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INSECTS AS BIOLOGICAL WEAPONS

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Abstract

This study was conducted at University of Gujrat during 2017 to 2018 as a term paper for Master of Philosophy. The data regarding use of Insects as Biological Weapons was reviewed and compiled as a review paper from various published articles of international reputed journals annual/environmental reports of recognized organization and e-books. Use of entomological weapons is a wide field of research. Insects were used as biological weapons from ancient times and this concept is very old. Different insects can be used for this purpose by different ways. Insects can be used as biological weapons against crops, animals and human beings. Insects may be used as direct pests against crop or they may be used as vectors to spread diseases in animals and human beings. In both cases their effects are devastating. House Flies, Oriental Rat Flea, Colorado potato beetle, Ticks, screw worm larvae are the examples of some insects which can be used as biological weapons. Use of biological weapons in war against humans is however illegal.

Keywords: Biological weapons; Entomological warfare; Agro terrorism and Legal status

Introduction

This concept of using insects as biological weapons is very old and even today research on this topic is carried out by many countries. In 14th century in Asia Minor plague which was spread through fleas also known as black death was the on the of earliest event of using insect as biological weapons it was used in Crimean against the city of Kaffa [1]. Another earliest use of insects as biological weapons by earliest humans was the use of bees for direct attack [2,3]. Japan and many other countries were accused of using Entomological warfare in World War 2. The only verified use of Entomological warfare on large scale is by Japanese against Chinese in World War 2. It is type of biological warfare [4]. In EW insect are used as a direct attack or used as vectors to spread disease through specific biological agent [5,6].

History

Insects are being used as biological weapons since ancient times. In 14th century fleas are used to spread plague against the city of Kaffa in Asia Minor [1]. In World War 2 Germans used Colorado beetle against enemy crops [7]. Japanese also used plague infected fleas and cholera infected flies against Chinese in World War 2 [5,8]. Many techniques are developed by soviets during cold war era to transmit diseases like foot and mouth disease using ticks. But however they did not used them against any country [9]. Similarly during Cold war USA also developed a laboratory capable of producing millions of yellow fever infected mosquitos to attack soviets and they also did experiment on their survivability if dropped from plane [7,10].

Biological Weapons

It is use of Living organisms like Viruses, Bacteria, Fungi, protozoa and insects or their toxins to cause disease or kill humans, animals and plants.

Entomological Warfare

It is use of insects to attack enemy. It is type of biological warfare in which insects are used as biological weapons. Different insects can be used by different ways in entomological warfare [4].

Different ways to use insects as biological weapons

EW can be used by 3 different ways [5]. For this purpose insects are first infected with pathogens then they are dispersed on an area which is to be targeted. These insects act as a vector and infect particular animal or people of targeted area. In second type insects are directly used to destroy crops. In this case insects may not cause damage by pathogens or by acting as a vector. In third type uninfected insects are directly used as a direct attack on enemy like bees [5].

Agro Terrorism

It is the destruction or disruption of food and agriculture industry by using pant pathogens or pests.

Colorado Potato Beetle

It is major potato pest and its female can lay up to 800 eggs. It has orange and yellow body with five strips on its elytra [11]. It is similar to false potato beetle. It is native to Colorado and Mexico [12]. With the passage of time Colorado potato beetle have become resistant to and dichloro-diphenyl-trichloroethane,other major pesticides classes [11,13]. Colorado potato beetle was also produced in large number by Germans during World War 2 to destroy enemy food sources [7]. They released 54000 Colorado beetles in south Frankfurt to check their

effect [14]. French entomologists also concluded that Colorado beetle can be used as biological weapon against enemy crops [7]. During Cold war CIA was also blamed to use it against soviet crops [15,16]. 15000 Colorado beetles are sent by USA to Britain in 1942 to study them as a biological weapon [14].

Oriental Rat Flea

It is the vector of murine typhus and bubonic plague, and these diseases are transmitted from one flea generation to the next by their eggs [17]. Japan used these fleas on large scale as a biological weapon against Chinese in Word War 2. This program was let by Lt. General Shirō Ishii [5]. These plague fleas was dropped by low flying panes on the city of Changde and caused plague which resulted in 500,000 death of Chinese [5,8].

House Fly

House fly can act as a lethal biological weapon. It is vector of up 100 different kinds of pathogens which can causes diseases like cholera, typhoid, salmonellosis, anthrax, tuberculosis, ophthalmic, bacillary dysentery and parasitic worms. It is also important vector of different viruses like poliomyelitis, enteroviruses and viral hepatitis [18-20]. Some strains of house fly are also resistant to many kinds of pesticides commonly used [21,22]. Japanese also used cholera infected flies as an entomological weapon against Chinese to spread disease during World War 2 [5].

Ticks

Ticks can also be used as biological weapon to spread different diseases in poultry and livestock and humans. They are the carrier of many bacteria, protozoan and viruses [23]. Aegyptianellosis is a common disease found in poultry caused by Argus spp. of ticks. It spread from one bird to another [24]. Similarly cattle fever tick is a vector of Babesia bigemina which causes cattle fever. Babesia bovis can also be transmitted by this tick. Babesiosis causes $3 billion annual losses to U.S. cattle industry ever year in early 20th century [23]. During Cold War era Soviet Union developed techniques to transmit diseases like foot and mouth disease using ticks. Avian ticks are also used by them to transmit Chlamydophila psittaci in chickens [9]. In humans they are responsible for causing rickettsialpox, typhus, African tick bite fever, Boutonneuse fever, Rocky Mountain spotted fever, Queensland tick typhus, Flinders Island spotted fever, Colorado tick fever, Q fever, tick-borne meningoencephalitis and Ehrlichiosis [25].

Mosquitos

Mosquitos can also be used as biological weapon to cause disease in birds, animals and humans. They are the vectors of different viruses and parasites. Viral diseases include Dengue fever, chikungunya and yellow fever which are mostly caused by Aedes aegyptus [26]. Similarly malaria is caused by protozoan called plasmodium [27]. During cold war USA made a laboratory which can produce 100 million yellow fever infected mosquitos to attack Soviet Union [7]. In 1955 United States dropped 300,000 yellow fever infected mosquitos during operation big buzz to check their survivability [10].

Caterpillars

Caterpillar is the larvae of order Lepidoptera members which include butterflies and moths. Sawflies larvae are also known as caterpillar [28]. Most caterpillars are herbivorous and agricultural pests [29]. They cause damage by eating leaves and many species have become resistant to many pesticides [30]. In 1990 USA spent 6.5 million dollars on research to use caterpillars as biological weapon against crops [31].

Black Flies

They are 3 to 6mm in size small robust flies with short wings and humped thorax. They are also known as turkey gnats and buffalo gnats. The feed on the blood of poultry and cattle. If flies attack in large number they cause death of animal. Death is caused in many cases due to acute toxaemia. Productivity is even reduced by low population of flies. They are also vectors of protozoans (Leucocytozoon) which cause leucocytozoonosis in poultry and filarial nematodes (Onchocerca) which cause bovine onchocerciasis [23,32-34]. In human black flies transmit onchocerciasis they are vectors of parasitic nematode *Onchocerca volvulus*. The parasite lives in the skin of human and is transmitted when flies take meal during feeding so they can also be used as biological weapon to transmit disease in humans, poultry and cattle [35].

Biting Midges

They are 1 to 4mm long flies which belong to order Diptera. They are also known as punkies, sand-flies and no-see-ums [36]. They are persistent and vicious biters [23]. They are vectors of arboviruses and different non-viral pathogens [37,38]. They are vectors of virus that cause blue tongue in cattle and in sheep. In cattle epizootic haemorrhagic disease is also caused by them. In poultry they spread blood protozoans and equine onchoceriasis [23]. So artificially infected biting midges colonies can be used to spread disease among cattle and poultry.

Horse Flies and Deer flies

They can also be used as biological weapons as they are livestock's major pest especially cattle transmitting different diseases in them. They are robust and large in size. They have blade like mouth parts which are designed by nature to inflict deep bleeding wounds [23,39]. They can transmit diseases like bovine leukemia, infectious anemia, hog cholera, Trypanosoma sp. Protozoans and Elaeophora sp. Nematodes. [23,40].

Warble Fly

They are large flies which are parasites of cattle. They are also known as gad flies, bomb flies or heel flies. Their larva is called wolves or cattle grub. Some species larvae also invade human tissues. They are large hairy orange to yellow in colour and bee like in appearance. The adults are free living and have vestigial mouth parts [41].

Warble fly larvae which is known cattle grub can be used as biological weapon as in 1976 U.S. alone faced estimated $360 million losses due cattle grub. When tissue invading cattle grub larvae reaches to oesophagus and spinal cord they cause paralysis [23]. In human H. bovis species larvae cause disease called intracerebral myiasis in which invasion of intracerebral tissues takes place. Symptoms of this disease include intracerebral hematoma and convulsions [42]. H. tarandi, which is a parasite of caribou is responsible for human eye myiasis which cause glaucoma, uveitis, and retinal detachment [43]. So warble

flies if produced in large scale in laboratory can be used as anti-livestock biological weapon.

Screw Worm Fly

Screw worm fly can also be used as biological weapon against livestock animals. It is parasitic fly whose larvae infests on open wounds of warm blooded animals [44]. Their larvae attack only healthy living tissues of their host. It is major pest of cattle and other livestock animals [23]. Screw worm can cause tissue loss, vital organ destruction and even death in extreme cases [45]. Screw worm female can lay up to 3000 eggs in her lifecycle and travel up to 200km in the search of host [46].

Legal status of entomological weapons

Insect vectors are not mentioned in the text of Biological and Toxic Weapons Convention (BWC) of 1972. However vectors are covered in treaty [47]. Use of vectors in armed conflict for hostile purposes is banned by article 1 of BWC [47,48]. So BWC covers insect vectors [49]. However the use of uninfected insects against crops is not clear [50].

Conclusion and Recommendations

Use of insects as biological weapons is very cheap and effective warfare. They can easily be used to spread disease among enemy and to destroy enemy crops and livestock. But unlike conventional weapons they act slowly and their use in war is illegal and considered as war crime so there should be laws and regulations to prohibit their proliferation or to be used in war. There also should be check and balance to prevent biological weapons going into hands of terrorists and to be used to spread terrorism. Airport security and export and import security should also be increased so that biological weapons may not be smuggled from one country to another for this purpose there should be entomological experts in anti-terrorism investigation teams, borders and airport security teams.

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