus, Oryzae philussurinamensis.*

Locust habitat monitoring and risk assessment using remote sensing technologies

Locust outbreaks occur on all continents except Antarctica and can affect the livelihoods of one in 10 people on Earth. To prevent economic and environmental losses, locust breeding areas should beperiodically monitored, and an early detection-early response strategy should be in place. Traditional, ground survey methods are inefficient to adequately address the large spatial scale of the locust problem.Remote Sensing and the associated geospatial technologies can provide timely data to assess the risk ofimpending locust outbreaks.

Remote sensing based on symptoms produced by insect's pests

Citrus Blackfly - The citrus blackfly (*Aleurocanthus woglumi* Ashby), an exotic pest of citrus indigenous to the Asian tropics, can cause extensive damage to citrus foliage by feeding injury and physiological damage caused by a sooty mold fungus (*Capnodium citri* B. & D.) that develops on the honey dew excreted by the developing insect (Hart *et al.*, 1976). When sooty mold deposits become heavy, reception of sunlight reduces the trees' ability to carry on photosynthesis, resulting in lower fruit production. Aerial CIR photography used to detect the presence of sooty mold deposits caused by citrus blackfly in citrus foliage (Hart *et al*. 1973).

Whitefly - The silver leaf whitefly (*Bemisia argentifolii* Bellows and Perring) is a pest of cotton, vegetables, and numerous ornamental plants. Heavy sooty mold deposits on the plant foliage, while detrimental in the sense that they impede photosynthesis, are highly visible and distinct. Aerial multispectral videography, GPS, and GIS technologies used to detect and map whitefly infestations in cottons (Everitt *et al*., 1996).

Mosquito habitats-Aerial photographs have proved extremely useful in surveying for mosquito breeding areas.

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