The University of Jordan
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A Cultural Method for Controlling the House Fly *Musca domestica* L. (Diptera: Muscidae) and Studying Certain Aspects of its Biology in the Jordan valley

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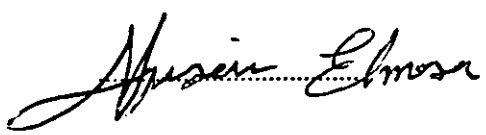
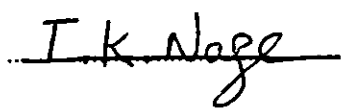
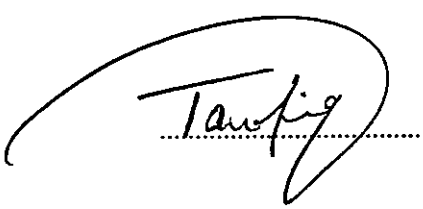
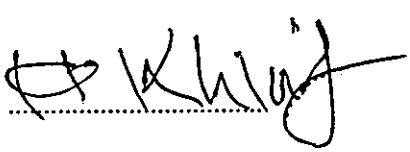
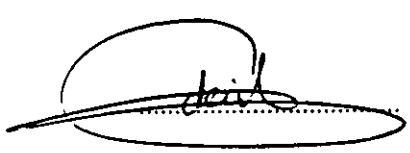
1. Prof. Husien M. Elmosa (Chairman of the Committee)	
2. Prof. Ibrahim K. Nazer (Member of the committee)	
3. Prof. Tawfiq M. Mustafa (Member of the committee)	
4. Dr. Hamed Khlaif (Member of the committee)	
5. Dr. Diefallah Badarneh (Member of the committee)	

DEDICATED

MY Father, Mother

Brothers & Sisters

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ABSTRACT

A Cultural Method for Controlling the House Fly *Musca domestica* L. (Diptera: Muscidae) and Studying Certain Aspects of its Biology in the Jordan valley

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This study was undertaken to determine whether or not incorporation of manure in the soil before applying water for fermentation would serve as a control method for the house fly *Musca domestica* L. Also the effect of this method on plant growth and fructification was investigated. Results showed that the method proved to be very effective in controlling the house fly since no larvae were detected in the manure incorporated in the soil, whereas high fly numbers were found in the method practiced by farmers in which manure is applied on the soil surface and then irrigation is performed. No negative effect on pepper plant growth, i.e. plant height, number of flowers, crop production and number of dead seedlings were found.

Experiments were conducted to investigate the various sources of infestation, i.e. dung heaps placed on farms prior to planting, manure applied to the soil in plastic houses and manure applied to vegetable farms in the open fields. Results indicated that manure applied in narrow strips around the irrigation pipes in vegetable farms in the open fields was the most important source of infestation followed by manure applied to citrus and banana orchards. Heaps placed on farms prior to planting are not considered as a source of infestation because they were kept dry by the high temperature prevailing in the valley.

In investigating the preferable kinds of manure for house fly development: poultry, compost from a local company, sheep and cow were found to be preferable in descending order. where cow manure which was kept in the open for over a year was free from infestation.

Studies were carried out on the population trends of the house fly. Flies attained high numbers in August, September and October. This conicided with the time where farmers start to prepare their lands and add manure especially for vegetable production in the open fields. The results of this study revealed that the house fly has 21 generations per year in Jordan Valley.

1. INTRODUCTION

The common house fly *Musca domestica* L.(Diptera: Muscidae) is a cosmopolitan insect. It has been known to cause nuisance to people over the world wherever livestock are kept and garbage accumulated. It thrives best where people are careless in the disposal of organic wastes. It feeds on and breeds in human waste and manure of animals (1).

The house fly is of utmost importance as a public health pest due to the fact that it can transmit a large number of diseases to man owing to its habit to visit almost indiscriminately feces and other unhygienic matter and then the food of man. Also it is an unbearable nuisance as well. The house fly has been shown to carry the disease organisms causing typhoid, cholera, summer diarrhia, dysentery, tuberculosis, anthrax, as well as intestinal worms. Also house flies can transmit viruses and other disease pathogens such as poliomyelitis, trachoma, infectious hepatitis, ricketisae, and numerous bacterial diseases such as streptococci and yaws (2).

The house fly *M. domestica* represent the main insect pest of public health importance in Jordan (3). And although the house fly is a problem in the country as in other parts of the world, it is especially so in Jordan Valley because intensive farming is practiced there which requires the application of manure to improve the potential of soil productivity. This practice in addition to the favorable weather conditions enhance the development and increases the fly population to very high levels causing nuisance and diseases to inhabitants and visiotrs.

The fly problem starts at the time when farmers apply manure to the surface of the soil approximately two to three weeks before planting. Manure is applied in narrow strips along the irrigation pipes then water is added in order to ferment it prior the planting to avoid damaging of seedling (4).

In the past few years chemical control of the fly by using various insecticides were attempted but unfortunately without success (5). This may be attributed to that insecticides do not reach the target where house fly breeds in the manure spread on the surface of the soil as mentioned previously (4), or due to the development of ressistance (6 and 7). Sacca (6) showed that the house fly in Amman area was resistance to DDT and gamma-HCH. Also the house fly was tolerant, resistant, or susciptable to various organophosphorous compounds.Also, Abu-Nada (7) found that the population of the house fly collected from the University Agricultural Experiment Station in central Jordan Valley have various degrees of homogeneity with tolerance or resistance to the tested insecticides.

Taking into consideration the forgoing, this study was undertaken for the following objectives :

1) To investigate if the manures brought before preparation of the soil for planting and placed in heaps by farmers on their farms are a source of fly infestation.
2) To study the population trends of the house fly in the central Jordan Valley all year round.
3) To determine the number of generations per year in relation to temperature.
4) To determine the preferable type of manure for house fly breeding, this include poultry, sheep, cow manure, old cow manure and compost from a local company .
5) To investigate the possiblility of incorporation of manure in the soil works as a cultural control method for the fly .
6) Study the effect of adding manure applied above the soil surface or incorporated into the soil on plant growth and fructification.

2. LITERATURE REVIEW

2.1. Sources of Infestation:

2.1.1. Dung Heaps :

Whenever manure is piled up and accessible to flies, these insects were afforded opportunity to breed (8, 9). Feldman-Musham (10) experimenting on the conditions of pupation of the house fly in Palestine stated that rapid drying of the surface of manure piles inhabited by larvae may prevent fly development. Bodenheimer (11) working on the different breeding places of the house fly in Palestine found that only the upper 20 cm of dung heaps serves as actual breeding places . Elmosa (4) investigating dung heaps as a source of infestation in Jordan Valley found these heaps free from infestation, because most of them were dry.

1.2. Different kinds of Manure :

There has been much controversy as to the most attractive substances for the house fly. Leikina (12) studied the value of various substrates as media for development of house fly and observed that pig manure, human feces, sheep dung, calf dung, cow dung, and horse dung were favourable media for larval development in the order named. The preference of flies for pig manure has been reported by several authors (13, 14). Also, Thomsen (13) stated that horse, chicken and rabbit dung were less attractive than pig dung and cow dung was least attractive of all. Coffey (15) made a study of fly breeding substances found that, the most important breeding places in descending order are horse manure, human excreta, cow manure and other garbages. Herms (8) reported that excrement especially of horses was the material upon which the house fly prefers to deposit its eggs. Also, he reported that cow manure if well mixed with bedding was frequently an important factor in the development of flies. Flies were also breeding in pig manure, where chicken manure is the most important factor in the breeding

of the flies in poultry districts; human excreta was a very dangerous substance, and if exposed to flies in open privies become a very prolific breeding place. Mallis (16) indicated that the most important breeding places in descending order were horse manure, human excreta, cow, chicken and pig excrements. Larsen *etal.* (17) stressed the choice of oviposition sites by house fly among eight manures. They found that the most attractive substrate in descending order were pig, human excreta, chicken, dog, calf, horse, sheep and cow manure. Service (2) reported that fertilized female of the house fly which ready to oviposit were attracted for egg laying to a variety of decomposing materials such as horse manure, poultry dung, urine – contaminated bedding, decaying and decomposing organic materials. In Jordan it was reported that garbage refuse dump, sewage, disposal plants, slaughter houses, stables, and poultry houses serves as breeding places of the house fly (18).

2.2. Population Trends of the House Fly:

2.2.1. Periods of Activity :

Mail and Schoof (19) working on house fly population in west Virginia, reported that the major period of activity occured in late July and August. Also Lysyk (20) found that the peak house fly captures occured in August and early September in Canada, and larval population peaked in early to mid-August. Enan *et.al.*(21) found that the house fly population has two peaks and two depressions during the year in Alexandria. In Jordan there is no reports on the subject .

2.2. Percentage of the House fly Found in the Fly Population

Shegehisa and Shemogama (22) studied the resting habits of the house fly and collected flies in June, September and October and reported that of all flies collected the house fly was the most abundant (91%), stable fly

(5%) the next and *Fannia spp.* (2%) third. Haines (23) reported that 99% of the files in houses in two cities in Georgira were *M. domestica*. Mallis (16) reported that thousands of house flies breeding in manure, of the flies present 95% were *M. domestica* and 5% were *Stomoxys calcitrans*.

2.3. Number of Generations:

Mallis (16) reported that during the warm weather of summer, when conditions are favorable for the development of house fly, it might require as little as 6 days to complete the life cycle from egg to adult emergence, and there may be as many as 10-12 generations in one Summer. Bodenheimer (11) found that house fly development was not interrupted during winter, and the life cycle was prolonged to two months. Also he reported that 5-6 days were the shortest period of development observed in July, and the total number of generations in Palestine was twenty. In the high lands of Jordan, Elmosa (24) found that there are about 15 generations in the open field per year.

2.Control of the House Fly:

Although a large volume of work has been reported in the literature in various parts in the world on the chemical and biological control of the house fly, no reports are available on the cultural control of the pest .

3. MATERIALS AND METHODS

3.1. Breeding Sites of the House Fly :

3.1.1. Manure Heaps as Source of Breeding Sites :

It is well-known that farmers place on their farms heaps of different kinds of manure in anticipation of using them as fertilizers a short time before planting. To investigate whether or not these heaps are source of infestation, visits were made to various locations in Jordan Valley and 228 heaps of manure in 50 farms were examined. From each heap four manure samples measuring 30 cm long, 10 cm wide and 20 cm deep were taken randomly. Numbers of larvae found in these samples were counted.

3.1.2. Manure Applied to Citrus and Banana Orchards :

Farmers apply manure as side dressing or in strips along the line of trees in the orchards .Visits were made to various citrus and banana orchards in Jordan Valley to determine whether or not manure applied are sources of fly infestation. Twenty five citrus orchards and twenty one banana orchards were investigated . Four random samples meauring 30 cm long, 10 cm wide and 5 cm deep were taken from citrus and banana orchards. Numbers of larvae found were counted.

3.1.3. Manure Applied to Vegetable Farms :

3.1.3.1. Manure Applied on Seed Beds :

Many farmers use seed beds to grow certain herbacious crops. Also, tobacco is planted to produce seedlings. Manure is applied either by braodcasting on bed surface or placed in furrows then covered with soil. Investigations were carried out on fifteen farms in different locations in Jordan Valley. Four samples were taken from each farm as described previously (3.1.2). Numbers of larvae found in each sample were counted.

3.1.3.2. Manure Applied into Plastic Houses :

Farmers apply manure of poultry mixed with sheep or cow manures to the soil in the plastic houses to improve plant productivity. After irrigation the land is plowed and manure applied on the surface and then rotivated under the soil surface, then water is added in excessive amounts for manure fermentation. To investigate whether or not these manures are considered as a source of fly infestation, seventy four plastic houses on eleven farms were investigated and four samples were taken from each plastic house as described previously (3.1.2) and numbers of larvae found were counted.

3.1.3.3. Manure Applied to Vegetable Farms in Open Fields:

It is well-known that farmers after preparing the soil for planting, irrigation pipes are established and manure applied in thin strips around them (15-20 cm on each side). Water then is added to ferment manure applied. To ascertain whether or not this practice of manure application is a source of fly infestation, twenty two farms were visited in various locations in Jordan Valley. Four samples measuring 30 cm long, 10 cm wide and 5 cm deep were taken at random from each farm, and numbers of larvae found in these samples were counted.

3.2. Population Trends of The House Fly

3.2.1. Periods of Activity

This experiment was performed at two locations in Jordan Valley, one in kraymah, 10 km north of Deir Alla and the other at the University Agricultural Experiment Station. Plastic dishes of 30 cm diameter and 15 cm deep were used as traps. Four dishes were placed in each site and distributed 30m apart from each other for monitoring of adult house fly population. Half gram of methomyl wettable powder insecticide dissolved in 100 ml of water were placed in each dish to kill the trapped flies .

Number of trapped flies in each dish were counted and recorded at weekly intervals.

3.2.2. Percentage of the House Fly Found in the Fly Population

Several samples of flies caught by the traps at University Agricultural Experiment Station were taken to the laboratory to determine the percentage of house fly (*M. domestica*). These flies were identified by using hand lense or a binocular microscope.

3.3. Number of Generations :

The purpose of this experiment was to determine the number of generations related to temperature. Approximately 5-7 kg of air dried poultry manure was put on a wooden board measuring 50 cm wide and 80 cm long and placed in a shaded location in Kraymah. Water was added to wet the manure which was left exposed for the females house fly for oviposition. Inspection of manure for the presence of immature stages were performed regularly to determine the number of days required for the development of the larval and pupal stages.

At the time larvae began transformation to the pupal stage, 60 specimens were introduced into a plastic jar containing dry manure and covered with muslin cloth. The jar was placed in the vicinity of the experiment site to determine duration of the pupal stage and adult emergence.

The length of different generations were related to temperature. Average temperatures were obtaind from Deir Alla Agricultural Experiment Station, Ministry of Agriculture, 10 km south of the experiment site.

3.4. House Fly Preference to Various Kinds of Manure :

This study was conducted at the University Agricultural Experiment Station in central Jordan Valley, to find out the preferable kind of manure for house fly breeding i,e. poultry, sheep, cow manures, composted manure by a local company and cow manure kept in the open for over a year . The work was carried out on a piece of land 50 m long and 18 m wide. The design was Randomized Complete Block Design RCBD, with 4 replication for each treatment, and each replicate represented in two raised beds 12 m long and 0.7 m wide. The total number of raised beds was 40.

The experimental plot was plowed, rotivated and raised beds were prepared. A drip irrigation system with laterals 12 m long and 1.2 m apart, and drippers spaced 35 cm were used to wet the manure; in addition, sprinkler irrigation system which was established in the midle of the raised beds to maintain adequate amount of moisture. Three kiolgram from each kind of manure mentioned previously was used for each linear meter and were distributed around the laterals. Water then was added for one hour by the sprinkler system, and approximately 6 hours by the drip irrigation once every other day.

After two days from irrigation, four samples of manure measuring 30 cm long, 10 cm wide and 5 cm deep were taken randomly from each replicate, and numbers of larvae and pupae found in each kind of manure were counted. The experiment was continued until the emergence of adult house flies from each kind of manure as mentioned in the previous experiment (3.3).

Data were statistically analyzed according to the RCBD design. Analysis of variance and Duncan's Multiple Range test for mean seperation were performed .

3.5. Fermenting Manure Under The Soil Surface as a Possible Control Measure for the House Fly :

This experiment was carried out at the University Agricultural Experiment Station in central Jordan Valley in the hope of finding a cultural control method for the house fly. The experiment consisted of six treatments namely: cow, sheep and poultry manures applied on the soil surface, and the same kinds of manure were incorporated in the soil by a rotivator. Each treatment consisted of two raised beds replicated three times.

A plot of land 120m long and 15 m wide were plowed, rotivated and then raised beds of 12 m long, 1.7 m wide were prepared. A drip irrigation system were installed on these raised beds with laterals 2.7 m apart, and drippers spaced 45 cm approximately along the laterals. Three kilogrames of fresh manure of cow, sheep and poultry were applied around the laterals on the soil surface to all raised beds. After irrigation pipes were put aside and manure on the raised beds to be incorporated in the soil were rotivated and irrigation pipes were reinstalled . Drip irrigation system was operated for six hours every other day on all the raised beds for fermenting manure .

After two days of irrigation, four samples of manure measuring 30 cm long, 10 cm wide and 5 cm deep were taken randomly from each replicate and numbers of larvae or pupae found were counted and recorded. Data were analyzed according to the 2*3 factorial RCBD design and Duncan's Multiple Range test were performed for mean separation.

3.6.Effect of Fermenting Manure Above or Under The Soil Surface on Pepper Plants :

This experiment was carried out in the same plot of land used for the preceeding experiment, to investigate whether or not fermenting manure under or above surface has deleterious effects on crop plant. After the

4. RESULTS AND DISCUSSION

4.1. Sources of Infestation

4.1.1 Manure Placed in Heaps

Numbers of larvae found in samples taken from 228 heaps of different kinds of manure from different locations in Jordan Valley are shown in table 1. The table indicates clearly that only wet heaps are considered a source of infestation, while no infestation in dry heaps.

Taking into consideration that only 6 out of 228 heaps examined were wet and source of infestation, it may be concluded that heaps of manure placed in farms may not be considered as a source of infestation. This is especially true if farmers be sure no water is added to heaps by chance and otherwise.

4.1.2 Manure Applied to Banana and Citrus Orchards

Numbers of larvae found in banana and citrus orchards are shown in tables 2 and 3, respectively. Table 2 shows that out of 21 orchards visited 11 were contained fairly large numbers of larvae, while ten orchards were free from larvae. This may be due to the variation in the time of investigation and that of application of manure. This indicate that manure in banana orchards plays an important role as a source of infestation. Table 3 shows that 10 orchards out of 25 harbored few larvae of house flies which indicate that application of manure to citrus orchards play a role in fly infestation.

Incorporation of manure in the soil before irrigation is considered an important measure to prevent fly infestation.

4.1.3 Manure Applied to Vegetable Farms

4.1.3.1 Manure Applied to Seed Beds

Numbers of larvae found in fifteen farms examined in Jordan Valley are shown in table 4. The table shows that eleven farms out of 15 visited contained house fly larvae. These farms are considered as a virtual

Table 1: Numbers of larvae found in samples taken from 228 heaps of different kinds of manure from different locations in JordanValley between July to September, 1994.

Farm number	Location	Date	Number of heaps			Condition of Heap	Average number of larvae per sample
			Sheep	Cow	Poultry		
1	Kraymah	Jul.8,94		1	2	D	0
2	»	7		2	4	D	0
3	»	8	5			D	0
4	»	12			2	D	0
5	Dair Alla	12			2	D	0
6	Mashare'	15	4			D	0
7	»	15			3	D	0
8	Kraymah	19	4		6	D	0
9	»	19		2	3	D	0
10	»	19	3		3	D	0
11	»	19	4		1	D	0
12	»	21	8			D	0
13	Dirar	Aug.7		1	2	D	0
14	»	7	1		1	D	0
15	»	7			3	D	0
16	Kraymah	9		2		D	0
17	»	9		2	3	D	0
18	Dirar	23		2	3	D	0
19	Karamah	25		2	2	D	0
20	»	25		2	3	D	0
21	»	25		1	2	D	0
22	»	25			2	D	0
23	»	27	2	3		D	0
24	»	27		1	3	D	0
25	»	27			3	D	0
26	»	27			1	W	63.5
27	»	27		1	2	D	0
28	S.Shuna	Sep.1	3			D	0
29	»	1	6			D	0
30	»	1	6			D	0
31	»	1	7			D	0
32	»	1	6			D	0
33	Kraymah	3			1	W	94.25
34	»	3			1	W	133.25
35	Mashare'	7	3			D	0
36	»	7	8			D	0
37	Ardah	11	4			D	0

Continue Table 1. ***(continued)***

Farm number	Location	Date	Number of heaps			Condition of Heap	Average number of larvae per sample
			Sheep	Cow	Poultry		
38	»	11	8		5	D	0
39	Karamah	15	6	2		D	0
40	»	15		3	2	D	0
41	Kafreen	15		1	3	D	0
42	S.Shuna	19	2			D	0
43	»	19	5			D	0
44	»	19	4			D	0
45	»	19	6			D	0
46	»	19	9			D	0
46	Damiah	Oct.12	9			D	0
47	»	12	6			D	0
48	Ardah	Nov.10	1			W	16.75
49	»	10	1			W	12.75
50	»	10	1			W	11.5

* Sample=30cm long, 10cm wide, 5cm deep.

D : Dry

W: Wet

Table 2: Numbers of larvae found in sheep manure applied to banana orchards in different locations in Jordan Valley between August, 1994 to March, 1995.

Farm number	Location	Date	number of Larvae per sample				Average
			1	2	3	4	
1	S.Shuna	Aug.23	0	0	0	0	0
2	»	23	0	0	0	0	0
3	»	23	12	13	26	4	13.75
4	»	23	0	0	0	0	0
5	»	Sept.6	16	32	23	14	21.25
6	»	6	0	0	0	0	0
7	»	6	19	30	15	24	22
8	»	Oct.7	0	12	0	23	8.75
9	»	7	17	31	40	27	28.75
10	Ardah	11	0	0	0	0	0
11	»	11	0	0	0	0	0
12	Karamah	Jan.8,	8	9	16	10	10.75
13	»	8	0	0	0	0	0
14	S.Shuna	8	9	0	13	17	9.75
15	»	10	0	0	0	0	0
16	»	Feb.8	0	0	0	0	0
17	»	8	32	15	40	20	26.75
18	Karamah	14	15	0	16	8	9.75
19	»	Mar.3	19	10	35	20	21
20	S.Ahuna	3	0	0	0	0	0
21	»	3	19	15	25	35	23.5

* Sample size equal 30cm × 10cm × 5 cm

Table 3: Numbers of larvae found in samples taken from sheep and cow manures applied to various citrus orchards in different locations in Jordan Valley between August and November, 1994.

Farm number	Location	Date	number of larvae per sample				Average
			1	2	3	4	
1	Kraymah	Aug.6	0	0	0	0	0
2	»	19	0	0	0	0	0
3	»	Sept.20	19	0	8	10	9.25
4	»	20	0	0	0	0	0
5	Mashare'	Oct.2	10	8	9	0	6.75
6	»	2	0	0	0	0	0
7	»	4	0	0	0	0	0
8	Damia	12	12	0	0	21	8.25
9	»	12	0	0	0	0	0
10	Kraymah	19	0	0	0	0	0
11	»	19	9	10	8	11	9.50
12	»	21	0	0	0	0	0
13	»	21	0	0	0	0	0
14	»	29	15	11	19	0	11.25
15	»	29	0	0	0	0	0
16	Al-yabis	Nov.3	0	0	0	0	0
17	Mashare'	3	17	15	10	0	10.5
18	»	3	9	12	6	14	10.25
19	»	3	0	0	0	0	0
20	Dirar	6	0	0	0	0	0
21	»	6	6	16	10	8	10
22	Kraymah	14	0	0	0	0	0
23	»	14	0	0	0	0	0
24	»	14	0	9	0	8	4.25
25	»	14	15	9	21	0	1.25

* Sample size = 30cm × 10cm × 5cm.

Table 4: Numbers of larvae found in different kinds of manure applied to seed beds in different locations in Jordan Valley between August, 1994 and January, 1995.

Fram numbere	Location	Date	Kinds of manure			Number of larvae/sample				Avarage
			sheep	cow	poult	1	2	3	4	
1	Karamah	Aug.26		*x	*x	0	31	0	49	20
2	»	26		*x	*x	0	0	0	0	0
3	»	26		*x	*x	21	61	32	81	48.75
4	»	Sept.14		*x	*x	0	0	0	0	0
5	»	14	*x	*x	*x	19	0	31	29	19.75
6	»	14			x	77	71	91	111	87.5
7	»	23		*x	*x	0	0	0	0	0
8	»	23		*x	*x	0	6	12	21	9.75
9	»	23		*x	*x	0	6	0	10	4
10	»	Oct.2		*x	*x	0	0	0	0	0
11	»	2		*x	*x	42	29	36	19	31.5
12	Ardah	Jan.15	x			0	10	9	5	6
13	»	15	x			21	12	10	5	12
14	»	15	x			0	6	11	20	9.25
15	»	15	x			6	0	9	13	7

* Sample size = 30 cm × 10 cm × 5 cm.

** manure mixed together .

source of fly infestation while the other 4 farms were free from investation because the time of investigation is far from that of application. Incorporation of manure in the soil before sowing is an important measure to prevent fly infestation.

4.1.3.2 Manure Applied to Plastic Houses

Number of larvae found in samples taken from 74 plastic houses in eleven farms are shown in Appendix 1. The table shows that no larvae of housefly were detected. This is because farmers turn manure under the soil before irrigation .This also proves the fact of preventing fly infestation by turning manure under the soil.

4.1.3.3 Manure Applied to Vegetable Farms in Open Fields

Numbers of larvae found in samples taken from 22 farms are shown in table 5. The table indicates that applying manure on the soil surface around the irrigation pipes created a suitable place for house fly breeding. Nineteen farms out of 22 harbored large numbers of larvae which indicate strongly that manure applied to vegetable farms in open field was a very important source of infestation. Advising farmers to incorporate manure in the soil before irrigation is a very important step in preventing fly breeding.

4.2. Population Trends of The House Fly

4.2.1 Periods of Activity

Figures 1, 2 and 3 show weekly numbers of flies caught per trap at two sites in Jordan Valley. In Kraymah, small numbers of flies were caught as soon as traps were in operation in mid-July (Figure 1). Numbers of flies increased through August and reached a peak in early October, then numbers fell off to a low level for the remainder of 1994 . In 1995 numbers of flies caught increased gradually in small numbers with continuous fluctuation till early July.

Table 5: Numbers of larvae found in samples taken from different kinds of manure applied on soil surface in vegetable farms between September and October, 1994.

Fram numbere	Location	Date	Kinds of manure			Number of larvae per sample**				Avarage
			sheep	cow	poult	1	2	3	4	
1	Karamah	Sep.11			x	210	295	321	285	277.75
2	»	13			x	402	270	350	200	305.5
3	»	13			x	185	260	245	352	260.5
4	»	13			x	93	115	112	185	123.75
5	»	17			x	201	92	55	115	115.75
6	Dirar	20			x	361	262	443	157	305.75
7	Al-Yabis	21	x*		x*	0	0	0	0	0
8	»	21			x	137	455	242	161	248.75
9	Dirar	25		x*	x*	112	48	60	70	72.5
10	»	25	x*		x*	55	135	52	98	85
11	Kraymah	Oct.1			x	204	175	180	112	167.75
12	»	1			x	80	60	140	82	90.5
13	Dair Alla	4			x	512	304	240	250	326.5
14	Arda	7			x	30	20	90	35	43.75
15	Dair Alla	9			x	95	111	103	132	110.25
16	Arda	11			x	105	95	80	104	96
17	Mashare'	15	x*		x*	0	0	0	0	0
18	»	15			x	185	140	209	222	189
19	Damia	17			x	361	305	145	204	253.75
20	GH.Kabed	17			x	321	315	292	290	304.5
21	Kafreen	22			x	0	0	0	0	0
22	Damia	22		x*	x*	109	100	0	203	103

* Sample size = 30cm × 10cm × 5cm .

** Manures mixed together.

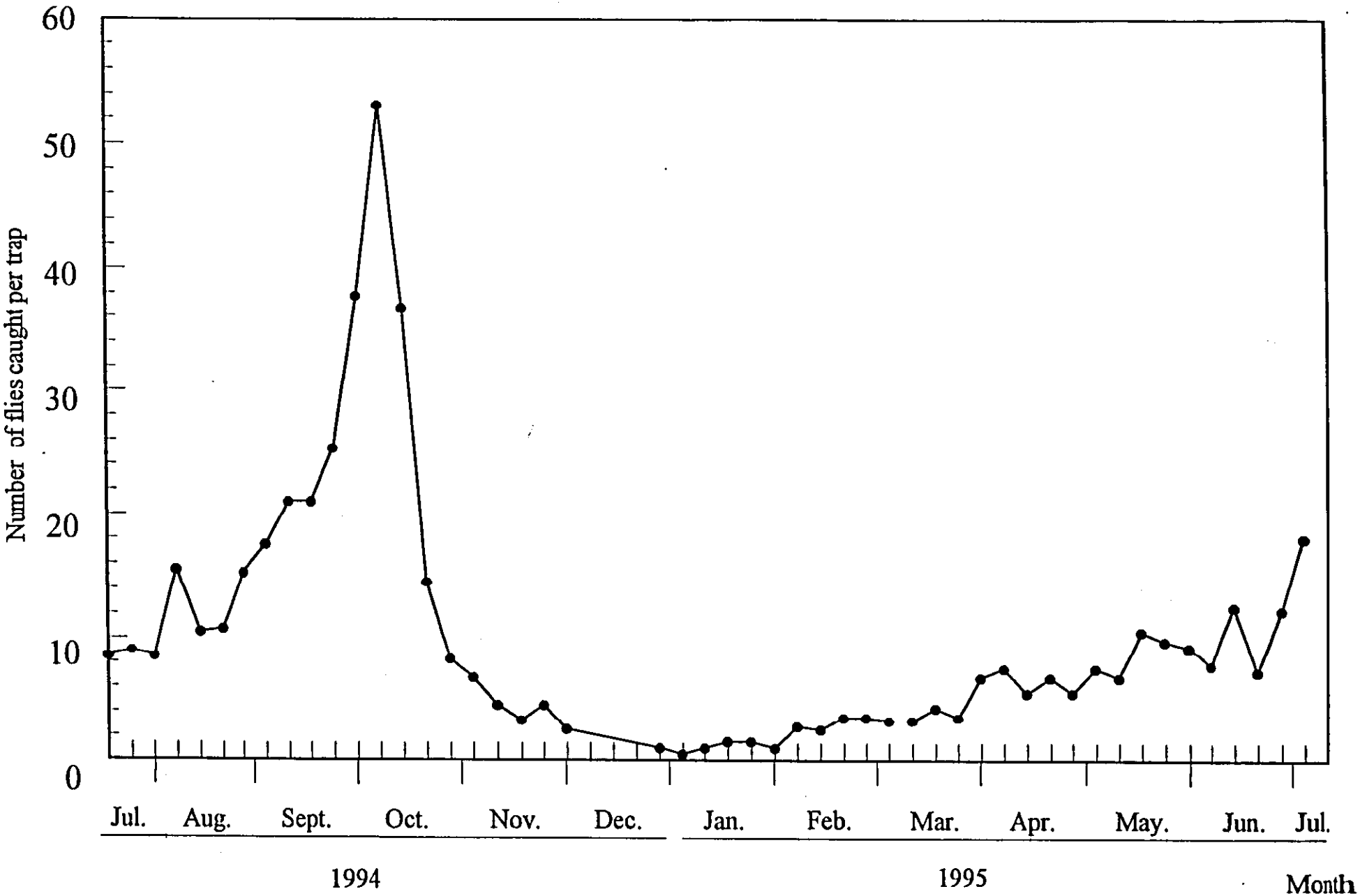

Figure 1 : Weekly average numbers of flies caught per trap in Kraymah.

At the University Agricultural Experiment Station, numbers of flies caught were high from the time traps were in operation in mid July (Figure 2) and remained so till early October when numbers decreased gradually to low levels till the end of 1994 . In 1995, numbers of flies caught per trap were low (Figure 3) from early January and remained so until late August . Then large numbers started to appear and reached a peak in late September and early October, then numbers fell down to low level in late october and remained so till the end of the experiment .

From the foregoing it is evident that flies attained high levels in August, September and October which coincide with the time farmers prepare the land especially in the open fields for vegetable production and add manure prior to planting. This indicates strongly that manure added by farmers to their fields is the source of infestation by the house fly.

4.2.2 Percentage of House fly Found in Fly Population

Numbers of house fly found in several samples of flies identified are presented in Table 6. The table shows that 94.2% were *M. domestica* and the remainder 7.2% were other species of flies. These results are in general agreement with data presented by (16, 22, 23).

4.3. Number of Generations :

Length of the life cycle of the house fly related to temperature and number of generations per year are shown in Table 7. The table indicates clearly that periodic mean temperature affected strongly the length of the life cycle. For example, the life cycle was 8, 21 and 59 days at 32.4 °C, 18.6 °C and 14.2 °C mean periodic temperatures, respectively.

Herms (8) found that the life cycle of the house fly was 44.8 days at 16 °C, 26.7 days at 18 °C , 20.5 days at 20 °C, 16.1 days at 25 °C and

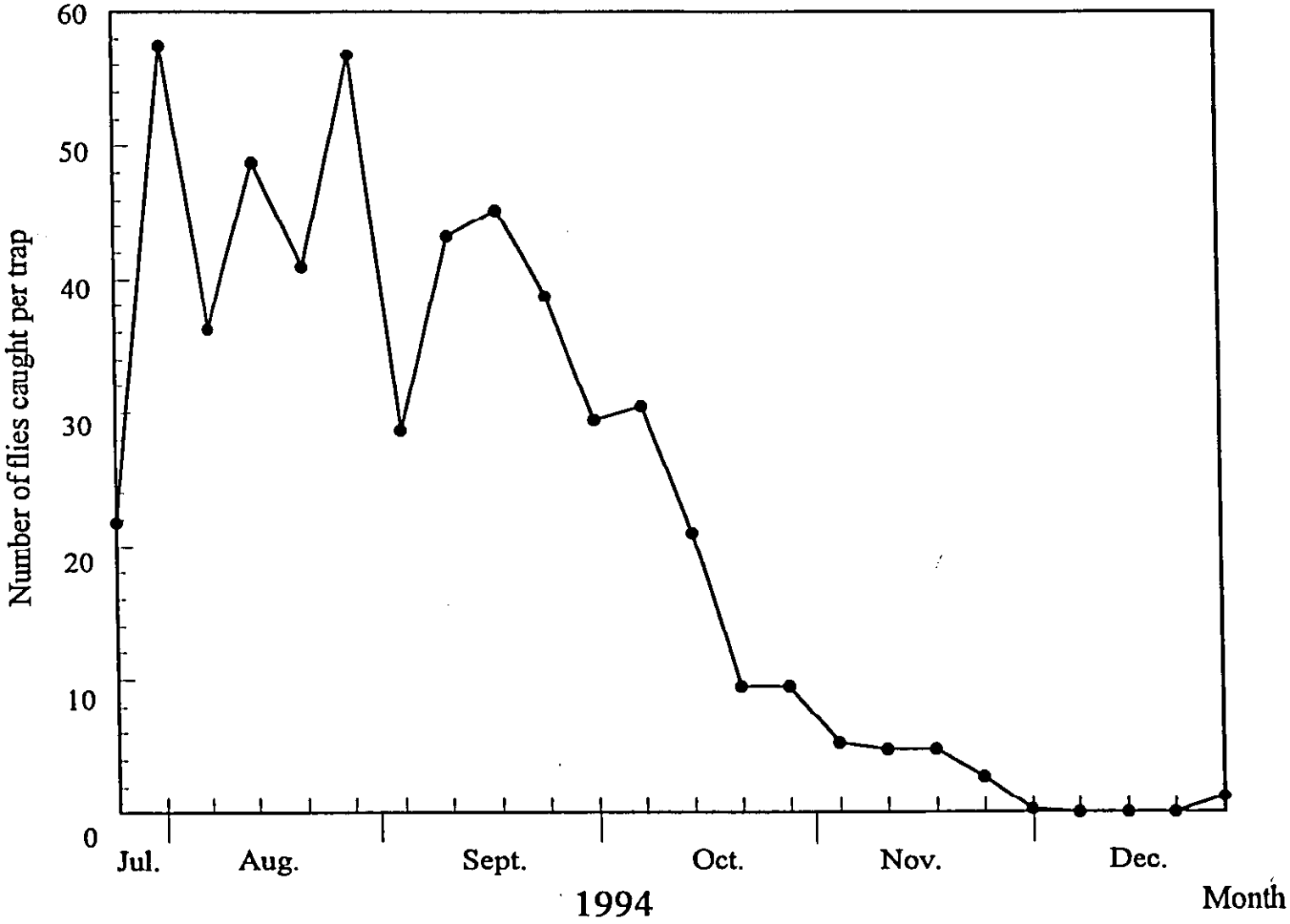

Figure 2 : Weekly average numbers of flies caught per trap in the University Agricultural Experiment Station.

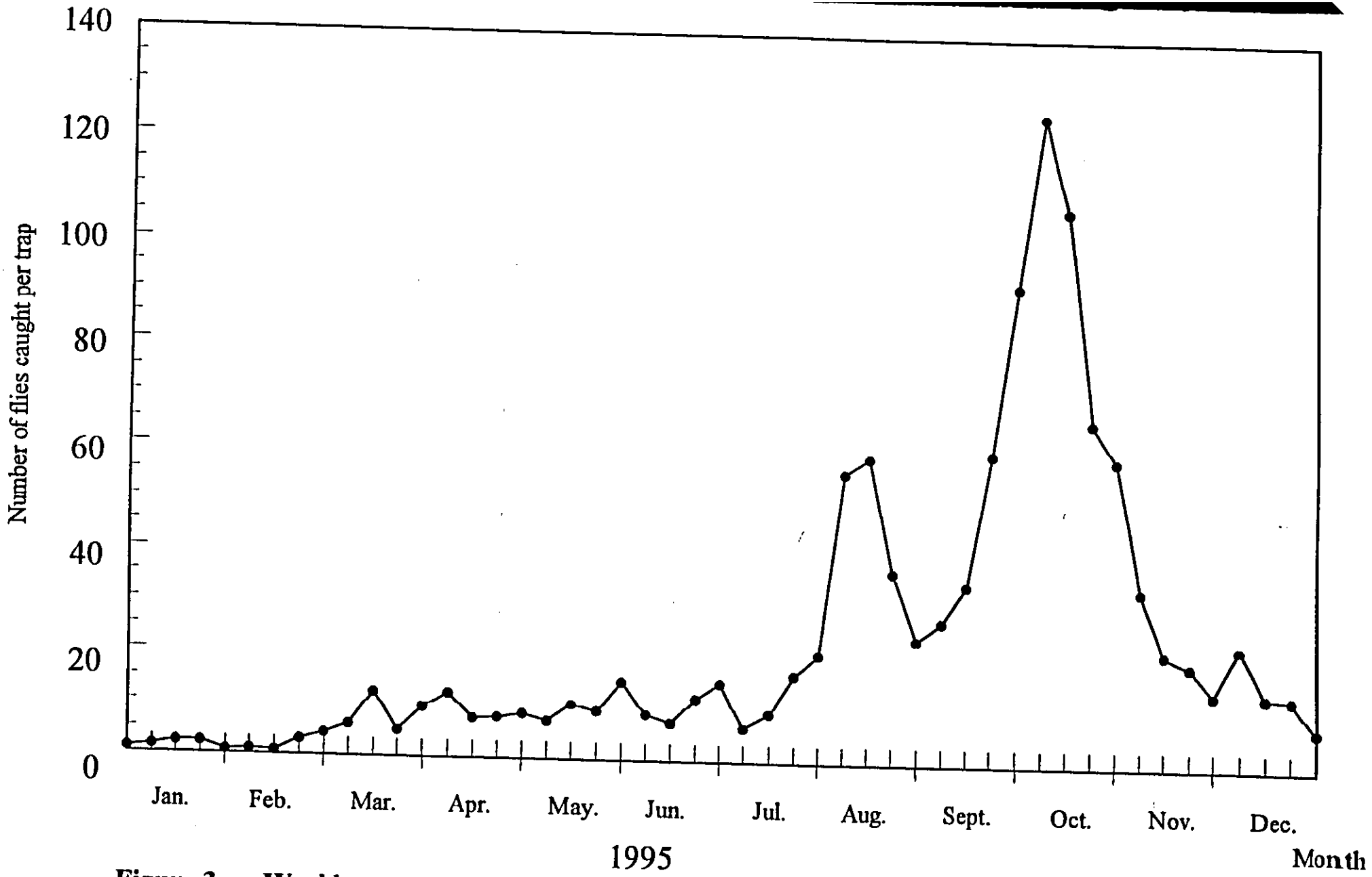

Figure 3 : Weekly average number of flies caught per trap in the University Agriculture Experiment Station.

Table 6: Percentage of house fly *Musca domestica* in the samples of flies caught in traps at the University Agricultural Experiment Station.

Date	Number of flies identified	Number of *M. domestica*	Percentage
Jul. 29, 1994	128	125	97.7%
Aug. 5, 1994	119	109	91.6%
Sept. 8, 1994	111	106	95.5%
Oct. 21, 1994	28	27	96.4%
Mar. 10, 1995	24	22	91.7%
Apr. 22, 1995	31	29	93.6%
May 16, 1995	42	40	95.2%
Jun. 17, 1995	67	60	89.6%
Jul. 17, 1995	48	47	97.9%
Aug. 5, 1995	236	219	92.8%
Total	834	774	92.80%

Table 7: Number of generations and length of each generation in relations to temperature.

Generation number	Date of fresh manure preperation	Date of larval appearance	Date of pupal transformation	Date of adult emergence	Length of generation (day)	Max. periodic temperature °C	Min periodic temperature °C	Average periodic temp. °C
1	Jul. 17, 1994	Jul. 18	Aug. 1st	Aug. 4	19	36.4	26.75	31.6
2	Aug.4	Aug. 5	11	15	12	39.83	25.50	32.7
3	15	16	23	26	12	39.46	26.33	32.9
4	26	27	Sep. 4	Sep. 7	13	39.64	27.08	33.4
5	Sep.7	Sep. 8	19	23	17	37.97	26.75	32.6
6	23	25	Oct. 6	Oct. 11	19	37.03	26.12	31.6
7	Oct.18	Oct. 20	25	29	13	38.07	21.00	29.5
8	Nov.1	Nov.11	Dec. 15	Dec. 29	59	18.6	9.74	14.2
9	Dec. 29, 1994	Jan. 5th, 1995	Jan. 23	Feb. 6	39	20.41	9.28	14.9
10	Feb. 6, 1994	Feb. 12	Feb. 16	25	20	26.14	9.27	17.7
11	25	28	Mar. 14	Mar.19	24	23.24	10.64	16.9
12	Mar.19	Mar. 21	Apr. 2	Apr. 8	21	24.6	12.65	18.6
13	Apr. 8	Apr. 10	18	21	14	30	13.98	22.0
14	21	22	29	May 3	13	31.05	15.40	23.2
15	May.3	May 4	May 11	14	12	33.9	14.71	24.6
16	14	15	23	27	14	37.6	22.32	30.0
17	27	29	Jun. 5	Jun. 9	14	37.35	22.70	30.0
18	Jun. 9	Jun 10	16	19	11	39.31	24.18	31.8
19	19	20	24	26	8	40.27	24.50	32.4
20	26	27	Jul. 3	Jul. 7	12	38.59	25.83	32.2
21	Jul. 7	Jul. 8	14	17	11	39.18	24.85	32.0

10.4 days at 30°C. Service (2) reported that the development time from egg to adult was about 49 days at 16°C, 21 days at 20°C, 16 days at 23°C, 9-11 days at 30°C and 8 days at 35°C.

The table also reveals that the house fly has 21 generations in central Jordan Valley . These results agrees with the finding of Bodenheimer (11) who reported that the house fly has 20 generations per year in Palestine. Also in the high lands in the open field in Jordan Elmosa (24) experimenting on the number of generations for the house fly reported that there are 14-15 generations per year .

4.4. Breeding Places of the House Fly :

The average number of house fly larvae found in different kinds of manure are shown in table 8 and Appendix 2. The table indicates that poultry manure was the most attractive for house flies, since large numbers of fly larvae were found. There was highly significant differences between number of larvae in poultry manure and other kinds of manure used, while no significant differences were obtained between sheep, cow and old cow manure kept in the ofen for over a year. Aslo composted manure obtained from a local company was more attractive for house flies than sheep and cow manures, since larger numbers of larvae were obtained. The preferable manure in the following order was poultry > compost > sheep > cow and > old cow manure where the mean numbers of larvae counted per sample were 336.24, 46.48, 19.21, 6.95 and zero, respectively. Also Appendix 2 indicates clearly that poultry manure was more preferable than other kinds of manure.

These results are in agreement with those reported by (2, 8). Also, Siverly and Schoof (25) found that chicken manure was more preferable than horse, cow, rabbit, pig, sheep and goat excrements. Leikina (12) reported that sheep manure was more preferable than cow manure. However Thomsen (13) stated that cow dung was least attractive than other manures used.

Table 8: Average numbers of house fly larvae found in different kinds of manure in different periods during June,1995.

Treatment	Average number of larvae per sample*			
	DATES			
Manure	Jun. 18	Jun. 20	Jun. 22	Mean**
Poultry	251.9_a	434.2_a	445.8_a	336.2_a
Compost	75.7b	55.7b	38.1b	46.5b
Sheep	9.0c	22.6c	21.1_{bc}	19.2_c
Cow	5.0c	12.1_c	9.4c	7.0_c
Old Cow	0.0c	0.0c	0.0c	0.0c

* : Sample size = 30cm long × 10 cm wide and 5 cm deep and represents average of samples from each four replicates.

** : Means in the same column with the same letter are not significantly different according to Duncan's multiple range test at 5% level..

Larsen *et.al.*; (17) found that the most attractive manure in descending order were pig, human excrate, chicken, dog, calf, horse, sheep and cow. It is to be mentioned that Kaiding (26) reported that cow dung is a source of fly breeding in many parts of the world but not in others, because house flies seem to have different preference for adaptation to dung in various geographical areas.

The developmental periods of house fly in different kinds of manure mentioned above are shown in table 9. The table shows the length of larval and pupal development time. These were 7,7,8 and 8 days for poultry, compost, sheep and cow manures, respectively. Taking these results into consideration it may be concluded that poultry manure and compost one are more preferable for house fly breeding than other kinds which is in agreement with those reported previously.

4.5. Fermenting Manure Under The Soil Surface

Number of larvae found in various kinds of manure applied at or incorporated in the soil are shown in Table 10. The table shows significant differences in numbers of larvae found in the conventional method of applying manure on soil surface and manures rotivated under the soil. The average number of larvae found in poultry, sheep and cow manures applied on the soil surface were 196.77, 15.92 and 8.65, respectively. Also the table indicates that no larvae were found in manures rotivated under the soil surface, since house flies can not find the suitable place to lay their eggs and inhibit their development as well.

These results show that the method of incorporation of manure in the soil is promising as a control measure for the house fly in Jordan Valley.

4.6. Effect of Fermenting Manure above or under the Soil Surface on Pepper Plant

Tables 11-16 show the effect of incorporation of manure in soil or by adding manure at soil surface on : number of dead plants, average plant

Table 9 : Duration of larval and pupal development in different kinds of manure.

Kind of manure	Date*			Length of time .Larvae-Adult (day)
	Larval appearance	Pupal transform	Adult emergence	
Poultry	18-6	23-6	25-6	7
Compost	18-6	23-6	25-6	7
Sheep	18-6	24-6	26-6	8
Cow	18-6	24-6	26-6	8

* Manure applied to the soil on June 16,1995

Table 10: Mean numbers of larvae found in samples taken from various kinds of manure applied above the soil surface or incorporated in the soil in August, 1995.

Date	Mean number of larvae per sample**					
	Above soil surface			Incorporated in the soil		
	Poultry	Sheep	Cow	Poultry	Sheep	Cow
Aug.23, 1995	128.25 a	12.58 b	7.1 b	0.0 c	0.0 c	0.0 c
Aug. 25	259.58 a	17.25b	9.0 bc	0.0 c	0.0 c	0.0 c
Aug. 27	259.17 a	19.58 b	10.17 bc	0.0 c	0.0 c	0.0 c
Aug. 29	208.58 a	22.0 b	12.0 b	0.0 c	0.0 c	0.0 c
Aug. 31	128.25 a	8.17 b	5.0 bc	0.0 c	0.0 c	0.0 c
MEAN*	196.77 a	15.92 b	8.65 bc	0.0 c	0.0 c	0.0 c
MEAN**	73.78 a			0.0 b		

* Means in the same row with the same letters are not significantly different according to Duncan's multiple range test at 5% level.

** Sample size = 30cm long × 10cm wide and 5 cm deep and represent average of samples from each three replicates.

height, average number of flowers, average number of fruits, average weight of harvested crop and average weight of mature fruits.

4.6.1 Number of Dead Plants :

The average numbers of dead plants of pepper in each kind of manure are shown in table 11. The table indicates that for the first three weeks from planting, (After one month from the fermentation of manures applied), no significant differences found between fermented manures above or under the soil. These results show that the effect of both methods of manure application on plants were not significantly different which indicate strongly that fermenting manure under the soil is not harmful to plants.

4.6.2 Plant Height :

The average heights of each 10 pepper plants taken from soil treated with different kinds of manure are shown in table 12 and Appendix 3. The table reveals that the height of plants from cow manure applied on soil surface is significantly less than other manures, while no significant differences were obtained between other treatments. Appendix 3 also shows clearly that fermenting manure under the soil surface has no harmful effects on plant height. This may be due to that cow manure need very long time to be composted and the plants can not make use of it in a short time after application.

4.6.3 Number of Flowers :

Average number of flowers counted from each 10 plants taken from soil treated with different kinds of manure are shown in table 13. The table reveals that numbers of flowers were consistently higher in plants taken from manure treated soil than control except those of cow manure applied above the soil surface. Also the table shows that number of flowers counted

Table 11 : Mean numbers of dead plants of pepper in several kinds of manure applied above the soil surface or incorporated in the soil in the University Agricultural Experiment Station during October, 1995.

Date	** Number of dead plants per raised bed per week						
	Above soil surface			Incorporated in the soil			Control
	Poultry	Sheep	Cow	Poultry	Sheep	Cow	
Oct. 7, 1995	2.7 a	4.3 a	3.7 a	3.7 a	4.0 a	3.7 a	2.0 a
14, 1995	5.3 a	5.3 a	7.3a	5.7 a	4.3 a	5.0 a	3.3 a
21, 1995	1.7 a	1.3 a	2.3 a	2.0 a	1.5 a	0.7 a	1.0 a
MEAN *	3.78 a			3.48 a			

* Means in the same row with the same letters are not significantly different according to Duncan's multiple range test at 5% level.
** Average of six raised beds.

Table 12: Mean height of each ten pepper plant grown in soil treated with different kinds of manure fermented above the soil surface or incorporated in the soil in the University Agricultural Experiment Station between October and December, 1995.

Date	Mean height of pepper plant (cm)						
	Above soil surface			Incorporated in the soil			
	Poultry	Sheep	Cow	Poultry	Sheep	Cow	Control
Oct. 7, 1995	17.81 a	17.52ab	17.76 a	17.93 a	17.1 b	17.55 ab	17.95 a
Oct. 14, 1995	22.42 a	22.11 a	21.17 b	22.21 a	22.36 a	22.45 a	22.45 a
Oct. 21, 1995	26.60 b	28.6 a	24.42 e	26.37 c	25.10 d	25.00 d	26.30 c
Oct.28, 1995	32.99 a	30.37 bc	25.94 e	31.87 ab	30.00 bc	27.80 de	28.78cd
Nov. 4, 1995	35.43 bc	22.82 c	30.70 d	38.00 ab	38.96 a	34.30 c	30.35 d
Nov. 11, 1995	36.10 ab	35.62 ab	31.14 c	35.74 ab	33.56 bc	37.62 a	34.73abc
Nov. 18, 1995	36.37 a	38.28 a	31.68 b	36.35 a	34.52 a	38.16 a	36.10 a
Nov. 25, 1995	37.80 a	38.90 a	34.00 b	37.50 a	36.20 ab	39.00 a	36.70 ab
Dec. 2, 1995	38.10 ab	39.00 a	34.90 b	38.00 ab	36.50 ab	39.40 a	36.80 ab
Dec. 9, 1995	38.80 b	39.40 a	35.10 c	38.70 b	36.90 b	39.40 a	37.50 bc
Mean	32.14 a	32.05 a	28.68 b	32.30 a	31.23 a	32.04 a	30.61ab
Mean	30.96 a			31.84 a			

Means in the same row with the same letters are not significantly different according to Duncan's multiple range test at 5% level.

Table 13: Mean numbers of flowers counted from each ten pepper plants grown in soil treated with several kinds of manure fermented above the soil surface or incorporated in the soil in the University Agricultural Experiment Station between October and December, 1995.

Date	Mean number of flowers per plant						
	Above soil surface			Inc orporated in the soil			
	Poultry	Sheep	Cow	Poultry	Sheep	Cow	Control
Oct. 281995	16.9 bc	14.1 c	10.1 d	20.8 a	18.2 ab	16.7 bc	9.9 d
Nov. 4, 1995	21.5 bcd	20.7 cd	18.4 de	26.0 ab	26.9 a	24.8 abc	14.3 e
Nov. 11, 1995	27.4 bc	27.1 bc	21.1 c	37.1 a	28.3 bc	29.6 b	23.5 bc
18, 1995	29.4 bc	29.1 bc	23.1 c	38.9 a	30.6 b	31.6 b	25.2 bc
25, 1995	32.5 b	31.8 b	26.9 b	41.4 a	33.1 b	33.0 b	27.7 b
Dec. 2, 1995	32.5 b	31.8 b	26.9 b	41.4 a	33.1 b	33.0 b	27.7 b
9, 1995	27.4 cd	32.7 ab	24.4 d	36.9 a	31.1 bc	33.9 ab	26.7 cd
Mean	25.9 b	25.9 b	20.7 c	33.5 a	28.1 b	28.3 b	21.2 c
Mean	24.14 b			29.96 a			

Means in the same row with the same letter are not significantly different according to Duncan's multiple range test at 5% level.

from plants grown in soil received poutlry manure fermented under the soil surface are significantly higher than those taken from soil received sheep and cow manures in the same manner. The average number of flowers 33.52, 28.1 and 28.27 flowers respectively, while for same manures applied above the soil surface were 25.85, 25.92 and 20.67 flowers, respectively. This shows significant difference betweent number of flowers obtained from plants grown in soil received manure fermented under the soil surface than those obtained from plants grown in soil received manures fermented above the soil surface. The average number of flowers were 29.96 and 24.14, respectively.

These results reveal that fermenting manure under the soil surface has a positive effect on number of flowers.

4.6.4. Number of Fruits

The average number of fruits counted from each 10 plants taken from soil recieved different kinds of manure are shown in table 14. The table shows clearly that the average fruit numbers were higher in plants grown in manure treated soil than the control. The table also shows that poultry manure applied to the soil in both methods gave significantly higher fruit numbers than other plants grown in soil recieved sheep and cow manures. As to manures fermented above the soil ,there were significant difference in numbers of fruits counted from plants taken from soil treated with poultry or cow manure but not significant in plants grown in soil treated with sheep manure where average number of fruits were 8.6, 6.1 and 7.4. Also, the results indicate that there is no significant differences in the number of fruits obtained between the two methods of applying manure. This indicate that fermenting manure under the soil surface has no negative effects on fruit numbers.

Table 14: Mean numbers of pepper fruits counted from each ten plants grown in soil treated with different kinds of manure fermented above the soil surface or incorporated in the soil in the University Agricultural Experiment Station between November and December,1995.

Date	Mean number of pepper fruit per plant per week						
	Above soil surface			Incorporated in the soil			
	Poultry	Sheep	Cow	Poultry	Sheep	Cow	Control
Nov. 4, 1995	2.0 ab	1.7 ab	1.2 b	2.1 ab	2.8 a	1.5 ab	1.3 b
11, 1995	4.0 ab	2.7 abc	2.0 bc	3.2 abc	3.8 abc	4.1 a	1.5 c
18, 1995	6.0 ab	4.5 abc	3.4 c	5.9 ab	5.9 ab	6.4 a	3.6 c
25, 1995	7.9 a	6.5 ab	5.6 b	8.0 a	7.6 a	8.1 a	5.4 b
Dec. 2, 1995	11.2 ab	9.4 c	8.9 c	11.9 a	10.8 b	10.7 b	7.4 d
9, 1995	20.5 ab	19.6 b	15.4 c	21.8 a	19.7 ab	18.4 b	14.6 c
Mean	8.6 a	7.4 abc	6.1 bc	8.8 a	8.4 a	8.2 ab	5.6 c
Mean	7.36 a			8.48 a			

Means in the same row with the same letter are not significantly different according to Duncan's multiple range test at 5% level.

4.6.5 Average Weight of Harvested Crop :

Harvesting mature fruits of pepper was performed on Dec. 9, 1995, and the average number of harvested fruits from each 10 plants taken from soil treated with different kinds of manure and their weights are shown in table 15. The table indicates that the yeild was higher in plants grown in manure treated soil than control. Also, number of mature fruits in cow manure applied on soil surface and in control treatment were significantly less than those of other treatments. Numbers of mature fruits obtained from fermenting manure under the soil surface were not different from those fermented above the soil surface.

4.6.6 Fruit Weight :

Ten mature fruits randomly selected from the picked fruits from each of the seven treatments were weighed, as shown in table 16. The table reveals that the average weight of the fruit is higher in manure treated than the control. Also the table shows no significant difference in weight of fruits harvested from plants grown in different manure treated soil . Also, the table shows no significant differences between the two methods of fermenting manure on the average weight of mature fruits.

Table 15 : Mean numbers of picked fruits of pepper and their weight taken from each ten plants grown in soil treated with different kinds of manure fermented above the soil surface or incorporated in the soil.

Kind of manure and application method	Number of picked fruits per plant	Total weight of picked fruits from 10 plants (g)	Average weight per fruit (g)
- Above soil surface			
- Poultry	5.6 a	1060.	18.94
- Sheep	5.3 a	977.1	18.44
- Cow	4.4 b	916.4	20.83
- Incorporated in the soil.			
- Poultry	5.8 a	1109.1	19.12
- Sheep	5.0 a		23.21
- Cow	5.3 a		19.11
Control	4.1 b	611.2	13.89

* Means with the same letters are not significantly different according to Duncan's multiple range test at 5% level.

Table 16: Mean weight per fruit of ten mature fruits taken from pepper plants grown in different kinds of manure fermented above the soil surface or incorporated in the soil.

Date	Mean weight per fruit (gm)						
	Above soil surface			Incorporated in the soil			Control
	Poultry	Sheep	Cow	Poultry	Sheep	Cow	
Dec. 12, 1995	18.4 a	20.57a	21.3 a	18.24a	21.78a	21.31a	13.11b
Mean	20.10 a			20.11 a			

* Means with the same letters are not significantly different according to Duncan's multiple range test at 5% level.

5. CONCLUSIONS & RECOMMENDATION

5.1. Conclusions :

1. The large majority of different dung heaps placed on farms prior to planting were found to be free from fly infestion, because they were kept dry by the prevailing high temperature. Therefore they are not considered as a source of infestation unless water is added to them.
2. The house fly attained high population levels during August, Septemper and October which coincided with the time farmers apply manure to their fields especially for vegetable production in the open fields.
3. The house fly development was prolonged to 59 days during November and December, and it was 8 days during June. There were twenty one generations annually in the Jordan Valley.
4. Poultry manure, compost from a local company, sheep and cow manures are considered suitable media for fly breeding in descending order.
5. Incorporation of manure in the soil deprive the house fly from their breeding sources, and prevent their development as well.
6. The method mentioned in item five above was not harmful to pepper plant growth and production. This should be brought to the attention of farmers to encourage them to follow the method mentioned.

5.2. Recommendation :

1. It is recommended that farmers refrain from allowing water to reach dung heaps placed on farms prior to planting, because dry dung heaps are not a source of infestation.
2. It is recommended not to prevent the use of any kind of manure used at present by farmers in Jordan Valley, because all are suitable breeding places for the house fly.
3. Since incorporation of manure in the soil deprive the house fly from its breeding places, it is recommended that farmers incorporate manure in the soil by mechanical rotivator.

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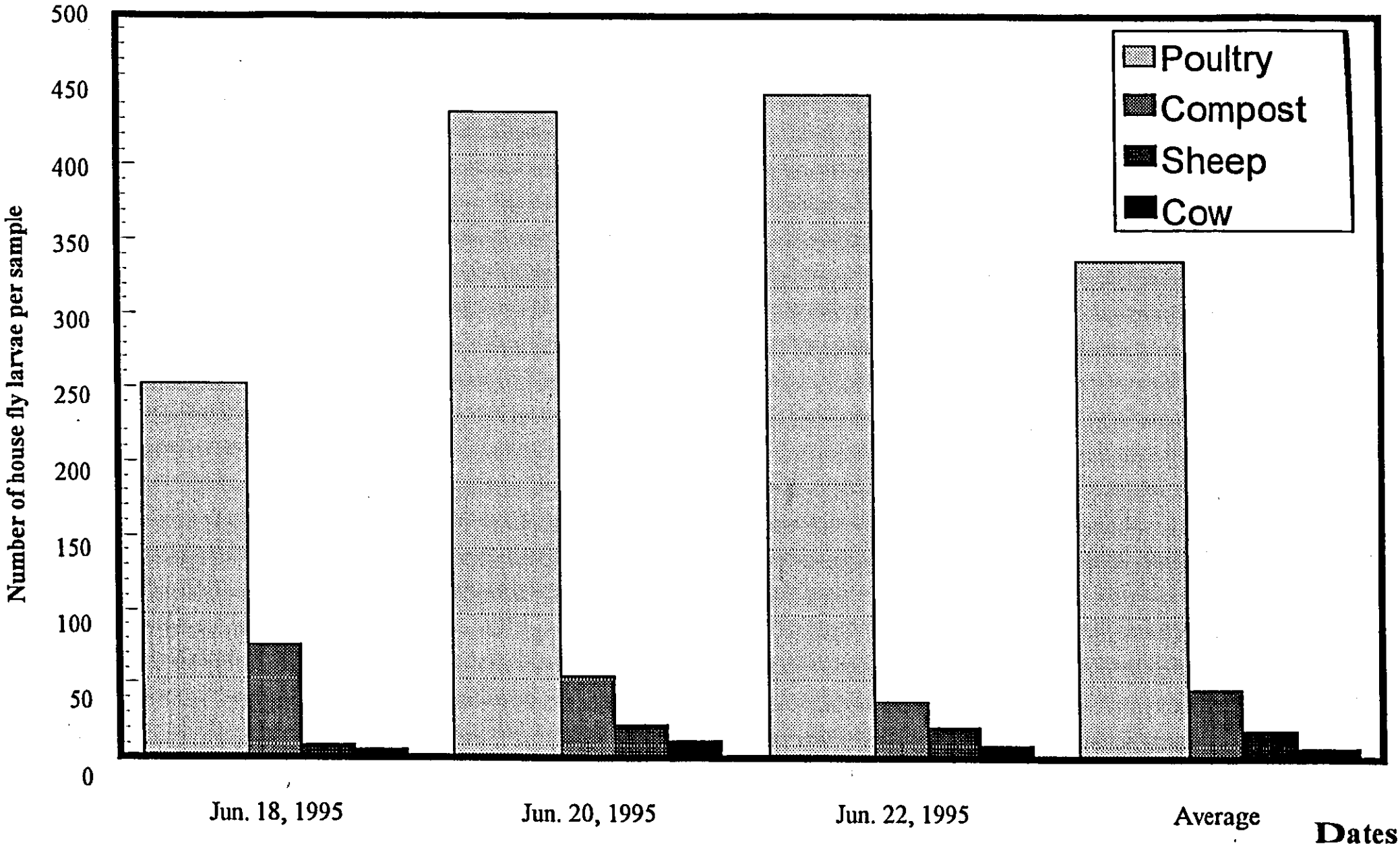
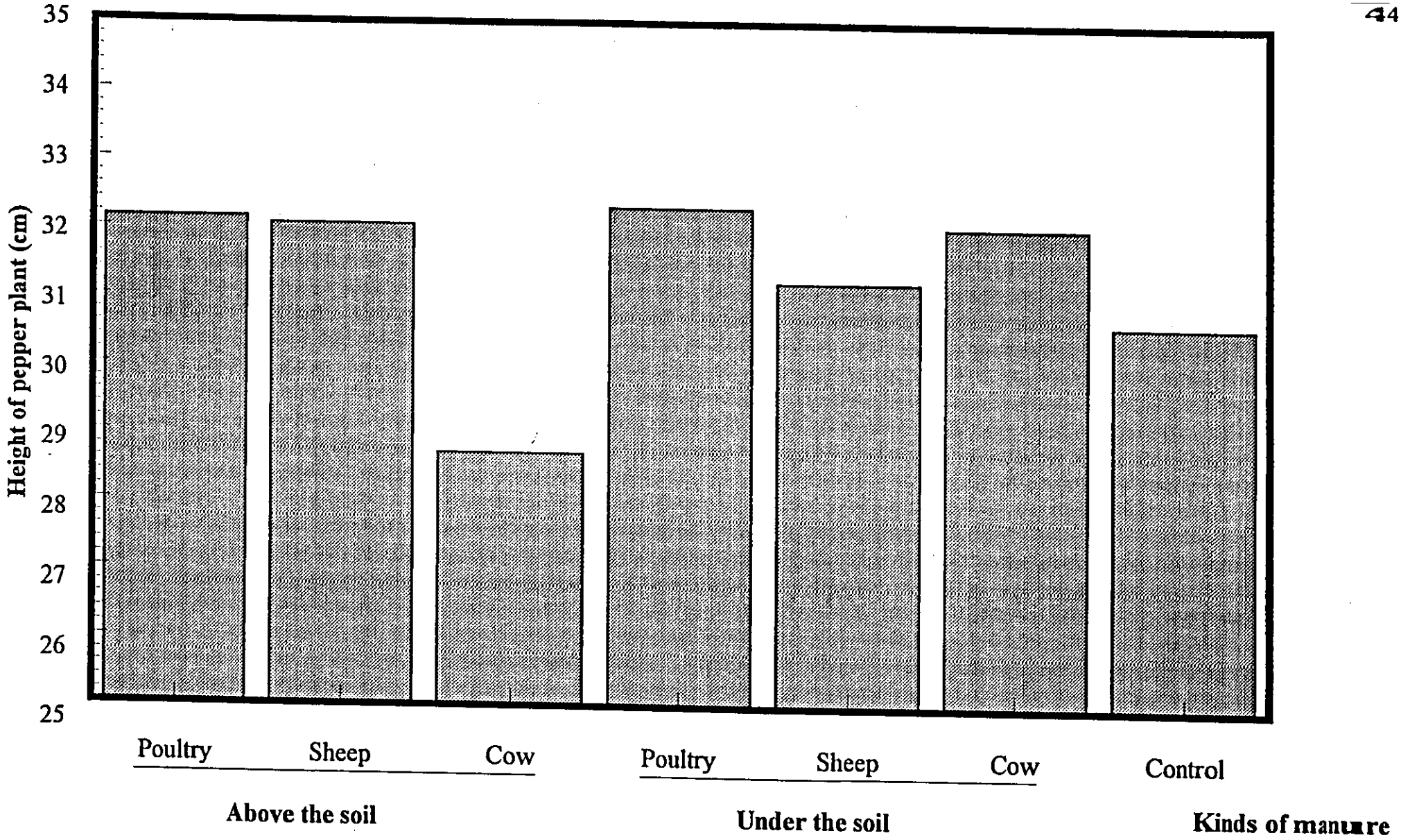
Appendix 1. Numbers of larvae found in samples taken from plastic houses received different kinds of manure in different locations in JordanValley between September and October, 1994.

Farm number	Location	Date	Manure kinds	Number of Plastic houses	Average number of larvae per sample
1	Kraymah	Sep.13	poultry + sheep	7	0
2	Ardah	19	poultry + sheep	8	0
3	Kraymah	22	poultry + sheep	7	0
4	»	22	poultry + sheep	6	0
5	Abu-obaidah	25	poultry + sheep	7	0
6	»	25	poultry + sheep	6	0
7	»	25	poultry + sheep	5	0
8	Dirar	25	poultry + sheep	8	0
9	»	25	poultry + sheep	5	0
10	Kafreen	Oct.3	poultry + sheep	8	0
11	Damiah	3	poultry + sheep	7	0
Total				74	



Appendix 2 : Numbers of house fly larvae found in different kinds of manure.



Appendix 3: Average height of each ten pepper plant grown in soil treated with different kinds of manure fermented above the soil surface or incorporated in the soil.

APPENDEX 4 : Analysis of variance (ANOVA table) of data presented in table 9.

Date 1

Source	DF	SS	MS
TRT	4	735200.7	183800.17*
REP	3	2070.8	690.27
Sample	3	2560.3	853.43
Error	69	60369.0	874.91

Date 2

Source	DF	SS	MS
TRT	4	2196070	549017.6
REP	3	12069.0	4023.0
Sample	3	5874.7	1958.2
Error	69	136021.1	1971.3

Date 3

Source	DF	SS	MS
TRT	4	2364360	591090.0*
REP	3	2364.5	788.2
Sample	3	1933.0	788.2
Error	69	82295.9	902.8

APPENDEX 5 : Analysis of variance (ANOVA table) of data presented in table 11.

Date 1

Source	DF	SS	MS
TRT	5	156120.2	31224.1*
REP	2	156.2	78.1
Error	64	3933.9	61.5

Date 2

Source	DF	SS	MS
TRT	5	649743.4	129948.7*
REP	2	1861.2	930.6*
Error	64	16364.0	255.7

Date 3

Source	DF	SS	MS
TRT	5	644905.1	128981.0*
REP	2	386.9	193.4
Error	64	12657.4	197.8

Date 4

Source	DF	SS	MS
TRT	5	411926.7	82385.4*
REP	2	431.2	215.6
Error	64	11999.7	187.5

Date 5

Source	DF	SS	MS
TRT	5	158479.7	31696.0*
REP	2	182.2	91.1
Error	64	3911.7	61.1

APPENDEX 5 (*Continued*):

Total

Source	DF	SS	MS
TRT	5	1852832.6	370566.5*
REP	2	1621.2	810.6
Error	352	260517.8	740.1

(Total, METH)

Source	DF	SS	MS
METH	1	489884.4	489884.4*
TRT	2	6816174.1	340737.0*
TRT*METH	2	681474.1	340737.0*
REP	2	1621.2	810.6
Error	352	260517.8	740.1

APPENDEX 6 : Analysis of variance (ANOVA table) of data presented in table 12.

Date 1

Source	DF	SS	MS
REP	2	0.3	0.14
TRT	6	11.81	1.97
Error	12	45.05	3.75

Date 2

Source	DF	SS	MS
REP	2	11.14	5.57
TRT	6	28.1	4.68
Error	13	97.35	7.49

Date 3

Source	DF	SS	MS
REP	2	7.4	3.7
TRT	6	9.13	1.52
Error	11	18.27	1.66

Total

Source	DF	SS	MS
TRT	6	33.5	5.6
REP	2	1.5	0.8
Error	54	339.8	6.3

(Total, METH)

Source	DF	SS	MS
TRT	2	0.71	0.35
METH	1	1.19	1.19
METH*TRT	2	8.26	4.13
REP	2	0.71	0.35
ERROR	46	321.74	6.99

APPENDEX 7 : Analysis of variance (ANOVA table) of data presented in table 13.

Date 1

Source	DF	SS	MS
TRT	6	5.35	0.89*
SAMP	9	2.93	0.33
Error	54	17.25	0.32

Date 2

Source	DF	SS	MS
TRT	6	35.29	5.88
SAMP	9	64.39	7.16
Error	54	425.59	7.86

Date 3

Source	DF	SS	MS
TRT	6	136.42	22.74*
SAMP	9	3.78	0.42
Error	54	20.46	0.38

Date 4

Source	DF	SS	MS
TRT	6	319.84	53.331*
SAMP	9	175.15	19.46*
Error	54	261.7	4.85

Date 5

Source	DF	SS	MS
TRT	6	652.4	108.7*
SAMP	9	93.4	10.4
Error	54	457.7	8.5

APPENDEX 7 *(Contibued)*:

Date 6

Source	DF	SS	MS
TRT	6	259.5	43.3*
SAMP	9	94.4	10.5
Error	54	913.7	16.9

Date 7

Source	DF	SS	MS
TRT	6	238.8	39.8
SAMP	9	64.2	7.1
Error	54	1008.8	18.7

Date 8

Source	DF	SS	MS
TRT	6	154.3	25.7
SAMP	9	104.0	11.6
Error	54	658.4	12.2

Date 9

Source	DF	SS	MS
TRT	6	143.7	24.0
SAMP	9	90.9	10.1
Error	54	684.5	12.7

Date 10

So	DF	SS	MS
TRT	6	119.3	19.9
SAMP	9	258.4	28.7
Error	54	1105.0	20.5

(Total)

Source	DF	SS	MS
TRT	6	1015.9	169.3*
SAMP	9	147.3	16.4
ERROR	684	39411.2	57.6

APPENDEX 8 : Analysis of variance (ANOVA table) of data presented in table 14.

Date 1

Source	DF	SS	MS
TRT	6	1008.0	168.1*
SAMP	9	141.7	15.8
Error	54	639.2	11.8

Date 2

Source	DF	SS	MS
TRT	6	1217.6	202.9*
SAMP	9	786.6	87.4*
Error	54	1445.0	26.8

Date 3

Source	DF	SS	MS
TRT	6	15397	256.6*
SAMP	9	1669.6	185.5*
Error	54	3512.5	65.1

Date 4

Source	DF	SS	MS
TRT	6	1533.2	255.5*
SAMP	9	1295.6	144.0*
Error	54	3363.9	62.3

Date 5

Source	DF	SS	MS
TRT	6	1350.7	2250*
SAMP	9	1306.6	145.2*
Error	54	3143.3	58.2

APPENDEX 9 *(Continued):*

Date 6

Source	DF	SS	MS
TRT	6	1189.6	198.3*
SAMP	9	887.3	98.6*
Error	54	1464.4	27.1

Total NFL

Source of Variation	DF	Sum of Square	Mean Square
Date	5	14718.81	29443.7*
TRT	6	7019.23	1169.87*
Date*TRT	30	833.5	27.78
Samp	9	3159.21	351.02*
Error	369	16482.53	44.67

Total NFL

Source of Variation	DF	Sum of Square	Mean Square
Date	5	14718.81	2944.7*
TRT	6	7019.23	1169.87*
Date*TRT	30	833.5	27.78
Samp	9	3159.21	351.02*
Error	369	16482.53	44.67

APPENDEX 10 : Analysis of variance (ANOVA table) of data presented in table 15.

Date 1

Source	DF	SS	MS
TRT	6	18.4	3.1
SAMP	9	14.1	1.6
Error	54	114.7	2.1

Date 2

Source	DF	SS	MS
TRT	6	92.8	15.4*
SAMP	9	55.4	6.2
Error	54	277.3	5.1

Date 3

Source	DF	SS	MS
TRT	6	92.8	15.4*
SAMP	9	75.7	8.41*
Error	54	229.8	4.3

Date 4

Source	DF	SS	MS
TRT	6	81.5	13.6*
SAMP	9	25.8	2.9
Error	54	253.7	4.7

Date 5

Source	DF	SS	MS
TRT	6	145.0	24.2*
SAMP	9	187.7	20.9*
Error	54	70.2	1.3

APPENDEX 10 (*Contibued*):

Date 6

Source	DF	SS	MS
TRT	6	423.3	70.6*
SAMP	9	85.4	9.5
Error	54	310.4	5.8

Total NFR

Source of Variation	DF	Sum of Square	Mean Square
Date	5	13141.24	2628.25**
TRT	6	595.77	99.29**
Date*TRT	30	248.5	8.28**
Samp	9	126.86	14.1**
Error	369	1561.38	4.23

APPENDEX 11 : Analysis of variance (ANOVA table) of data presented in table 16.

Source	DF	SS	MS
TRT	6	23.14	3.86*
SAMP	9	4.64	0.52
Error	54	22.86	0.42

APPENDEX 12: Analysis of variance (ANOVA table) of data presented in table 17.

Source	DF	SS	MS
SAMP	9	216.2	24.02
TRT	6	528.74	88.12*
Error	54	769.47	14.2

TOTAL (METH)

Source	DF	SS	MS
SAMP	9	167.41	18.6
METH	1	0.001	0.001
TRT	2	9744	48.12
METH * TRT	2	11.97	5.98
Error	45	725.51	16.12

الملخـــــص

مكافحة الذبابة المنزلية *Musca domestica L.* (ثنائية الأجنحة: Muscidae) بطريقة زراعية ودراسة بعض النواحي البيولوجية للحشرة في وادي الأردن

إعـــداد

ناصر عيسى رومية

اشراف

الاستاذ الدكتور حسين الموسى

اجري هذا البحث لدراسة امكانية استخدام طريقة خلط الزبل مع التربة باستخدام محراث دوراني قبل اضافة الماء اليه كوسيلة لمكافحة الذباب المنزلي *Musca domestica L.* وأثر ذلك على نمو وانتاجية نبات الفلفل .وقد دلت النتائج على فعالية هذه الطريقة كوسيلة للمكافحة حيث ان يرقات الحشرة لم تظهر في العينات التي اخذت من الزبل الذي تم خلطه مع التربة بينما وجدت اعداد كبيرة جدا في العينات التي اخذت من الزبل الذي تم اضافته فوق سطح التربة بعد اضافة الماء اليه (الطريقه التقليدية التي يستخدمها المزارع حاليا). كذلك لم يلاحظ لهذه الطريقة اي اثر ضار على النبات من حيث : طول النبات، عدد الازهار، عدد الثمار، وزن المحصول الناتج وعدد الاشتال الميتة.

كما اجريت عدة تجارب لمعرفة مصادر العدوى المختلفة للذباب مثل اكوام الزبل التي توضع في المزارع قبل الزراعة وكذلك الزبل الذي يتم اضافته الى التربة في مزارع الموز والحمضيات والبيوت البلاستيكية ومزارع الخضار في الحقول المكشوفة. واثبتت الدراسة ان الزبل المضاف في خطوط حول انابيب الري في مزارع الخضار المكشوفة يعتبر اهم مصادر العدوى يليه الزبل المضاف الى مزارع الموز والحمضيات. كما وجد ان اكوام الزبل التي توضع في المزارع قبل الزراعة لا تعتبر مصدر عدوى للذباب وذلك لكونها جافة بفعل درجات الحرارة العالية في وادي الأردن.

لمعرفة انواع الزبل المفضل لنمو و تطور الذباب اجريت دراسة على عدة انواع من الزبل، ووجد ان زبل الدجاج، السماد المختمر المصنع من قبل شركة محلية، زبل الاغنام وروث الابقار

كانت مفضلة للذباب على التوالي، ووجد ان روث الابقار الذي تم تعريضه للظروف الخارجية في الحقل لاكثر من سنة كان خاليا من يرقات الذباب.

وفي دراسة على تعداد الذباب في الاغوار وجد ان الذباب يتواجد في اعداد كبيرة جدا ابتداء من شهر آب، ايلول وحتى تشرين اول وهذا يتزامن مع الوقت الذي يقوم به المزارع بأضافة الزبل الى التربة وخصوصا في مزارع الخضار المكشوفة. وكذلك اظهرت الدراسة ان للذبابة المنزلية واحد وعشرين جيلا في السنة في وادي الاردن.