LASER BEAM TECHNOLOGY- A POWERFUL TOOL IN THE WORLD SCIENCE

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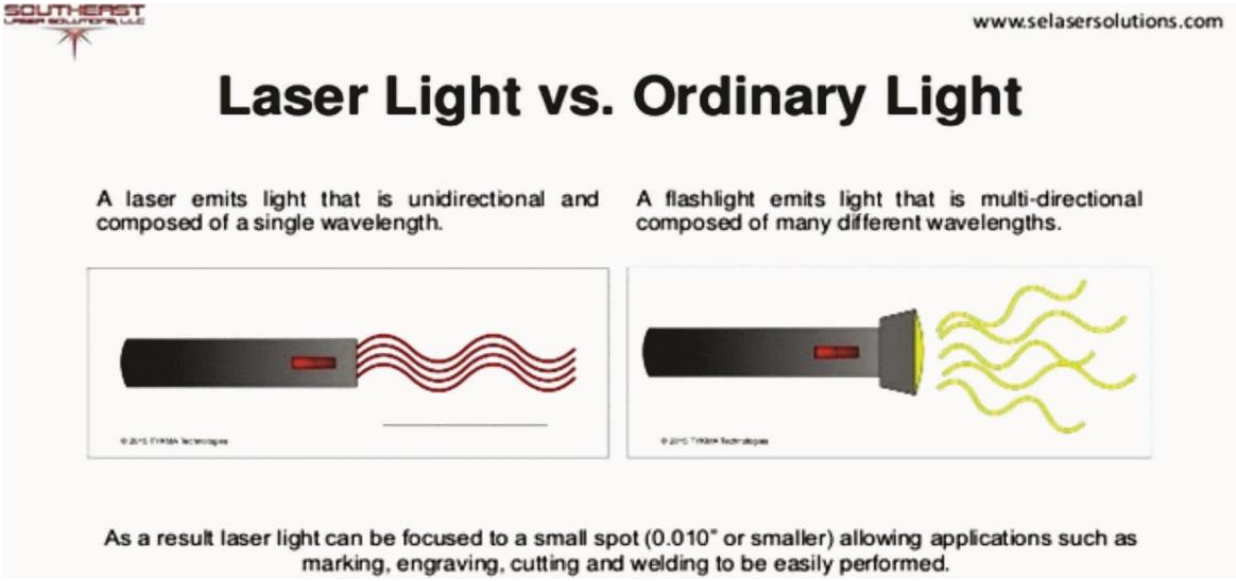
A Laser device is a Light Amplified by Stimulated Emission of Radiation. Lasers produce a narrow beam of concentrated light. The special effects produced by laser energy relating with a material strongly based on the wavelength, power level of the laser, the absorption features and chemical composition of the material.

The Invention of the Laser:

The Laser originated from the Maser, the difference being a maser was concentrated microwaves instead of light. Masers were invented by Charles Townes and Arthur Schawlow in the 1950s, both of them were Nobel peace prize winners for the endeavours in Physics. But the first working model of a laser was invented Theodore Maiman. Maiman invented the first working model of the Laser; the name laser was first coined by Gordon Gould a student of Charles Townes.



Types of Lasers:

Generally, there are five types of lasers, which are as follows:-

1. Solid-State Laser: The medium is something like a ruby rod or other solid crystalline material, and a flash tube wrapped around it which pumps its atoms full of energy. To work effectively, the solid has to be doped, a process that replaces some of the solid's atoms with ions of impurities, giving it just the right energy levels to produce laser light of a certain, precise frequency.
2. Gas Lasers: Gas lasers, by contrast, produce continuous bright beams using compounds of noble gases (in what are called excimer lasers) or carbon dioxide (CO2) as their medium, pumped by electricity. CO2 lasers are powerful, efficient, and typically used in industrial cutting and welding.
3. Liquid dye lasers: it uses a solution of organic dye molecules as the medium, pumped by something like an arc lamp, a flash lamp, or another laser. The advantage is they can be used to produce a broader band of light frequencies than solid-state and gas lasers, and they can even be "tuned" to produce different frequencies.
4. Semiconductor lasers: these are cheap, tiny, chip-like devices used in things like CD players, laser printers, and barcode scanners. They work like a cross between a conventional Light-emitting diode (LED) and a traditional laser.

5. Fibre lasers: work their magic inside optical fibres; in effect, a doped fibre-optic cable becomes the amplifying medium. They're powerful, efficient, reliable, and make it easy to pipe laser light to wherever it's needed.

Lasers used for?

As a tool:

Cutting tools based on CO2 lasers are widely used in industry: they're precise, easy-to-automate, and, unlike knives, never need sharpening. Where pieces of cloth were once cut by hand to make things like denim jeans, now fabrics are chopped by robot-guided lasers. They're faster and more accurate than humans and can cut multiple thicknesses of fabric at once, which improves efficiency and productivity.

Hospitals:

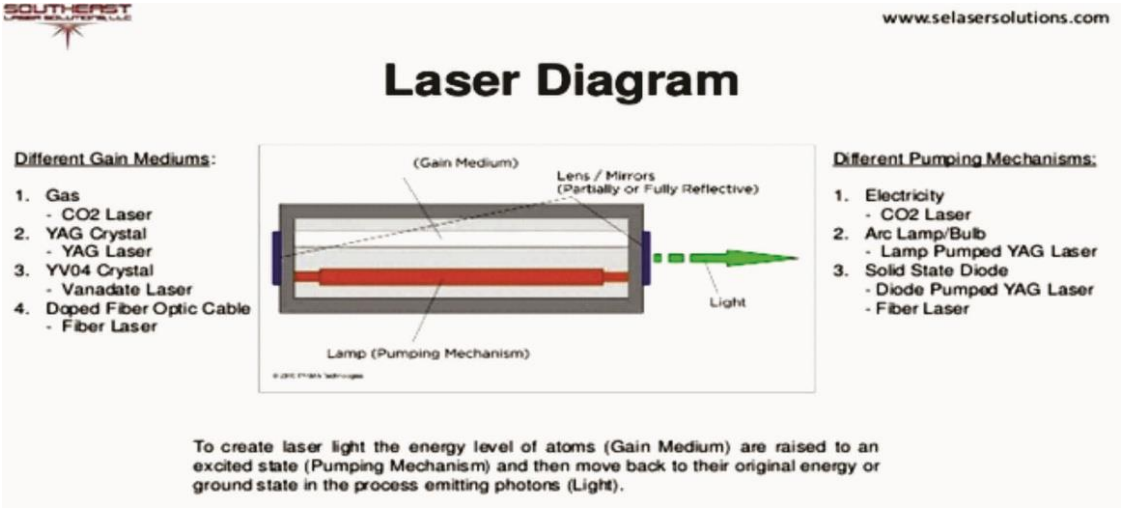
The same precision is equally important in medicine: doctors routinely use lasers on their patients' bodies. For everything from blasting cancer tumours and cauterizing blood vessels to correcting problems with people vision (laser-eye surgery, fixing detached retinas, and cataract treatments all involve lasers).

Communications:

Along with fibre-optic cables, lasers are widely used in a technology called photonics—using photons of light to communicate, for example, to send vast streams of data back and forth over the Internet. They are also used in Barcode scanners and to relay messages back and forth as communication.

Defense:

Using solid-state lasers pumped by LEDs, it's designed to damage or destroy enemy equipment more cheaply and precisely than conventional missiles, and expected to be rolled out more widely from 2016 onward. Meanwhile, the development of space lasers continues, though none have so far been deployed.



Advantages of Using a Laser:

- It has a high information-carrying capacity and hence is used in the communication domain for transmission of information.
- It is free from electromagnetic interference. This phenomenon is used in optical wireless communication through free space for telecommunication as well as computer networking.
- It has very minimum signal leakage.
- Laser-based fibre optic cables are very light in weight and hence are used in fibre optic communication system.
- It is less damaging compare to X-rays and widely used in the medical field for the treatment of cancers. It is used to burn small tumours on the eye surface and also on the tissue surface

- High intensity and low divergence of laser are used for knocking down the enemy tank with accurate range determination. For this purpose, neodymium and carbon dioxide laser types are used. A laser range finder is also used in several defence areas for medium-range up to 10 Km.
- Single laser beam can be focused in areas smaller than 1-micron diameter. One square micro area is needed to store 1 bit of data. This helps in storing 100 million data in one square cm. Due to this fact; the laser is being used in laser CDs and DVDs for data storage in the form of audio, video, documents etc.

Disadvantages of using a laser:

- It is expensive and more expenditure to the patients requiring laser-based treatments.
- It is costly to maintain and hence more cost to doctors and hospital management.
- Increases complexity and duration of the treatment based on laser devices or types of equipment.
- Lasers cannot be used in many commonly performed dental procedures e.g. to fill cavities between teeth etc.
- The laser beam is very delicate to handle in the cutting process. The slight mistake in adjusting distance and temperature may lead to burning or discoloring of the metals. Moreover, it requires a higher power during the cutting process.

It is harmful to human beings and often burns them during contacts.

EPIDEMIOLOGY OF TICKS AND ASSOCIATION OF DIFFERENT RISK FACTORS WITH TICK PREVALENCE IN DISTRICT FAISALABAD

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Ticks (Acari: Ixodidae) are known as obligate hematophagous ectoparasites and are worldwide in distribution. Ticks are known as first arthropod to be reported as vector and are known as second most important vector. Almost 900 species of ticks are identified till now and are divided into four main families.

Vector borne diseases (VBDs) are considered as main threat for animal and human health. Tick act as vector for disease transmission in vertebrates including some life threating diseases. Tick act as vector for Babseiosis, Anaplasmois, Thelieriosis, Lyme disease, Louping ill, Tick-borne fever, Rocky mountain spotted fever, Crimean Congo Hemorrhagic Fever (CCHF) etc. Ticks are reported as responsible for transmission of almost 38 viruses belonging to six families. Tick and tick-borne diseases (TBD) are known as major cause for decrease in livestock and agriculture growth rate. Livestock sector is main source of income, food products, dung sources, transport source. TBDs prevalence depend upon tick density, breed, season, age, management practices, geographical area.

Tick and TBDs cause economic losses by decreasing production and increasing management and treatment costs. Tick infestation cause loss in blood and exposure to pathogen, damage to skin and hides. Cross bred and exotic animals are more prone to tick infestation and carrier animals act as reservoir for infection transmission. Currently chemical acaricides are used for controlling tick and TBDs but their continued use may cause environmental contamination and resistance. To control ticks and TBDs environment friendly methods are needed like anti-tick vaccine. Use of vaccines for control of tick infestations is not a new concept but the major constraint is lack of highly efficient antigen.

Current study was conducted in district Faisalabad consisting of six tehsils to check the tick prevalence and its association with different factors including climatic, host, housing, feeding system, type of farming, farm structure, and hygienic factors from October 2018 to September 2019. During current study 1536 animals were screened including cattle, sheep, goat and buffalo and 782 ticks were collected. All the risk factors are divided into two categorized i.e. extrinsic factors (age, sex, species) and extrinsic factors (feeding system, type of farming, farm structure, housing system and hygienic measures). Present study revealed 53.91% tick infestation rate in cattle, 50.26% in buffaloes, 50.78% in sheep and 48.70% in goats.

Among intrinsic factors the study showed higher tick prevalence in female population followed by male animals. Based on age wise prevalence animals were divided into three groups (0-6 months, 7-12 months and above 1 year) high tick infestation was reported in young animals of age 7-12 months followed by age above than 1 year followed by juvenile stage of livestock species i.e. 0-6 month.

Ticks were available from start of February and high surge in prevalence was recorded from May to August and while lowest was in December and January. Association of season variation with tick infestation rate was also observed in study district and higher prevalence was reported in summer season followed by autumn, spring and winter. Statistical analysis showed a significant association ($P < 0.05$) of season with tick infestation rate. Among ecological factors association it was found that with increase in humidity and rainfall tick prevalence rate increase highest prevalence was during the month of July when rainfall and humidity level is high and with decrease in humidity level a decline in prevalence rate was record. Among collected species higher prevalence of *Hyalomma anatolicum* 59.46% was recorded followed by and *Rhipicephalus (Boophilus) microplus* 40.53%.

Tick infestation rate among livestock species of different tehsils of study district was also figured out in this study and it was higher in Tandlianwala followed by Jaranwala, Samundri, Chak Jhumra, Faisalabad Saddar and Faisalabad city.

In case of extrinsic factors feeding type system also has a significant effect (P- value 0.05) on tick prevalence having high prevalence value in grazing animals followed by mix feeding and stall feeding. Significant statistical association ($P < 0.05$) was also reported among tick infestation rate and type of farming. Animals were divided into two categories i.e. free ranged and farmed and higher tick prevalence as reported in free ranged animals followed by farmed.

On the basis of farm structure high tick infestation was observed in animals kept on kacha (uncemented) floor followed by cemented type of farm structure. Statistically significant association ($P <0.05$) was found among the farm structure and tick infestation rate. Animals were categorized into three groups i.e. animals that are kept free, tethered and mixed housing on the basis of housing facilities and significant association was found ($P <0.05$) with tick infestation and type of housing system. Higher prevalence was recorded in free housing followed by mixed and tethered housing. Animals kept in poor hygienic conditions showed higher prevalence compared to good and excellent hygiene animals. Hygienic condition of animals was also found statistically associated ($P<0.05$) with tick prevalence. Alternate control methods like use of nanoparticles should be adopted to minimize the losses caused by chemical methods. Awareness programs should be launched to educate people regarding the use of alternate control methods for ticks.

EPIZOOTIOLOGY AND FUNCTIONAL GENOMICS OF *AEDES AEGYPTI* TO IDENTIFY POTENTIAL CANDIDATES FOR ALTERNATE CONTROL STRATEGIES IN SELECTED STUDY DISTRICTS OF PUNJAB, PAKISTAN

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Mosquitoes are of great importance in the perspective of public health. They are not only an irritating factor in terms of biting but also transmit life threatening diseases. The most important arboviruses are mainly mosquito borne viruses responsible for health hazards in humans belong to four viral families such as *Flaviviridae, Bunyaviridae, Togaviridae* and *Reoviridae*. Various factors such as socio-cultural practices, development activities, human interference and climatic changes have influenced the abundance of parasitic load in the community and prevalence of mosquito borne diseases. Generally, the prevalence of dengue, malaria and lymphatic filariasis have made them the top priorities for control programs and global elimination.

The prevalence of *Ae. aegypti* has been reported in both rural and urban areas throughout the world in indoor or outdoor water holding containers including; refrigerator trays, flower tubs, plastic buckets, plastic bags, plastic sheets, plastic bottles, water tanks, tires, tree holes and plant axil. In urban areas,

neglected construction sites may involve in providing the potential breeding habitats for *Ae. aegypti*. The probability of *Aedes* mediated outbreaks can easily be predicted using different risk indices e.g. House Index (HI), Breteau Index (BI) and Container Index (CI). The assessment of these indices is done based on the number of immature *Ae. aegypti* present per container in a house. The assessment of the indices helps to identify the risk of *Aedes* borne pathogens in the specific area and appropriate strategies that may be used to intervene the risk of *Aedes* borne diseases. Therefore, the knowledge of preferred mosquito breeding sites is necessary to devise and implement appropriate control strategies through elimination of breeding sites of mosquito's larvae. In mid-20th century effective control measures were taken against *Ae. aegypti* resulting in minimizing the population of *Aedes* in most of the parts of America and to some extent in Brazil. Similarly, bed nets impregnated with pyrethroid insecticides and indoor sprays of residual insecticides were used to control *Anopheles* vector and proved effective in controlling malaria and preventing the life of billions of people in Africa. Despite effectiveness of these insecticides, there are reports of development of resistance against these insecticides.

The improper and frequent use of same insecticides results in development of insecticidal resistance. Undeniably, recent monitoring of mosquitoes and mosquito-borne diseases has reported the persistence of insecticidal resistance worldwide against various insecticides including cypermethrin and pyrethroids etc. The present study was designed with the objectives to investigate (a) *Stegomyia* indices and risk of *Aedes* borne pathogens in selected study areas of Punjab, Pakistan. (b) the association of Seasonal variation, Temperature, Relative humidity, and Rainfall with the abundance of *Ae. aegypti* in breeding containers screened in selected agro-geoclimatic zones of Punjab, Pakistan and (c) functional genomics of *Ae. aegypti* for identification of potential candidates for alternate control of mosquito vector. The highest *Stegomyia* indices were calculated in Chakwal (HI = 46.61%, BI = 91.67% and CI = 15.28%) as compared to Faisalabad and DG Khan. Regarding association of water containers, In Faisalabad, flower tubs, plastic buckets, tires, water tanks, plastic bags and earthen jars were having significant ($P < 0.05$) association. In DG Khan, Refrigerator trays, tires, plastic bottles, water tanks, tree holes and earthen jars were having significant ($P < 0.05$) association. In Chakwal, plastic drums, flower tubs, plastic buckets, refrigerator trays, water tanks, plastic bags, plant axil, tree holes and earthen jars were having significant association ($P < 0.05$) with *Aedes aegypti* larvae. Mosquito are found abundant as the temperature falls between 25-33°C. As, the temperature falls below 18°C and increases above 35°C, the mosquitoes tend to disappear. Rainfall has an indirect effect on mosquito abundance as it provides breeding sites for mosquitoes and provide suitable environment for their growth and multiplication such as stagnant water, water collected in various premises, discarded tires etc. But during rainfall, the mosquitoes are not found.

As described earlier that the selected districts have remarkable differences in climatic condition thus, these climatic conditions influence the mosquito abundance at various values of RH providing a favorable niche for their multiplication and dissemination. In Chakwal district, mosquitoes were abundant at 52.5% relative humidity. In DG Khan, the maximum mosquitoes were reported at 65% RH. In Faisalabad, maximum mosquito abundance was found at 46%. Graphs show the abundance of mosquitoes with respect to temperature in the selected districts. In Chakwal district, maximum mosquito abundance was found at 18.5°C. In DG Khan, the maximum mosquitoes were reported at 16.6°C. In Faisalabad, maximum mosquito abundance was found at 27.45°C. Graphs show the abundance of mosquitoes with respect to rainfall in the selected districts. In district Chakwal and DG Khan, shows maximum mosquitoes when there is low rainfall 0 mm. While, in Faisalabad maximum mosquito abundance was found at 7.1mm. The identification of the genes encoding *Ae. aegypti's* CO_2 receptor will help in further studies to uncover the cell signaling pathways involved in transducing CO_2 reception into a neuronal signal that initiates a mosquito's host-seeking behavior. In addition, by identifying the CO_2 reception components, it will be possible to custom design inhibitors that could disrupt a mosquito's ability to find a host. By identifying the precise proteins involved in CO_2 reception and eventually learning their structure, we will be able to make better predictions of which compounds will be most effective at repelling mosquitoes and reducing the risk of insect-borne diseases.