LABORATORY STUDIES ON BLOW FLY (*Lucilia cuprina*) (WIEDEMANN) (DIPTERA: CALLIPHORIDAE) IN RELATION TO STERILE INSECT TECHNIQUE (SIT): REARING MANAGEMENT

BY

ZUBEDA KHANOM

REGISTRATION NO. 23905/00162

A Thesis

Submitted to the Faculty of Agriculture,
Sher- e -Bangla Agricultural University, Dhaka.
In partial fulfillment of the requirements
for the degree of

MASTER OF SCIENCE
IN
ENTOMOLOGY

SEMESTER: JANUARY-JUNE, 2006

Approved by:

Prof. Dr. Md. Serajul Islam Bhuiyan Supervisor Department of Entomology	**Dr. Reza Md. Shahjahan** PSO. (IFRB, IAEA, SAVAR) Co-Supervisor

Assoc. Prof. Mohammad Ali
Chairman
Department of Entomology

CERTIFICATE

This is to certify that the thesis entitled "Laboratory studies on blow fly (*Lucilia cuprina*) (Wiedemann) (Diptera:Calliphoridae) in relation to sterile insect technique (SIT): rearing management" submitted to the faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE IN ENTOMOLOGY**, embodies the result of a piece of bonafide research work carried out by **Zubeda Khanom**, Registration No. 23905/00162 under my supervision and my guidance. No part of the thesis has been submitted for any other degree or diploma.

I further certify that such help or source of information, as has been availed during the course of this investigation has duly been acknowledged.

Dated:

Prof. Dr. Md. Serajul Islam Bhuiyan
Supervisor

Dhaka, Bangladesh.

Dedicated to

My

Beloved Parents & Brothers

Acknowledgement

All of my gratefulness to almighty Allah who enabled me to accomplish this thesis paper.

I wish to express my deep gratitude and sincere appreciation to my honorable teachers Professor **Dr. Md. Serajul Islam Bhuiyan**, Department of Entomology, Sher-E-Bangla Agricultural University, **Dr. Reza Md. Shahjahan**, Principal Scientific Officer, IFRB, AERE for their scholastic guidance, valuable suggestions and steady help throughout the thesis work.

I am grateful to **Professor Jahanara Begum, Associate Professor Mohammad Ali**, Department of Entomology, Sher-E-Bangla Agricultural University and **Dr. Gul Nahar Begum**, Chief Scientific Officer, Institute of Food & Radiation Biology for their kind permission and continuous support during thesis work.

I offer my special thanks to **Dr. Saifullah**, Scientific Officer, Institute of Food & Radiation Biology, for inspiration and constructive criticism. I also acknowledge my best regard to all my honorable and respected teachers of the Department of Entomology, Sher-E-Bangla Agricultural University, Dhaka for their academic collaboration during thesis work and blessing to well wishes.

I am thankful to **Md. Rashidunnabi Khan, Bidhan Chandra Bapary,** for their time to time support.

I owe much to my parents and brothers due to their financial support as well as the well wishes of them. Very special thanks to **Mahmud, Riyadh, Farhana** for their helping hand in my thesis work. All of their helps, inspiration, and encouragement have facilitated me to reach at this stage of education. Lastly I like to extend my heartiest thanks to all my friends, classmates and others who directly or indirectly helped me in my thesis work.

The Author

ABSTRACT

Laboratory mass production of quality insect is one of the prerequisite of the successful application of sterile insect technique (SIT) and insect pest management. Attempts were made to produce quality insect *Lucilia cuprina* that infest marine fish in the offshore Islands during the process of drying. As a part of rearing management, adult longevity and pupal quality of the insect were evaluated for *L. cuprina* in different food media and at different food stress and strain on the colony. Longevity of adult in both sexes either derived from non-irradiated and irradiated pupae was found to be varied with the supply of foods. Longevity range was 5 days at post-emergence when no foods were supplied, the range was 6 days when only water was supplied to the colony. Then range of longevity was found to be 10 days in fish only, 19 days in water-fish, 37 days in water-sugar, 37 days in water-sugar-blood, 46 days in water-sugar-fish, 49 days in water-sugar-liver respectively. Longevity of adults was found to be similar when irradiated pupae were reared in the above food regimes. However, in general mortality started 1-2 days early in case of irradiated pupae. The peak mortality in the above food media were at day–4 with no food, only water day–4, only fish day-5 and day–7, water-fish day-5, water-sugar day-17 to 23. But there were no regular peak when supplied water-sugar-blood, water-sugar-fish, water-sugar-liver. Mortality trend in the sexes were similar, however, the apparently the males had early mortality. Pupae lost about 22% of their weight during the period of 4-days from pre-pupate to pre-emerge. In an attempt to develop a cheaper larval rearing medium, different grades poultry feeds available in the market i.e.; Imported Poultry Feed (IPF), Marine Poultry Feed (MPF), Local Poultry Feed (LPF) were used at different proportions, with natural food (liver) to produce quality pupae. None of these were found to be superior to the natural food medium as indicated by pupal weight. However, IPF could be mixed up to fifty percent (1:1) with no loss in pupal quality.

LIST OF CONTENTS

LIST OF CONTENTS (Contd.)

LIST OF TABLES

LIST OF FIGURES

LIST OF FIGURES(Contd.)

LIST OF FIGURES(Contd.)

LIST OF FIGURES (Contd.)

LIST OF FIGURES (Contd.)

LIST OF APPENDICES

LIST OF APPENDICES (Contd.)

LIST OF APPENDICES (Contd.)

LIST OF APPENDICES (Contd.)

LIST OF APPENDICES (Contd.)

LIST OF APPENDICES (Contd.)

Chapter 1

Introduction

INTRODUCATION

The struggle between man and insects began long before the dawn of civilization, has continued without cessation to the present time, and will continue, no doubt, as long as the human race endures. It is due to fact that both men and certain insect species constantly want the same things at the same time. So they act as enemy to human being, thus they are injurious insect or pest to us. The Asutralian sheep blow fly, *Lucilia cuprina* (Wiedemann) (Diptera:Calliphoridae) is the primary myiasis fly of sheep and introduced as pest "Public enemy number one" as far as the Australian woolgrower is concerned in Australia (Mackerras and Fuller,1937; Watts *et al.*,1976; Murray, 1978; Barton, 1982; McQuillan *et al.,* 1984).

They have evolved from a very successful class of carrion-breeding flies. As carrion breeders they fulfill an important function, accelerating the breakdown of carcasses and the return of nutrients to the environment. Its larvae normally feed on carcasses of dead animals but will also cause fly-strike in sheep and fish. Fly-strike occurs when maggots feed on living flesh near open wounds, and is one of the most significant problems for the pastoral industry in Australia. In Bangladesh, the blow fly, *Lucilia cuprina* (Wied.), seriously affects the process of fish drying in the offshore islands in the Bay of Bengal.

Australian sheep blow fly, *Lucilia cuprina* (Wiedemann) is thought to have arrived from South Africa, perhaps as early as the mid-to late-19^{th} century (Norris, 1990). This species covered the South-eastern Australia and also occur through the contiguous states and in many other temperate regions of the world as well. There were reports of fly blown sheep as early as 1870 (Tillyard and Seddon, 1933) in the Australia. They also distribute arid zone of New South Wales (Mcleod, 1997), New Zealand, Scotland, Europe, North America, Hawaii, Uganda, Senegal, Bristol, Langford of United Kingdom and coastal fish drying belt of Bangladesh.

Fly strike was first recognized as an emerging problem for the Australian sheep industry in the late 1890s (Froggatt, 1904). There were reports of fly blown sheep as early as 1870 (Tillyard and Seddon, 1933), but evidence of a pending national problem did not emerge until 1897, when major outbreaks of fly strike occurred simultaneously in Victoria (Cameron, 1908) and in the Riverina district of New South Wales (Froggatt, 1915). Over the next decade, fly strike became an endemic problem in most of the sheep grazing areas of mainland Australia.

This progressive escalation of fly activity was almost certainly related to the successful establishment of *L. cuprina*, but because of species' close resemblance to *L. sericata*, its importance as the main initiator of strike defied detection for a further twenty years (Mackerras, 1930). By the mid-1900s, *L. cuprina* had been recorded from most parts of Australia (Waterhouse and Paramonov, 1950), with Tasmania being the last major sheep-grazing region to be colonized (Ryan, 1954). Broadmeadow *et al.* (1984) claim that fly strike may cause the death of some 3 million sheep annually. As such, it imposes a substantial annual cost to the Australian sheep industry.

Accordingly, it was not until the late 1920s that the real cause of the escalating problem of strike was identified, namely the presence and spread of a new species of blow fly, *Lucilia cuprina* (Mackerras, 1930). *L. cuprina* has been implicated in the development of myiasis in cattle (Wilkinson and Norris,1961) and humans (Lukins, 1989), but over much of its range the species function effectively as an obligatory parasite of sheep (Waterhouse 1947; Barton 1982; Anderson *et al.* 1984a; Anderson *et al.*1988). However, the fact that the known distribution of *L. cuprina* is more extensive than the area devoted to sheep-grazing (Norris, 1990) clearly indicates the species. The larvae of several of the species can cause myiasis in man or livestock i.e. they may infect surface wounds, or they may be ingested and continue to develop as parasites in the intestine. Adult flies of most pest species are attracted to rotting material (such as decomposing fish offal) and dung, where they may feed and breed. They may thus transmit pathogenic bacteria when they lay eggs on the fish.

In Bangladesh, the blow fly, *Lucilia cuprina* (Wied.) seriously affects the fish industries of the offshore islands in the Bay of Bangal (Huda *et al.* 1983a). The feeding of the larvae of *L. cuprina* (Wide.) Calliphoridae on moist fish cause quantitative losses. These losses can be severe if conditions are optimal for fly development under such conditions i.e. if unsalted or poorly salted fish is dried slowly because of rain or high humidity, weight losses of 10-30% can be caused by fly larvae. Over 25% of quantity and 100% of quality of marine dry fishes are lost due to fly infestation besides there is quality deterioration of the product during the process of sun-drying (Doe *et al.* 1977). The adult blow fly lays eggs on fishes and the hatching larvae infest fishes during sun drying.

Fragmentation of the fish by fly attack can cause quality loss and may lead to increased risk of damage by beetles and mites. Substantial weight losses due to fragmentation of fish during processing have been recorded, but the contribution of blow fly damage to this has not been separately assessed. Additional costs are implicated in the role of flies as the agents of myiasis and as carriers of pathogens. The most important fly pests only infest and damage the fish while it is drying. The length of drying period is thus a critical factor influencing the extent of losses due to fly attack, and any measures that increase the speed of drying of fish will reduce fly damage.

On the above discussion we regard, as the flies are major pest of our country and other parts of the world, so we have to undertake such program for management of blow fly (*Lucilia cuprina*).

Lucilia curprina usually traces more in urban areas, semi-arid environments forests and woodlands although factors regulating the movement and spatial distribution of *L. cuprrina* are not well understood and seem likely to vary according to weather and pasture conditions. Larvae of Calliphoridae, require a high moisture content for development and cannot infest fully cured fish. In the arid region, *L. cuprina* was uncommon in open pasture and its preferred habitats were sheep camps, patches of Acacia scrub and shady creek beds, with or without water (Anderson *et al.* 1984b). In contrast, in temperate areas, *L. cuprina* is predominantly a species of open pasture, being rare or absent in bush land habitats (Vogt and Woodburn, 1979).

Bangladesh exports about 2000 m.ton of marine dry fish annually. Over 25% of quantity and 100% of quality of marine dry fishes are lost due to blow fly infestation during the process of sun drying. Initial infestation is due primarily to flying adults. For prevention of blow fly infestation local people use insecticides. Dependence on, and resistance to, broad-spectrum chemical insecticides have become widespread, as has community concern over pesticide residues in fish products and in the 'on-farm' environment, rise to certain problems in public health, livestock management, food preservation and other agricultural sectors as well as the over all human environment (Carson, 1963; Muller, 1988).

The need to minimize insecticide usage, either through the more timely application of chemicals (Monzu and Mangano, 1984; Mackenzie and Anderson, 1990), or through the development of alternative, non-chemical methods of control i.e. genetic control, (Whitten *et al.*, 1977) has stimulated much new research on the population dynamics of *L. cuprina* which are safe and relatively non-hazardous. Fly-screens around and over drying racks may reduce infestation pressure during drying. The risk of cross-infestation can be reduced by treatment of the ground beneath drying racks and mats (where flies often pupate) with a recommended insecticide. Improved hygiene at fish processing sites, specially the rapid disposal of wet offal, will reduce fly infestation problems by removing a secondary food source. However, it is now more than two decades since the last major reviews of biology and ecology of *L. cuprina* were conducted (Vogt and Woodburn, 1979; Barton Browne, 1979).

A considerable progress made in this area are the use of biological control agents, synthetic attractants, repellants, plant origin toxicants (Singhamony *et al.* 1986; Shorey and Mckelvey, 1977; Fuffaker and Smith, 1980) and the use of radiation-sterilized insects (Knipling, 1979).

The Sterile Insect Technique (SIT) is amongst the most non-disruptive, a cheaper and safer alternative to chemical control has proved highly effective against several key insect pests. The Sterile Insect Technique (SIT), pioneered in the USA and advanced by the joint FAO\IAEA Division in Vienna, has achieved considerable success in the control of New World Screwworm, tsetse and fruit flies, stable fly, codling moth, boll weevil etc. By appreciating that SIT is a more environmentally friendly way of dealing with insect pests (Knipling, 1982),

Unlike some other biologically based methods it is species specific, does not release exotic agents into new environments and does not even introduce new genetic material into existing populations as the released organisms are not self-replicating. However, the SIT is only effective when integrated on an area wide basis, addressing the total population of the pest, irrespective of its distribution.

It requires an area-wise operation; apparently SIT seems to be expensive and warrants feasibility studies prior to practice. A comparison however, between chemical control and SIT in several case studies, particularly in the Med fly, it was found to be more profitable (Rhode, 1975). Moreover, SIT could lead to a zero population of the pest concern when applied properly (Knipling, 1979).

For prevention of blow fly infestation on marine fish, local people use Nogos as insecticides that arises certain problem in public health, livestock management, food preservation and other agriculture sectors as well as the environment. Whereas SIT is an autocidal control methods prevent loss from blow fly infestation using nuclear technique. This method is also sound for public health, livestock management, food prevention and other agriculture sectors as well as the environment.

The major activities involved in SIT are the mass rearing, sterilization, transportation, field release and assessment. To perform SIT program against blow fly various researches was conducted in Bangladesh.

Huda *et al.* (1983b) worked on the Sterilization of the Australian sheep blow fly (*Lucilia cuprina*) by gamma radiation. Shahjahan *et al.* (1994) studied that laboratory rearing of blow fly (*Lucilia cuprina*) (Wied.) in relation to application in SIT-pest management. Huda (1997a) studied on the effect of gamma radiation on the pupation of blow fly (*Lucilia cuprina*). Huda (1997b) studied on the influence of gamma radiation copula duration and mating propensity in *Lucilia cuprina* (Wied.) (Diptera:Calliphoridae). Huda and Khan (1998) studied the effect of radiation and food on the mortality of the adult blow fly. Huda *et al.* (1999), studied on the preliminary survey and trapping of blow fly for the application

Sterile Insect Technique (SIT) in the off-shore island Sonadia of Bay of Bengal.

Haque *et al.* (1999a) studied on the influences of food on the development and number of ovariole in the *Lucilia cuprina* (Wied) (Diptera : Calliphoridae). Haque (1999b) studied on the effect of gamma radiation on the quantitative aspects of sperm transfer in blow fly (*Lucilia cuprina*) (Wied) (Diptera: Calliphoridae. Huda and Khan (2000), studied that longevity and mating competitiveness of irradiated males and untreated wild-type F_1 males and females of blow fly (*Lucilia cuprina*) (Wied.) in the laboratory for success the SIT program. Huda and Khan (2001) again developed an easy technique for handling and sexing *Lucilia cuprina* adult blowflies in Sterile Insect Release Method (SIRM).

The broad objective and the ultimate goal of this work is to apply are wide management of blow fly in an operational scale where the quality parameters in the mass rearing would be elucidated.

Objectives of my present work are as follows:

- The quality changes due to environment changes such as food, temperature, photoperiod (day length) etc. during the process of industrial scale of rearing.

- Optimize, improve quality, mass rearing technique of blow fly in the laboratory, which is requisite for area wide management.
- To assess the quality parameters associated with the mass rearing at various steps of life cycle of blow fly.

In order to achieve these above objectives, laboratory scale miniature rearing trials were conducted in the following parameters:

1. The effect of different categories of adult diet on the longevity of *L. cuprina* adults (male & female) for both irradiated and non-irradiated pupae.
2. The effect of pupal ageing on its weight.
3. The effect of artificial larval diet on pupal weight.

Chapter 2

Review of literature

REVIEW OF LITERATURE

To appraise the development of any field of study is very difficult without review of literature. Certain key discoveries have greatly influenced the progress along certain research lines. Publications are usually due to the cooperation and investigation of many minds. Knowledge of the published reports provides information about the nature and methodology of a certain research lines. To facilitate these, attempts were made to collect the published articles, reports, or papers of other workers on these lines of studies. In this brief outline of literature one may be able to see some relations between one's research works with that of another, so that the present research works do not appear completely isolated. Some of the potential findings in relation to Sterile Insects Technique (SIT): Rearing Management are furnished below and presented in order by date of publication.

Waterhouse (1962) reported that in Australia, for controlling the blow fly *Lucilia cuprina* by applying the sterile insect release method (SIRM), used with spectacular success against the New World screwworm fly, *Cochliomyia hominivorax* in America, the cost would undoubtedly outweigh the economic benefits.

According to Curtis (1966), the translocation method is limited for the reduction in population fertility at each generation and ineffective against population whose size was strongly buffered by density-dependent factors with special reference to tsetse flies (*Glossina sp.*). It is also less effective than sterile male method.

Dean *et al.* (1968) studied on *Glossina morsitans orientalis* (Vanderplank) to assess the ability of the sterile male treated with tepa or gamma irradiation to compete with untreated male for normal female at lab and field cage trials. They stated that the irradiation of the pupal and adult stages reduced reproduction by 87 – 100% (mean 95%) with 800 – 1500 rad. and produced complete sterility (mean 99%) treated by tepa in 0 – or 2 – d old male flies. But they suggested that in field trial, the treated males released in nature might not compete for normal females as readily as untreated males.

Weisbrot (1969) stated that competition among irradiated genotypes of *Drosophila*, when compared with their un – irradiated sibs, may lead to different survival rates due both to the direct effects of the radiation on the carriers of the induced mutations, as well as indirect effects such as the interactions among competing genotypes. Irradiation modifies the competitive ability of particular strains of *Drosophila*.

ManDson *et al.* (1969) stated that by irradiation the reproductive potential of *Drosophila melanogaster* (Meigen) was suppressed more by introduction of treated males into a population than by introduction of treated females and suppression of reproduction in a population was about the same when treated males and females or treated males only were introduced.

Coaker and Smith (1970) studied the effects of 0.1% tepa in 10% sucrose solution on the adults of cabbage rootfly, *Erioischia brassicae* (Bch.) (Diptera: Anthoniziidae), fed during the second and third days after emergence and found over 95% sterile eggs. Nearly completed sterility was also obtained from females, when fed them 0.1% tepa for two days between mating and oviposition. But it has no effect on longevity, of either both sexes and the competitiveness of treated males. In field trial they found 70% of the eggs laid were sterile.

Pollock (1971) observed that injection of 4.36 μg tepa/male blow fly; *Lucilia sericata* (Mg.) (Diptera: Calliphoridae) induced approximately 95% sterility. Tepa- injected flies mated freely and the treatment did not interfere with the mated status test subsequently performed. And this test had potential value in sterile male release studies.

Hooper (1972) reported that the competitiveness of Mediterranean fruit fly decreased with increased dose of irradiation. This factor counteracted the increased degree of sterility induced by increased dose. Evidence was obtained that the presence of sterile females neither augmented nor detracted from the degree of control given by irradiated males.

Drosophila melanogaster sperms were treated with different dose of EMS (ethyl methane sulfonate), stored in untreated females. After then dominant lethal were examined by Ikebuchi and Nakao (1973). They found that at high EMS doses wielding 25 – 33% X – linked recessive lethals and it increased markedly with increasing storage time. They finally reported that storage effects of EMS were dose–dependent.

Schroeder and Chambers (1973) observed that the propensity for flight can affect mating and the ability of flies to successfully seek food and shelter in the field. The threshold of response resulting in flight can be measured for different population of flies in "startle test" chambers under reproducible laboratory conditions. After establishing the startle activity for a population, individual effects of various treatments on this activity can be determined. There are also individual flies within each population that have lower startle activity than the mean. By exposing the population to predators in field cages, one can eliminate flies with lowest activity. Survivors can then be used as parent stock to maintain and increase startle activities.

Cirio *et al.* (1974) investigated that the mass rearing procedures for the Mediterranean fruit fly can seriously affect the field performance of released flies. Strains of different geographic origin used in a sterile insect technique program may exhibit different physiological and ecological traits resulting in additional deviations in important quality traits due to the specific environment. The study of movement of different strains under field conditions in a valuable supplement to preliminary studies in the laboratory and in field cages. Comparative tests with different strains can over the following aspects: 1. Local movement; 2. Host finding; 3. Localization of fruit.

Hooper (1975) found that the primary requirement of the sterile insect technique for population suppression on eradication is that released sterilized flies must successfully mate with the wild population. To be successful, the released flies and the wild flies must be compatible, mating propensity of the released flies must be high and the times of mating of released and wild flies must be synchronized. For example *Ceratitis capitata* males created with 10 krad gamma radiation mated less than did untreated males, and the time of peak mating response was delayed. Mating speed and propensity have been determined for untreated and irradiated *Dacus cucumis* under "natural dusk" and "artificial dusk" conditions and the technique should be appropriate for the other crepuscular-mating species.

Bailey (1975) investigated on the measurement of locomotor activity in *Dacus* *cucumis*. Wild populations of fruit flies include individuals with capabilities over a rage of locomotor performance. Laboratory selected strains may differ from wild strains in the average locomotor performance of their individuals. Further, various treatments and the environment of fruit flies (e.g., diet, temperature, insecticides and ionizing radiation) may affect locomotor activity. Locomotor activity is easily and directly measured using a simple apparatus that costs less than $2.00. The tests take little time and the technique is suitable for routine monitoring.

Leppla *et al.* (1976) stated that life story measurements are used to ensure the adequacy and continuity of laboratory rearing of *Anastrepha suspensa*. They can also be used to quantify "bottle necks" and identify the causes of inadvertent selection during initial establishment and subsequent colonization. Survival, reproductive contribution and specific phenotypic traits of each developmental stage indicate environmental deficiencies and /or genetic divergence from previous generations. Thus undesirable changes are avoided are providing essential requirements and eliminating causal factors.

Haisch and Forster (1976) stated the take off frequency as a criterion on flight propensity. Flight is essential for maintaining the population as well as individuals of fly species. Therefore, flight behavior is an important criterion for assessing the physiological and genetic status of a species or strain. Internal and external stimuli eliciting starting and ending of flight establish the flight phase. The technique describe here provides and assessment of the propensity to enter the flight phase, i.e. take off. When environmental factors are carefully controlled it is possible to establish the influence of internal factors on flight propensity; if the later are known to be constant the effects of environment on take off propensity can be studied.

Huettel (1976) evaluated the ability of mass reared fruit flies to mate successfully and competitively with their native conspecifies in the field. The procedure out line is essentially a genetic mark recapture technique. The parents are genetically marked and the progeny resulting from their mating with the native population are "recaptured". The technique assesses a summed value of all relevant quality measures except the effects of sterilizing irradiation.

Manoukas and Tsiropoulos (1977) stated that the quality traits are given organism can be expressed only when it's nutritional needs for growth, reproduction and other special activities satisfied. Unfortunately, no reliable technique yet been found for the quantitative determination of *Dacus oleae* nutrient intake. However, among several parameters studied, pupal weight seems to expressed best the nutrient intake of a given stock of this insect. A technique for producing pupae of specific weights and presumably of specific quality is by the use of specified larval densities in a standardized larval diet. Adults emerged from this pupae are then utilized in test of the quality of performance of certain traits.

Sharp and Webb (1977) worked on measuring wingbeat frequencies. Wingbeat frequency, a measure of flight ability, is the speed at which the wings oscillate through the wing stroke angle. It depends upon the ratio between the power of thoracic muscles and resistance they must overcome. Wingbeat frequency tests are conducted in the laboratory under controlled conditions and provide insight on the possible detrimental effects to the flight musculature due to various treatments to immatures or adults. Among tephritid fruit flies, measurements of frequency with electronic stroboscopes have shown significant differences due to temperature, humidity, sex, age and radiation and provided insight on subtle changes to flight behavior in test insects not detectable with flight mill measurements.

Whittten *et al.* (1977) reported that the cost of applying the technique of sterile insect released method (SIRM), using radiation – sterilized males of Australian sheep blow fly, *Lucilia cuprina* throughout the Australia would undoubtedly outweigh the economic benefits.

Donnelly (1980) reported that the males of *Lucilia sericata* (Mg.) showed 3% fertility at 3000 rep. irradiated as 3 days old pupae, while complete sterility was achieved above the dose level of 3000 rep.

Barton Browne (1979) described that during her life time the female of Australian sheep blow fly *Lucialia cuprina,* must locate a number of resources in order that the life cycle may be completed. She must find sufficient carbohydrate and water to sustain life and enough protein-rich food to support egg maturation. She must locate or be located by a male so that mating can occur and must find a site at which lay her eggs. Her ability to achieve these goals depends upon the performance of appropriate pieces of behavior. The male needs to find carbohydrate and water to sustain life and females with which to mate. Non-protein-fed males are capable of mating, but ingestion of protein-rich materials heightens the levels of sexual activity of males. The behavior of adult *Lucialia cuprina* has not been systematically observed in the field, but a number of inferences can be made form the results of laboratory investigations and from some casual observations made in the field. I will devote the major part of this article to a discussion of the likely behavior of the fly in the field and to an examination of the laboratory results from which it was inferred. I will make more detailed reference to the nutritional requirements of the fly and will conclude by considering ways of reducing the fly's pest status by influencing or taking advantage of its behavior.

El–Gazzar *et al.* (1983) reported that the presence of nitrogen protected both pupae and adult males of *Culax quinquefasciatus* against the introduction of post – treatment sterility and no improvement was observed in the mating competitiveness when air was replaced with nitrogen during pupal irradiation and only marginal improvement was observed after adult exposure. They suggested that because of deleterious effect of nitrogen on male competitiveness, irradiation might have limited usefulness as a method of sterilization for this species.

El-Gazzar and Dame (1983) reported that combinations of radiation and chemical sterilization, each at sub-sterilizing levels, produced levels of sterility expected for an additive relationship between the two sterilizing agents. Males sterilized by bisazir were fully 96% competitive under laboratory condition, whereas males sterilized by treatments involving irradiation (26%) or a combination of bisazir and irradiation (15%) were less competitive.

Knapp and Herald (1983) exposed adult *Musca autamnalis* to surfaces treated with different doses of penfluron on BAY SIR 8514 and reported that inhibition of egg hatch and F1 larval mortality dependent on exposure time, concentration, mating regime and elapsed time after exposure. Exposed female flies mated with untreated males demonstrated more greatly inhibited egg hatch than exposed male flies mated with untreated females.

Huda *et al.* (1983b) studied on the sterilization of Australian sheep blow fly *Lucilia cuprina* (Wied) (Diptera: Calliphoridae) by gamma radiation. Pupae of *Lucilia cuprina* irradiated 1 day before emergence were completely sterilized by 5 Krad. A dose of 3 Krad, which produced infecundity in females, 98% sterility in males, and competitiveness of those males was 80%. Irradiation in nitrogen gave no significant increase in competitiveness. When sterile and untreated flies of both sexes were allowed to mate there was no evidence of assortative mating and the mating propensity of irradiated males was not less than that of untreated males.

Friedel and McDonell (1985) reported that both egg production and subsequent larval development were inhibited in a concentration–dependent manner when cyromazine was administered to adult blowflies, *Lucilia cuprina* (Wied.) via drinking water.

Busch – Petersen *et al.* (1986) reported that EMS (ethyl methanesulfonate) fed to adult Mediterranean fruit flies in 10% sugar water was found to be the most effective treatment for the induction of dominant lethals in male germ cells and showed a direct relation between log concentration of EMS and the probit F1 egg lethality, whereas adult emergence from surviving pupae was never affected.

Wong *et al.* (1986) reported that to suppress a wild Mediterranean fruit fly, *Ceratitis capitata* (Wied) population by applying sterile insect release method. Released irradiated flies showed significant reduction of *Ceratitis capitata* occurred in the treated area compared with the control area. They also found that the average percent egg hatch dropped from 85.5% (control) to 13.5% (treated). Result showed that the laboratory strain of *C. capitata* was highly competitive in the field.

Seo *et al.* (1987) worked on *Ceratitis capitata* (Wied) to estimate age and rate of development of pupae for the sterile insect technique (SIT) by using colorimetric method and estimated from eye color of pre – adults. They found mean eye color (J) 37.50, 23.02, 7.52 or 2.13 from 1, 2, 3, or 4 days before eclosion (DBE) respectively.

Carpenter (1991) studied on sterility, flight ability and sexual competitiveness by comparing response to radiation of a genetic sexing strain and a wild type strain of the Mediterranean fruit fly, *Ceratitis capitata* (Wied.) and reported that males of the genetic sexing strains were sterilized at a lower dose of radiation than the wild type strain. He also reported that flight ability and sexual competitiveness of the wild type strain was higher than those of the genetic sexing strain.

Moreno *et al.* (1991) reported that un-irradiated Lab reared Mexican fruitflies, *Anastrepha ludens* (Loew) (Diptera: Tephritidae) were very competitive with wild flies. They also stated the irradiation showed the mating response of Lab reared males on compared with un–irradiated males but the slow response put the flies in phase with the mating period of the feral flies.

Wong *et al.* (1992) released irradiated adult of Mediterranean fruit fly, *Ceratitis capitata* (Wied) in a sterile insect technique (SIT) program in Kula, Maui, and Hawaii. Concurrent with sterile fly release, the braconid larval parasitoid *Diachasmimorpha tryoni* (Cameron) was released, and suggested that the concurrent released of parasitoids and sterile flies represent a valuable approach to eradication of established Mediterranean fruit fly population.

Shahjahan *et al.* (1994) worked on laboratory rearing of blow fly, *Lucilia cuprina* (Wied.) in relation to application in SIT–Pest management. They reported that by using eleven different food media to obtain a parameter in the pupae, to monitor the production quality of insects on a semi–mass scale, all media were able to support rearing to produce pupae except for agar and tannery waste product based food media.

Huda (1997a) studied on the population of blow fly, *Lucilia cuprina* (Wied.) (Diptera: Calliphoridae). Post feeding 3rd instar larvae were exposed to gamma radiations ranging from 10, 15, 20, 25 and 30 Gy and effects on pupation were observed. The prepupal period was prolonged and the duration of this delay increased with higher doses from 15 to 30 Gy. Besides post ponement of pupation, formation of abnormal puparia and production of pupal–adults intermediates were also recorded. It is indicated that gamma radiations interfered with the secretion or release of moulting hormone (MH) in the same way as that of exogenous juvenile hormone (JH).

Huda (1997b) studied on the influence of gamma radiation copula duration and mating propensity in *Lucilia cuprina* (Wied.). Copula duration varied from average of 8.4 minutes at control to average 7.4 minutes at 15 Gy. Radiation had no appreciable effect on the time from pairing of the start of mating. The frequency of mating attempts by males increased with rising doses between 30 and 50 Gy but not at 0, 10, and 20 Gy. The optimal doses for mating between 30 and 50 Gy, when the frequency of mating attempts and the proportion of flies mating where highest. It has been observed with *Lucilia cuprina* that optimum radiation dose for mating is 40 Gy having no average effects on the copula duration and mating capabilities.

Morris *et al.* (1997) studied the response of female *Lucilia cuprina* to odours from sheep, offal and bacterial cultures. A significant movement towards odours from faces, gut mucas and urine was observed. Odours from cultures of the bacteria *Proteus mirabilis*, *Dermatophilus congolensis* and *Serratia marcescens* also elicited significant movement. The movement and probing responses are discussed with reference to the possible uses of the substances tested as bait for attracting *L. cuprina*.

Blackwell *et al.* (1997) studied on the susceptibility of Romney and Perendale sheep to flystrike by the Australian green fly, *Lucilia cuprina* (Wied.), and fly attractant trials. In total, 5 trials (10 animals/treatment) were run to compare: the susceptibility of Romney and Panned sheep, using wetting, dung or homogenised liver as attractance. Wetting was applied along the back from a watering can while the other attractants were applied to a patch on the shoulder, mid-back and rump. About 2000 gravid flies were released into a fly-proof room along with the panned sheep. The main results of these trials were: a) It was very difficult to get an established maggot population on clean wet sheep; few eggs were laid and no cases of established strike occurred; b) Dung acted as a moderately successful attractant; maggots were hatched on the sheep but none developed to the skin penetrating stage; c) Liver acted as a very successful attractant and maggots developed on all treated sheep. No between-breed differences occurred with wetting, dung or liver attractants.

Gleeson and Heath (1997) studied on the population biology of *Lucilia cuprina* in the lower North Island of New Zealand using trap data and estimates of gene flow from genetic data. The result from the survey provided evidence that *L. cuprina* may be restricted to sheep farms and, within these, are predominantly found in the presence of sheep.

Eric *et al*. (1998) suggested that irradiation of males inducing gamete sterility does not affect the factor(s) from the accessory gland associated with altering female olfactory behavior. The ability of sterile males to alter adequately olfactory mediated behavior of wild females is discussed in the context of the sterile insect technique (SIT) for controlling Mediterranean fruit flies in the field.

Huda and Khan (1998) studied on the effect of radiation and food on the mortality of blow fly *Lucilia cuprina* (Wied). Pupae of fly 2-3 days before eclosion were irradiated at 0, 3, 4 and 5 Krad from gamma source. After emergence they were provided with water-sugar-liver (WSL), sugar-liver (SL), water-fish (WF), water-sugar (WS), water-liver (WL), sugar-fish (SF), liver (L), fish (F), sugar (S), or water (W). Mortality of irradiated males and females was not affected by any radiation doses when assessed up to 7 weeks after emergence. But dietary effects on the mortality of adults showed that 100% mortality of both sexes was achieved within (a) 7 weeks when fed with either WSL or WSF, (b) 5 weeks when fed with WS, (c) 4 weeks when fed with WL, (d) 3 weeks when fed with WF or SL, and (e) 2 weeks when fed with SF. When fed with single food like L, F, S, W or without food survived for less than a week.

Huda et al. (1999), a preliminary survey work was conducted on the geographical position, land physiography, flora and fauna, human population, fish dying areas, drying seasons, drying process and annual out-put of dried fish, loss due to insect pest and other aspects of fish trading in the Sonadia, a potentially fish drying off shore island in the Bay of Bengal. Trapping of the different species of flies dwelling around the fish drying beds were carried out using locally made "Box Type Traps", Temperature and humidity were recorded in different period of the day. Wild flies caught in the traps were collected, identified in the laboratory, their relative abundance around fish drying areas also recorded. A preliminary estimation was made on the population density of different flies with a particular attention to sheep blow fly, *Lucilia cuprina* directed towards the development of SIT pest management strategy.

Haque *et al.* (1999a), worked on the influence of food on the development and number of ovarioles in the *Lucilia cuprina.* The relationship of the body weight, different food media, starvation and the refedment on the ovariole number *Lucilia cuprina* were investigated. The number of ovariole did not vary in the fly of given weight and was virtually identical in the left and right ovaries. But there was positive relationship between ovariole number and weight of fly. The numbers of ovariolies decrease with starvation. In contrast larvae prematurely taken of the food, but fed again after starvation for several days, developed ovaries with normal number of ovarioles.

Haque *et al.* (1999b), were conducted a research on blow fly (*Lucilia cuprina*) the effects of the gamma radiation on sperm transfer, subsequent fecundity and egg viability. Radiation doses (20-50 Gy) were administered to the pupal stage (3 days before emergence) to find out the adverse effect on the ability to mate but sperm transfer to the sperm thecae of the female was affected. Correlation was found in between the number of sperm present in the sperm thecae and fecundity of the female. Irradiation had a greater effect on the fecundity. Viability of the egg laid by females decreased by 100% when males were irradiated with dose up to 50 Gy. It was found that males transferred significantly less amount of sperm after treatment with 50 Gy.

Young *et al.* (2000) stated that a number of proteases were identified in the eggshell washings (ESW) collected during the egg hatching of *Lucilia cuprina* (sheep blow fly). Characterization of these protesses indicated p^{H} optima in a similar p^{H} range that was optimal for *L. cuprina* egg hatching. Mechanistic characterization of these proteases indicated that they were predominantly of the serine class. Several protease inhibitors were tested for their ability to inhibit *L. cuprina* egg hatching in vitro. Egg hatching was significantly ($P < 0.05$) inhibited by PMSF (61%), 1, 10-Phenanthroline (42%) and Pepstatin (29%). The inhibition of egg hatching by PMSF showed strong concentration dependence, with its effects ranging from inhibition at high concentrations to enhancement of egg hatching at low concentrations. Addition of ESW to unhatched eggs, significantly ($P < 0.05$) enhanced their rate of hatching above untreated control eggs. This enhancement of egg hatching was significantly ($P < 0.05$). Addition of EW reversed by the protease inhibitors Elastatinal (40%), 1, 10-Phenanthroline (40%) and PMSF (38%). These studies indicate a role for serine and/or metallo-proteases in facilitating *L. cuprina* egg hatch.

Huda and Khan (2000) worked on the wild blow fly species (*Lucilia cuprina*) (Wied) rearing on Hilsha fish at 28 ± 2○C and 60-75% R.H. to determine the emergence, longevity of wild, sterility and competitiveness of laboratory reared irradiate male and unirradiate native males and females with a view to suppress or eradicate fly population by sterile insects techniques. The males were treated with 0, 20, 25, 30 GY and mated with wild untreated females after emergence (5-6 days old). Irradiation treatment produced 2.1, 92.3, 98.3 and 99.6 percent sterility in males respectively without affecting their competitive capabilities with the wild population.

Scholtz *et al.* (2000) used an insecticide-free sheep blow fly trapping system, utilizing a synthetic lure, was evaluated at 4 localities in the Western Cape. The blow fly population was monitored for 48 hours monthly at each of the localities. 5 to 7 suppression traps at the respective localities were identified for this purpose. 3 to 10 traps were set monthly for monitoring in the control areas. Trapping resulted in the suppression ($P< 0.0\ 1$) of the *Lucilia* population at Caledon, where a large area of approximately 50 km² was trapped. The suppression area of all the localities was 1 to 850 ha. The results obtained at Caledon and published reports suggest that large-scale trapping of *Lucilia* spp. may play a role in an integrated pest management system blowflies.

Huda and Khan (2001) was developed a mechanical aspirator, which designed for easy collecting, sorting, trapping and sexing of blow flies in SIRM (sterile insects release method). It was observed that manual separation of 1000 flies took more than 6 hours, whereas the same work can be accomplished within 35 minutes by the proposed mechanical device.

Moe *et al.* (2001), they studied on effects of a toxicant on population growth rates: Sublethal and delayed responses in blow fly populations. Previous studies have shown that cadmium exposure in blow fly populations, *Lucilia sericata* results in reduced population growth rate, but also in higher individual mass, because of reduced competition for food (Meigen 1826). In this study, measuring direct and delayed effects of cadmium investigate the discrepancy between the positive effect on individual growth and the negative effect on population growth, in the adult stage. Individuals exposed to cadmium in the larval stage had higher meant pupal and adult mass (because of reduced densities), but also reduced adult longevity and fecundity. Adult longevity and fecundity were also reduced by cadmium exposure in the adult stage. In stage-structured populations, the link between individual-level and population-level responses to a toxicant may be complicated by stage-specific sensitivities to the toxicant, by delayed responses in the adult stage to sub lethal effects in the juvenile stage, and by density-dependent compensatory responses to toxicant-induced mortality.

Gabre-Refaat (2002), was accomplished seasonal field studies on 4 bait traps (Fish, Bovine-lung, Grapes and Molasses) were conduct in El-Arabaeen fish-market, El-Arabaeen district, Suez governorate Egypt in 1999 and 2000 to describe the pattern and sex-ratio of sarcosaprophagous flies. The presence of of sarcosaprophagous flies (Calliphoridae, Muscidae and Sarcophagidae) revealed that *Chrysomya megacephala* (Fabricius), *Lucilia cuprina* (Wiedemann) and *Musca domestica* (Linnaeus) were the most dominant flies. Almost equal number of male and female flies of *C. megacephala*, *L. cuprina* and *M. domestica* trapped on baits of grapes and molasses possibly represent real proportion of male and female population of these flies. The number of female flies recorded on fish and bovine-lung baits was significantly higher than those recorded on grapes and molasses. As row fish and bovine-lung are important breeding media for flies, they may have attracted a larger number of female flies for ovary maturation and oviposition.

Mahon *et al.* (2005) found that longer duration of larvae feeding in the food media increase the quality production. Any interruption in feeding cause early dropping and pupation affects the adult quality in *C. bezziana.*

Alahmed and Khair (2005) made an intensive survey on the encidence of blow fly on sheep of different age's and found that young lambs and the ewe were more prone to myasis. The fly strike was more prevalent (60%) at warm and moist weather March to May as compared to 31% in September to November. In cold season the infestation rate was low (1.5% -5%).

Chapter 3

Materials and Methods

MATERIALS AND METHODS

3.1 The effect of different categories of adult diet on longevity of *L. cuprina* adults (Male and Female) emerged from both irradiated and non-irradiated pupae

3.1.1 Stock rearing

The study was conducted at the Institute of Food and Radiation Biology (IFRB), Atomic Energy Research Establishment (AERE), Savar, Dhaka. Larvae of blowfly, *L. cuprina* were collected from the offshore Islands near Cox's Bazar along with infested fish (Hilsha) and reared for several generations in the laboratory. The flies of the culture were maintained in the laboratory at a temperature 25 ± 2^0c with 60-80% relative humidity and with a 12h light and 12h dark cycle. Adult stock was kept in (20″ × 16 ″ × 16″) rectangular cage. The adults were fed sugar and water soaked in cotton bolls; often-bovine blood meals were also supplied to the stock.

The females laid egg 48–72 hours post- emergence. A piece of bovine liver was supplied on a petridish to collect eggs. Females lay eggs in mass, one egg mass is often followed by the deposition of several females.

Larvae were reared on bovine liver or fish. The eggs or egg masses were seeded on the food medium on an aluminium plate (12″d). The egg hatched with 20-25 hrs at RT (25± 2^0c). Plate containing seeded eggs was put inside large plastic bowl (30 –32 L). This bowl was covered with cotton cloth to prevent external invasion. The bowl contained sawdust for the dropping mature larvae. The full-grown larvae dropped on to the sawdust to undergo pupation.

The pupae were sieved out from the sawdust and kept in small (3L) plastic bowl in the adult's cage to maintain the next stock culture or used for experimental purposes.

3.1.2 Collection and measurement of eggs

A piece of Poa fish was supplied on a petridish to collect eggs. Half gram (0.50g) eggs were measured with the help of electric balance.

3.1.3 Larvae rearing and pupation

Half gram (0.50 g) eggs or egg masses were seeded on the food medium of 1 Kg Poa fish on an aluminium plate (12″ d). Plate containing seeded eggs was put inside large plastic bowl (30-32 L). This bowl was covered with white cotton cloth. The bowl contained sawdust for the dropping mature larvae. The egg hatched with 20-25 hrs. After 4-5 days, full-grown larvae dropped on to the sawdust to undergo pupation.

The pupae were sieved out from the sawdust and kept in plastic bowl. About 6000 pupae were obtained from 1 Kg. Poa fish.

3.1.4.1 Irradiation treatment

Two thousand four hundred (2400) pupae were taken randomly out of these 6000 pupal stocks for irradiation treatment. These pupae (2400 pupae) were divided equally in 24 conical flasks. Thus each flask contains 100 pupae and each of the samples was subjected to 4.5 kr (dose rate 30000 cui/hr) gamma radiation from a Co^{60} source, 2days before eclosion.

3.1.4.2 Non-irradiation treatment

Another 2400 pupae were taken for non- irradiation treatment.

3.1.5 Observation on the rate of mortality based on food supply

3.1.5.1 Irradiated pupae

Eight hundred pupae were taken 8 petridish and were caged in an aluminium framed cage (6″×6″×8″) and provided with a feed either of (1) water- sugar- liver (W-S-L), (2) Water- sugar- fish (W- S-F), (3) water -sugar -blood (W-S-B), (4) water-sugar (W-S, (5) Water -fish (W-F), (6) only fish (F), (7) only water (W), (8) or without food (Starvation).Three replicates were made for each cage treatment.

3.1.5.2 Non Irradiated Pupae

Similarly, 800 pupae were kept in 8 petridishes and then kept in an aluminium framed caged (6″×6″×8″) and provided with similar 8 categorized food. Three replicates were made for each cage treatment. Emergence percentage of pupae, the daily mortality rate of male, female and the cumulative mortality of the sexes and both were recorded until the death of the last individual.

3.2The effect of pupal ageing on its weight

About 0.2565 g. eggs or egg masses were seeded on the food medium of 500 g Poa fish on an aluminium plate (12″d). Plate containing seeded eggs was put inside large plastic bowl (30-32 L). This bowl was covered with white cotton cloth. The bowl contained sawdust for the dropping mature larvae. The egg hatched with 20-25 hrs. After 4-5 days full grown larvae dropped on to the sawdust to undergo pupation.

The pupae were sieved out from the sawdust and kept in small (3L) plastic bowl. About 3000 pupae were collected from 500 g. Poa fish. From 3000 pupae, 110 pupae were selected randomly for the measure of daily weight of pupae. Each of the pupae was put into a small (2 ml) glass vial and a small amount of sawdust was put in it and the neck of the vial was plugged with a cotton stub. These pupae were weighted daily from pupation to before eclosion (4 days). These data obtained were subjected to statistical analysis.

Percentage weight loss was calculated using the following forı $\frac{X - X_4}{X}$ X100 % (pre-pupae to adult transition)

where X = pupal weight at day 0. X_4= pupal weight at day 4.

3.3 The effect of artificial larval diets on pupal weight

3.3.1 Site of collection of *Lucilia cuprina*

Flies initially collected from Cox's Bazar fish drying area by Huda, in 1982 (personal communication), were reared on Hilsha fish. After establishing a regular stock colony, eggs were collected from this colony on a routine basis and seeded on the experimental artificial food media.

3.3.2 Site of collection of artificial diets

The artificial diets were collected from Bangabazar, Fulbaria, Dhaka.

3.3.3 Preparation of artificial diets

Three categories of poultry feed were collected as under –

1) Imported poultry feed (Bovine bone and dry fish dust) product (IPF)
2) Marine dry fish dust product (MPF)
3) Local poultry feed (Bovine bone and dry fish dust) product (LPF)

Each of the above type of feed was taken at different ratio adding a constant amount of liver and blood to make a fine puff as artificial feeding media for Blow fly larvae. Example of such feeding medium has been cited bellow –Using the IPF (Imported poultry feed) as a type:

50 g IPF + (50 g. liver + 20ml blood)-1:1 -(IPF1)

100g IPF + (50 g. liver +20 ml blood) - 2:1-(IPF2)

150 g IPF + (50 g. liver + 20 ml blood) - 3:1-(IPF3)

200 g IPF + (50 g. liver +20ml blood) - 4:1–(IPF4)

Each of the above feed mix was replicated thrice. Each replicate was collected in a small plastic bowl (500 ml) and 100 fly eggs were put onto the feed. The plastic bowl was kept inside a larger plastic bowl (4L) containing sawdust and the larger bowl was covered with a white cotton cloth to prevent external contamination. The eggs hatched into tiny larvae after 20-25 hours and start feeding on the provided diet. Larvae became full grown in 4-5 days and dropped on the saw dust in the larger bowl to undergo pupation. The pupae were sieved from the sawdust and kept in a small plastic bowl for further study. Fifty pupae were taken randomly from each of the diet mixed (IPF1). These were weighted individually. Three replicates were maintained in each case.

The similar procedure was followed for other types of feed (MPF, LPF).

Data obtained were subjected to statistical analysis, using computer software "MS Stat 98".

Chapter 4

Results and Discussion

RESULTS AND DISCUSSION

The results are presented in the following three sections:

The section–1 represents the effect of different categories of adult diet on the longevity of *L. cuprina* (Male & Female) for both non-irradiated and irradiated pupae.

The section-2 represents the effect of pupal ageing on its weight.

The section–3 represents the effect of artificial larval diets on pupal weight.

4.1 Section-1

4.1.1 The effect of different categories of adult diet on the longevity of *L. cuprina* (Male & Female) for both non- irradiated and irradiated pupae:

Attempts were made to compare the longevity of adult drive from non-irradiated or irradiated pupae and raised a different food selections viz no food; only water; only fish (Poa); water and fish; water and sugar; water, sugar and blood; water, sugar and fish; water, sugar and liver.

Daily mortality of both sexes of *L. cuprina* from non-irradiated and irradiated pupae with no food supplied is presented in figure-1 & 2 respectively. The cumulative mortality for the above cases is presented in the figure-3 & 4 respectively.

Figure-1 indicates that mortality started on day-2 and ended on day-5. The peak mortality was at day-4 irrespective of sexes. Figer-2 indicates that the pattern of mortality in male and female was similar with no food. Figer-3 and- 4 indicate that the mortality trend/pattern were similar in the non-irradiated pupae as well as irradiated in the case of cumulative mortality where no food was supply.

Daily mortality of the both sexes of *L. cuprina* from non-irradiated and irradiated pupae is presented in figure-5 & 6 while the cumulative mortality is presented in figure-7 & 8. In the above cases food supply for the adult was only water. Figure-5 indicated that mortality started virtually on day-3 and the peak mortality was on day–4 in case of non-irradiated pupae but for irradiated pupae (Figure-6) the mortality started on day-2, the peak mortality was day-3 when the food supply was only water. The trend of cumulative mortality was similar in all cases (Figure-7 and 8).

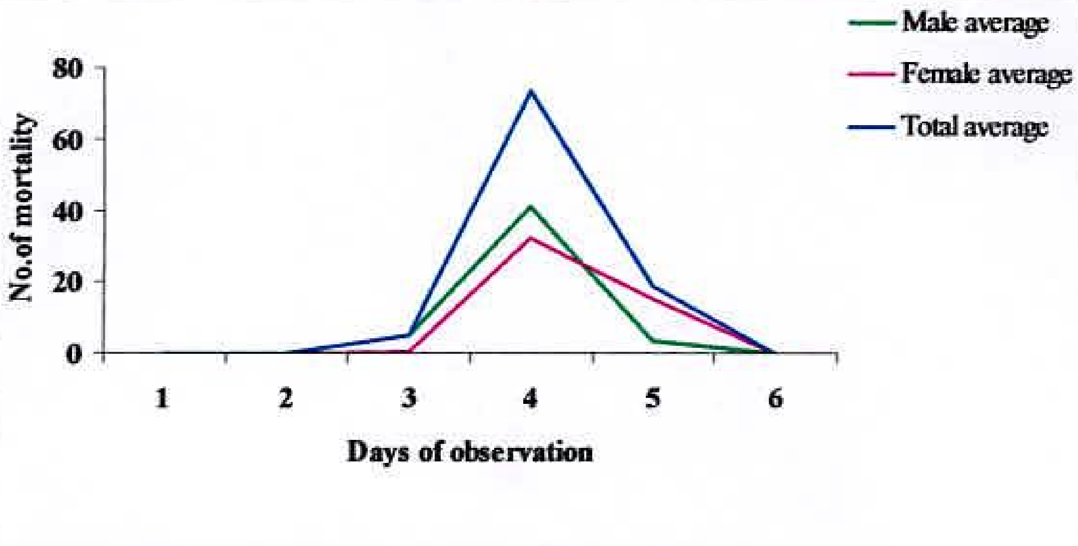

Figure 1. Daily mortality nos. of both sexes of *L. cuprina*, adult emerged from non-irradiated pupae, supplied no food

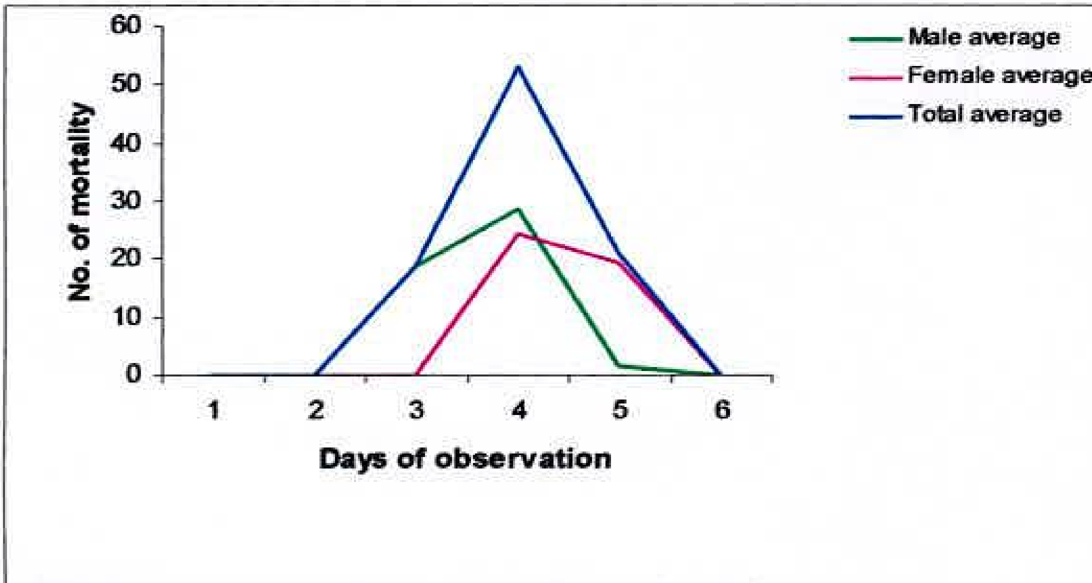

Figure 2. Daily mortality nos. of both sexes of *L. cuprina*, adult emerged from irradiated (4.5kr) pupae, supplied no food

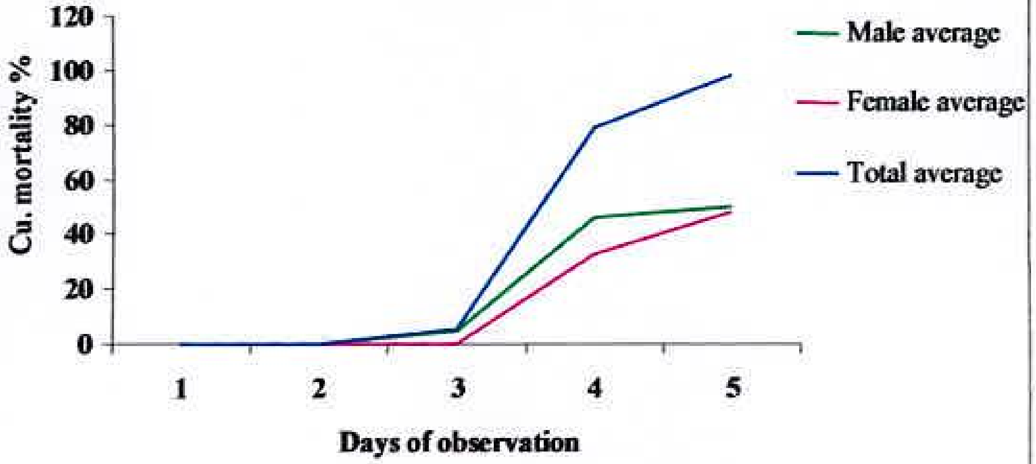

Figure 3. Daily cumulative mortality % of both sexes of *L. cuprina*, adult emerged from non-irradiated pupae, supplied no food

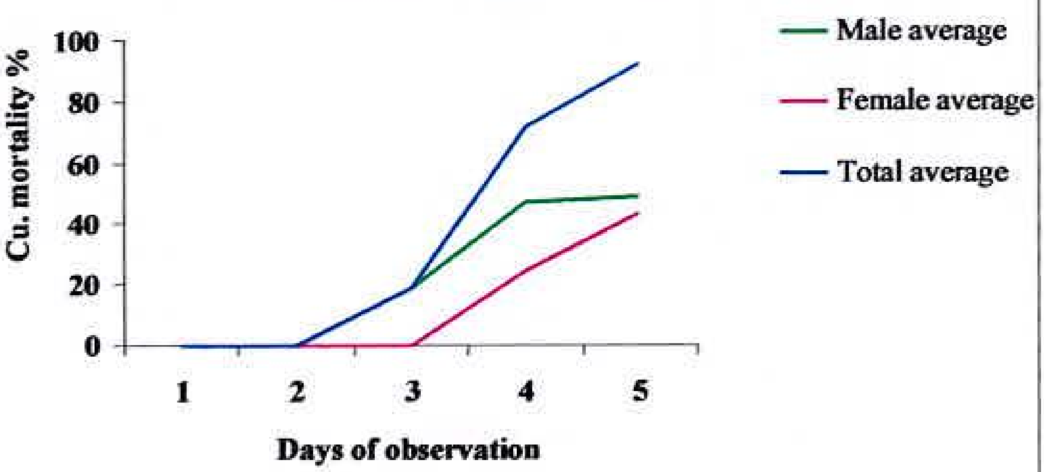

Figure 4. Daily cumulative mortality % of both sexes of *L. cuprina*, adult emerged from irradiated (4.5kr) pupae, supplied no food

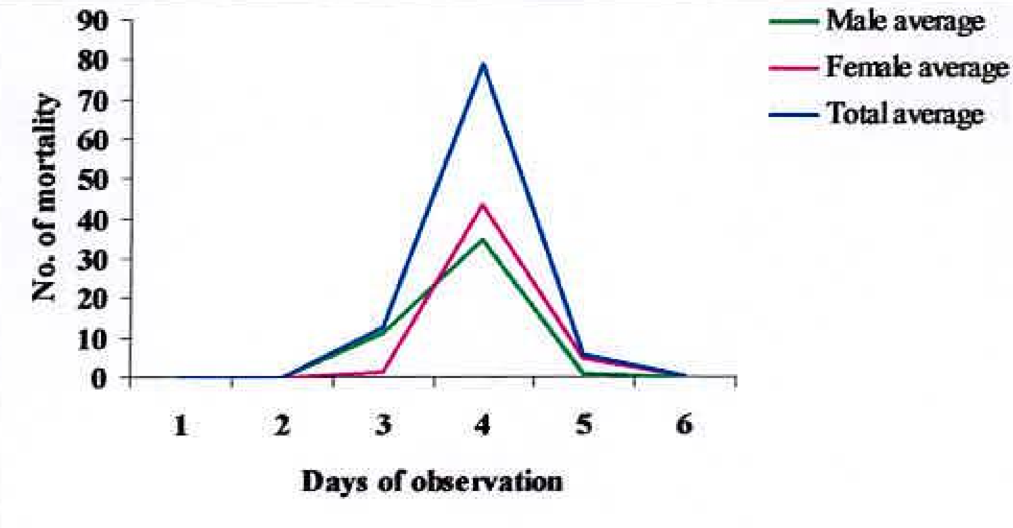

Figure 5. Daily mortality nos. of both sexes of *L. cuprina*, adult emerged from non-irradiated pupae, supplied only water

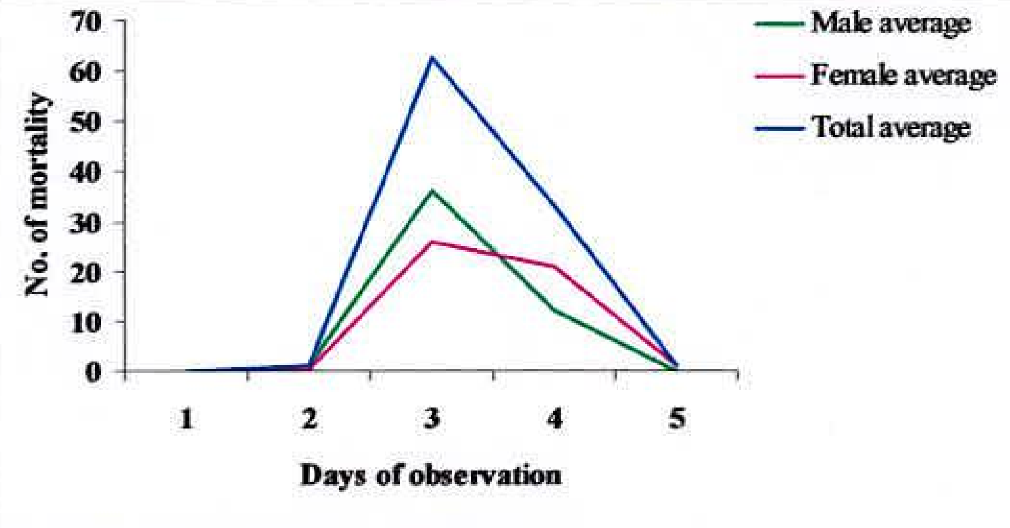

Figure 6. Daily mortality nos. of both sexes of *L. cuprina*, adult emerged from irradiated (4.5kr) pupae, supplied only water

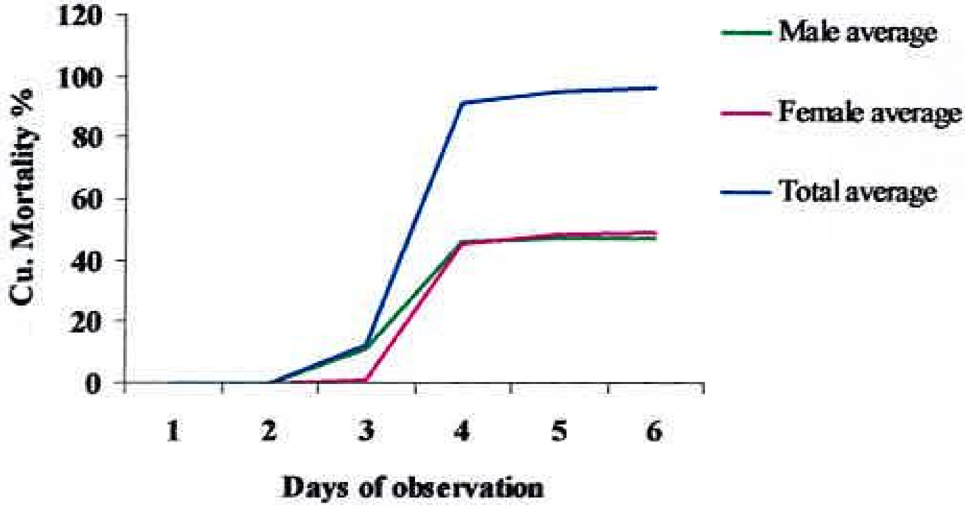

Figure 7. Daily cumulative mortality % of both sexes of *L.cuprina*, adult emerged from non-irradiated pupae, supplied only water

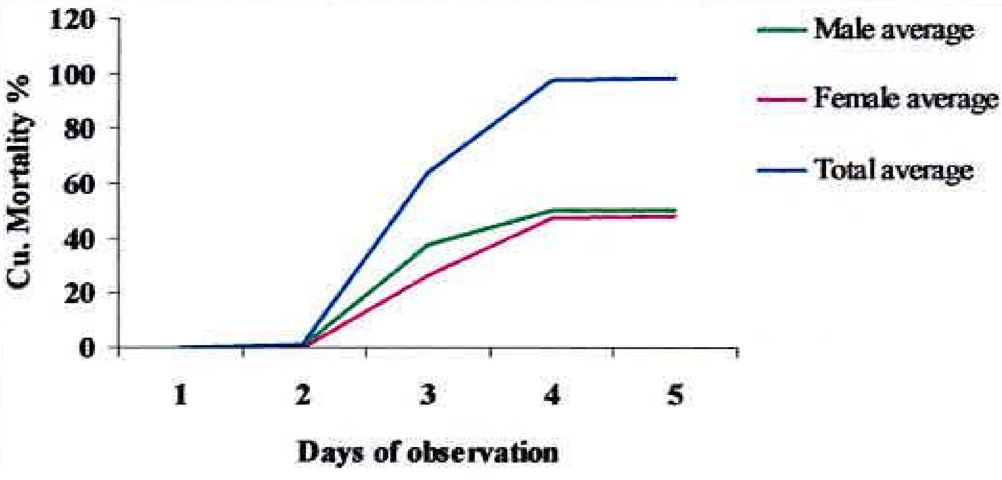

Figure 8. Daily cumulative mortality % of both sexes of *L. cuprina*, adult emerged from irradiated (4.5kr) pupae, supplied only water

Figure-9 & 10 represent the daily mortality and figure-11 & 12 represent cumulative mortality of the flies (both non-irradiated and irradiated pupae) when the food supply was only fish (poa fish). Figure-9 and 10 indicate the daily mortality pattern of adult emerged from non-irradiated and irradiated pupae respectively when the flies were supplied with poa fish. In case of non-irradiated flies the mortality was started on day-3 and there were two mortality peak on day-5 and 7. Whereas in case of irradiated flies the mortality was started at day-1 and continued up to day-9 and the gross peak mortality was at day-4. The trend of cumulative mortality was similar in all such cases (Figure-11 and 12).

Figure-13 & 14 indicated the daily adult mortality for both flies from non-irradiated and irradiated pupae when the food supply was fish and water. The cumulative mortality for the above cases is presented in figure-15& 16 respectively. When the adult was supplied with both fish and water (Figure-13 and 14) the mortality initiated on day-3 and 2 respectively. For on non-irradiated and irradiated, the peak mortality remained on day-5 in both cases and the mortality continued tailoring up to the day-19. The cumulative mortality showed no difference in pattern (Figure-15 and 16).

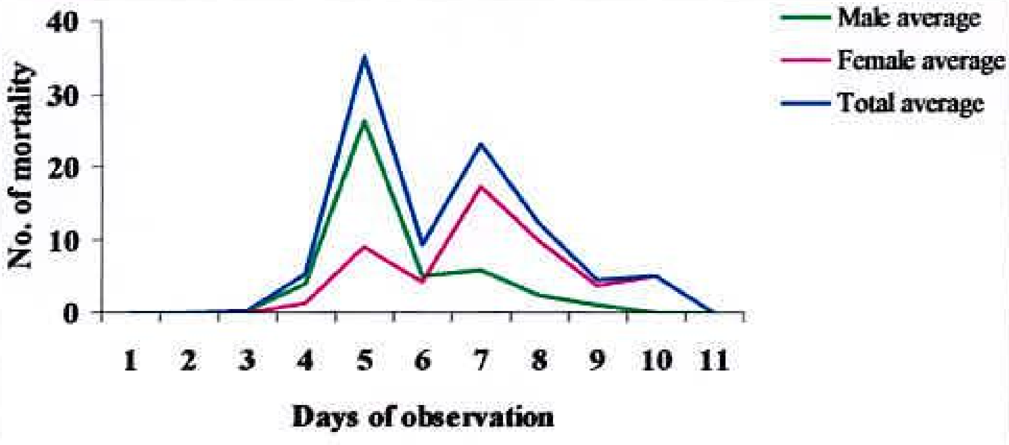

Figure 9. Daily mortality nos. of both sexes of *L. cuprina*, adult emerged from non-irradiated pupae, supplied only fish (Poa)

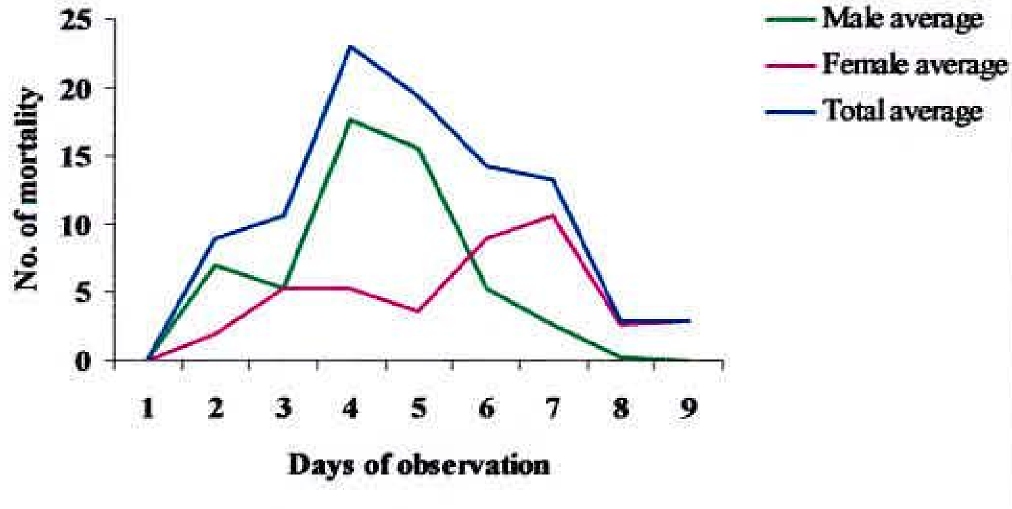

Figure 10. Daily mortality nos. of both sexes of *L. cuprina*, adult emerged from irradiated (4.5 Kr) pupae, supplied only fish (Poa)

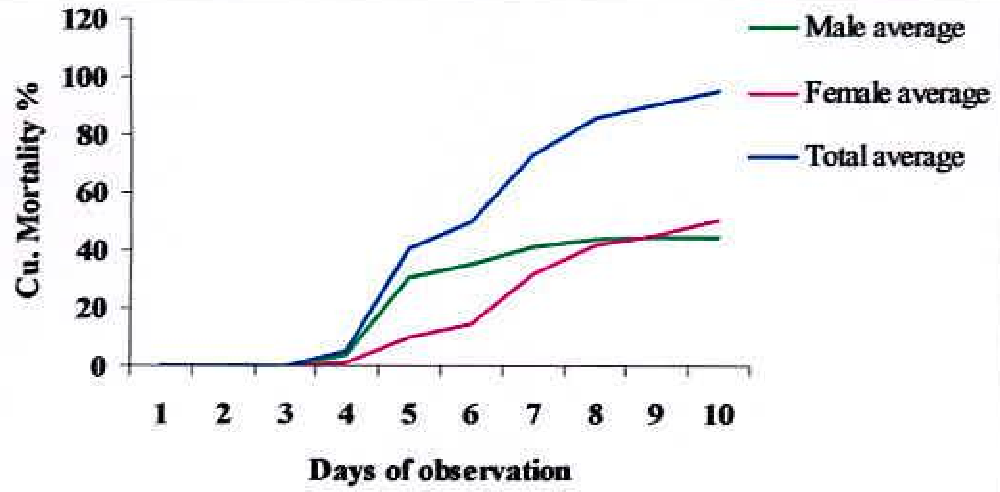

Figure 11. Daily cumulative mortality % of both sexes of *L. cuprina*, adult emerged from non-irradiated pupae, supplied only fish (Poa)

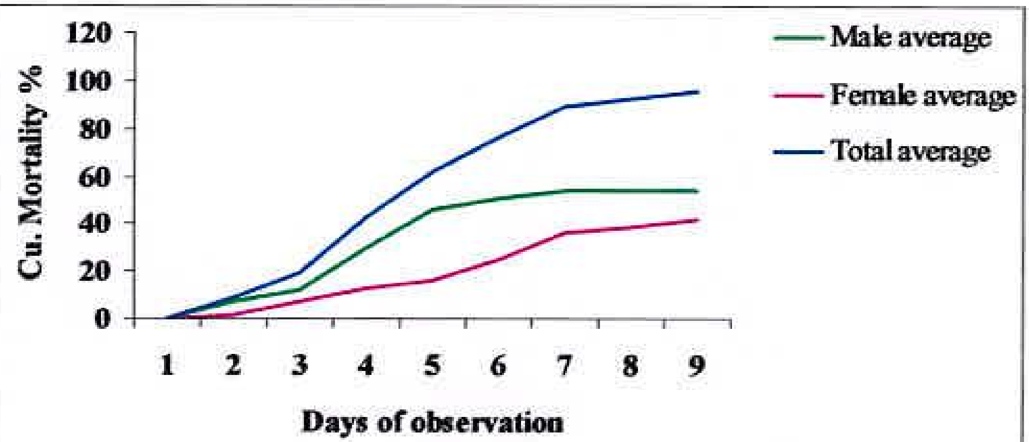

Figure 12. Daily cumulative mortality % of both sexes of *L. cuprina*, adult emerged from irradiated (4.5Kr) pupae, supplied only fish (Poa)

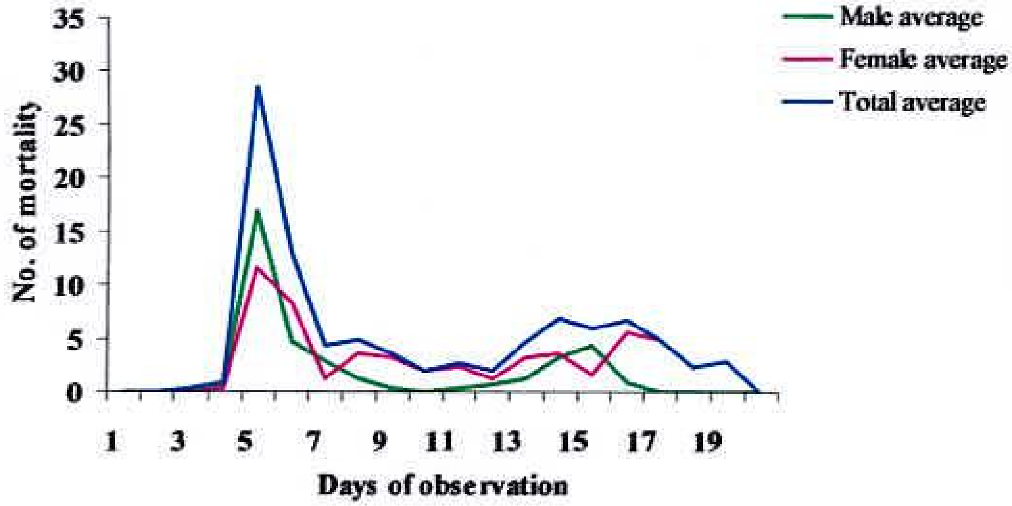

Figure 13. Daily mortality nos. of both sexes of *L. cuprina*, adult emerged from non-irradiated pupae, supplied wate-fish (W-F)

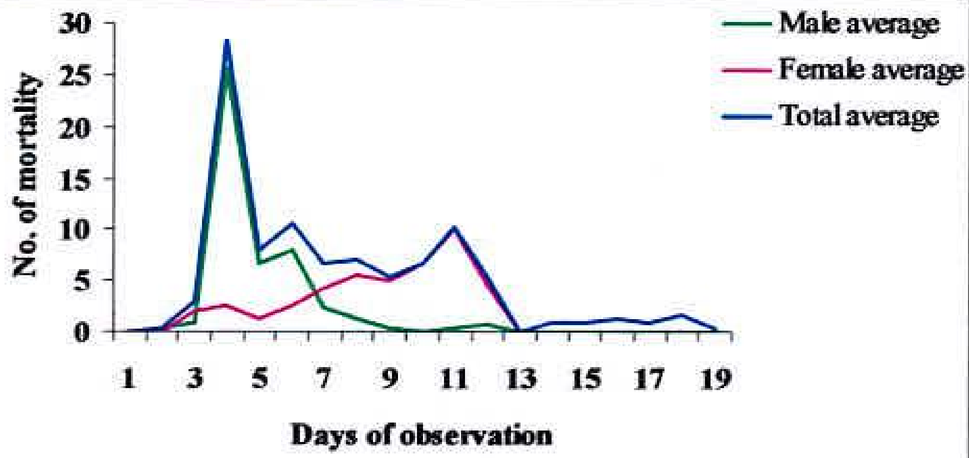

Figure 14. Daily mortality nos. of both sexes of *L. cuprina*, adult emerged from irradiated (4.5kr) pupae, supplied water-fish (W-F)

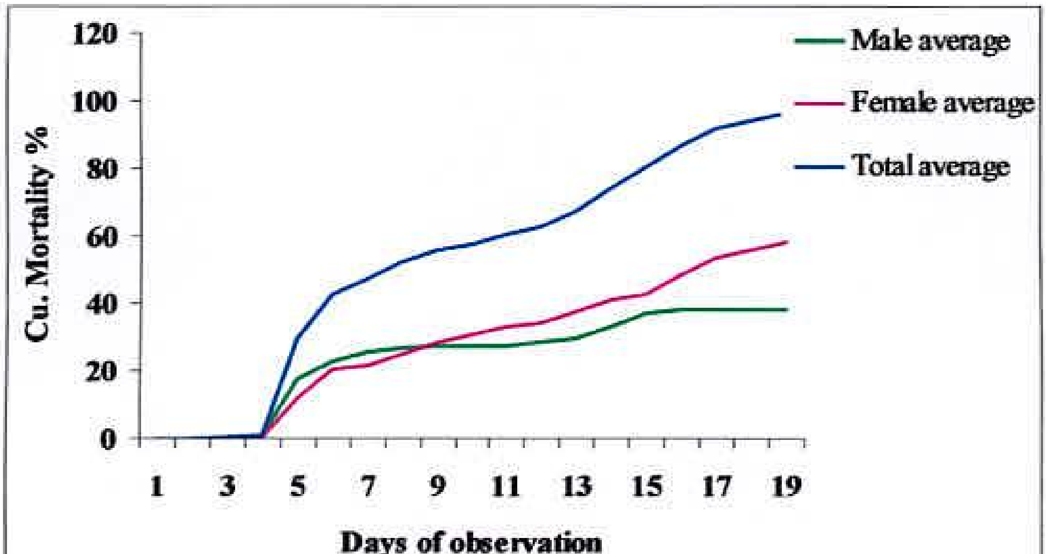

Figure 15. Daily cumulative mortality % of both sexes of *L. cuprina*, adult emerged from non-irradiated pupae, supplied water-fish (W-F)

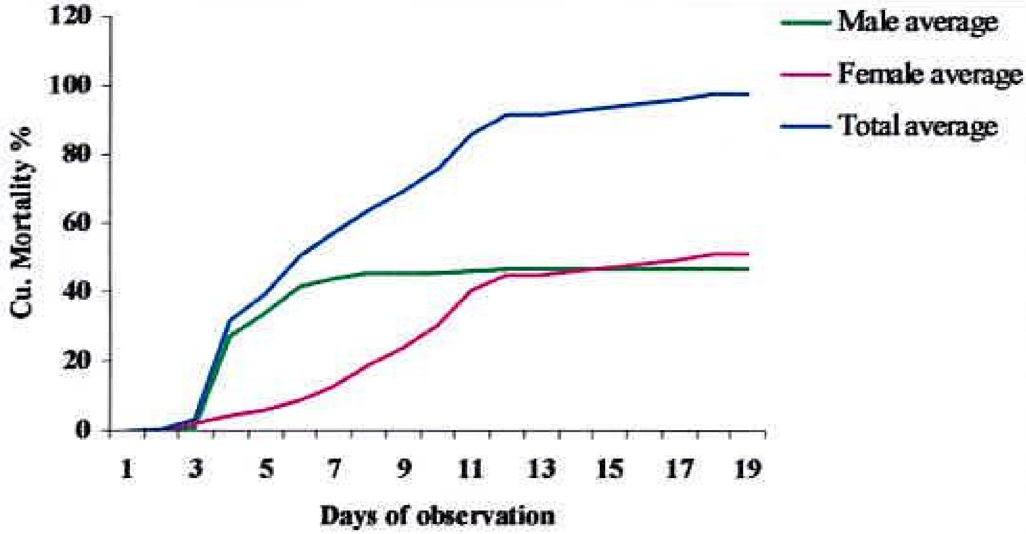

Figure16. Daily cumulative mortality % of both sexes of *L. cuprina*, adult emerged from irradiated (4.5kr) pupae, supplied water fish (W-F)

* The numerical data for these Figures–1 to 16 are presented in Appendix–1 to 16

Figure-17 (non-irradiated pupae) and 18 (irradiated pupae) represents the daily mortality of both sexes when the food supply was water and sugar. The cumulative values of the above cases are represented in figure-19 & 20 respectively. When the emerging flies from non-irradiated pupae were supplied with sugar and water the longevity continued up to day 37 with initiation of mortality at day 7, the peak of which was stretching day 17 to 23 (Figure-17). In case of flies from irradiated pupae the mortality trend was similar for the initiation of mortality was at day-1, the peak range of day-15 to 23 (Figure-18). The trend of cumulative mortality was similar in both cases (non-irradiated; Figure-19 and irradiated; Figure-20). In all cases the females were less prone to mortality effect.

Daily mortality of both sexes (emerged from non-irradiated and irradiated pupae) supplied with water, sugar and blood is presented in figure-21 & 22 respectively. The cumulative mortality of above cases is in figure-23 & 24. When the flies were supplied with water, sugar and blood the mortality happened to occur on day-3 and continued up to day-37 virtually with no regular peak (Figure-21; non-irradiated and 22; irradiated).The trend of cumulative mortality was similar in both sexes when flies feed with the above food, however, the females had a bit higher mortality in general (Figure-23 and 24).

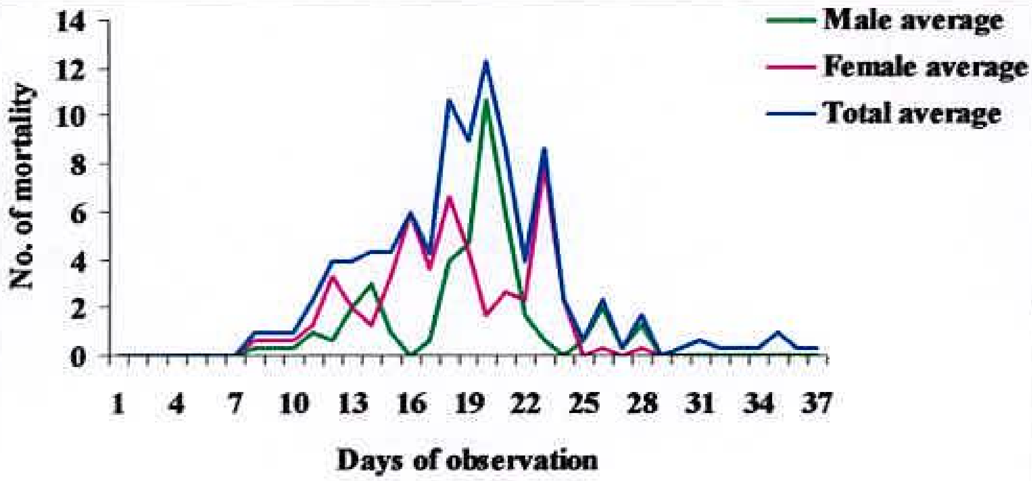

Figure 17. Daily mortality nos. of both sexes of *L. cuprina*, adult emerged from non-irradiated pupae, suupied water-sugar (W-S)

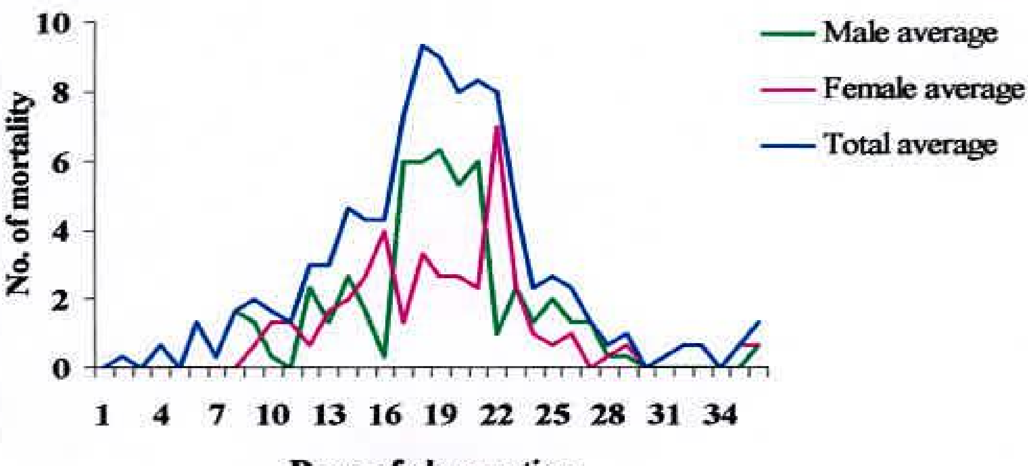

Figure 18. Daily mortality nos. of both sexes of *L. cuprina*, adult emerged from irradiated (4.5kr) pupae, supplied water-sugar (W-S)

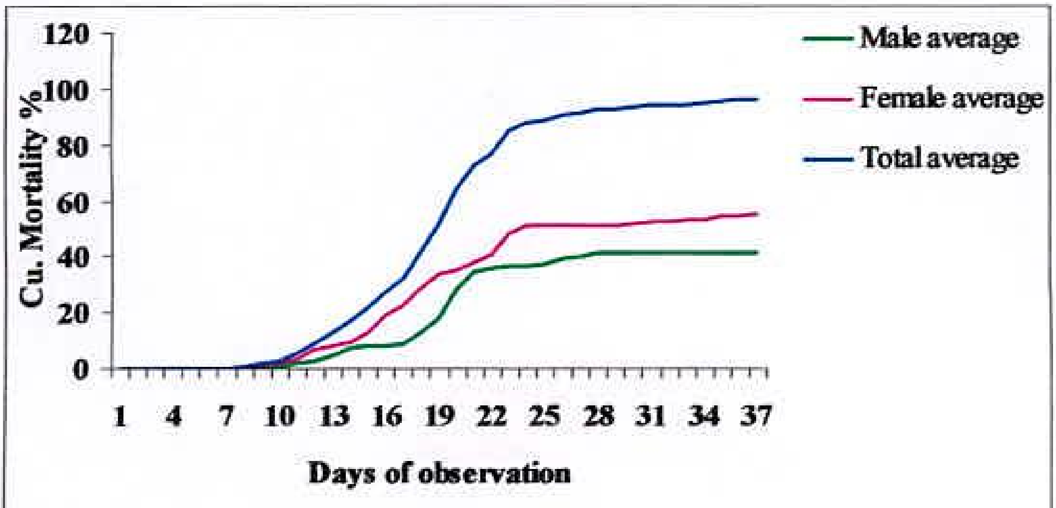

Figure 19. Daily cumulative mortality % of both sexes of *L. cuprina*, adult emerged from non-irradiated supplied water-sugar (W-S)

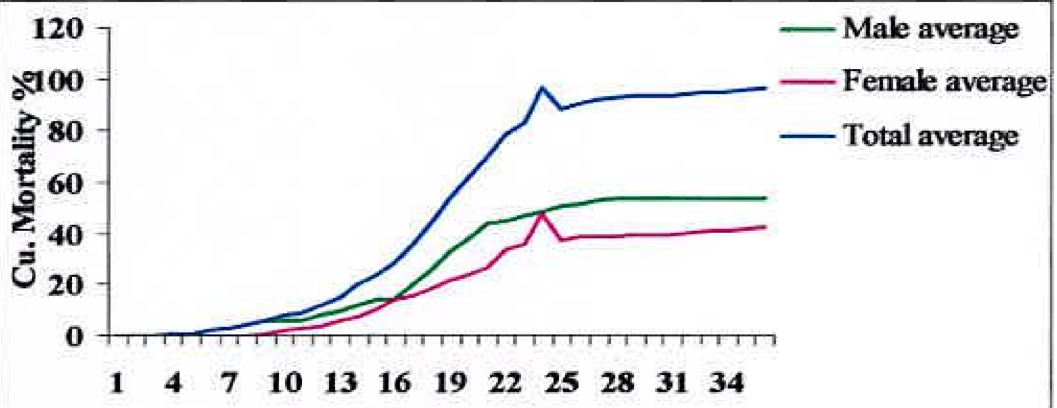

Figure 20. Daily cumulative mortality % of both sexes of *L. cuprina*, adult emerged from irradiated (4.5kr) pupae, supplied water-sugar (W-S)

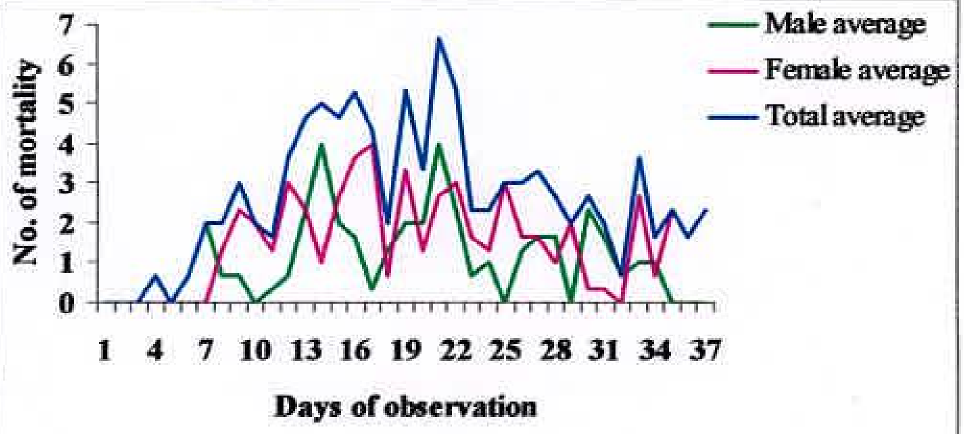

Figure 21. Daily mortality nos. of both sexes of *L. cuprina*, adult emerged from non-irradiated pupae, supplied water-sugar-blood (W-S-B)

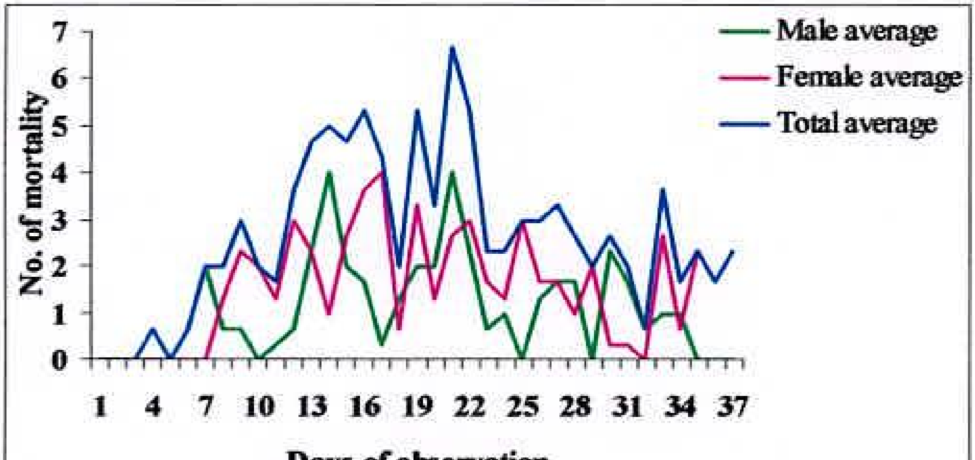

Figure 22. Daily mortality nos. of both sexes of *L. cuprina*, adult emerged from irradiated (4.5kr) pupae, supplied water-sugar-blood (W-S-B)

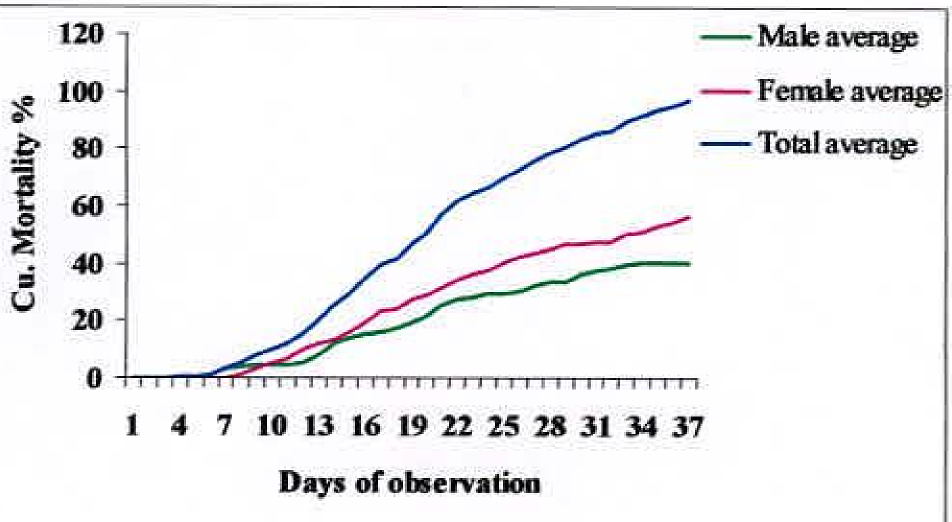

Figure 23. Daily cumulative mortality % of both sexes of *L. cuprina*, adult emerged from non irradiated pupae, supplied water-sugar-blood (W-S-B)

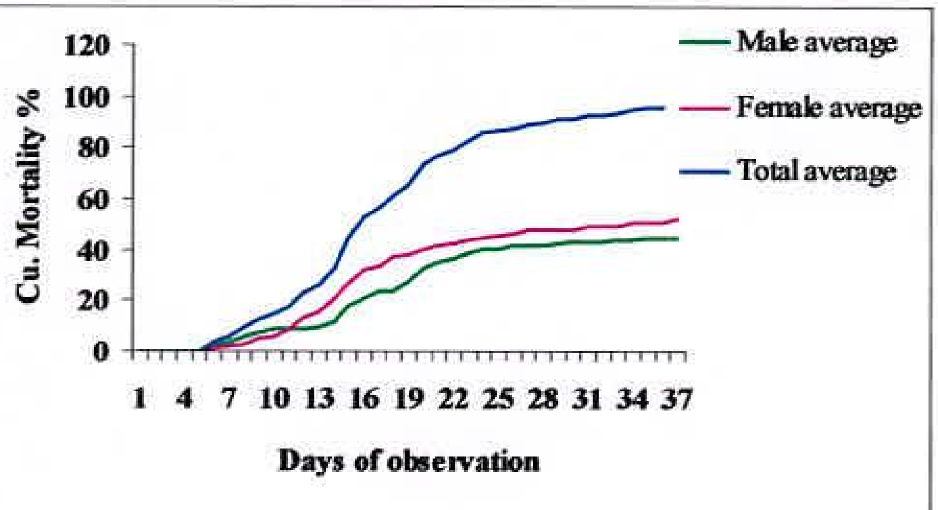

Figure 24. Daily cumulative mortality % of both sexes of *L. cuprina*, adult emerged from irradiated (4.5kr) pupae, supplied water-sugar-blood(W-S-B)

Figure-25 and 26 represents daily mortality of both sexes of adults with water, sugar and fish for non-irradiated and irradiated cases. The cumulative mortality for the above cases is shown in figure-27 & 28 respectively. When flies were supplied with water, sugar and fish and longevity of adults extended up to day-46 with an irregular peak, starting from day-8 (non-irradiated; Figure-25) and starting from day-3 (irradiated; Figure-26).Virtually there is no difference between the cumulative mortality of sexes (Figure-27; non-irradiated and- 28; irradiated).

Daily mortality of adult flies supplied with water, sugar and liver is presented in figure-29 and 30. Their cumulate value is presented in figure-31 and 32 respectively for non-irradiated and irradiated cases. The longevity extended up to day 49 with irregular peak (Figure-29) and the longevity extended up to day-48 with irregular peak (Figure-30) when the flies were supplied with water, sugar and liver. When the flies were supplied with water, sugar and liver, the trend of cumulative mortality was almost similar in both sexes (Figure-31 and 32).

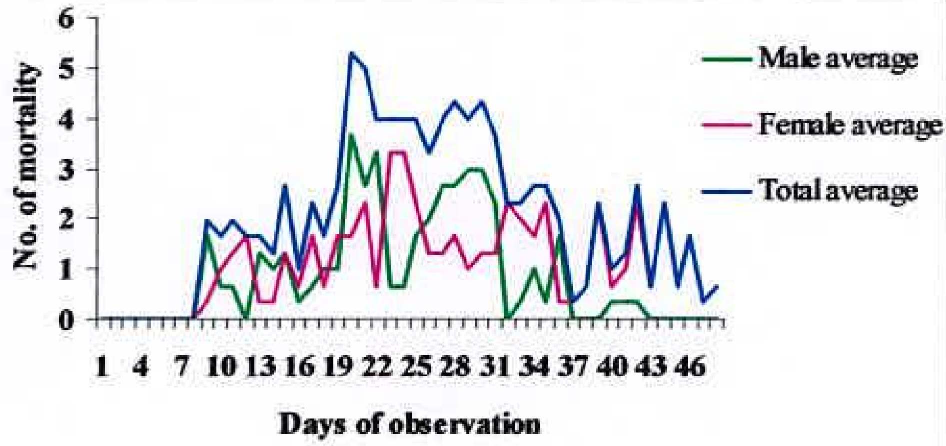

Figure 25. Daily mortality nos. of both sexes of *L. cuprina*, adult emerged from non-irradiated pupae, supplied water-sugar-fish (W-S-F)

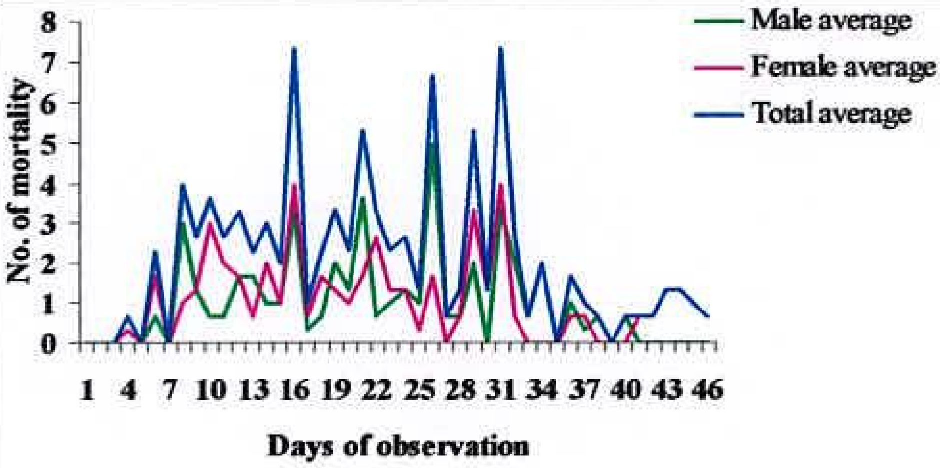

Figure 26. Daily mortality nos. of both sexes of *L. cuprina*, adult emerged from irradiated (4.5kr) pupae, supplied water-sugar-fish (W-S-F)

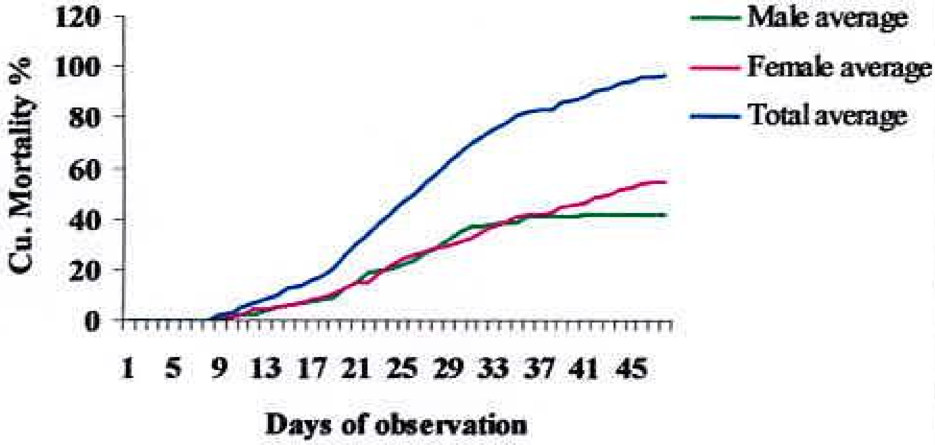

Figure 27. Daily cumulative mortality % of both sexes of *L. cuprina*, adult emerged from non-irradiated pupae, supplied water-sugar-fish (W-S-F)

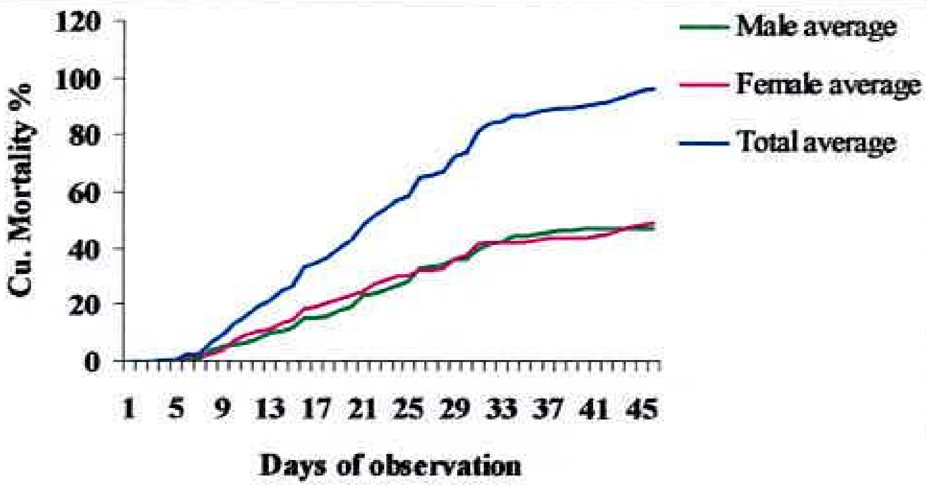

Figure 28. Daily cumulative mortality % of both sexes of *L. Cuprina*, adult emerged from irradiated (4.5kr) pupae, supplied water-sugar-fish (W-S-F)

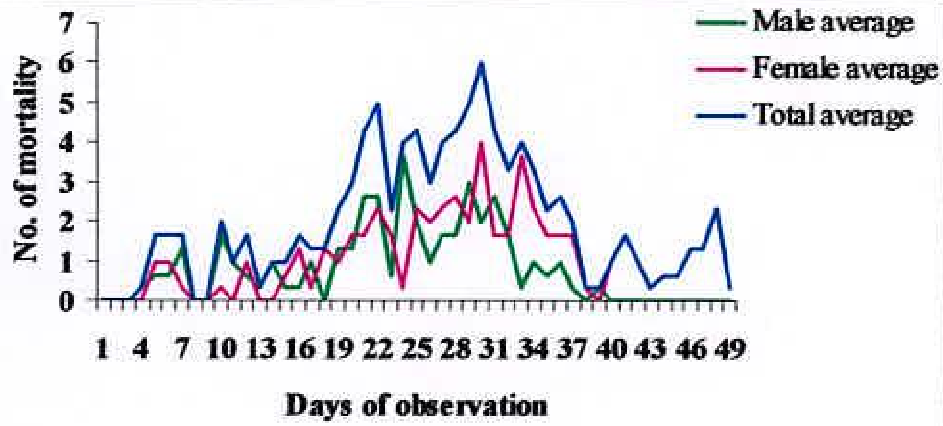

Figure 29. Daily mortality nos. of both sexes of *L. cuprina*, adult emerged from non-irradiated pupae, supplied water-sugar-liver (W-S-L)

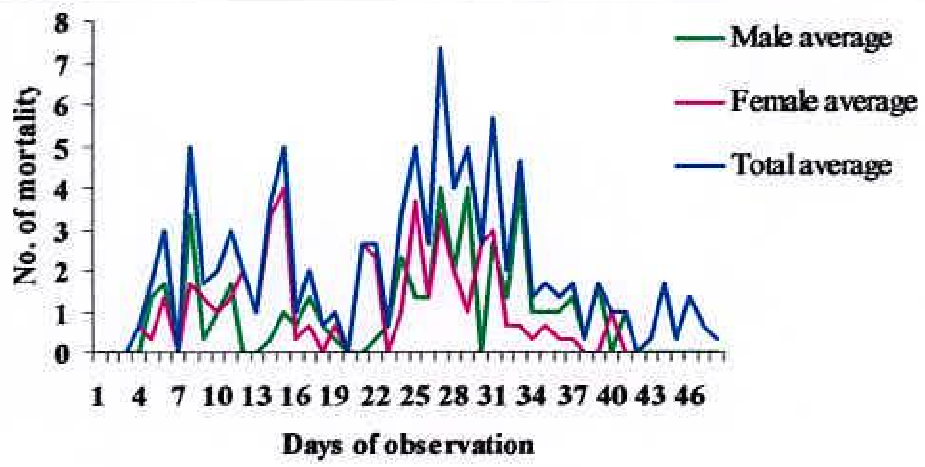

Figure 30. Daily mortality nos. of both sexes of *L. cuprina*, adult emerged from irradiated (4.5kr) irradiated pupae, supplied water-sugar-liver (W-S-L)

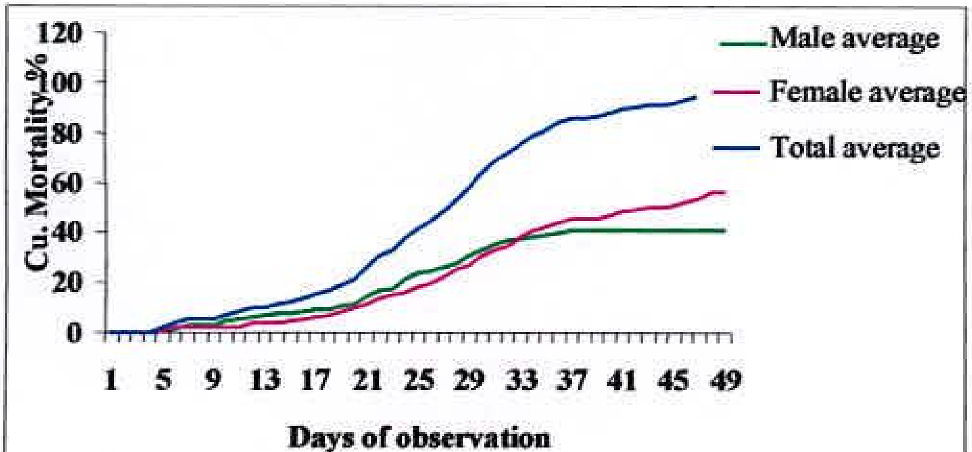

Figure 31. Daily cumulative mortality % of both sexes of *L. Cuprina*, adult emerged from non-irradiated pupae, supplied water-sugar-liver (W-S-L)

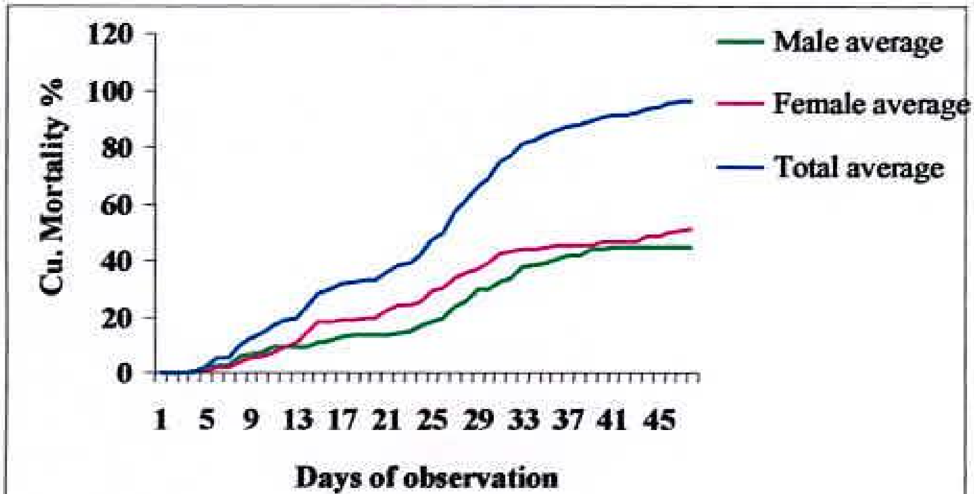

Figure 32. Daily cumulative mortality % of both sexes of *L. Cuprina*, adult emerged from irradiated (4.5kr) pupae, supplied water-sugar-liver (W-S-L)

* The numerical data for these Figures – 17 to 32 are presented in Appendix – 17 to 32.

From the above experiments the adult longevity traits with food supply could be summarized as follows: The longevity of adults ranged up to 5 days where no food were supplied. No difference was observed in longevity between sexes or application of irradiation in pupae at 4.5 kr. Adult longevity ranged up to 6 days which remained similar irrespective of sexes or irradiation treatment when only water was supplied to the adult colony. With only water-fish longevity extend up to 19 days by the addition of sugar in the food stock age limit goes beyond 35 days, also there happen to appears several peaks in the mortality curve, indicating that consistent food supplied increases the viability of adults, in general. To see the effect of food on Laboratory colony is a new attempt in case of fisheries and livestock pest in the colony. The idea to elucidate and predict the tentative fitness of the individual or population in the fields, when mass released.

Literature review reveals no such work on dietary stress of adult life span of *Lucilia cuprina*, (although there teauser of information on New World screwworm fly, *Cochlimyia hominivorax*). Except for Huda and Khan (1998), who found that on the effect of radiation and food on the mortality of blow fly *Lucilia cuprina*. Pupae of fly 2-3 days before eclosion were irradiated at 0, 3, 4 and 5 Krad from gamma source. After emergence they were provided with water-sugar-liver (W-S-L), sugar-liver (S-L), water-fish (W-F), water-sugar (W-S), water-liver (W-L), sugar-fish (S-F), liver (L), fish (F), sugar (S), or water (W). Mortality of irradiated males and females was not affected by any radiation doses when assessed up to 7 weeks after emergence. But dietary effects on the mortality of adults showed that 100%mortality of both sexes was achieved within (a) 7 weeks when fed with either WSL or WSF, (b) 5 weeks when fed with WS (c) 4 weeks when fed with WL, (d) 3 weeks when fed with WF or SL, and (e) 2 weeks when fed with SF. When fed with single food like L, F, S, W or without food survived for less than a week. The present study is in agreement with the results of Huda and Khan (1998). The logistics behind observing the longevity with different food stress and strain was to assess the tentative field situation of fly, life table and probable performance of the sterile released insects in the field. It is clear from the present work and the works done previously by several workers' Barton Browne L. (1979) that irradiation sterility is equally viable in the field as regards longevity concerned. Field situation is experienced by complex food and other environmental stress and strain and the lively activity of the flies are sequenced accordingly. Thus establishment of a thumb rule for adult longevity in the field is often difficult. However, the present study could provide a basis for prediction of the fate of released sterile flies in the field.

A very little is known about the nutritional requirement of adult flies as well as larvae. However, laboratory experiments helped to define the qualitative and quantitative requirements of female *L. cuprina* for protein rich food and to have a gross insight into the physiology of the reproduction process, with special reference to the ingested protein and ovarian development and subsequent egg laying. Webber (1958), Clift and McDonald (1976) investigated the adequacy of a number of naturally occurring protein sources and the larval development. Webber (1958) found that the faeces of sheep grazing pastures between April and November would support ovarian maturation and lively activities, while faeces produce between December and January do not. During the present study with laboratory cage experiment using different food, it was clearly observed that ingestion of protein rich food provide higher longevity along with other physiological cycles such as the oocyte maturation.

That, *L .cuprina* need carbohydrate and water to sustain life was also reported by Barton Browne (1979). In nature, these food materials may be frequently taken as carbohydrate solution in the form of nectar or honey dew produced by Scale insects in Australia. Webber (1957) showed that adequate carbohydrates are required for the survival of the flies in the laboratory tests. Good survival was also recorded by him when the flies were supplied with honey dew by scale insects. It was also observed from the crop of the field- caught flies that contains nectar and honey dew. In addition the flies feed on carrion and animal faeces contain considerable amount of carbohydrate. Barton Browne (1979) stated the field samples of flies *L. cuprina,* those ingested nectar or honey dew have a life span about 2-3 weeks which is closed to our present observation. He also stated that the males had always fewer life spans, also comply with the present study.

It is interesting to note that *L. cuprina* can with stand water starvation up to five days of emergence, which is supported by the statement by experimental proof (Barton Browne, 1979) that they possessed on well developed physiological mechanism for water intake and regulation and the flies can sustain themselves in arid environment.

4.2 Section-2:

4.2.1 The effect of pupal ageing on its weight:

Daily weight loss of the pupae (pre-pupae to adult transition) is presented in figure –33 and Appendix -33. Figure-33 indicates that there were about 22% loss in the pupal weight during the 4 days period of pre-pupate to pre-emergence.

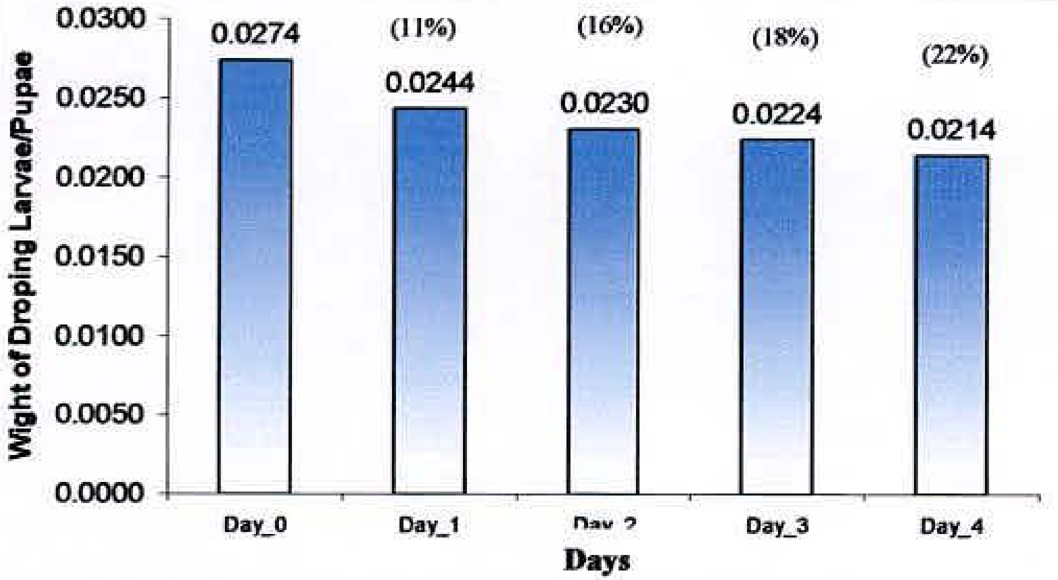

Figure 33. Daily weight loss of the pupae, (Pre-pupae to adult transition, % Wt. loss are shown in parenthesis.)

The correlation of the weight loss in course of time is presented in figure–34 along with the linear regression curve. This figure shows that the regression equation was y= -0.0014x+0.0265 and the correlation coefficient was R^2=0.9054. The correlation coefficient appears to be highly significant and the pupal weight is negatively correlated with duration (time).

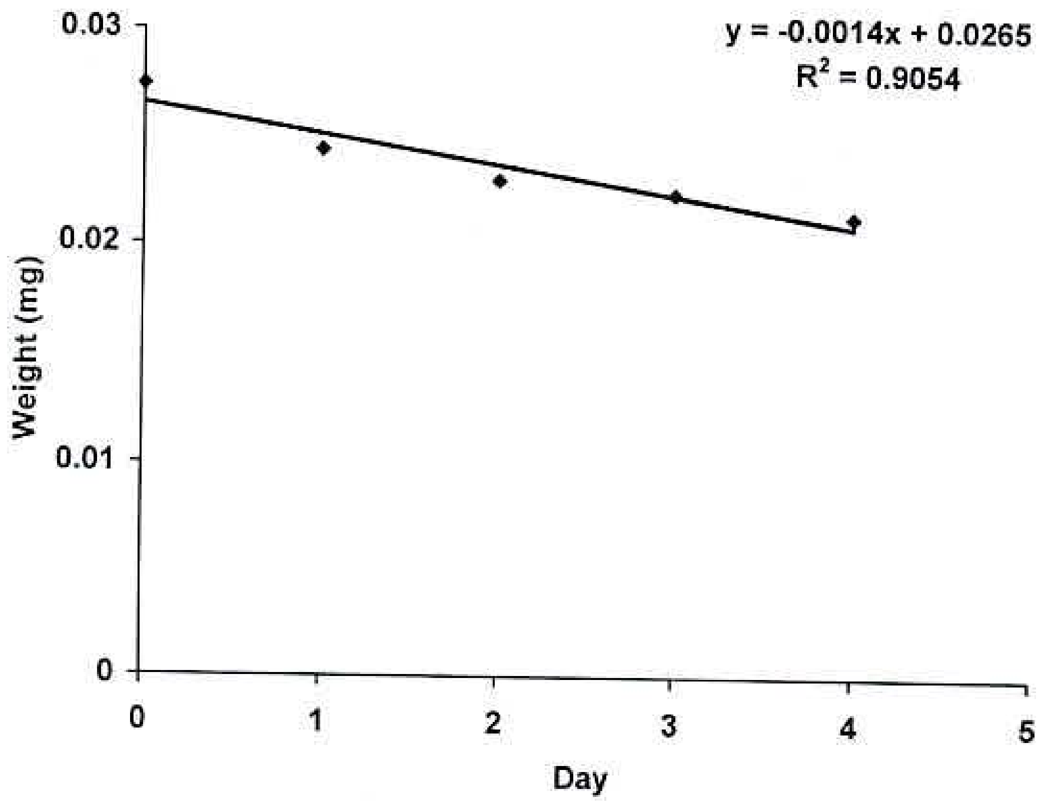

Figure 34. The correlation of weight loss in course of time along with the linear regression curve.

This is a universal observation for almost all of the pupating holometabolous insects (Shajahan *et al.* 1993). However the rate of loss or its pattern varies from insects to insects. In insects, the pupal period remained physically inactive where no intake of food takes place, but it remains physiologically active and morphogenesis for pupae-adult transition takes place. The physical inactiveness at this stage made it convenient for handling and a potentially stable criterion for the mass production quality measure of the insects while taking their weight as a parameter. However it is important to understand the flexibility of this parameter by knowing the nature of weight loss. Thus necessary error correction could be made during industrial mass production of insects for application in SIT pest management.

4.3 Section-3:

4.3.1 The effect of artificial larval diets on pupal weight.

Efforts were made to supplement and standardize different grades of poultry feed in order to rear blow fly larvae. These were Imported Poultry Feed (IPF), Marine Poultry Feed (MPF), and Local Poultry Feed (LPF). The idea was to formulate and screen for a cheaper food medium in larval rearing. To perform this experiment, larval diets were prepared by mixing different proportions of the above three grades of poultry feed along with the natural food medium (liver). The pupae obtained there from weighted to obtain pupal quality measures. These data are present as follows:

1. Pupal weight of blow fly *L. cuprina* larvae reared on Imported Poultry Feed based diet with different ratios namely IPF1, IPF2, IPF3, IPF4 and control.
2. Pupal weight of blow fly *L. cuprina* larvae reared on Marine Poultry Feed based diet with different ratios namely MPF1, MPF2, MPF3, MPF4 and control.
3. Pupal weight of blow fly *L. cuprina* larvae reared on Locale Poultry Feed based diet with different ratios namely LPF1, LPF2, LPF3, LPF4 and control.
4. Pupal weight of blow fly *L. cuprina* larvae reared on different based diet namely IPF, MPF, LPF and control.

Pupal weight obtained from the larvae feed with normal food that served as control is presented in appendix 34. Pupal weight obtained as a result of feeding four different mix of Imported Poultry Feed (IPF1, IPF2, IPF3 and IPF4) are presented in Appendix – 35, 36, 37 and 38 respectively.

Appendix – 39, 40, 41 and 42 represent the pupal weights obtained from larvae reared on the four different mix of Marine Poultry Feed (MPF1, MPF2, MPF3 and MPF4) respectively.

Larvae were reared on different doses (four mix) Local Poultry Feed (LPF1, LPF2, LPF3 and LPF4) and pupal weights obtain there from is presented in Appendix – 43, 44, 45 and 46 respectively.

The mean pupal weight (g) obtain from different rearing mix of Imported Poultry Feed (IPF1, IPF2, IPF3 ,IPF4 and control) are presented in Figure- 35 (Appendix -47).Here the control gave the best pupal weight followed by IPF1, IPF2, IPF3 and IPF4 in order.

The mean pupal weight (g) obtain from different rearing mix of Marine Poultry Feed (MPF1, MPF2, MPF3, MPF4) as compared to the control are presented in Figure-36 (Appendix -48).Here also the control gave the best pupal weight followed by MPF1> MPF2>MPF3>MPF4.

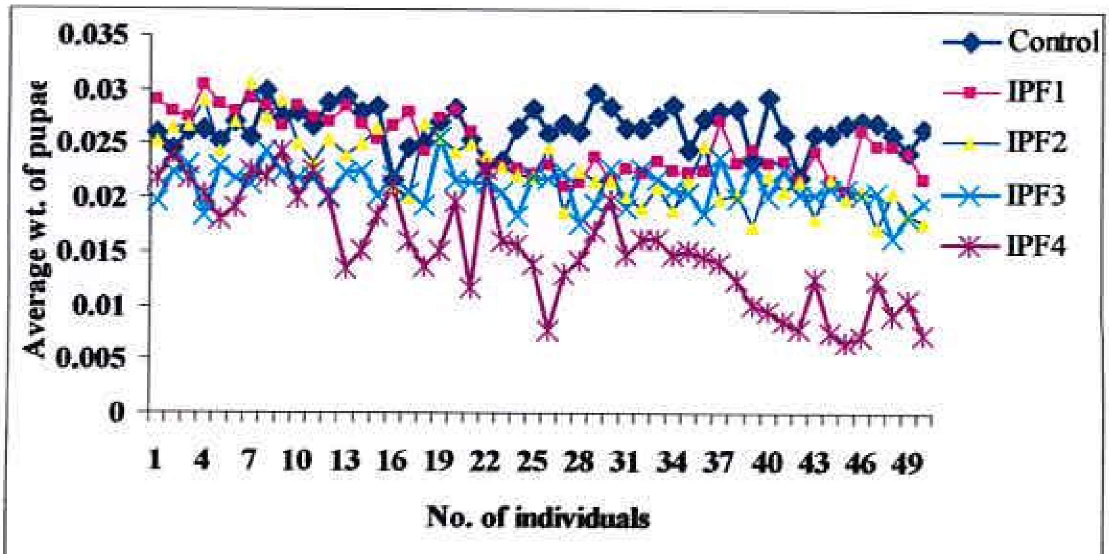

Figure 35. Pupal weight of blow fly *Lucilia cuprina* larvae reared on imported poultry feed based diet with different ratios namely IPF1, IPF2, IPF3,IPF4 & control.

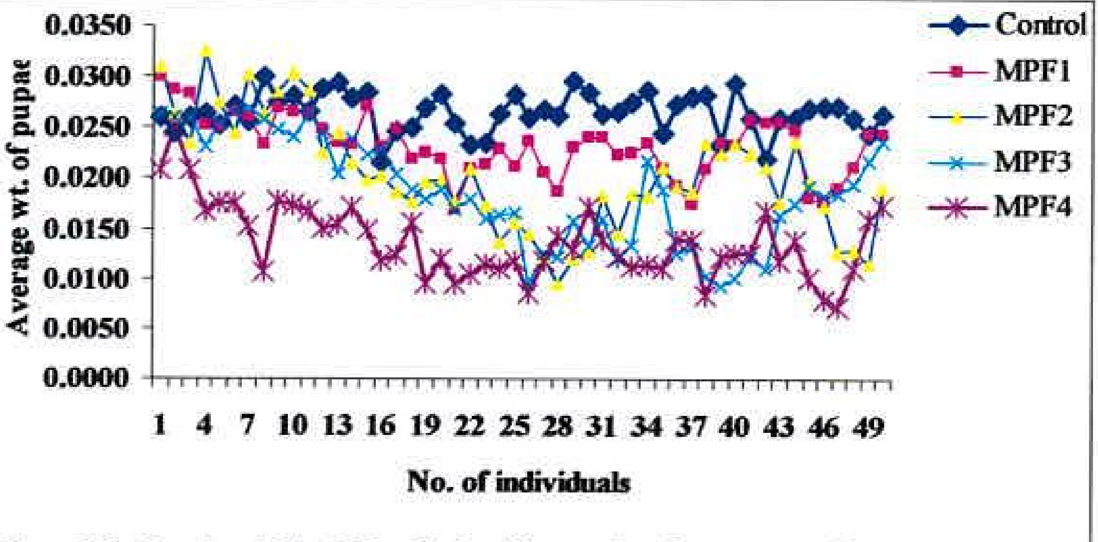

Figure 36. Pupal weight of blow fly *Lucilia cuprina* larvae reared on Marine Poultry Feed based diet with different ratios namely MPF1, MPF2, MPF3, MPF4 & control.

The mean pupal weight (g) obtain from different rearing mix of Local Poultry Feed (LPF1, LPF2, LPF3 and LPF4) in comparison with the control are presented in Figure-37 (Appendix -49).The similar observation was recorded in case LPF (Local Poultry Feed) series of rearing where the control gave the best product followed by LPF1 > LPF2 > LPF3 >LPF4.

Figure-38 represents the average weight of pupae of the three different dietary media Imported Poultry Feed (IPF), Marine Poultry Feed (MPF) and Local Poultry Feed (LPF) versus control and the data are presented in Appendix-50.Here the order of better pupal weight are as follows control > IPF > MPF > LPF.

All, the above cases indicated that when the larvae were reared on IPF (figure-35), MPF (figure-36) and LPF (figure-37), the pupal weight was always higher when the larvae was reared on its normal food medium.

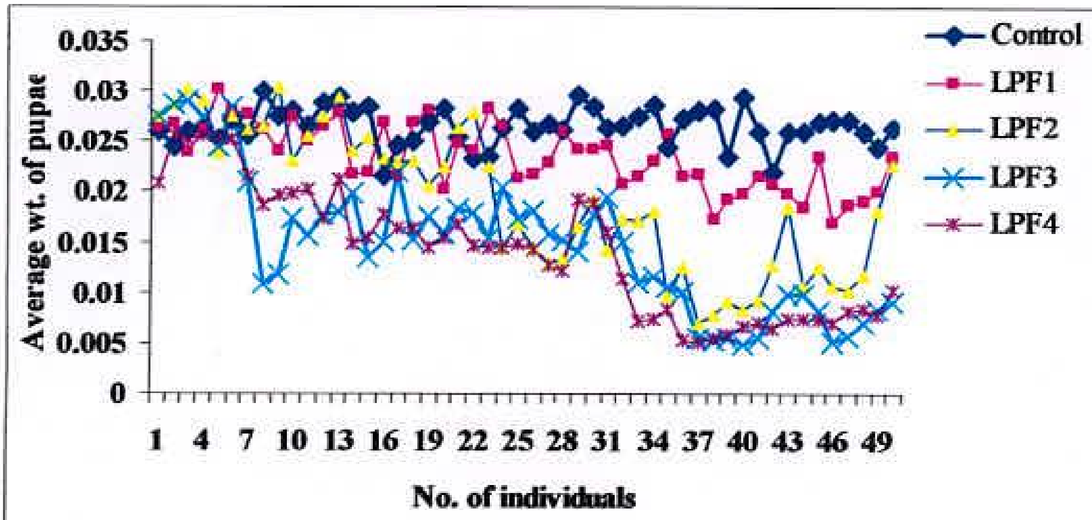

Figure 37. Pupal weight of blow fly *Lucilia cuprina* larvae reared onLocal PoultryFeed based diet with different ratios namely LPF1, LPF2, LPF3, LPF4 & control.

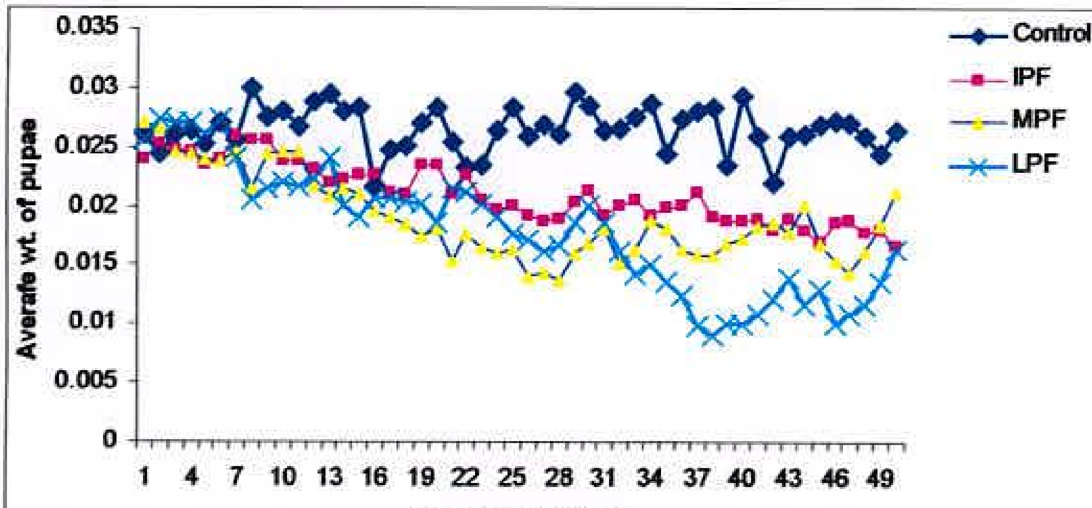

Figure 38. Pupal weight of blow fly *Lucilia cuprina* larvae reared on different based diet namely IPF, MPF, LPF & control.

To ascertain the degree goodness of fit for the pupal weight obtained from different grades of poultry feed (IPF, MPF and LPF) and their different dose mix along with the normal food medium were subjected to statistical analysis (ANOVA); the results of which is presented in Appendix –51.

The above data were also subjected to DMRT, to compare

A. Effect of different diets (Control, IPF, MPF and LPF) on pupal weight, presented in Table–1. This table indicated that mean pupal weight (mg) was 26.55, 21.08, 19.04 and 17.94 for control (Liver and Blood), IPF (Imported Poultry Feed), MPF (Marine Poultry Feed) and LPF (Local Poultry Feed) respectively. The table also indicated that each category of food was significantly different from each other.
B. Effect of different proportions (Pooled data for IPF, MPF, LPF) on pupal weight, presented in Table–2. This table indicated that mixing 50% of the artificial diet with the natural food medium of the larvae caused no quality loss.
C. Effect of different diets and proportions combined together presented in Table–3. This table showed that the combined effect of proportion as well as different formulations of commercial poultry feed blend. Control always ranked A, only IPF at proportion level 50% (i.e. 50 g IPF + 50 g liver + 20 ml blood) was not significantly different from control. Rests of proportions were always

significantly different from control as well as IPF1. All other diets (MPF, LPF) and there proportions were significantly different from the control.

Table 1. Effect of different diets on pupal weight at 5% DMRT

Diet	Mean of pupal weight	Ranked order
Control (Liver + Blood)	26.55	A
IPF (Imported Poultry Feed)	21.08	B
MPF (Marine Poultry Feed)	19.04	C
LPF (Local Poultry Feed)	17.94	C

Table 2. Effect of different proportions (pooled data for different diets) on pupal weight at 5% DMRT

% Proportions (Different diets)	Mean of pupal weight	Ranked order
50	24.61	A
100	22.26	B
150	20.32	C
200	17.43	D

Table 3. Effect of different diets and their proportions on the pupal weight at 5% DMRT.

Diets	Proportions	Pupal WT. (mg)	Rank
Control	50g liver+20ml blood	26.55	A
IPF	IPF1 (50g IPF + 50g liver+20ml blood)	25.01	AB
	IPF2 (100g IPF + 50g liver+20ml blood)	22.85	C
	IPF3 (150g IPF + 50g liver+20ml blood)	21.08	D
	IPF4 (200g IPF + 50g liver+20ml blood)	15.40	F
MPF	MPF1 (50g MPF + 50g liver+20ml blood)	23.32	C
	MPF2 (100g MPF + 50g liver+20ml blood)	20.38	DE
	MPF3 (150g MPF + 50g liver+20ml blood)	18.72	E
	MPF4 (200g MPF + 50g liver+20ml blood)	13.75	F
LPF	LPF1 (50g LPF + 50g liver+20ml blood)	23.57	BC
	LPF2 (100g LPF + 50g liver+20ml blood)	19.25	E
	LPF3 (150g LPF + 50g liver+20ml blood)	14.92	F
	LPF4 (200g LPF + 50g liver+20ml blood)	14.04	F

In an attempt to device low cost rearing media for larval mass rearing, three grades (Imported poultry feed, IPF; Marine poultry feed, MPF; Local poultry feed, LPF) of commercially available poultry feeds were used along with its natural food medium (liver). It was observed that there were no significant differences among three poultry feed supplements (Figure-35, 36, 37 and 38), although the IPF apparently showed a better performance in producing pupae with a higher weight. Again the natural food was always found to be the superior for larval rearing of blow fly. However mixing up to 50% of poultry feed in the diet made virtually no significant quality loss and remained in the acceptable range as per industrial "process control chart" stated by Boller *et al.* 1977. Mixing poultry feed in the diet up to more than 50% caused a significant depletion in the pupal weight concern, however it remained still acceptable as per other quality parameter concern i.e. emergence, startle activity, flight (Shahjahan *et al., personal communication).*

Chapter 5

Conclusion

CONCLUSION

Studies were conducted in three different aspects of mass rearing on the blow fly, *L. cuprina,* in relation to application of Sterile Insect Technique (SIT) for the management of the pest. These were (1)The effect of feeding different food medium to the adult longevity.(2)Loss of weight in the pupae during period pre-pupae to pre-emergence.(3)The effect of different larval feed on the production of quality pupae.

The aim of the first experiment series was to assess the probable nutritional requirement of the adult to sustain life and lively activities. The ultimate goal of such experiment was to predict how the field released flies would behave and sustain themselves in the field in other words how long the factory reared sterile flies could survive in the field to act as counterpart of the wild flies. Because longevity of the flies under food stress and strain is important here. It was evident from the experiments that laboratory population of *L. cuprina* survived up to 5 days without any food and water; they survived maximum 6 days when only water was given as food. Addition of sugar in the diet increased the longevity up to 37 days. When protein food was added to the diet in addition to sugar and water the longevity increase up to 36-49 days. It is interesting to note that the addition of proteinacious food to the diet increases the longevity remarkably as there various irregular mortality peaks i.e. there is no definite mortality peak that occurs due to starvation. In fact protein food is essential for the adult for the maturation eggs, enhanced sexual activities and for higher longevity, which sometimes become a crucial factor for the success of an SIT program.

The second experiment series was conducted on the extent of weight loss of the pupae during pre-pupae to pre-emergence. This information is essential for (1) Understanding the stage at which the pupal weight calibration should be done for mass scale quality control measure of the pupae.(2) To set the actual time of the irradiation of the pupae for sterilization. In *L. cuprina,* the percentage of loss in pupal weight is about 22%.

The third experiment was on the use of larval diet; The aim of these study were to devise a cheaper, easy available and a consistant diet medium for larvae production in mass rearing. Thus the different poultry feed were screened for there suitability as larval food. The feed were mixed with natural food medium (liver) of the *L. cuprina.* Among the three (Imported Poultry Feed, IPF; Marine Poultry Feed, MPF; Local Poultry Feed, LPF) different commercial blend of poultry feed available in the local market were used for this purpose. Only IPF was found to be suitable. Mixing up to 50% IPF was found to be suitable without scarifying any quality of the pupa.

Future Plan:

The present study is associated with the development of "SIT" technology against fish infesting fly *L. cuprina* offshore islands of Bay of Bengal. In fact SIT is an integration of physical, chemical and biological methods which uses the pest species itself to kill/suppress the pest. The major steps involved in SIT are: (A) Mass rearing of the target species.(B) Its radio-sterilization.(c) Mass release as pupa or adult.(D) Post release field assessment. Each of the steps requires innovative as well as routine research. The following area of research has been proposed to apply, maintain and improve the technology further.

A. Mass rearing:

1. Improvement of larval diet.
2. Improvement over all rearing environment of including factory automation.
3. Improvement and maintenance of larval, pupal and adult quality and setting up quality control measure as regards larval mortality, pupal weight, adult size, flight, mating behavior, mating competiveness, statle activity and longevity of adult.

B. Radio-sterilization:

1. Setting standard dose for sterilization.
2. Setting the critical period (age) for irradiation.
3. Determining the variables of the irradiation environment.

c. Field Release:

1. determining the population density and population dynamic of the release area
2. Setting the frequency of release (weekly or biweekly).
3. Feasibility of adult and larval release.
4. Setting standards for aerial release or hand release.
5. Regular post-releases monitoring of the program.
6. Finally assessment of lost benefit aspects as well as public awareness growing program.

References

REFERENCES

Alahmed, A. and Kheair, S. 2005. Present status of old world screw worm *Chrysomya bezziana* (Diptera: Calliphoridae); In the middle region of Saudia Arabia. IAEA-CN 131/31Pp 285.

Anderson, J.M.E.; Shipp, E. and Anderson, P. J. 1984b. Distribution of Calliphoridae in an arid zone habitat using baited sticky traps. *General and Applied Entomology* 16: 3-8.

Anderson, J.M.E.; Shipp, E.; Anderson, P.J. 1984a. Blowfly populations and strikeincidence in the arid zone of NSW. *Wool Technology and Sheep Breeding* 32 : 12-14.

Anderson, P. J.; Shipp, E.; Anderson, J.M.E. and Dobbie, W. 1988. Population maintenance *of Lucilia cuprina* (Wied.) in the arid zone. *Australian Journal of Ecology* 36:241-249.

Bailey, P. T. 1975. Behavioral changes induced by irradiating *Dacus cucumis* with gamma rays. J. Insect Physiol. 21:1247-1250.

Barton Browne, L. 1979. The behavior and nutritional requirements of adults of *Lucilia cuprina* possibilities for modification.National Symposium on the Sheep Blow fly and Fly Strike on sheep. N.S.W. Sydney, Australia. Pp 33-43.

Barton, N. J. 1982. Studies of sheep blowflies in Victoria. *Research Project* Series 116: Victorian Department of Agriculture, Australia.

Blackwell-G-L; Potter-M-A; Cottam-Y-H; Blair-H-T. 1997. Susceptibility of Romney and Perendale sheep to flystrike by the Australian green fly, *Lucilia cuprina* (Wied.), and fly attractant trials. *Proceedings of the New Zealand Society of Animal Production* 57 (0): 37-40

Boller, E. F. and Chambers, D. L. 1977 . Quality of mass reared insects. pages 219-236 in R. L. Ridgway and S. B. Vinson (eds.). Biological Control of Insects by Augmentation of Natural Enemies. Plenum press, New York .

Broadmeadow, M. E.; Gibson, J. E.; Dimmock, C.K.; Thomas, R.J. and O'Sullivan, B.A. 1984. The pathogenesis of flystrike in sheep. In Sheep Blowfly and Flystrike in Sheep. Second National Symposium, NSW Department of Agriculture, Sydney, Australia. Pp 327-331.

Busch-Petersen, E.; Pyrek, A.; Ripfel, J. and Ruhm, E. 1986. Efficiency of different mehods of EMS application for the induction of dominant lelhals in germ cells of medfly, *Ceratitis capilata* (Wied.), males. *Mutation Research,* 163: 247-254.

Cameron, S. S. 1908. Diseases of the skin. II - Parasitic skin diseases. I - Animal Parasites.Fly-blow in sheep. *Journal of Department Agriculture, Victoria* 6, 444-445.

Carpenter, J. E. 1991. Comparative response to radiation of T : Y (wp^+) 30 C genetic sexing strain and a wild type strain of the Mediterranean fruit fly (Diptera: Tephritidae). *J. Earn. Entomol.* 84 (6): 1705-1709.

Carson, R. 1963. The Silent Spring. Houghton Mifflin & Co. U. K.

Cirio, U.; De Murtas, I. and Barbera, D. 1974. The procida med fly pilot experiment. pages 809-814 in EUATOM program Biology , No. 2 .

Clift, A.D. and McDonald, F. J. D. 1976. Some relationships between diet and ovarian development in *Lucilia cuprina* (Wied.) (Diptera : Calliphoridae). *Aust. J. Zool.* 24: 87-93.

Coaker, T. H. and Smith, J. L. 1970. Sterilization of the cabbage rootfly *(Erioischia brassicae* (Ben.)) (Diptera : Anthoniziidae) with tepa : laboratory and field cage tests. *Bull. Entomol. Res.* 60: 53-59.

Curtis, C. F. 1966. A possible genetic method for the control of insect pests, with special reference to tsetse flies *(Glossina* sp.). *Bull. Entomol. Res.* 57: 509-523.

Dean, G. J. W., Dame, D. A. and Drikenmeyer, D. R. 1968. Field cage evaluation of the competitiveness of the male *Glossina morsitans oriertalis* (Vanderplank) sterilized with tepa or gamma irradiation. *Bull. Entomol. Res.* 59: 339-344.

Doe, P. E.; Ahmed, M.; Muslemuddin, M. and Schithananthan, K. 1977. A polythene tent drier for improved sun drying offish. *Food Technol. Aust.* 29 (11) : 437-441.

Donnelly, J. 1980. The effects of gamma radiation on the viability and fertility of *Lucilia sericata* (Mg.) (Dipt.) irradiated as pupae. *Entomologia exp. appl.* 3 : 46-58.

El-Gazzar, L. M. and Dame, D. A. 1983. Effects of combinations of irradiation and chemosterilization on mating competitiveness *of Culex quinquefasciatus* (Say). *J. Econ. Entomol.* 76(6): 1331-1334.

El-Gazzar, L. M.; Dame, D. A. and Smittle, B. J. 1983. Fertility and competitiveness *of Culex quinquefasciatus* (Say) males irradiated in nitrogen. *J. Econ. Entomol.* 76(4) 821-823.

Eric, B. J.; Donald, O. M.; David, R. L. and Loria, C. 1998. Mating-induced changes in olfactory-mediated behavior of laboratory reared normal, sterile and wild female Mediterranean fruit flies (Diptera : Tephritidae) mated to conspecific males. *Ann. Entomol. Soc. Am.* 91(1): 139-144.

Friedel, T. and McDonell, P. A. 1985. Cyromazine inhibits reproduction and larval development of the Australian sheep blow fly (Diptera ; Calliphoridae). *J. Econ. Entomol.* 78(4): 868-873.

Froggatt W.W. 1915. Sheep-maggot flies. *Farmers Bulletin* 95: 1-52.

Froggatt, W.W. 1904. The sheep maggot fly with some notes on other common flies.' *Agricultural Gazette of New South Wales* 15: 1205-121 1.

Fuffaker, C. and Smith, R. 1980. Rationale, Organization and Development of a National Integrated Pest Management Project, In: *New Technology in pest Control.* Huffaker, C. eds. pp. 1-24, John Welly & Sons.

Gabre-Refaat-M. 2002. Sarcosaprophagous flies in Suez Province, Egypt. I- seasonal distribution and sex-ratio. *Journal of the Egyptian Society of Parasitology.* 32 (3): 867-878.

Gleeson-D-M and Heath-A-C-G. 1997. The population biology of the Australian sheep blowfly, *Lucilia cuprina*, in New Zealand. *New Zealand Journal of Agricultural Research.*, 40 (4) 529-535.

Haisch, A. and Forster, S. 1976. Experimental estimating the flight activity in fruit fly (Dipt . : Trypetidae) . Anz. Schadlingskunde . 49: 17-21.

Haque, R; Islam, A.T.M.F.; Islam, S; and Huda, S.M.S. 1999a. Influence of food on the development and number of ovarioles in the *Lucilia cuprina* (Wied) (Diptera: Calliphoridae). *Progressive Agriculture,* 10(1&2): 161-164

Haque, R; Islam, A.T.M.F.; Islam, S. 1999b. Effect of gamma radiation on the quantitative aspect of sperm transfer in blow fly *Lucilia cnprina* (Wied) (Diptera: Calliphoridae). *Bangladesh J. Entomol.* 9 (1&2): 33-38

Heath, A. C. G. and Appleton, C. 2000. Small vertebrate carrion and its use by blowflies (Calliphoridae) causing ovine myiasis (flyslrikc) in New /ealand. *New Zealand Entomologist.* 22: 81-87.

Hooper, G. H. S. 1972. Sterilization of the Mediterranean fruit fly with gamma radiation : Effects on male competitiveness and change in fertility of females alternately mated with irradiated and untreated males. *J. Econ. Entomol.* 65 (1): 1-6.

Hooper, G.H.S. 1975. Sterilization of *Dacus cucumis* French (Diptera : Tephritidae) by gamma radiation . I. Effect of dose on fertility, survival and competitiveness. *j . Aust . Entomol . Soc.* 14: 81-87.

Huda, S. M. S.; Bhuyia, A. D.; Rezaur, R. and Ahmed, M. 1983a. Incidence of blow flies associated with fish drying in the offshore islands of Bangladesh and a study of *Lucilia cuptina* (Wied.) to eradicate them by Sterile Insect Release Method. *Nucl. Sc. and Appl.* 14 (SERIES A): 70-73.

Huda, S.M.S. 1997a. Effect of Gamma Radiation on the pupation of Blow fly *(Lucilia cuprina).* (Wied)(Diptera: Calliphoridae). *Nuclear Sci. and Application,* 6(l&2):27-32

Huda, S.M.S. 1997b. The influence of gamma radiation copula duration and mating propensity in *Lucilia cuprina* (Wied) (Diptera: Calliphorisae). *Nuclear Sci. and Application,* 6(l&2):33-35

Huda, S.M.S. and R.N. Khan 2000, Longevity and mating competitiveness of irradiated males and unitreared wild-type F_1 males and females of blow fly *(Lucilia cuprina)* (Wied) in the laboratory. *Bangladesh J. Life Sci.* 12(1&2): 99-102

Huda, S.M.S. and R.N. Khan, 2001. An easy technique for handling and sexing *Lucilia cuprina* adult blow flies in sterile insect release method (SIR.M). *Bangladesh J. Life Sci.* 13(1&2): 145-148.

Huda, S.M.S. and R.N. Khan. 1998. Effect of radiation and food on the mortality of the adult blow fly *(Lucilia cuprina}* (Wied)(Diptera: Calliphoridae), *J. Asiat. Soc. Bangladesh.* 24(l): 55-62.

Huda, S.M.S.; Shaha, A.K; Shahjahan, R.M and Khan, R.N. 1999. A preliminary Survey and trapping of Blow fly for the application sterile insect technique (SIT) in the off-shore island Sonadia of Bay of Bengal. *Bangladesh Atomic Energy Commission,* IFRB-PCM-SIT-1 April, 1999.

Huda, S.M.S; Hooper, G.H.S and Singh-Asa, S. 1983b. The Sterilisation of the Australian sheep blow fly *(Lucilia cuprina)* (Wied)(Diptera: Calliphoridae), by gamma radiation. *J. Aust. Ent. Soc.* 22: 201-204

Huettel, M. D. 1976. Monitoring the quality of Laboratory reared insects: A biological and behavioral perspective. *Environ . Entomol.* 5: 807-814.

Ikebuchi, M. and Nakao. 1973. Storage effects on translations and dominant lethals induced by ethyl methanesulphonate (EMS) in *Drosophila melanogaster, Jpn. J. Genet.* 54(2): 133-137.

Knapp, F. W. and Herald, F. 1983. Mortality of eggs and larvae of the Face fly (Diptera: Muscidae) after exposure of adults to surface treated with BAY SIR 8514 and Penfluron. *J. Econ. Entomol.* 76(6) : 1350-1352.

Knipling, E. F. 1979. The basic principles of insect population suppression and management. *USDA Agriculture. Hand book no.* 512 Sept. : 623pp.

Knipling, E. F. 1982. Present status and future trend of SIT approach to the control of arthropod pests, In: *Sterile Insect Technique and the Radiation in Insects Control, IAEA/STI/PUB./595, Vienna,* pp. 3-24.

Leppla, N. C.; Huettel, M. D. and Turner, W. K. 1976. Comparative life history and respiratory activity of wild and colonized Caribbean fruit flies (Dipt . : Tephritidae) . *Entomophaga* 21 : 353-357.

Lukins, G. 1989. Human cutaneous myiasis in Brisbane: a prospective study. *Medical Journal of Australia* 30: 237-240.

MacKenzie, J.A. and Anderson, N. 1990. Insecticidal control of *Lucilia cuprina:* strategic timing of treatment. *Australian Veterinary Journal* 67: 385-386.

Mackerras, I.M. 1930. Recent developments in blowfly research. *Journal of Council Scientific and Industrial Research Aus*tralia 3:212-19.

Mackerras, I.M. and Fuller, M. 1937. A survey of Australian sheep blowflies. *Journal for Council of Scientific and Industrial Research, Australia* 10: 261-270.

Mahon, R.; Ahmed, H. and Mahon, D 2005. Seeding rates during mass rearing of the old world screw worm fly. IAEA-CN 131/151P, 281-282.

ManDson, H. C.; Mary, C. P. and Stanley, W. J. 1969. Effects of irradiation on mating preference and reproduction suppression of *Drosophila melanogaster. J. Econ. Entomol.* 62(4); 818-821.

Manoukas, A.G. and Tsiropoulos, G.J. 1977. Effect of density upon larval survival and pupal yield of the olive fruit fly. *Ann. Entomol. Soc. Am.* 70 : 414-416 .

McLeod, L.J. 1997. The Australian sheep blowfly, *Lucilia cuprina* (Wied.) and the hairy maggot blowfly, *Chrysoniya rufifacies* (Macq.) in the arid zone of New South Wales. *M. Sc. Thesis, CERIT, School of Biological Sciences, University of New South Wales.* pp 1-166.

McQuillan, P.M.; Jones, A.L. and Williams, H. 1984. Recent studies on sheep blowflies in Tasmania. In Sheep Blowfly and Flystrike in Sheep. *Second National Symposium, NSW Department of Agriculture, Sydney, Australia,* p 100-104.

Moe, S.J.; Stenseth, N.C.; Smith, R.H. 2001. Effects of a toxicant on population growth rates: Sublethal and delayed responses in blowfly populations. : *Functional-Ecology* 15 (6): 712-721.

Monzu, N. and Mangano, G.P. 1984. The development of an early warning system for the timing of insecticide application to prevent body strike on sheep in Western Australia. *Western Australia Department of Agriculture, Agdex,* 612, Pp57.

Moreno, D.S.; Sanchez, M.; Robacker, D.C. and Worley, J. 1991. Mating competitiveness of irradiated Mexican fruit fly (Diptera : Tephritidae).*J. Econ. Entomol* 84(4): 1227-1234.

Morris-M-C; Joyce-M-A; Heath-A-C-G; Rabel-B; Delisle-G-W; 1997. The response of *Lucilia cuprina* to odors from sheep, offal and bacterial cultures. *Medical and Veterinary Entomology* 11(1): 58-64

Muller, P. 1988. Pesticide food and environmental implications. IAEA/ STI/ PUB/ 764. Viena, Austria.

Murray, M.D. 1978. The species of flies reared from struck sheep in Western Australia. *Australian Veterinary Journal* 54: 262.

Norris, K.R. 1990. Evidence for multiple exotic origin of Australian populations of the sheep blowfly, *Lucilia cuprina* (Wiedemann) (Diptera: Calliphoridae). *Australian Journal of Zoology* 38: 635-48.

Pollock, J. N. 1971. Sterility and the mated status test in tepa-treated male sheep blow-flies, *Lucilia sericata* (Mg.) (Diptera : Calliphoridae). *Bull. Entomol. Res.* 60: 663-669.

Rhode, R. 1975. A medfly eradication proposal for Central America. IAEA/ Pub. 1976b.pp. 159-166.

Ryan, A.F.; 1954. The sheep blowfly problem in Tasmania. *Australian Veterinary Journal* April edition 109-113.

Scholtz-A-J; Cloete-S-W-P; Laubscher-J-M; de-Beer-E-F. 2000. A preliminary evaluation of a sheep blowfly trap in the Western Cape. *Journal-of-the-South-African-Veterinary-Association,* 71 (3): 148-152.

Schroeder, W. J. and Chambers, D. L. 1973. Mediterranean fruit fly: Propensity to flight of sterilized flies . *J . Econ . Entomol* . 66: 1261-1262 .

Seo, S. T.; Williamson, D. L. and Fujimoto, M. 1987. *Ceratitis capitata* (Diptera : Tephritidae) colorimetric method to estimate age and rate of development of pupae for the Sterile Insect Technique. *J. Econ. Entomol.* 80(5): 1087-1090.

Shahjahan, R. M.; Bhuyian, A. D. and Khan, R N. 1994. Laboratory rearing of blow fly, *Lucilia cuprina* (Wied.) in relation to application in SIT-Pest management. *Nucl. Sc. and Appl.* 3(2): 69-72.

Sharp, J. D. and Webb, J. C. 1977. Flight performance and signaling sound of irradiated or unirradiated *Anastrepha suspense* . In Quality Control of Fruit fly , Boller and Chambers (eds.) . Pp 33-34.

Shorey, L. and McKelvey, J. 1977. Chemical control of insect behavior; Theory and application. John Willey & Sons.

Singhamony, S., Anees, I.., Chadrakala, T. and Osmani, Z. 1986. *J. Stored Prod. Res.* 22:21-23.

Tillyard, R.J. and Seddon, H.R. 1933. The sheep blowfly problem in Australia. Joint Blowfly Committee, Report No.1. *Council for Scientific and Industrial Research Australia,* Pamphlet No. 37.

Vogt, W.G. and Woodburn, T.L. 1979. Ecology, distribution and importance of sheep myiasis flies in Australia. *National Symposium on the Sheep Blowfly and Flystrike in Sheep.* New South Wales Department of Agriculture Sydney, Australia. Pp23-32.

Waterhouse, D. F. 1962. Insect control by radiation sterilization in Australia. Int. *J. Appl. Radiation and Isotopes.* 13 : 435-439.

Waterhouse, D.F. 1947. The relative importance of live sheep and carrion as breeding grounds for the Australian sheep blowfly, *Lucilia cuprina. Bulletin for Council of Scientific and Industrial Research,* No. 217.

Waterhouse, D.F. and Paramanov, S.J. 1950. The status of two species of *Lucilia* (Diptera:Calliphoridae) attacking sheep in Australia. *Australian Journal for Scientific Research* (B) 3:310-336.

Watts, J.E.; Muller, M.J.; Dyce, A.L. and Norris, K.R.. 1976. The species of flies reared from struck sheep in south-eastern Australia. *Australian Veterinary Journal* 52: 488-489.

Webber, L. G. 1958. Nutrition and reproduction in the Australion sheep blow fly *Lucilia cuprina. Aust. J. Zool.* 6:139-144.

Weisbrot, D.R. 1969. Effects of radiation on competitive ability in *Drosophila melanogaster. Genetics.* 62(4): 819-825.

Whitten, M. J.; Foster, G. G.; Vogt, W. G.; Kitching, R. L.; Woodbern, T. L. and Konovalov, C. 1977. Current status of genetic control of the Australian sheep blow fly, *Lucilia cuprina* (Wiedemann) (Diptera : Calliphoridae). *Proc. IV Int. Cong. Entomology. Washington, D. C.,* 1976. pp. 129-139.

Whitten, M.J. and Taylor, W.C. 1970. Arole for sterile females in insects control. *J. Econ. Entomol.* 63: 269-272.

Wilkinson, P.R. and Norris, K.R. 1961. Australian sheep blowfly infesting a bullock. *Journal of the Australian Institute of Agricultural Science* 27: 25-26.

Wong, T. T. Y.; Kobayashi, R. M. and McInnis, D. O. 1986. Mediterranean fruit fly (Diptera : Tephritidae) : Methods of assessing the effectiveness of sterile insect releases. *J. Econ. Entomol.* 79 : 1501-1506.

Wong, T.; Mohsen, Y.; Ramadan, M.; Herr, J. C. and Mcinnis, D. O. 1992. Suppression of a Mediterranean fruitfly (Diptera : Tephritidae) population with concurrent parasitoid and sterile fly release in Kula, Maui, Hawii. - *J, Econ. Entomol.* 85(5): 1671-1681.

Young, A.R.; Mancuso, N.; Meeusen, E.N. and Bowles,V.M., 2000. Characterisation of proteases involved in egg hatching of the sheep blowfly, *Lucilia cuprina. Int. J. for Parasitology.* 30(8): 925-932.

Appendix-1: Daily mortality rate of sexes (male and female) of *Lucilia cuprina* , adult emerged from non-irradiated pupae (100 nos.) supplied no food

Sexes	No. of mortality				
	Day-1	Day-2	Day-3	Day-4	Day-5
Male average	0	0	5	41.33	3.66
Female average	0	0	0.33	32.33	15.66
Total average	0	0	5.33	73.66	19.32

Appendix-2: Daily mortality rate of sexes (male and female) of *Lucilia cuprina* , adult emerged from irradiated pupae (100 nos.), supplied no food

Sexes	No. of mortality				
	Day-1	Day-2	Day-3	Day-4	Day-5
Male average	0	0	18.66	28.66	1.66
Female average	0	0	0	24.44	19.33
Total average	0	0	18.66	53.1	20.99

Appendix-3: Daly cumulative mortality % of sexes (male and female) of *Lucilia cuprina* , adult emerged from non- irradiated pupae (100 nos.), supplied no food

Sexes	Cu. mortality %				
	Day-1	Day-2	Day-3	Day-4	Day-5
Male average	0	0	5	46.33	50
Female average	0	0	0.33	32.66	48.33
Total average	0	0	5.33	78.99	98.33

Appendix-4: Daly cumulative mortality % of sexes (male and female) of *Lucilia cuprina* , adult emerged from irradiated pupae (100 nos.) ,supplied no food

Sexes	Cu. mortality %				
	Day-1	Day-2	Day-3	Day-4	Day-5
Male average	0	0	18.66	47.33	49
Female average	0	0	0	24.33	43.66
Total average	0	0	18.66	71.66	92.66

Appendix-5: Daily mortality nos. of sexes (male and female) of *Lucilia cuprina* , adult emerged from non-irradiated pupae (100 nos.) , supplied only water

Sexes	No. of mortality					
	Day-1	Day-2	Day-3	Day-4	Day-5	Day-6
Male average	0	0	11.33	35	1	0
Female average	0	0	1.33	44	5	0.66
Total average	0	0	12.66	79	6	0.66

Appendix-6: Daily mortality nos. of both sexes (male and female) of *Lucilia cuprina*, adult emerged from irradiated pupae (100 nos.) , supplied only water

Sexes	No. of mortality				
	Day-1	Day-2	Day-3	Day-4	Day-5
Male average	0	1	36.33	12.33	0
Female average	0	0.33	26	21	1
Total average	0	1.33	62.66	33.33	1

Appendix-7: Daily Cumulative mortality % of both sexes (male and female) of *Lucilia cuprina* , adult emerged from non-irradiated pupae (100 nos.) , supplied only water

Sexes	Cu. mortality %					
	Day-1	Day-2	Day-3	Day-4	Day-5	Day-6
Male average	0	0	11.33	46.33	47.33	47.33
Female average	0	0	1.33	45.33	48.33	49
Total average	0	0	12.66	91.66	95.66	96.33

Appendix-8: Daily Cumulative mortality % of both sexes (male and female) of *Lucilia cuprina,* adult emerged from irradiated pupae (100 nos.) , supplied only water

Sexes	Cu. mortality %				
	Day-1	Day-2	Day-3	Day-4	Day-5
Male average	0	1	37.66	50	50
Female average	0	0.33	26.33	47.33	48.33
Total average	0	1.33	63.99	97.33	98.33

Appendix-9: Daily mortality nos. of both sexes (male and female) of *Lucilia cuprina*, adult emerged from non- irradiated pupae (100 nos.) ,supplied only fish

Sexes	No. of mortality					
	Day-1	Day-2	Day-3	Day-4	Day-5	Day-6
Male average	0	0	0.33	4	26.33	5
Female average	0	0	0	1.33	9	4.33
Total average	0	0	0.33	5.33	35.33	9.33

Sexes	No. of mortality			
	Day-7	Day-8	Day-9	Day-10
Male average	6	2.33	1	0
Female average	17.33	10	3.66	5
Total average	23.33	12.33	4.66	5

Appendix-10: Daily mortality nos. of both sexes (male and female) of *Lucilia cuprina*, adult emerged from irradiated pupae (100 nos.) ,supplied only fish.

Sexes	No. of mortality					
	Day-1	Day-2	Day-3	Day-4	Day-5	Day-6
Male average	0	7	5.33	17.66	15.66	5.33
Female average	0	2	5.33	5.33	3.66	9
Total average	0	9	10.66	22.99	19.32	14.33

Sexes	No. of mortality		
	Day-7	Day-8	Day-9
Male average	2.66	0.33	0
Female average	10.66	2.66	3
Total average	13.32	2.99	3

Appendix-11 Daily Cumulative mortality % of both sexes (male and female) of *Lucilia cuprina* , adult emerged from non- irradiated pupae (100 nos.) ,supplied only fish.

Sexes	Cu. Mortality %					
	Day-1	Day-2	Day-3	Day-4	Day-5	Day-6
Male average	0	0	0.33	4.33	30.66	35.66
Female average	0	0	0	1.33	10.33	14.66
Total average	0	0	0.33	5.66	40.99	50.32

Sexes	Cu. Mortality %			
	Day-7	Day-8	Day-9	Day-10
Male average	41.66	44	45	45
Female average	32	42	45.66	50.66
Total average	73.66	86	90.66	95.66

Appendix-12: Daily Cumulative mortality % of both sexes (male and female) of *Lucilia cuprina.* irradiated pupae (100 nos.) , supplied only fish

Sexes	Cu. Mortality %					
	Day-1	Day-2	Day-3	Day-4	Day-5	Day-6
Male average	0	7	12.33	30	45.66	51
Female average	0	2	7.33	12.66	16.33	25.33
Total average	0	9	19.66	42.66	61.99	76.33

Sexes	Cu. Mortality %		
	Day-7	Day-8	Day-9
Male average	53.66	54	54
Female average	36	38.66	41.66
Total average	89.66	92.66	95.66

Appendix-13: Daily mortality nos. of both sexes (male and female) of *Lucilia cuprina*, adult emerged from non-irradiated pupae (100 nos.) ,supplied water-fish (W-F)

Sexes	No. of mortality				
	Day-1	Day-2	Day-3	Day-4	Day-5
Male average	0	0	0.33	0.66	17
Female average	0	0	0	0.33	11.66
Total average	0	0	0.33	0.99	28.66

Sexes	No. of mortality				
	Day-6	Day-7	Day-8	Day-9	Day-10
Male average	4.66	3	1.33	0.33	0
Female average	8.33	1.33	3.66	3.33	2
Total average	12.99	4.33	4.99	3.66	2

Sexes	No. of mortality				
	Day-11	Day-12	Day-13	Day-14	Day-15
Male average	0.33	0.66	1.33	3.33	4.33
Female average	2.33	1.33	3.33	3.66	1.66
Total average	2.66	1.99	4.66	6.99	5.99

Sexes	No. of mortality			
	Day-16	Day-17	Day-18	Day-19
Male average	1	0	0	0
Female average	5.66	0	2.33	3
Total average	6.66	0	2.33	3

Appendix-14 Daily mortality nos. of both sexes (male and female) of *Lucilia cuprina,* adult emerged from irradiated pupae (100 nos.), supplied water-fish (W-F)

Sexes	No. of mortality				
	Day-1	Day-2	Day-3	Day-4	Day-5
Male average	0	0.33	1	25.66	6.66
Female average	0	0	2	2.66	1.33
Total average	0	0.33	3	28.32	7.99

Sexes	No. of mortality				
	Day-6	Day-7	Day-8	Day-9	Day-10
Male average	8	2.33	1.33	0.33	0
Female average	2.66	4.33	5.66	5	6.66
Total average	10.66	6.66	6.99	5.33	6.66

Sexes	No. of mortality				
	Day-11	Day-12	Day-13	Day-14	Day-15
Male average	0.33	0.66	0	0	0
Female average	10	4.66	0	1	1
Total average	10.33	5.32	0	1	1

Sexes	No. of mortality			
	Day-16	Day-17	Day-18	Day-19
Male average	0	0	0	0
Female average	1.33	1	1.66	0.33
Total average	1.33	1	1.66	0.33

Appendix-15: Daily Cumulative mortality % of sexs (male and female) of *Lucilia cuprina*, adult emerged from non-irradiated pupae (100 nos.) ,supplied water-fish (W-F)

Sexes	Cu. Mortality %				
	Day-1	Day-2	Day-3	Day-4	Day-5
Male average	0	0	0.33	1	18
Female average	0	0	0	0.33	12
Total average	0	0	0.33	1.33	30

Sexes	Cu. Mortality%				
	Day-6	Day-7	Day-8	Day-9	Day-10
Male average	22.66	25.66	27	27.33	27.33
Female average	20.33	21.66	25.33	28.66	30.66
Total average	42.99	47.32	52.33	55.99	57.99

Sexes	Cu. Mortality %				
	Day-11	Day-12	Day-13	Day-14	Day-15
Male average	27.66	28.33	29.66	33	37.33
Female average	33	34.33	37.66	41.33	43
Total average	60.6	62.66	67.32	74.33	80.33

Sexes	Cu. Mortality %			
	Day-16	Day-17	Day-18	Day-19
Male average	38.33	38.33	38.33	38.33
Female average	48.66	53.66	56	58.33
Total average	86.99	91.99	94.33	96.66

Appendix-16 Daily cumulative mortality % of both sexes (male and female) of *Lucilia cuprina,* adult emerged from irradiated pupae (100 nos.), supplied water-fish (W-F)

Sexes	Cu. Mortality %				
	Day-1	Day-2	Day-3	Day-4	Day-5
Male average	0	0.33	1	27	33.66
Female average	0	0	2	4.66	6
Total average	0	0.33	3	31.66	39.66

Sexes	Cu. Mortality %				
	Day-6	Day-7	Day-8	Day-9	Day-10
Male average	41.66	44	45.33	45.66	45.66
Female average	8.66	13	18.66	23.66	30.33
Total average	50.32	57	63.99	69.32	75.99

Sexes	Cu. Mortality %				
	Day-11	Day-12	Day-13	Day-14	Day-15
Male average	46	46.66	46.66	46.66	46.66
Female average	40.33	45	45	46	47
Total average	86.33	91.66	91.66	92.66	93.66

Sexes	Cu. Mortality %			
	Day-16	Day-17	Day-18	Day-19
Male average	46.66	46.66	46.66	46.66
Female average	48.33	49.33	51	51.33
Total average	94.99	95.99	97.66	97.99

Appendix-17: Daily mortality nos. of both sexes (male and female) of *Lucilia cuprina*, adult emerged from non- irradiated pupae (100 nos.),supplied water-sugar (W-S)

Sexes	No. of mortality				
	Day-1	Day-2	Day-3	Day-4	Day-5
Male average	0	0	0	0	0
Female average	0	0	0	0	0
Total average	0	0	0	0	0

Sexes	No. of mortality				
	Day-6	Day-7	Day-8	Day-9	Day-10
Male average	0	0	0.33	0.33	0.33
Female average	0	0	0.66	0.66	0.66
Total average	0	0	0.99	0.99	0.99

Sexes	No. of mortality				
	Day-11	Day-12	Day-13	Day-14	Day-15
Male average	1	0.66	2	3	1
Female average	1.33	3.33	2	1.33	3.33
Total average	2.33	3.99	4	4.33	4.33

Sexes	No. of mortality				
	Day-16	Day-17	Day-18	Day-19	Day-20
Male average	0	0.66	4	4.66	10.66
Female average	6	3.66	6.66	4.33	1.66
Total average	6	4.32	10.66	8.99	12.32

Sexes	No. of mortality				
	Day-21	Day-22	Day-23	Day-24	Day-25
Male average	6	1.66	0.66	0	0.66
Female average	2.66	2.32	8	2.33	0
Total average	8.66	3.99	8.66	2.33	0.66

Sexes	No. of mortality				
	Day-26	Day-27	Day-28	Day-29	Day-30
Male average	2	0.33	1.33	0	0
Female average	0.33	0	0.33	0	0.33
Total average	2.33	0.33	1.66	0	0.33

Sexes	No. of mortality				
	Day-31	Day-32	Day-33	Day-34	Day-35
Male average	0	0	0	0	0
Female average	0.66	0.33	0.33	0.33	1
Total average	0.66	0.33	0.33	0.33	1

Sexes	No. of mortality	
	Day-36	Day-37
Male average	0	0
Female average	0.33	0.33
Total average	0.33	0.33

Appendix-18: Daily mortality nos. of both sexes (male and female) of *Lucilia cuprina*, adult emerged from irradited pupae (100 nos.), supplied water-sugar (W-S)

Sexes	No. of mortality					
	Day-1	Day-2	Day-3	Day-4	Day-5	Day-6
Male average	0	0.33	0	0.66	0	1.33
Female average	0	0	0	0	0	0
Total average	0	0.33	0	0.66	0	1.33

Sexes	No. of mortality					
	Day-7	Day-8	Day-9	Day-10	Day-11	Day-12
Male average	0.33	1.66	1.33	0.33	0	2.33
Female average	0	0	0.66	1.33	1.33	0.66
Total average	0.33	1.66	1.99	1.66	1.33	2.99

Sexes	No. of mortality					
	Day-13	Day-14	Day-15	Day-16	Day-17	Day-18
Male average	1.33	2.66	1.66	0.33	6	6
Female average	1.66	2	2.66	4	1.33	3.33
Total average	2.99	4.66	4.32	4.33	7.33	9.33

Sexes	No. of mortality					
	Day-19	Day-20	Day-21	Day-22	Day-23	Day-24
Male average	6.33	5.33	6	1	2.33	1.33
Female average	2.66	2.66	2.33	7	2.33	1
Total average	8.99	7.99	8.33	8	4.66	2.33

Sexes	No. of mortality					
	Day-25	Day-26	Day-27	Day-28	Day-29	Day-30
Male average	2	1.33	1.33	0.33	0.33	0
Female average	0.66	1	0	0.33	0.66	0
Total average	2.66	2.33	1.33	0.66	0.99	0

Sexes	No. of mortality					
	Day-31	Day-32	Day-33	Day-34	Day-35	Day-36
Male average	0	0	0	0	0	0.66
Female average	0.33	0.66	0.66	0	0.66	0.66
Total average	0.33	0.66	0.66	0	0.66	1.32

Appendix-19: Daily cumulative mortality % of both sexes (male and female) of *Lucilia cuprina, a*dult emerged from non. irradiated pupae (100 nos.) ,supplied water-Sugar (W-S)

Sexes	Cu. mortality %				
	Day-1	Day-2	Day-3	Day-4	Day-5
Male average	0	0	0	0	0
Female average	0	0	0	0	0
Total average	0	0	0	0	0

Sexes	Cu. Mortality %				
	Day-6	Day-7	Day-8	Day-9	Day-10
Male average	0	0	0.33	0.66	1
Female average	0	0	0.66	1.33	2
Total average	0	0	0.99	1.99	3

Sexes	Cu. Mortality %				
	Day-11	Day-12	Day-13	Day-14	Day-15
Male average	2	2.66	4.66	7.66	8.66
Female average	3.33	6.66	8.66	10	13.33
Total average	5.33	9.32	13.22	17.66	21.99

Sexes	Cu. Mortality %				
	Day-16	Day-17	Day-18	Day-19	Day-20
Male average	8.66	9.33	13.33	18	28.66
Female average	19.33	23	29	34	35.66
Total average	27.99	32.33	42.33	52	64.32

Sexes	Cu. mortality %				
	Day-21	Day-22	Day-23	Day-24	Day-25
Male average	34.66	36.33	37	37	37.66
Female average	38.33	40.66	48.66	51	51
Total average	72.99	76.99	85.66	88	88.66

Sexes	Cu. mortality %				
	Day-26	Day-27	Day-28	Day-29	Day-30
Male average	39.66	40	41.33	41.33	41.33
Female average	51.33	51.33	51.66	51.66	52
Total average	90.99	91.33	92.99	92.99	93.33

Sexes	Cu. mortality %				
	Day-31	Day-32	Day-33	Day-34	Day-35
Male average	41.33	41.33	41.33	41.33	41.33
Female average	52.66	53	53.33	53.66	54.66
Total average	93.99	94.33	94.66	94.99	95.99

Sexes	Cu. mortality %	
	Day-36	Day-37
Male average	41.33	41.33
Female average	55	55.33
Total average	96.33	96.66

Appendix-20: Daily cumulative mortality % of both sexes (male and female) of *Lucilia cuprina,* adult emerged from irradiated pupae (100 nos.), supplied water-sugar (W-S)

Sexes	Cu. Mortality %					
	Day-1	Day-2	Day-3	Day-4	Day-5	Day-6
Male average	0	0.33	0	1	0	2.33
Female average	0	0	0	0	0	0
Total average	0	0.33	0	1	0	2.33

Sexes	Cu. Mortality %					
	Day-7	Day-8	Day-9	Day-10	Day-11	Day-12
Male average	2.66	4.33	5.66	6	6	8.33
Female average	0	0	0.66	2	3.33	4
Total average	2.66	4.33	6.32	8	9.33	12.33

Sexes	Cu. Mortality %					
	Day-13	Day-14	Day-15	Day-16	Day-17	Day-18
Male average	9.66	2.33	14	14.33	20.33	26.33
Female average	5.66	7.66	10.33	14.33	15.66	19
Total average	15.32	19.99	24.33	28.66	35.99	45.33

Sexes	Cu. mortality %					
	Day-19	Day-20	Day-21	Day-22	Day-23	Day-24
Male average	32.66	38	44	45	47.33	48.66
Female average	21.66	24.33	26.66	33.66	36	38
Total average	54.32	62.33	70.66	78.66	83.33	86.66

Sexes	Cu. mortality %					
	Day-25	Day-26	Day-27	Day-28	Day-29	Day-30
Male average	50.66	52	53.33	53.66	54	54
Female average	38.66	38.66	38.66	39	39.66	39.66
Total average	88.32	90.66	91.99	92.66	93.66	93.66

Sexes	Cu. mortality %					
	Day-31	Day-32	Day-33	Day-34	Day-35	Day-36
Male average	54	54	54	54	54	54
Female average	40	40.66	41.33	41.33	42	42.66
Total average	94	94.66	95.33	95.33	96	96.66

Appendix-21: Daily mortality nos. of both sexes (male and female) of *Lucilia cuprina,* adult emerged from non-irradiated pupae (100 nos.) , supplied water-sugar-blood (W-S-B)

Sexes	No. of mortality					
	Day-1	Day-2	Day-3	Day-4	Day-5	Day-6
Male average	0	0	0	0.66	0	0.66
Female average	0	0	0	0	0	0
Total average	0	0	0	0.66	0	0.66

Sexes	No. of mortality					
	Day-7	Day-8	Day-9	Day-10	Day-11	Day-12
Male average	2	0.66	0.66	0	0.33	0.66
Female average	0	1.33	2.33	2	1.33	3
Total average	2	1.99	2.99	2	1.66	3.66

Sexes	No. of mortality					
	Day-13	Day-14	Day-15	Day-16	Day-17	Day-18
Male average	2.33	4	2	1.66	0.33	1.33
Female average	2.33	1	2.66	3.66	4	0.66
Total average	4.66	5	4.66	5.32	4.33	1.99

Sexes	No. of mortality					
	Day-19	Day-20	Day-21	Day-22	Day-23	Day-24
Male average	2	2	4	2.33	0.66	1
Female average	3.33	1.33	2.66	3	1.66	1.33
Total average	5.33	3.33	6.66	5.33	2.32	2.33

Sexes	No. of mortality					
	Day-25	Day-26	Day-27	Day-28	Day-29	Day-30
Male average	0	1.33	1.66	1.66	0	2.33
Female average	3	1.66	1.66	1	2	0.33
Total average	3	2.99	3.32	2.66	2	2.66

Sexes	No. of mortality					
	Day-31	Day-32	Day-33	Day-34	Day-35	Day-36
Male average	1.66	0.66	1	1	0	0
Female average	0.33	0	2.66	0.66	2.33	1.66
Total average	1.99	0.66	3.66	1.66	2.33	1.66

Appendix-22: Daily mortality nos. of both sexes (male and female) of *Lucilia cuprina*, adult emerged from irradiated pupae (100 nos.) , supplied water-sugar-blood (W-S-B).

Sexes	No. of mortality				
	Day-1	Day-2	Day-3	Day-4	Day-5
Male average	0	0	0	0	0
Female average	0	0	0	0	0
Total average	0	0	0	0	0

Sexes	No. of mortality				
	Day-6		Day-8	Day-9	Day-10
Male average	2.33	1.33	2.66	1.33	1
Female average	1.33	1	1	1.66	1.33
Total average	3.66	2.33	3.66	2.99	2.33

Sexes	No. of mortality				
	Day-11	Day-12	Day-13	Day-14	Day-15
Male average	0.66	0	0.66	1.66	6
Female average	2.33	5	2.33	5	6
Total average	2.99	5	2.99	6.66	12

Sexes	No. of mortality				
	Day-16	Day-17	Day-18	Day-19	Day-20
Male average	3.33	2.66	0	4	5.66
Female average	5	1.66	4	0.66	2.33
Total average	8.33	4.32	4	4.66	7.99

Sexes	No. of mortality				
	Day-21	Day-22	Day-23	Day-24	Day-25
Male average	2	1.33	2.33	1.66	0
Female average	1.33	1	1.33	1	0.66
Total average	3.33	2.33	3.66	2.66	0.66

Sexes	No. of mortality				
	Day-26	Day-27	Day-28	Day-29	Day-30
Male average	1	0	0.66	0.66	0.33
Female average	0.33	1.33	0.33	0.33	0
Total average	1.33	1.33	0.99	0.99	0.33

Sexes	No. of mortality				
	Day-31	Day-32	Day-33	Day-34	Day-35
Male average	0.33	0	0.66	0	0.33
Female average	1	0.33	0	1	0.33
Total average	1.33	0.33	0.66	1	0.66

Sexes	No. of mortality	
	Day-36	Day-37
Male average	0.33	0
Female average	0.33	1
Total average	0.66	1

Appendix-23: Daily cumulative mortality % of both sexes (male and female) of *Lucilia cupri* adult emerged from non-irradiated pupae (100 nos.) , supplied water-sugar-blood (W-S-B)

Sexes	Cu. Mortality %					
	Day-1	Day-2	Day-3	Day-4	Day-5	Day-6
Male average	0	0	0	0.66	0.66	1.33
Female average	0	0	0	0	0	0
Total average	0	0	0	0.66	0.66	1.33

Sexes	Cu. Mortality %					
	Day-7	Day-8	Day-9	Day-10	Day-11	Day-12
Male average	3.33	4	4.66	4.66	5	5.66
Female average	0	1.33	3.66	5.66	7	10
Total average	3.33	5.33	8.32	10.32	12	15.66

Sexes	Cu. mortality %					
	Day-13	Day-14	Day-15	Day-16	Day-17	Day-18
Male average	8	12	14	15.66	16	17.33
Female average	12.33	13.33	16	19.66	23.66	24.33
Total average	20.33	25.33	30	35.32	39.66	41.66

Sexes	Cu. mortality %					
	Day-19	Day-20	Day-21	Day-22	Day-23	Day-24
Male average	19.33	21.33	25.33	27.66	28.33	29.33
Female average	27.66	29	31.66	34.66	36.33	37.66
Total average	46.99	50.33	56.99	62.32	64.66	66.99

Sexes	Cu. mortality %					
	Day-25	Day-26	Day-27	Day-28	Day-29	Day-30
Male average	29.33	30.66	32.33	34	34	36.33
Female average	40.66	42.33	44	45	47	47.33
Total average	69.99	72.99	76.33	79	81	83.66

Sexes	Cu. mortality %					
	Day-31	Day-32	Day-33	Day-34	Day-35	Day-36
Male average	38	38.66	39.66	40.66	40.66	40.66
Female average	47.66	47.66	50.33	51	53.33	54.33
Total average	85.66	86.32	89.99	91.66	93.99	94.99

Appendix-24: Daily cumulative mortality % of both sexes (male and female) of *Lucilia cuprina*, adult emerged from irradiated pupae (100 nos.) , supplied water-sugar-blood (W-S-B).

Sexes	Cu. mortality %				
	Day-1	Day-2	Day-3	Day-4	Day-5
Male average	0	0	0	0	0
Female average	0	0	0	0	0
Total average	0	0	0	0	0

Sexes	Cu. mortality %				
	Day-6	.	Day-8	Day-9	Day-10
Male average	2.33	3.66	6.33	7.66	8.66
Female average	1.33	2.33	3.33	5	6.33
Total average	3.66	5.99	9.66	12.66	14.99

Sexes	Cu. Mortality %				
	Day-11	Day-12	Day-13	Day-14	Day-15
Male average	9.33	9.33	10	11.66	17.66
Female average	8.66	13.66	16	21	27
Total average	17.99	22.99	26	32.66	44.66

Sexes	Cu. mortality %				
	Day-16	Day-17	Day-18	Day-19	Day-20
Male average	21	23.66	23.66	27.66	33.33
Female average	32	33.66	37.66	38.33	40.66
Total average	53	57.32	61.32	65.99	73.99

Sexes	Cu. Mortality %				
	Day-21	Day-22	Day-23	Day-24	Day-25
Male average	35.33	36.66	39	40.66	40.66
Female average	42	43	44.33	45.33	46
Total average	77.33	79.66	83.33	85.99	86.66

Sexes	Cu. Mortality %				
	Day-26	Day-27	Day-28	Day-29	Day-30
Male average	41.66	41.66	42.33	43	43.33
Female average	46.33	47.66	48	48.33	48.33
Total average	87.99	89.32	90.33	91.33	91.66

Sexes	Cu. mortality %				
	Day-31	Day-32	Day-33	Day-34	Day-35
Male average	43.66	43.66	44.33	44.33	44.66
Female average	49.33	49.66	49.66	50.66	51
Total average	92.99	93.32	93.99	94.99	95.66

Sexes	Cu. mortality %	
	Day-36	Day-37
Male average	45	45
Female average	51.33	52.33
Total average	96.33.	97.33

Appendix-25: Daily mortality nos. of both sexes (male and female) of *Lucilia cuprina*, adult emerged from non irradiated pupae (100 nos.), supplied water-sugar-fish (W-S-F)

Sexes	No. of mortality					
	Day-1	Day-2	Day-3	Day-4	Day-5	Day-6
Male average	0	0	0	0	0	0
Female average	0	0	0	0	0	0
Total average	0	0	0	0	0	0

Sexes	No. of mortality					
	Day-7	Day-8	Day-9	Day-10	Day-11	Day-12
Male average	0	0	1.66	0.66	0.66	0
Female average	0	0	0.33	1	1.33	1.66
Total average	0	0	1.99	1.66	1.99	1.66

Sexes	No. of mortality					
	Day-13	Day-14	Day-15	Day-16	Day-17	Day-18
Male average	1.33	1	1.33	0.33	0.66	1
Female average	0.33	0.33	1.33	0.66	1.66	0.66
Total average	1.66	1.33	2.66	0.99	2.32	1.66

Sexes	No. of mortality					
	Day-19	Day-20	Day-21	Day-22	Day-23	Day-24
Male average	1	3.66	2.66	3.33	0.66	0.66
Female average	1.66	1.66	2.33	0.66	3.33	3.33
Total average	2.66	5.32	4.99	3.99	3.99	3.99

Sexes	No. of mortality					
	Day-25	Day-26	Day-27	Day-28	Day-29	Day-30
Male average	1.66	2	2.66	2.66	3	3
Female average	2.33	1.33	1.33	1.66	1	1.33
Total average	3.99	3.33	3.99	4.32	4	4.33

Sexes	No. of mortality					
	Day-31	Day-32	Day-33	Day-34	Day-35	Day-36
Male average	2.33	0	0.33	1	0.33	1.66
Female average	1.33	2.33	2	1.66	2.33	0.33
Total average	3.66	2.33	2.33	2.66	2.66	1.99

Sexes	No. of mortality					
	Day-37	Day-38	Day-39	Day-40	Day-41	Day-42
Male average	0	0	0	0.33	0.33	0.33
Female average	0.33	0.66	2.33	0.66	1	2.33
Total average	0.33	0.66	2.33	0.99	1.33	2.66

Sexes	No. of mortality					
	Day-43	Day-44	Day-45	Day-46	Day-47	Day-48
Male average	0	0	0	0	0	0
Female average	0.66	2.33	0.66	1.66	0.33	0.66
Total average	0.66	2.33	0.66	1.66	0.33	0.66

Appendix-26: Daily mortality nos. of both sexes (male and female) of *Lucilia cuprina*, adult emerged from irradiated pupae (100 nos.), supplied water-sugar-fish (W-S-F)

Sexes	No. of mortality					
	Day-1	Day-2	Day-3	Day-4	Day-5	Day-6
Male average	0	0	0	0.33	0	0.66
Female average	0	0	0	0.33	0	1.66
Total average	0	0	0	0.66	0	2.32

Sexes	No. of mortality					
	Day-7	Day-8	Day-9	Day-10	Day-11	Day-12
Male average	0	3	1.33	0.66	0.66	1.66
Female average	0	1	1.33	3	2	1.66
Total average	0	4	2.66	3.66	2.66	3.32

Sexes	No. of mortality					
	Day-13	Day-14	Day-15	Day-16	Day-17	Day-18
Male average	1.66	1	1	3.33	0.33	0.66
Female average	0.66	2	1	4	0.66	1.66
Total average	2.32	3	2	7.33	0.99	2.32

Sexes	No. of mortality					
	Day-19	Day-20	Day-21	Day-22	Day-23	Day-24
Male average	2	1.33	3.66	0.66	1	1.33
Female average	1.33	1	1.66	2.66	1.33	1.333
Total average	3.33	2.33	5.32	3.32	2.33	2.66

Sexes	No. of mortality					
	Day-25	Day-26	Day-27	Day-28	Day-29	Day-30
Male average	1	5	0.66	0.66	2	0
Female average	0.33	1.66	0	0.66	3.33	1.33
Total average	1.33	6.66	0.66	1.32	5.33	1.33

Sexes	No. of mortality					
	Day-31	Day-32	Day-33	Day-34	Day-35	Day-36
Male average	3.33	2	0.66	2	0	1
Female average	4	0.66	0	0	0	0.66
Total average	7.33	2.66	0.66	2	0	1.66

Sexes	No. of mortality					
	Day-37	Day-38	Day-39	Day-40	Day-41	Day-42
Male average	0.33	0.66	0	0.66	0	0
Female average	0.66	0	0	0	0.66	0.66
Total average	0.99	0.66	0	0.66	0.66	0.66

Sexes	No. of mortality			
	Day-43	Day-44	Day-45	Day-46
Male average	0	0	0	0
Female average	1.33	1.33	1	0.66
Total average	1.33	1.33	1	0.66

Appendix-27 Daily cumulative mortality % of both sexes (male and female) of *Lucilia cuprina* adult emerged from non-irradiated pupae (100 nos.), supplied water-sugar-fish (W-S-F)

Sexes	Cu. Mortality %					
	Day-1	Day-2	Day-3	Day-4	Day-5	Day-6
Male average	0	0	0	0	0	0
Female average	0	0	0	0	0	0
Total average	0	0	0	0	0	0

Sexes	Cu. mortality %					
	Day-7	Day-8	Day-9	Day-10	Day-11	Day-12
Male average	0	0	1.66	2	2.66	2.66
Female average	0	0	0.33	1.33	2.66	4.33
Total average	0	0	1.99	3.33	5.32	6.99

Sexes	Cu. mortality %					
	Day-13	Day-14	Day-15	Day-16	Day-17	Day-18
Male average	4	5	6.33	6.66	7.33	8.33
Female average	4.66	5	6.33	7	8.66	9.33
Total average	8.66	10	12.66	13.66	15.99	17.66

Sexes	Cu. mortality %					
	Day-19	Day-20	Day-21	Day-22	Day-23	Day-24
Male average	9.33	13	15.66	19	19.66	20.33
Female average	11	12.66	15	15.66	19	22.33
Total average	20.33	25.66	30	34.66	38.66	42.66

Sexes	Cu. mortality %					
	Day-25	Day-26	Day-27	Day-28	Day-29	Day-30
Male average	22	24	26.66	29.33	32.33	35.33
Female average	24.66	26	27.33	29	30	31.33
Total average	46.66	50	53.99	58.33	62.33	66.66

Sexes	Cu. mortality %					
	Day-31	Day-32	Day-33	Day-34	Day-35	Day-36
Male average	37.66	37.66	38	39	39.33	41
Female average	32.66	35.33	37.33	39	41.33	41.66
Total average	70.32	72.99	75.33	78	80.66	82.66

Sexes	Cu. mortality %					
	Day-37	Day-38	Day-39	Day-40	Day-41	Day-42
Male average	41	41	41	41.33	41.66	42
Female average	42	42.66	45	45.66	46.66	49
Total average	83	83.66	86	86.99	88.32	91

Sexes	Cu. mortality %					
	Day-43	Day-44	Day-45	Day-46	Day-47	Day-48
Male average	42	42	42	42	42	42
Female average	49.66	52	52.66	54.33	54.66	55.33
Total average	91.66	94	94.66	96.33	96.66	97.33

Appendix-28 Daily cumulative mortality % of both sexes (male and female) of *Lucilia cuprina*, adult emerged from irradiated pupae (100 nos.), supplied water-sugar-fish (W-S-F)

Sexes	Cu. mortality %					
	Day-1	Day-2	Day-3	Day-4	Day-5	Day-6
Male average	0	0	0	0.33	0.33	1
Female average	0	0	0	0.33	0.33	2
Total average	0	0	0	0.66	0.66	3

Sexes	Cu. mortality %					
	Day-7	Day-8	Day-9	Day-10	Day-11	Day-12
Male average	1	4	5.33	6	6.66	8.33
Female average	2	3	4.33	7.33	9.33	11
Total average	3	7	9.66	13.33	15.99	19.33

Sexes	Cu. mortality %					
	Day-13	Day-14	Day-15	Day-16	Day-17	Day-18
Male average	10	11	12	15.33	15.66	16.33
Female average	11.66	13.66	14.66	18.66	19.32	21
Total average	21.66	24.66	26.66	33.99	34.99	37.33

Sexes	Cu. mortality %					
	Day-19	Day-20	Day-21	Day-22	Day-23	Day-24
Male average	18.33	19.66	23.33	24	25.66	27
Female average	22.33	23.33	25	27.66	29	30.33
Total average	40.66	42.99	48.33	51.66	54.66	57.33

Sexes	Cu. mortality %					
	Day-25	Day-26	Day-27	Day-28	Day-29	Day-30
Male average	28	33	33.66	34.33	36.33	36.33
Female average	30.66	32.33	32.33	33	36.33	37.66
Total average	58.66	55.33	65.99	67.33	72.66	73.99

Sexes	Cu. mortality %					
	Day-31	Day-32	Day-33	Day-34	Day-35	Day-36
Male average	39.66	41.66	42.33	44.33	44.33	45.33
Female average	41.66	42.33	42.33	42.33	42.33	43
Total average	81.32	83.99	84.66	86.66	86.66	88.33

Sexes	Cu. mortality %					
	Day-37	Day-38	Day-39	Day-40	Day-41	Day-42
Male average	45.66	46.33	46.33	47	47	47
Female average	43.66	43.66	43.66	43.66	44.33	45
Total average	89.32	89.99	89.99	90.66	91.33	92

Sexes	Cu. mortality %			
	Day-43	Day-44	Day-45	Day-46
Male average	47	47	47	47
Female average	46.33	47.66	48.66	49.33
Total average	93.33	94.66	95.66	96.33

Appendix-29: Daily mortality nos. of both sexes (male and female) of *Lucilia cuprina*, adult emerged from non-irradiated pupae (100 nos.), supplied water-sugar-liver (W-S-L)

Sexes	No. of mortality						
	Day-1	Day-2	Day-3	Day-4	Day-5	Day-6	Day-7
Male average	0	0	0	0.33	0.66	0.66	1.33
Female average	0	0	0	0	1	1	0.33
Total average	0	0	0	0.33	1.66	1.66	1.66

Sexes	No. of mortality						
	Day-8	Day-9	Day-10	Day-11	Day-12	Day-13	Day-14
Male average	0	0	1.66	1	0.66	0.33	1
Female average	0	0	0.33	0	1	0	0
Total average	0	0	1.99	1	1.66	0.33	1

Sexes	No. of mortality						
	Day-15	Day-16	Day-17	Day-18	Day-19	Day-20	Day-21
Male average	0.33	0.33	1	0	1.33	1.33	2.66
Female average	0.66	1.33	0.33	1.33	1	1.66	1.66
Total average	0.99	1.66	1.33	1.33	2.33	2.99	4.32

Sexes	No. of mortality						
	Day-22	Day-23	Day-24	Day-25	Day-26	Day-27	Day-28
Male average	2.66	0.66	3.66	2	1	1.66	1.66
Female average	2.33	1.66	0.33	2.33	2	2.33	2.66
Total average	4.99	2.32	3.99	4.33	3	3.99	4.32

Sexes	No. of mortality						
	Day-29	Day-30	Day-31	Day-32	Day-33	Day-34	Day-35
Male average	3	2	2.66	1.66	0.33	1	0.66
Female average	2	4	1.66	1.66	3.66	2.33	1.66
Total average	5	6	4.32	3.32	3.99	3.33	2.32

Sexes	No. of mortality						
	Day-36	Day-37	Day-38	Day-39	Day-40	Day-41	Day-42
Male average	1	0.33	0	0.33	0	0	0
Female average	1.66	1.66	0.33	0	1	1.66	1
Total average	2.66	1.99	0.33	0.33	1	1.66	1

Sexes	No. of mortality						
	Day-43	Day-44	Day-45	Day-46	Day-47	Day-48	Day-49
Male average	0	0	0	0	0	0	0
Female average	0.33	0.66	0.66	1.33	1.33	2.33	0.33
Total average	0.33	0.66	0.66	1.33	1.33	2.33	0.33

Appendix-30: Daily mortality nos. of both sexes (male and female) of *Lucilia cuprina*, adult emerged from irradiated pupae (100 nos.), supplied water-sugar-liver (W-S-L)

Sexes	No. of mortality					
	Day-1	Day-2	Day-3	Day-4	Day-5	Day-6
Male average	0	0	0	0	1.33	1.66
Female average	0	0	0	0.66	0.33	1.33
Total average	0	0	0	0.66	1.66	2.99

Sexes	No. of mortality					
	Day-7	Day-8	Day-9	Day-10	Day-11	Day-12
Male average	0	3.33	0.33	1	1.66	0
Female average	0	1.66	1.33	1	1.33	2
Total average	0	4.99	1.66	2	2.99	2

Sexes	No. of mortality					
	Day-13	Day-14	Day-15	Day-16	Day-17	Day-18
Male average	0	0.33	1	0.66	1.33	0.66
Female average	1	3.33	4	0.33	0.66	0
Total average	1	3.66	5	0.99	1.99	0.66

Sexes	No. of mortality					
	Day-19	Day-20	Day-21	Day-22	Day-23	Day-24
Male average	0.33	0	0	0.33	0.66	2.33
Female average	0.66	0	2.66	2.33	0	1
Total average	0.99	0	2.66	2.66	0.66	3.33

Sexes	No. of mortality					
	Day-25	Day-26	Day-27	Day-28	Day-29	Day-30
Male average	1.33	1.33	4	2	4	0
Female average	3.66	1.33	3.33	2	1	2.66
Total average	4.99	2.66	7.33	4	5	2.66

Sexes	No. of mortality					
	Day-31	Day-32	Day-33	Day-34	Day-35	Day-36
Male average	2.66	1.33	4	1	1	1
Female average	3	0.66	0.66	0.33	0.66	0.33
Total average	5.66	1.99	4.66	1.33	1.66	1.33

Sexes	No. of mortality					
	Day-37	Day-38	Day-39	Day-40	Day-41	Day-42
Male average	1.33	0.33	1.66	0	1	0
Female average	0.33	0	0	1	0	0
Total average	1.66	0.33	1.66	1	1	0

Sexes	No. of mortality					
	Day-43	Day-44	Day-45	Day-46	Day-47	Day-48
Male average	0	0	0	0	0	0
Female average	0.33	1.66	0.33	1.33	0.66	0.33
Total average	0.33	1.66	0.33	1.33	0.66	0.33

Appendix-31: Daily cumulative mortality % of both sexes (male and female) of *Lucilia cupr.* adult emerged from non-irradiated pupae (100 nos.) , supplied water-sugar-liver (W-S-L)

Sexes	Cu. mortality %						
	Day-1	Day-2	Day-3	Day-4	Day-5	Day-6	Day-7
Male average	0	0	0	0.33	1	1.66	3
Female average	0	0	0	0	1	2	2.33
Total average	0	0	0	0.33	2	3.66	5.33

Sexes	Cu. mortality %						
	Day-8	Day-9	Day-10	Day-11	Day-12	Day-13	Day-14
Male average	3	3	4.66	5.66	6.33	6.66	7.66
Female average	2.33	2.33	2.66	2.66	3.66	3.66	3.66
Total average	5.33	5.33	7.32	8.32	9.99	10.32	11.32

Sexes	Cu. mortality %						
	Day-15	Day-16	Day-17	Day-18	Day-19	Day-20	Day-21
Male average	8	8.33	9.33	9.33	10.66	12	14.66
Female average	4.33	5.66	6	7.33	8.33	10	11.66
Total average	12.33	13.99	15.33	16.66	18.99	22	26.32

Sexes	Cu. mortality %						
	Day-22	Day-23	Day-24	Day-25	Day-26	Day-27	Day-28
Male average	17.33	18	21.66	23.66	24.66	26.33	28
Female average	14	15.66	16	18.33	20.33	22.33	25.33
Total average	31.33	33.66	37.66	41.99	44.99	48.66	53.33

Sexes	Cu. mortality %						
	Day-29	Day-30	Day-31	Day-32	Day-33	Day-34	Day-35
Male average	31	33	35.66	37.33	37.66	38.66	39.33
Female average	27.33	31.33	33	34.66	38.33	40.66	42.33
Total average	58.33	64.33	68.66	71.99	75.99	79.32	81.66

Sexes	Cu. mortality %						
	Day-36	Day-37	Day-38	Day-39	Day-40	Day-41	Day-42
Male average	40.33	40.66	40.66	41	41	41	41
Female average	44	45.66	46	46	47	48.66	49.66
Total average	84.33	86.32	86.66	87	88	89.66	90.66

Sexes	Cu. mortality %						
	Day-43	Day-44	Day-45	Day-46	Day-47	Day-48	Day-49
Male average	41	41	41	41	41	41	41
Female average	50	50.66	51.33	52.66	54	56.33	56.66
Total average	91	91.66	92.33	93.66	95	97.33	97.66

Appendix-32: Daily cumulative mortality % of both sexes (male and female) of *Lucilia cuprina*, adult emerged from irradiated pupae (100 nos.), supplied water-sugar-liver (W-S-L)

Sexes	Cu. Mortality %					
	Day-1	Day-2	Day-3	Day-4	Day-5	Day-6
Male average	0	0	0	0	1.33	3
Female average	0	0	0	0.66	1	2.33
Total average	0	0	0	0.66	2.33	5.33

Sexes	Cu. mortality %					
	Day-7	Day-8	Day-9	Day-10	Day-11	Day-12
Male average	3	6.33	6.66	7.66	9.33	9.33
Female average	2.33	4	5.33	6.33	7.66	9.66
Total average	5.33	10.33	11.99	13.99	16.99	18.99

Sexes	Cu. mortality %					
	Day-13	Day-14	Day-15	Day-16	Day-17	Day-18
Male average	9.33	9.66	10.66	11.33	12.66	13.33
Female average	10.66	14	18	18.33	19	19
Total average	19.99	23.66	28.66	29.66	31.66	32.33

Sexes	Cu. mortality %					
	Day-19	Day-20	Day-21	Day-22	Day-23	Day-24
Male average	13.66	13.66	13.66	14	14.66	17
Female average	19.66	19.66	22.33	24.66	24.66	25.66
Total average	33.32	33.32	35.99	38.66	39.32	42.66

Sexes	Cu. mortality %					
	Day-25	Day-26	Day-27	Day-28	Day-29	Day-30
Male average	18.33	19.66	23.66	25.66	29.66	29.66
Female average	29.33	30.66	34	36	37	39.66
Total average	47.66	50.32	57.66	61.66	66.66	69.32

Sexes	Cu. mortality %					
	Day-31	Day-32	Day-33	Day-34	Day-35	Day-36
Male average	32.33	33.66	37.66	38.66	39.66	40.66
Female average	42.66	43.33	44	44.33	45	45.33
Total average	74.99	76.99	81.66	82.99	84.66	85.99

Sexes	Cu. mortality %					
	Day-37	Day-38	Day-39	Day-40	Day-41	Day-42
Male average	42	42.33	44	44	45	45
Female average	45.66	45.66	45.66	46.66	46.66	46.66
Total average	87.66	87.99	89.66	90.66	91.66	91.66

Sexes	Cu. mortality %					
	Day-43	Day-44	Day-45	Day-46	Day-47	Day-48
Male average	45	45	45	45	45	45
Female average	47	48.66	49	50.33	51	51.33
Total average	92	93.66	94	95.33	96	96.33

Appendix-33: Daily weight (g) of dropping larvae/pupae

Sl No.	Wt. Of Droping Larvae	Wt. Of Pupae			
		Day_1	Day_2	Day_3	Day_4
01	0.0295	0.0243	0.0238	0.0218	0.0214
02	0.0350	0.0278	0.0244	0.0239	0.0236
03	0.0310	0.0278	0.0243	0.0236	0.0232
04	0.0286	0.0248	0.0244	0.0221	0.0220
05	0.0306	0.0260	0.0235	0.0232	0.0228
06	0.0310	0.0276	0.0255	0.0242	0.0240
07	0.0257	0.0227	0.0212	0.0211	0.0200
08	0.0261	0.0215	0.0212	0.0206	0.0204
09	0.0279	0.0235	0.0211	0.0203	0.0199
10	0.0275	0.0245	0.0230	0.0229	0.0222
11	0.0260	0.0223	0.0214	0.0202	0.0196
12	0.0289	0.0236	0.0231	0.0230	0.0224
13	0.0312	0.0281	0.0268	0.0265	0.0247
14	0.0282	0.0245	0.0235	0.0234	0.0228
15	0.0283	0.0232	0.0228	0.0227	0.0205
16	0.0233	0.0193	0.0187	0.0186	0.0185
17	0.0313	0.0275	0.0273	0.0265	0.0258
18	0.0208	0.0164	0.0160	0.0153	0.0125
19	0.0275	0.0247	0.0203	0.0174	0.0145
20	0.0310	0.0266	0.0258	0.0253	0.0249
21	0.0286	0.0239	0.0238	0.0236	0.0225
22	0.0277	0.0234	0.0229	0.0226	0.0223
23	0.0291	0.0273	0.0229	0.0228	0.0227
24	0.0265	0.0224	0.0216	0.0215	0.0207
25	0.0319	0.0272	0.0257	0.0252	0.0245
26	0.0283	0.0244	0.0226	0.0225	0.0219
27	0.0250	0.0224	0.0213	0.0207	0.0196
28	0.0301	0.0251	0.0248	0.0233	0.0212

29	0.0314	0.0282	0.0253	0.0251	0.0242
30	0.0258	0.0233	0.0224	0.0200	0.0213
31	0.0282	0.0252	0.0234	0.0180	0.0137
32	0.0278	0.0272	0.0260	0.0254	0.0252
33	0.0271	0.0247	0.0229	0.0225	0.0221
34	0.0286	0.0273	0.0249	0.0247	0.0235
35	0.0265	0.0260	0.0258	0.0256	0.0237
36	0.0313	0.0186	0.0170	0.0165	0.0163
37	0.0275	0.0231	0.0210	0.0208	0.0197
38	0.0260	0.0251	0.0228	0.0226	0.0225
39	0.0292	0.0253	0.0236	0.0234	0.0229
40	0.0309	0.0228	0.0209	0.0208	0.0202
41	0.0263	0.0255	0.0224	0.0220	0.0218
42	0.0281	0.0235	0.0214	0.0209	0.0205
43	0.0295	0.0263	0.0244	0.0238	0.0232
44	0.0274	0.0272	0.0253	0.0249	0.0246
45	0.0328	0.0285	0.0261	0.0258	0.0253
46	0.0278	0.0242	0.0223	0.0221	0.0220
47	0.0243	0.0195	0.0191	0.0187	0.0167
48	0.0301	0.0265	0.0247	0.0242	0.0240
49	0.0257	0.0231	0.0212	0.0211	0.0209
50	0.0290	0.0240	0.0209	0.0208	0.0206
51	0.0296	0.0258	0.0251	0.0245	0.0243
52	0.0234	0.0201	0.0193	0.0190	0.0180
53	0.0286	0.0265	0.0239	0.0238	0.0237
54	0.0235	0.0209	0.0190	0.0189	0.0188
55	0.0237	0.0223	0.0199	0.0193	0.0190
56	0.0261	0.0239	0.0229	0.0205	0.0200
57	0.0237	0.0233	0.0218	0.0212	0.0192
58	0.0318	0.0297	0.0273	0.0259	0.0208
59	0.0244	0.0240	0.0239	0.0209	0.0203
60	0.0277	0.0275	0.0240	0.0222	0.0179
61	0.0284	0.0263	0.0244	0.0240	0.0231
62	0.0269	0.0254	0.0229	0.0218	0.0191
63	0.0296	0.0274	0.0265	0.0253	0.0229
64	0.0323	0.0275	0.0271	0.0252	0.0222
65	0.0237	0.0228	0.0210	0.0204	0.0201
66	0.0313	0.0278	0.0272	0.0265	0.0257
67	0.0342	0.0282	0.0275	0.0271	0.0258
68	0.0301	0.0250	0.0248	0.0243	0.0232
69	0.0234	0.0228	0.0215	0.0214	0.0198
70	0.0296	0.0258	0.0247	0.0244	0.0236
71	0.0323	0.0287	0.0272	0.0263	0.0238
72	0.0240	0.0232	0.0230	0.0225	0.0167

73	0.0266	0.0212	0.0210	0.0209	0.0204
74	0.0234	0.0225	0.0223	0.0215	0.0170
75	0.0256	0.0249	0.0226	0.0221	0.0206
76	0.0231	0.0211	0.0204	0.0202	0.0200
77	0.0273	0.0258	0.0252	0.0246	0.0242
78	0.0236	0.0225	0.0216	0.0212	0.0198
79	0.0197	0.0178	0.0171	0.0165	0.0158
80	0.0303	0.0259	0.0258	0.0250	0.0248
81	0.0238	0.0228	0.0219	0.0215	0.0205
82	0.0220	0.0198	0.0167	0.0165	0.0164
83	0.0299	0.0275	0.0249	0.0248	0.0235
84	0.0272	0.0238	0.0229	0.0221	0.0219
85	0.0209	0.0193	0.0186	0.0178	0.0173
86	0.0305	0.0284	0.0253	0.0251	0.0242
87	0.0315	0.0292	0.0247	0.0240	0.0228
88	0.0267	0.0215	0.0205	0.0202	0.0188
89	0.0278	0.0253	0.0244	0.0237	0.0235
90	0.0235	0.0226	0.0219	0.0217	0.0210
91	0.0149	0.0141	0.0130	0.0125	0.0124
92	0.0271	0.0244	0.0237	0.0227	0.0226
93	0.0244	0.0239	0.0206	0.0202	0.0199
94	0.0319	0.0277	0.0272	0.0270	0.0269
95	0.0260	0.0245	0.0236	0.0231	0.0230
96	0.0259	0.0219	0.0217	0.0207	0.0189
97	0.0227	0.0215	0.0200	0.0198	0.0194
98	0.0283	0.0241	0.0235	0.0233	0.0227
99	0.0270	0.0255	0.0235	0.0234	0.0229
100	0.0287	0.0243	0.0239	0.0234	0.0230
101	0.0195	0.0187	0.0184	0.0177	0.0174
102	0.0263	0.0245	0.0227	0.0225	0.0213
103	0.0251	0.0242	0.0236	0.0224	0.0205
104	0.0277	0.0248	0.0240	0.0231	0.0224
105	0.0305	0.0275	0.0250	0.0247	0.0245
106	0.0285	0.0262	0.0256	0.0250	0.0248
107	0.0280	0.0237	0.0234	0.0233	0.0230
108	0.0312	0.0272	0.0262	0.0258	0.0257
109	0.0282	0.0268	0.0257	0.0255	0.0242
110	0.0269	0.0254	0.0239	0.0238	0.0230
Average	**0.0274**	**0.0244**	**0.0230**	**0.0224**	**0.0214**

Appendix-34: Weight (gm) of 50 pupae (within 24 hrs.) on the mixture of larval diet of 50gm liver + 20ml blood (control diet)

Sl. No.	R1	R2	R3
1	0.0253	0.0267	0.0262
2	0.0255	0.0224	0.0256
3	0.026	0.0254	0.0269
4	0.0244	0.0282	0.0265
5	0.0254	0.0222	0.0283
6	0.028	0.0302	0.023
7	0.0289	0.023	0.0247
8	0.0288	0.0281	0.033
9	0.0279	0.0296	0.0249
10	0.0282	0.0263	0.0296
11	0.0265	0.0295	0.024
12	0.0289	0.0262	0.0315
13	0.0233	0.0332	0.0319
14	0.0272	0.0313	0.0254
15	0.0249	0.0312	0.0292
16	0.0196	0.022	0.0233
17	0.0222	0.0283	0.0238
18	0.0199	0.0272	0.0282
19	0.0239	0.0284	0.0287
20	0.0273	0.0267	0.0311
21	0.0282	0.0235	0.0248
22	0.0218	0.0199	0.0281
23	0.0232	0.0241	0.0233
24	0.0297	0.0266	0.023
25	0.0234	0.033	0.0287
26	0.0246	0.0276	0.0258
27	0.0262	0.0284	0.026
28	0.0249	0.0258	0.0278
29	0.0299	0.0273	0.032
30	0.0292	0.0291	0.0273
31	0.0277	0.0244	0.0272
32	0.0232	0.0289	0.0277
33	0.027	0.0243	0.0315
34	0.029	0.0257	0.0315
35	0.0237	0.0183	0.0314
36	0.0313	0.0261	0.0246
37	0.0281	0.0293	0.0268
38	0.0283	0.0268	0.0301
39	0.0199	0.0248	0.0256

40	0.0321	0.0279	0.0281
41	0.0229	0.0304	0.0247
42	0.0196	0.0236	0.0229
43	0.0281	0.0254	0.0243
44	0.0234	0.0288	0.0259
45	0.0261	0.0279	0.0269
46	0.026	0.031	0.0245
47	0.027	0.0276	0.0268
48	0.0252	0.0274	0.0254
49	0.0283	0.0229	0.0221
50	0.0246	0.0251	0.0297

Appendix-35: Weight (gm) of 50 pupae (within 24 hrs.) on the mixture of larval diet of 50 gm IPF + 50gm liver + 20ml blood (IPF1)

Sl. No.	R1	R2	R3
1	0.027	0.0285	0.0314
2	0.0232	0.0284	0.0322
3	0.0244	0.031	0.0267
4	0.0254	0.0333	0.0326
5	0.0311	0.0268	0.0282
6	0.0292	0.0288	0.0259
7	0.0277	0.0329	0.0269
8	0.0299	0.0272	0.0285
9	0.0244	0.0282	0.0276
10	0.0307	0.0258	0.0292
11	0.0286	0.0268	0.0266
12	0.0258	0.0288	0.0264
13	0.0282	0.0298	0.0275
14	0.0269	0.029	0.0246
15	0.0243	0.0274	0.0244
16	0.0324	0.026	0.0219
17	0.0304	0.0232	0.0305
18	0.0258	0.0257	0.0217
19	0.0265	0.0303	0.0255
20	0.0312	0.0269	0.0262
21	0.0221	0.0266	0.0299
22	0.0241	0.024	0.0201
23	0.0262	0.0229	0.0199
24	0.0242	0.0241	0.0198
25	0.0232	0.0266	0.0169
26	0.0257	0.0249	0.0188
27	0.0215	0.0214	0.0204

28	0.0223	0.0219	0.0202
29	0.0258	0.0251	0.0203
30	0.0218	0.023	0.0203
31	0.026	0.0226	0.0197
32	0.0249	0.0224	0.0199
33	0.0244	0.0252	0.0206
34	0.0237	0.0229	0.021
35	0.0221	0.0241	0.0211
36	0.023	0.0232	0.0216
37	0.0301	0.0291	0.0226
38	0.0218	0.0248	0.0232
39	0.0236	0.0251	0.0249
40	0.0218	0.027	0.0208
41	0.0242	0.0222	0.0239
42	0.022	0.0235	0.0196
43	0.0202	0.0246	0.0283
44	0.0233	0.0212	0.0204
45	0.0198	0.021	0.0213
46	0.0269	0.0259	0.0262
47	0.0266	0.0242	0.0241
48	0.0243	0.0238	0.0268
49	0.024	0.0269	0.0216
50	0.0214	0.0218	0.0223

Appendix-36: Weight (gm) of 50 pupae (within 24 hrs.) on the mixture of larval diet of 100 gm IPF + 50gm liver + 20ml blood (IPF2)

Sl. No.	R1	R2	R3
1	0.0238	0.0276	0.0246
2	0.0321	0.0243	0.0229
3	0.033	0.0262	0.0209
4	0.0346	0.0247	0.0279
5	0.0214	0.0292	0.0222
6	0.0289	0.0235	0.029
7	0.0321	0.0315	0.0284
8	0.0318	0.0272	0.0234
9	0.031	0.0282	0.028
10	0.0259	0.0283	0.0209
11	0.0238	0.0186	0.0274
12	0.0266	0.0229	0.0267
13	0.0232	0.0239	0.0249
14	0.0302	0.0221	0.023
15	0.0251	0.0304	0.024

16	0.0191	0.0241	0.0201
17	0.0195	0.0188	0.0218
18	0.0285	0.0273	0.0246
19	0.0321	0.0202	0.0248
20	0.0264	0.0237	0.0228
21	0.0225	0.0285	0.0244
22	0.0292	0.0221	0.0209
23	0.024	0.0226	0.022
24	0.0269	0.0169	0.0228
25	0.021	0.0217	0.0232
26	0.0243	0.0232	0.0267
27	0.0131	0.0222	0.0208
28	0.0188	0.025	0.0237
29	0.0189	0.0245	0.0215
30	0.0202	0.023	0.0215
31	0.0208	0.0178	0.022
32	0.0176	0.0183	0.0217
33	0.0185	0.0207	0.0241
34	0.0124	0.023	0.0212
35	0.0215	0.0241	0.0196
36	0.0191	0.0272	0.0282
37	0.0184	0.0211	0.0205
38	0.019	0.0235	0.0186
39	0.0167	0.0141	0.0218
40	0.021	0.0246	0.0212
41	0.0151	0.0235	0.0239
42	0.0182	0.0236	0.0234
43	0.0173	0.0203	0.0171
44	0.0223	0.0232	0.0198
45	0.0126	0.0254	0.0223
46	0.0204	0.023	0.0188
47	0.0168	0.0185	0.0165
48	0.0177	0.0235	0.0203
49	0.0114	0.0233	0.021
50	0.0126	0.022	0.0189

Appendix-37: Weight (gm) of 50 pupae (within 24 hrs.) on the mixture of larval diet of 150 gm IPF + 50gm liver + 20ml blood (IPF3)

Sl. No.	R1	R2	R3
1	0.0182	0.0215	0.0194
2	0.022	0.021	0.0242
3	0.0243	0.0206	0.0245
4	0.0203	0.0165	0.0185
5	0.0227	0.0189	0.0274
6	0.0236	0.0214	0.0205
7	0.0245	0.019	0.0206
8	0.022	0.025	0.0262
9	0.0214	0.0265	0.0191
10	0.0204	0.0256	0.0193
11	0.0225	0.0257	0.0175
12	0.0223	0.0219	0.0162
13	0.0207	0.0247	0.0215
14	0.021	0.0261	0.0206
15	0.0205	0.0194	0.0205
16	0.0208	0.0201	0.0253
17	0.017	0.0235	0.021
18	0.0184	0.0243	0.0153
19	0.0264	0.0247	0.0259
20	0.0239	0.0224	0.0187
21	0.0239	0.0214	0.0191
22	0.0212	0.0243	0.0187
23	0.0198	0.0236	0.0182
24	0.0192	0.0191	0.0171
25	0.0264	0.021	0.0188
26	0.0198	0.0234	0.0221
27	0.0267	0.0238	0.0166
28	0.0196	0.0149	0.0188
29	0.0183	0.0188	0.0214
30	0.025	0.0236	0.0195
31	0.0221	0.0176	0.0177
32	0.0232	0.026	0.019
33	0.0213	0.0191	0.0249
34	0.0216	0.0223	0.0184
35	0.0216	0.0225	0.0175
36	0.0178	0.0216	0.0162
37	0.0261	0.0244	0.0208
38	0.0208	0.0183	0.021
39	0.025	0.0228	0.0215

40	0.0217	0.0205	0.0182
41	0.0231	0.0197	0.0252
42	0.0197	0.0231	0.0186
43	0.0235	0.0195	0.0182
44	0.0218	0.0195	0.0213
45	0.0212	0.0214	0.0201
46	0.0187	0.0193	0.0234
47	0.0193	0.0232	0.0192
48	0.0138	0.0198	0.0157
49	0.0161	0.0241	0.0152
50	0.0191	0.0165	0.0234

Appendix-38: Weight (gm) of 50 pupae (within 24 hrs.) on the mixture of larval diet of 200 gm IPF + 50gm liver + 20ml blood (IPF4)

Sl. No.	R1	R2	R3
1	0.021	0.0213	0.023
2	0.0254	0.0253	0.0217
3	0.0206	0.0224	0.0225
4	0.016	0.0241	0.0209
5	0.0104	0.021	0.0229
6	0.0084	0.0222	0.0268
7	0.0152	0.0252	0.0272
8	0.0175	0.0254	0.0232
9	0.0184	0.0271	0.0274
10	0.0127	0.0235	0.0238
11	0.0191	0.025	0.0234
12	0.0106	0.0269	0.0224
13	0.0117	0.0146	0.0143
14	0.0104	0.0131	0.0222
15	0.0143	0.0145	0.0265
16	0.0167	0.0211	0.0254
17	0.0096	0.0161	0.0224
18	0.0095	0.0215	0.0103
19	0.0109	0.0205	0.0142
20	0.0079	0.0272	0.0241
21	0.0086	0.0142	0.0125
22	0.0163	0.0245	0.0275
23	0.0151	0.0256	0.0072
24	0.0101	0.0178	0.0194
25	0.0077	0.0123	0.0216
26	0.0058	0.0094	0.008
27	0.0221	0.0107	0.0061

28	0.0205	0.0116	0.0109
29	0.0194	0.0239	0.0078
30	0.0194	0.025	0.0149
31	0.0136	0.0216	0.0094
32	0.0139	0.026	0.0086
33	0.0163	0.0256	0.0069
34	0.0209	0.0149	0.0086
35	0.0148	0.0155	0.015
36	0.0114	0.0212	0.011
37	0.0099	0.0249	0.0076
38	0.0081	0.0228	0.0067
39	0.0118	0.0101	0.0083
40	0.0097	0.0113	0.0076
41	0.0115	0.0088	0.0055
42	0.0084	0.0087	0.0067
43	0.0071	0.0252	0.0058
44	0.0073	0.0078	0.0074
45	0.0083	0.0075	0.004
46	0.0078	0.0089	0.0051
47	0.0102	0.0221	0.0052
48	0.0079	0.0113	0.0083
49	0.0106	0.0122	0.0092
50	0.0071	0.0093	0.0056

Appendix-39: Weight (gm) of 50 pupae (within 24 hrs.) on the mixture of larval diet of 50 gm MPF + 50gm liver + 20ml blood (MPF1)

Sl. No.	R1	R2	R3
1	0.0354	0.0272	0.0276
2	0.0353	0.0265	0.0244
3	0.0347	0.0287	0.0213
4	0.029	0.0246	0.0223
5	0.0301	0.0212	0.0238
6	0.0274	0.0238	0.0283
7	0.033	0.0212	0.024
8	0.026	0.0227	0.0213
9	0.0276	0.0226	0.0308
10	0.0252	0.0236	0.0309
11	0.0244	0.0284	0.0262
12	0.0253	0.0239	0.0253
13	0.0218	0.0233	0.0252
14	0.027	0.0212	0.0219
15	0.0256	0.0284	0.0277

16	0.0204	0.0226	0.0265
17	0.0261	0.028	0.0203
18	0.0223	0.0237	0.0199
19	0.0203	0.0276	0.0197
20	0.0247	0.0215	0.0195
21	0.018	0.0225	0.0108
22	0.0253	0.0157	0.022
23	0.0217	0.0198	0.0225
24	0.0236	0.0215	0.0239
25	0.0257	0.0169	0.0209
26	0.0279	0.0202	0.0233
27	0.0218	0.0183	0.0218
28	0.0196	0.0142	0.0226
29	0.0221	0.0249	0.0222
30	0.0182	0.0276	0.0267
31	0.02	0.0254	0.0268
32	0.0173	0.0236	0.0261
33	0.0169	0.0283	0.0224
34	0.025	0.0225	0.0231
35	0.0171	0.0229	0.0233
36	0.0155	0.0231	0.0196
37	0.0153	0.0211	0.0165
38	0.0254	0.0189	0.0188
39	0.0277	0.0231	0.0195
40	0.0278	0.0266	0.0154
41	0.0255	0.0239	0.0282
42	0.0203	0.0308	0.0258
43	0.0279	0.028	0.0208
44	0.0188	0.0288	0.0269
45	0.0204	0.0144	0.0198
46	0.0188	0.0152	0.0194
47	0.0156	0.0199	0.0218
48	0.0229	0.0168	0.0239
49	0.0301	0.0221	0.021
50	0.0283	0.0233	0.0219

Appendix-40: Weight (gm) of 50 pupae (within 24 hrs.) on the mixture of larval diet of 100 gm MPF + 50gm liver + 20ml blood (MPF2)

Sl. No.	R1	R2	R3
1	0.0361	0.0277	0.0293
2	0.0253	0.0261	0.0279
3	0.0254	0.0222	0.0228
4	0.0348	0.0317	0.031
5	0.0321	0.027	0.0235
6	0.0285	0.0207	0.0243
7	0.029	0.0342	0.0273
8	0.0317	0.0192	0.0284
9	0.0299	0.024	0.0314
10	0.0339	0.027	0.0302
11	0.0352	0.0238	0.0273
12	0.0244	0.0178	0.0253
13	0.0295	0.0227	0.0213
14	0.0241	0.0159	0.0247
15	0.0292	0.0048	0.0256
16	0.0321	0.0048	0.0242
17	0.0261	0.0046	0.0257
18	0.024	0.0054	0.0237
19	0.0281	0.0064	0.0247
20	0.0279	0.0063	0.0257
21	0.0211	0.0051	0.0273
22	0.0251	0.0092	0.0288
23	0.0075	0.023	0.0216
24	0.0037	0.0215	0.0162
25	0.0045	0.0258	0.0167
26	0.0252	0.0091	0.0092
27	0.0236	0.0054	0.0078
28	0.0048	0.0214	0.00241
29	0.0034	0.0232	0.0095
30	0.0236	0.0051	0.0099
31	0.0258	0.0084	0.0208
32	0.0232	0.0083	0.0121
33	0.0089	0.0248	0.0219
34	0.0182	0.0076	0.029
35	0.0182	0.0209	0.0245
36	0.0189	0.0213	0.0177
37	0.0149	0.0249	0.0165
38	0.0218	0.0253	0.0233
39	0.0165	0.0263	0.0251

40	0.0196	0.0253	0.0254
41	0.0193	0.0272	0.0212
42	0.0214	0.0229	0.0194
43	0.0233	0.0098	0.0203
44	0.0282	0.0193	0.0238
45	0.0239	0.0276	0.0078
46	0.0179	0.0178	0.0164
47	0.0122	0.0169	0.0096
48	0.005	0.0248	0.0094
49	0.0059	0.0209	0.0083
50	0.0089	0.0242	0.0241

Appendix-41: Weight (gm) of 50 pupae (within 24 hrs.) on the mixture of larval diet of 150 gm MPF + 50gm liver + 20ml blood (MPF3)

Sl. No.	R1	R2	R3
1	0.0263	0.0275	0.0255
2	0.0242	0.0294	0.0244
3	0.0265	0.0253	0.0255
4	0.0272	0.0202	0.0223
5	0.0255	0.0298	0.0211
6	0.0286	0.0277	0.0233
7	0.0294	0.0248	0.0265
8	0.0298	0.0232	0.0246
9	0.0304	0.0233	0.0209
10	0.0286	0.0232	0.0205
11	0.033	0.0263	0.0198
12	0.0301	0.0218	0.0214
13	0.0231	0.0179	0.0204
14	0.0232	0.0234	0.0254
15	0.0191	0.0241	0.024
16	0.0224	0.0251	0.0212
17	0.0186	0.0242	0.0185
18	0.0155	0.0222	0.0189
19	0.0153	0.0201	0.0185
20	0.0162	0.0191	0.0216
21	0.0193	0.0174	0.0145
22	0.0187	0.021	0.014
23	0.0092	0.0196	0.0194
24	0.0093	0.0209	0.0192
25	0.0098	0.0212	0.0188
26	0.0097	0.0096	0.0092
27	0.0094	0.0198	0.0088

28	0.0087	0.0195	0.0086
29	0.0195	0.0193	0.0089
30	0.0197	0.0109	0.0095
31	0.0192	0.0195	0.0097
32	0.0193	0.011	0.0056
33	0.0108	0.0226	0.0066
34	0.0199	0.0254	0.0202
35	0.0178	0.0176	0.0213
36	0.0222	0.0083	0.0075
37	0.0234	0.0077	0.0086
38	0.0168	0.0076	0.0067
39	0.0109	0.0085	0.0086
40	0.011	0.0099	0.0093
41	0.0059	0.0192	0.0115
42	0.0092	0.0109	0.0129
43	0.0058	0.0203	0.023
44	0.0066	0.024	0.0223
45	0.0088	0.0242	0.0252
46	0.0129	0.0256	0.0168
47	0.0176	0.0169	0.021
48	0.0168	0.0209	0.0206
49	0.0239	0.0209	0.0206
50	0.0293	0.0229	0.0192

Appendix-42: Weight (gm) of 50 pupae (within 24 hrs.) on the mixture of larval diet of 200 gm MPF + 50gm liver + 20ml blood (MPF4)

Sl. No.	R1	R2	R3
1	0.0217	0.0208	0.0203
2	0.0301	0.0161	0.0292
3	0.0208	0.0211	0.0204
4	0.0209	0.0177	0.0119
5	0.0191	0.0147	0.0192
6	0.0191	0.0182	0.0154
7	0.0179	0.0105	0.0177
8	0.0151	0.0054	0.0118
9	0.0175	0.0153	0.0206
10	0.0179	0.014	0.0201
11	0.0117	0.0207	0.0183

12	0.0207	0.0056	0.0192
13	0.0185	0.0091	0.0189
14	0.0196	0.0149	0.0172
15	0.0198	0.012	0.0132
16	0.0175	0.0065	0.0116
17	0.0133	0.0118	0.0122
18	0.0141	0.0164	0.0163
19	0.0135	0.0084	0.0069
20	0.0153	0.0101	0.0108
21	0.0102	0.0088	0.0098
22	0.0189	0.0059	0.0067
23	0.018	0.0079	0.0085
24	0.0133	0.0112	0.0089
25	0.0157	0.0089	0.011
26	0.0088	0.0089	0.0079
27	0.0097	0.0099	0.0158
28	0.0214	0.0095	0.0124
29	0.0164	0.0102	0.0122
30	0.0169	0.0123	0.0223
31	0.0082	0.0125	0.0209
32	0.0155	0.0129	0.0085
33	0.0136	0.0106	0.0096
34	0.0143	0.0113	0.0088
35	0.0111	0.0122	0.0101
36	0.0124	0.0086	0.0208
37	0.0118	0.0091	0.0211
38	0.0151	0.00102	0.0093
39	0.0175	0.0095	0.0097
40	0.0165	0.0124	0.0091
41	0.0145	0.0122	0.0111
42	0.0123	0.0094	0.029
43	0.0112	0.0109	0.0133
44	0.0096	0.011	0.0213

45	0.0058	0.0053	0.0193
46	0.0079	0.0103	0.0058
47	0.0055	0.0102	0.0062
48	0.0101	0.013	0.0099
49	0.0173	0.0205	0.0104
50	0.0091	0.0231	0.0203

Appendix-43: Weight (gm) of 50 pupae (within 24 hrs.) on the mixture of larval diet of 50 gm LPF + 50gm liver + 20ml blood (LPF1)

Sl. No.	R1	R2	R3
1	0.026	0.0266	0.0268
2	0.0254	0.0275	0.0276
3	0.0233	0.0239	0.0245
4	0.0241	0.0241	0.0303
5	0.0243	0.0332	0.0333
6	0.0282	0.0301	0.0257
7	0.0243	0.0291	0.0297
8	0.0287	0.0289	0.0209
9	0.0256	0.0256	0.0212
10	0.028	0.0252	0.0295
11	0.0277	0.0197	0.0275
12	0.032	0.0199	0.0281
13	0.029	0.0301	0.0248
14	0.0274	0.0182	0.0199
15	0.0265	0.0189	0.0208
16	0.0258	0.0287	0.0266
17	0.0303	0.0158	0.0187
18	0.0229	0.0268	0.0311
19	0.0264	0.0277	0.0301
20	0.0206	0.0222	0.0178
21	0.0247	0.0289	0.021
22	0.0298	0.021	0.0215
23	0.0312	0.0295	0.0243
24	0.0232	0.031	0.0258
25	0.0173	0.0204	0.0266
26	0.0182	0.0265	0.0209
27	0.0199	0.024	0.0252
28	0.018	0.0345	0.0254
29	0.0246	0.0269	0.0213
30	0.0303	0.0282	0.0142

31	0.0212	0.025	0.0277
32	0.0219	0.0191	0.0213
33	0.0146	0.0236	0.0269
34	0.0211	0.0275	0.0207
35	0.0198	0.0303	0.0272
36	0.0156	0.0299	0.0193
37	0.0202	0.0218	0.0233
38	0.0231	0.0146	0.0143
39	0.0145	0.021	0.0227
40	0.0153	0.0257	0.0189
41	0.0188	0.0238	0.0222
42	0.0192	0.0198	0.0236
43	0.0205	0.0206	0.0186
44	0.0169	0.0186	0.0199
45	0.0309	0.0198	0.0197
46	0.0233	0.0168	0.0112
47	0.0276	0.012	0.0169
48	0.0221	0.0113	0.0239
49	0.0237	0.0162	0.0205
50	0.0285	0.0204	0.0215

Appendix-44: Weight (gm) of 50 pupae (within 24 hrs.) on the mixture of larval diet of 100 gm LPF + 50gm liver + 20ml blood (LPF2)

Sl. No.	R1	R2	R3
1	0.0271	0.0277	0.0276
2	0.0291	0.0269	0.0299
3	0.0301	0.0314	0.0289
4	0.0288	0.0286	0.0296
5	0.0241	0.0243	0.0234
6	0.0291	0.0283	0.0251
7	0.0242	0.0292	0.0253
8	0.0282	0.0287	0.0229
9	0.0312	0.0299	0.0301
10	0.0195	0.0186	0.0312
11	0.0234	0.0202	0.0333
12	0.0272	0.0262	0.0292
13	0.0302	0.0312	0.0267
14	0.0219	0.0222	0.0281
15	0.028	0.027	0.0212
16	0.0279	0.0213	0.0207
17	0.0212	0.027	0.0205
18	0.0254	0.0193	0.0246

19	0.023	0.0169	0.0219
20	0.0256	0.0187	0.0236
21	0.026	0.0267	0.0264
22	0.0284	0.0301	0.0251
23	0.0192	0.0229	0.0257
24	0.0231	0.0096	0.011
25	0.0294	0.0102	0.0108
26	0.0184	0.0084	0.0166
27	0.0162	0.0133	0.0093
28	0.0113	0.0169	0.012
29	0.015	0.0198	0.0152
30	0.0208	0.0178	0.0193
31	0.0195	0.017	0.0068
32	0.0085	0.0244	0.0192
33	0.0091	0.0213	0.021
34	0.0066	0.0233	0.0246
35	0.0122	0.0069	0.0099
36	0.0124	0.0059	0.0196
37	0.006	0.0068	0.0086
38	0.0085	0.0077	0.0076
39	0.0095	0.0086	0.0093
40	0.0086	0.0092	0.0075
41	0.0102	0.0103	0.0078
42	0.0123	0.0157	0.0105
43	0.021	0.0134	0.021
44	0.0089	0.0139	0.0092
45	0.0091	0.0191	0.0094
46	0.0099	0.0091	0.0134
47	0.0094	0.0096	0.0122
48	0.0143	0.0102	0.0111
49	0.0122	0.0222	0.0202
50	0.0205	0.0273	0.0204

Appendix-45: Weight (gm) of 50 pupae (within 24 hrs.) on the mixture of larval diet of 150 gm LPF + 50gm liver + 20ml blood (LPF3)

Sl. No.	R1	R2	R3
1	0.0257	0.0294	0.0278
2	0.0293	0.0268	0.0298
3	0.0301	0.0267	0.0302
4	0.0276	0.0268	0.0278
5	0.0241	0.0245	0.0248
6	0.0281	0.0292	0.0282
7	0.0143	0.0196	0.0293
8	0.0108	0.011	0.0109
9	0.011	0.012	0.0124
10	0.0196	0.0169	0.0155
11	0.0121	0.0202	0.0149
12	0.0222	0.0154	0.0156
13	0.0242	0.0156	0.0143
14	0.0267	0.0206	0.0122
15	0.0108	0.0109	0.0192
16	0.011	0.0144	0.0198
17	0.0253	0.0204	0.0202
18	0.0167	0.013	0.0163
19	0.0232	0.0134	0.0164
20	0.0202	0.0133	0.0144
21	0.0209	0.0131	0.021
22	0.0212	0.0138	0.019
23	0.021	0.0134	0.0123
24	0.0222	0.0196	0.0198
25	0.0211	0.0182	0.0128
26	0.0196	0.0199	0.0149
27	0.0143	0.02	0.0133
28	0.0136	0.0177	0.0148
29	0.0126	0.0168	0.0129
30	0.012	0.0222	0.0191
31	0.0166	0.0239	0.0183
32	0.0164	0.0144	0.0143
33	0.0156	0.0089	0.0085
34	0.0092	0.0169	0.0088
35	0.0093	0.0143	0.0086
36	0.0133	0.0098	0.0075
37	0.0046	0.0062	0.006
38	0.0045	0.0054	0.0059
39	0.0049	0.0059	0.0057

40	0.0052	0.0051	0.0049
41	0.0056	0.0052	0.0058
42	0.0082	0.0083	0.008
43	0.012	0.0088	0.0092
44	0.0123	0.0124	0.0053
45	0.0048	0.0148	0.0049
46	0.0052	0.0053	0.0051
47	0.0058	0.0059	0.0056
48	0.008	0.0062	0.0069
49	0.0088	0.0081	0.0083
50	0.0091	0.0087	0.0099

Appendix-46: Weight (gm) of 50 pupae (within 24 hrs.) on the mixture of larval diet of 200 gm LPF + 50gm liver + 20ml blood (LPF4)

Sl. No.	R1	R2	R3
1	0.0235	0.0243	0.0145
2	0.0292	0.0222	0.0252
3	0.0241	0.0251	0.0263
4	0.0242	0.0264	0.0265
5	0.0234	0.0262	0.0267
6	0.0218	0.0268	0.0272
7	0.0145	0.0259	0.0243
8	0.0181	0.0193	0.0188
9	0.0202	0.0198	0.0193
10	0.0204	0.0199	0.0196
11	0.0208	0.0201	0.0202
12	0.021	0.0211	0.0101
13	0.0222	0.0101	0.0108
14	0.0108	0.0231	0.0106
15	0.0109	0.0243	0.011
16	0.0213	0.0107	0.0213
17	0.0143	0.0219	0.0134
18	0.0209	0.0148	0.0136
19	0.0165	0.0135	0.0138
20	0.0188	0.0136	0.0142
21	0.0169	0.0186	0.0152
22	0.0154	0.0129	0.0161
23	0.0145	0.013	0.016
24	0.0143	0.0132	0.0159
25	0.0149	0.0133	0.0163
26	0.0144	0.0141	0.0148
27	0.0153	0.0111	0.0122

28	0.0123	0.0124	0.0121
29	0.0193	0.0198	0.0188
30	0.0199	0.0181	0.0189
31	0.0106	0.0186	0.0192
32	0.0108	0.0193	0.0044
33	0.0049	0.0052	0.0118
34	0.0049	0.0057	0.012
35	0.0121	0.0086	0.0047
36	0.0058	0.0049	0.0051
37	0.0046	0.0054	0.0053
38	0.0054	0.0055	0.0058
39	0.0056	0.0059	0.0062
40	0.0063	0.0081	0.0059
41	0.0068	0.0066	0.008
42	0.0072	0.0062	0.0061
43	0.0077	0.0073	0.0075
44	0.0078	0.0076	0.0071
45	0.0079	0.0069	0.0073
46	0.0083	0.0072	0.0059
47	0.0081	0.0089	0.0075
48	0.0088	0.0093	0.0074
49	0.0089	0.0099	0.0047
50	0.01	0.0102	0.0105

<u>Appendix-47</u>: Pupal weight (g) of blow fly *Lucilia cuprina* larvae reared on Imported Poultry Feed based diet with different ratios namely IPF1, IPF2, IPF3, IPF4 & control.

Sl No.	Average wt. Of pupae				
	Control	IPF1	IPF2	IPF3	IPF4
1	0.0261	0.0290	0.0253	0.0197	0.0218
2	0.0245	0.0279	0.0264	0.0224	0.0241
3	0.0261	0.0274	0.0267	0.0231	0.0218
4	0.0264	0.0304	0.0291	0.0184	0.0203
5	0.0253	0.0287	0.0243	0.0230	0.0181
6	0.0271	0.0280	0.0271	0.0218	0.0191
7	0.0255	0.0292	0.0307	0.0214	0.0225
8	0.0300	0.0285	0.0275	0.0244	0.0220
9	0.0275	0.0267	0.0291	0.0223	0.0243
10	0.0280	0.0286	0.0250	0.0218	0.0200
11	0.0267	0.0273	0.0233	0.0219	0.0225
12	0.0289	0.0270	0.0254	0.0201	0.0200
13	0.0295	0.0285	0.0240	0.0223	0.0135
14	0.0280	0.0268	0.0251	0.0226	0.0152
15	0.0284	0.0254	0.0265	0.0201	0.0184
16	0.0216	0.0268	0.0211	0.0221	0.0211
17	0.0248	0.0280	0.0200	0.0205	0.0160
18	0.0251	0.0244	0.0268	0.0193	0.0138
19	0.0270	0.0274	0.0257	0.0257	0.0152
20	0.0284	0.0281	0.0243	0.0217	0.0197
21	0.0255	0.0262	0.0251	0.0215	0.0118
22	0.0233	0.0227	0.0241	0.0214	0.0228
23	0.0235	0.0230	0.0229	0.0205	0.0160
24	0.0264	0.0227	0.0222	0.0185	0.0158
25	0.0284	0.0222	0.0220	0.0221	0.0139
26	0.0260	0.0231	0.0247	0.0218	0.0077
27	0.0269	0.0211	0.0187	0.0224	0.0130
28	0.0262	0.0215	0.0225	0.0178	0.0143
29	0.0297	0.0237	0.0216	0.0195	0.0170
30	0.0285	0.0217	0.0216	0.0227	0.0198
31	0.0264	0.0228	0.0202	0.0191	0.0149
32	0.0266	0.0224	0.0192	0.0227	0.0162
33	0.0276	0.0234	0.0211	0.0218	0.0163
34	0.0287	0.0225	0.0189	0.0208	0.0148
35	0.0245	0.0224	0.0217	0.0205	0.0151
36	0.0273	0.0226	0.0248	0.0185	0.0145
37	0.0281	0.0273	0.0200	0.0238	0.0141

38	0.0284	0.0233	0.0204	0.0200	0.0125
39	0.0234	0.0245	0.0175	0.0231	0.0101
40	0.0294	0.0232	0.0223	0.0201	0.0095
41	0.0260	0.0234	0.0208	0.0227	0.0086
42	0.0220	0.0217	0.0217	0.0205	0.0079
43	0.0259	0.0244	0.0182	0.0204	0.0127
44	0.0260	0.0216	0.0218	0.0209	0.0075
45	0.0270	0.0207	0.0201	0.0209	0.0066
46	0.0272	0.0263	0.0207	0.0205	0.0073
47	0.0271	0.0250	0.0173	0.0206	0.0125
48	0.0260	0.0250	0.0205	0.0164	0.0092
49	0.0244	0.0242	0.0186	0.0185	0.0107
50	0.0265	0.0218	0.0178	0.0197	0.0073

Appendix-48: Pupal weight(g) of blow fly *Lucilia cuprina* larvae reared on Marine Poultry Feed based diet with different ratios namely MPF1, MPF2, MPF3, MPF4 & control.

Sl No	Average wt. Of pupae				
	Control	MPF1	MPF2	MPF3	MPF4
1	0.0261	0.0301	0.0310	0.0264	0.0209
2	0.0245	0.0287	0.0264	0.0260	0.0251
3	0.0261	0.0282	0.0235	0.0258	0.0208
4	0.0264	0.0253	0.0325	0.0232	0.0168
5	0.0253	0.0250	0.0275	0.0255	0.0177
6	0.0271	0.0265	0.0245	0.0265	0.0176
7	0.0255	0.0261	0.0302	0.0269	0.0154
8	0.0300	0.0233	0.0264	0.0259	0.0108
9	0.0275	0.0270	0.0284	0.0249	0.0178
10	0.0280	0.0266	0.0304	0.0241	0.0173
11	0.0267	0.0263	0.0288	0.0264	0.0169
12	0.0289	0.0248	0.0225	0.0244	0.0152
13	0.0295	0.0234	0.0245	0.0205	0.0155
14	0.0280	0.0234	0.0216	0.0240	0.0172
15	0.0284	0.0272	0.0199	0.0224	0.0150
16	0.0216	0.0232	0.0204	0.0229	0.0119
17	0.0248	0.0248	0.0188	0.0204	0.0124
18	0.0251	0.0220	0.0177	0.0189	0.0156
19	0.0270	0.0225	0.0197	0.0180	0.0096
20	0.0284	0.0219	0.0200	0.0190	0.0121
21	0.0255	0.0171	0.0178	0.0171	0.0096
22	0.0233	0.0210	0.0210	0.0179	0.0105
23	0.0235	0.0213	0.0174	0.0161	0.0115

24	0.0264	0.0230	0.0138	0.0165	0.0111
25	0.0284	0.0212	0.0157	0.0166	0.0119
26	0.0260	0.0238	0.0145	0.0095	0.0085
27	0.0269	0.0206	0.0123	0.0127	0.0118
28	0.0262	0.0188	0.0095	0.0123	0.0144
29	0.0297	0.0231	0.0120	0.0159	0.0129
30	0.0285	0.0242	0.0129	0.0134	0.0172
31	0.0264	0.0241	0.0183	0.0161	0.0139
32	0.0266	0.0223	0.0145	0.0120	0.0123
33	0.0276	0.0225	0.0185	0.0133	0.0113
34	0.0287	0.0235	0.0183	0.0218	0.0115
35	0.0245	0.0211	0.0212	0.0189	0.0111
36	0.0273	0.0194	0.0193	0.0127	0.0139
37	0.0281	0.0176	0.0188	0.0132	0.0140
38	0.0284	0.0210	0.0235	0.0104	0.0085
39	0.0234	0.0234	0.0226	0.0093	0.0122
40	0.0294	0.0233	0.0234	0.0101	0.0127
41	0.0260	0.0259	0.0226	0.0122	0.0126
42	0.0220	0.0256	0.0212	0.0110	0.0169
43	0.0259	0.0256	0.0178	0.0164	0.0118
44	0.0260	0.0248	0.0238	0.0176	0.0140
45	0.0270	0.0182	0.0198	0.0194	0.0101
46	0.0272	0.0178	0.0174	0.0184	0.0080
47	0.0271	0.0191	0.0129	0.0185	0.0073
48	0.0260	0.0212	0.0131	0.0194	0.0110
49	0.0244	0.0244	0.0117	0.0218	0.0161
50	0.0265	0.0245	0.0191	0.0238	0.0175

<u>Appendix-49:</u> Pupal weight of blow fly *Lucilia cuprina* larvae reared on Local Poultry Feed based diet with different ratios namely LPF1, LPF2, LPF3, LPF4 & control.

Sl No	Average wt. Of pupae				
	Control	LPF1	LPF2	LPF3	LPF4
1	0.0261	0.0265	0.0275	0.0276	0.0208
2	0.0245	0.0268	0.0286	0.0286	0.0255
3	0.0261	0.0239	0.0301	0.0290	0.0252
4	0.0264	0.0262	0.0290	0.0274	0.0257
5	0.0253	0.0303	0.0239	0.0245	0.0254
6	0.0271	0.0280	0.0275	0.0285	0.0253
7	0.0255	0.0277	0.0262	0.0211	0.0216
8	0.0300	0.0262	0.0266	0.0109	0.0187
9	0.0275	0.0241	0.0304	0.0118	0.0198

10	0.0280	0.0276	0.0231	0.0173	0.0200
11	0.0267	0.0250	0.0256	0.0157	0.0204
12	0.0289	0.0267	0.0275	0.0177	0.0174
13	0.0295	0.0280	0.0294	0.0180	0.0212
14	0.0280	0.0218	0.0241	0.0198	0.0148
15	0.0284	0.0221	0.0254	0.0136	0.0154
16	0.0216	0.0270	0.0233	0.0151	0.0178
17	0.0248	0.0216	0.0229	0.0220	0.0165
18	0.0251	0.0269	0.0231	0.0153	0.0164
19	0.0270	0.0281	0.0206	0.0177	0.0146
20	0.0284	0.0202	0.0226	0.0160	0.0155
21	0.0255	0.0249	0.0264	0.0183	0.0169
22	0.0233	0.0241	0.0279	0.0180	0.0148
23	0.0235	0.0283	0.0226	0.0156	0.0145
24	0.0264	0.0267	0.0146	0.0205	0.0145
25	0.0284	0.0214	0.0168	0.0174	0.0148
26	0.0260	0.0219	0.0145	0.0181	0.0144
27	0.0269	0.0230	0.0129	0.0159	0.0129
28	0.0262	0.0260	0.0134	0.0154	0.0123
29	0.0297	0.0243	0.0167	0.0141	0.0193
30	0.0285	0.0242	0.0193	0.0178	0.0190
31	0.0264	0.0246	0.0144	0.0196	0.0161
32	0.0266	0.0208	0.0174	0.0150	0.0115
33	0.0276	0.0217	0.0171	0.0110	0.0073
34	0.0287	0.0231	0.0182	0.0116	0.0075
35	0.0245	0.0258	0.0097	0.0107	0.0085
36	0.0273	0.0216	0.0126	0.0102	0.0053
37	0.0281	0.0218	0.0071	0.0056	0.0051
38	0.0284	0.0173	0.0079	0.0053	0.0056
39	0.0234	0.0194	0.0091	0.0055	0.0059
40	0.0294	0.0200	0.0084	0.0051	0.0068
41	0.0260	0.0216	0.0094	0.0055	0.0071
42	0.0220	0.0209	0.0128	0.0082	0.0065
43	0.0259	0.0199	0.0185	0.0100	0.0075
44	0.0260	0.0185	0.0107	0.0100	0.0075
45	0.0270	0.0235	0.0125	0.0082	0.0074
46	0.0272	0.0171	0.0108	0.0052	0.0071
47	0.0271	0.0188	0.0104	0.0058	0.0082
48	0.0260	0.0191	0.0119	0.0070	0.0085
49	0.0244	0.0201	0.0182	0.0084	0.0078
50	0.0265	0.0235	0.0227	0.0092	0.0102

Appendix-50: Pupal weight of blow fly *Lucilia cuprina* larvae reared on different feed based diet namely IPF, MPF, LPF & control.

Sl No	Average wt. Of pupae			
	Control	IPF	MPF	LPF
1	0.0261	0.0239	0.0271	0.0256
2	0.0245	0.0252	0.0266	0.0274
3	0.0261	0.0248	0.0246	0.0271
4	0.0264	0.0246	0.0245	0.0271
5	0.0253	0.0235	0.0239	0.0260
6	0.0271	0.0240	0.0238	0.0273
7	0.0255	0.0259	0.0246	0.0241
8	0.0300	0.0256	0.0216	0.0206
9	0.0275	0.0256	0.0245	0.0215
10	0.0280	0.0238	0.0246	0.0220
11	0.0267	0.0238	0.0246	0.0217
12	0.0289	0.0231	0.0217	0.0223
13	0.0295	0.0221	0.0210	0.0242
14	0.0280	0.0224	0.0215	0.0201
15	0.0284	0.0226	0.0211	0.0191
16	0.0216	0.0228	0.0196	0.0208
17	0.0248	0.0212	0.0191	0.0208
18	0.0251	0.0211	0.0185	0.0205
19	0.0270	0.0235	0.0175	0.0202
20	0.0284	0.0235	0.0182	0.0186
21	0.0255	0.0211	0.0154	0.0216
22	0.0233	0.0227	0.0176	0.0212
23	0.0235	0.0206	0.0166	0.0203
24	0.0264	0.0198	0.0161	0.0191
25	0.0284	0.0200	0.0163	0.0176
26	0.0260	0.0193	0.0141	0.0172
27	0.0269	0.0188	0.0143	0.0162
28	0.0262	0.0190	0.0138	0.0168
29	0.0297	0.0205	0.0160	0.0186
30	0.0285	0.0214	0.0169	0.0201
31	0.0264	0.0192	0.0181	0.0187
32	0.0266	0.0201	0.0153	0.0162
33	0.0276	0.0206	0.0164	0.0143
34	0.0287	0.0192	0.0188	0.0151
35	0.0245	0.0200	0.0181	0.0137
36	0.0273	0.0201	0.0163	0.0124
37	0.0281	0.0213	0.0159	0.0099
38	0.0284	0.0191	0.0158	0.0090

39	0.0234	0.0188	0.0169	0.0100
40	0.0294	0.0188	0.0174	0.0101
41	0.0260	0.0189	0.0183	0.0109
42	0.0220	0.0180	0.0187	0.0121
43	0.0259	0.0189	0.0179	0.0140
44	0.0260	0.0179	0.0201	0.0117
45	0.0270	0.0171	0.0169	0.0129
46	0.0272	0.0187	0.0154	0.0101
47	0.0271	0.0188	0.0145	0.0108
48	0.0260	0.0178	0.0162	0.0116
49	0.0244	0.0180	0.0185	0.0136
50	0.0265	0.0167	0.0212	0.0164

Appendix-51: ANOVA showing the level of significances among different diets and proportions of commercial grade of poultry feeds (IPF, MPF and LPF) and dose IPF1, IPF2, IPF3, IPF4; MPF1, MPF2, MPF3, MPF4 and LPF1, LPF2, LPF3, LPF4

Source of variance	Degrees of freedom	Sum of squares	Mean square	F value
Diets	3	527.074	175.691	78.3408
Error	8	17.941	2.243	
Proportions	9	332.522	110.841	122.1840
Died & Proportions	9	137.844	15.316	16.8834
Error	24	21.772	0.907	
Total	**47**	**1037.153**		