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POPULATION TRENDS OF CERTAIN ARTHROPODS AND SOME FUNGAL DISEASES OF GRAPEVINES IN CENTRAL JORDAN VALLEY

BY

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SUMMARY

The population trends of arthropod pests, natural enemies, fungal diseases incidence and severity, and growth and development of grapevines were studied on Darawishi and Salti cultivars in 1989 and 1990 seasons.

The grape berry moth, thrips, leafhopper, black vine thrips and eriophid mite attacked the grapevines in the two seasons. Grape berry moth attacked grapevines late in fruit formation period, and during maturation and ripening period. The insect has two major peaks of activity representing two generations, and two other small peaks which may represent two other generations. The second peak is the important one on grapevines culture in Central Jordan Valley. The grape berry moth is considered a key pest. Thrips and leafhopper occurred in small numbers in both growing seasons and are considered non-significant pests, if they not associated with disease transmission. Black vine thrips, occurred in fairly large numbers especially on Darawishi and since the insect appeared late in the season it is considered a non-significant pest, The population of eriophid mite attacked grapevines late in the two growing seasons and reached fairly large numbers on Salti only. The insect is considered a non-significant pest in both seasons.

As for fungal diseases, powdery mildew infected grapevines regularly in the two seasons and caused considerable damage. Darawishi was more susceptible to the disease than Salti. The disease is considered a key pest.

The bunch rots appeared in the two seasons during the maturation and ripening period and caused some damage. It is considered a secondary pest.

Population trends of arthropod pests severity and incidence of powdery mildew were related to temperature and relative humidity. These factors influenced these organisms as follows :

Moderate temperature and relative humidity were favorable to the grape berry moth, since large number of adults emerged under these conditions. High temperature accompanied by low relative humidity and low temperature accompanied by high relative humidity have negative effects on population. High mean temperature accompanied by low relative humidity were favorable to the black vine thrips, while low mean temperature and high relative humidity seemed to have adverse effects on its population.

Leafhopper population was insignificant in both seasons. High mean temperature accompanied by low relative humidity were favorable to the insect.

High mean temperature accompanied by low relative humidity were favorable for the eriophid mite population.

Thrips population occurred during the period of moderate mean temperature and relative humidity.

Moderate to high temperature accompanied by moderate and low humidity were most favorable for the powdery mildew development.

The annual growth and development of grapevine is divided into four periods. These are : 1) Bud burst and shoot growth. 2) Fruit formation. 3) Maturation and ripening. 4) Post harvest. The length of these periods in 1989 were : Bud burst and shoot growth 39 and 41 days. Fruit formation 45 and 48 days. Maturation and ripening 36 and 34 days and post harvest 152 and 147 days for Darawishi and Salti, respectively. Accordingly, the length of the annual growth and development was 272

and 270 days for Darawishi and Salti respectively.

Two parasites were found to attack the grape berry moth larvae. A braconid parasite *Ascogaster quadridentata* W. has potential importance and an ichneumonid sp. was of no significance because of its low numbers.

Four predators were found in the vineyard. A phytoseiid mite *Euseius scutalis* A.H. was the most important one due to its high population and long period of activity.

The green lacewing, the seven spotted lady beetle, *mantid* sp. and spiders were found in small numbers at different periods during the growing seasons.

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INTRODUCTION

Grapevine, *Vitis vinifera* L. is considered one of the most important fruit trees constituting about 30% of the total area planted to fruit trees in Jordan. According to the Ministry of Agriculture Annual Report (1988-1989) the area planted to grapes was 24828 under irrigation and 107561 donums under rain fed, producing 78924 tons. Out of this area 1277 donums were planted in Central Jordan Valley with 2848 tons production.

Grapevines are attacked by different arthropod pests and fungal diseases which inflict heavy losses to the crop. At present, farmers depend entirely on the use of chemical pesticides to control insect pests and diseases whether or not the pest is present. This situation created problems in pest control and to the environment.

Due to problems which have been created by the irrationable use of chemical pesticides, man started to look for new control programs where he finally focused on integrated control approach. This has been mainly stimulated by the failures brought on by the almost total reliance on the synthetic organic chemical pesticides in dealing with pest problems (Falcon and Smith,1973). Integrated pest control originally was proposed to describe the interaction of biological and chemical control into a cohesive pest management system (Stern *et al.*, 1959). The FAO panel of experts on integrated pest control broadened the definition and considered it as a management system that in the context of the associated environment and the population dynamics of the pest species, utilizes all suitable techniques and methods in as compatible manner as possible and maintain the pest population at levels below those causing economic injury (FAO, 1967).

The concept of integrated pest management system depends on several components among of these is the understanding the agroecosystem (Metcalf and Luckmann, 1975). The agroecosystem can be defined as a unit composed of the total complex of organisms in a crop area together with overall conditioning environment and as further modified by various agricultural, industrial and social activities of man ((Falcon and Smith, 1973). For an effective integrated pest management programe, knowledge about the reactions and interaction of the agroecosystem components is required. Accordingly, investigations to obtain preliminary basic data on certain aspects of the grapevine agroecosystem were undertaken.

Since the major biotic elements of the agroecosystem are the arthropod pests and diseases, the population trends, chronology, disease incidence and severity were investigated in this study. Also, it is well known that natural enemies play an important role in reducing various insects population and is an integral part of the agroecosystem. Therefore, predators and parasites were studied. Also, the grapevine is one of the major biotic component of the agroecosystem. Therefore, data were taken on grapevine growth and development, and fruitification.

Climatic factors influence plant growth as well as diseases and insect population. Changes in weather conditions can be either helpful or harmful to insect population. In addition, climatic factors that favour the growth of fungi have been responsible for plant disease epidemics (Hartmann *et al.*, 1981). The disease and pest prevalence and intensity were evaluated with correspondence to prevailing weather conditions are included in this work. It is hoped that this work will provide certain basic information to researchers and students to assist them in pursuing further research on pests and diseases of grapesvines.

LITERATURE REVIEW

It is well known that several pests including insects, mites, and plant diseases attack grapevines. Although little work has been done on these pests in Jordan valley, little work has been carried out in the uplands. Information available in the literature is as follows:

2:1 ARTHROPOD PESTS

2:1.1 Grape Berry Moth, *Lobesia (polychrosis) botrana* Schiff.

This moth is found in Mediterranean countries (Harriri, 1978).

In Jordan, Sudah (1966) reported that this pest infested grapevine, and caused great damage to the yield. Also, Sudah (1966), Alsannea (1970), Sudah (1973) and Sudah *et al.* (1977) tested several insecticides for controlling this pest. Kabour and Sudah (1983) used the sex pheromone trap for population monitoring at Fuheis and Zei area.

2:1.2 Black Vine Thrips, *Retithrips syriacus* Mayet.

This pest apparently originates from central Africa. Apart from tropical Afrcia it is also found in north Africa (Libya and Egypt), and Syria (Avidov and Harpaz, 1969).

In Jordan, Sudah (1966) in her study on grapevines pests reported that this insect infest grapevines especially in Salt area.

2:1.3 Leafhopper, *Empoasca lybica* Berg.

This leafhopper is found in many countries of the Mediterranean basin, as well as in Africa. This leafhopper is known as a pest of numerous plant species including grapevines. (Ibrahim, 1986).

No work has been reported in the literature on this insect in Jordan.

2:1.4 Eriophid Mite, *Eriophyes vitis* Pagenst.

This mite is widespread throughout the world being a pest of grapevines in nearly every area where the vine grows (Jeppson *et al.*, 1975).

The mite causes gall of special type on various cultivated cultivars of grapevines (Slepyan *et al.*, 1969).

Sudah (1966) reported that this mite infest grapevines in Jordan and infestation differ from one area to another.

2:1.5 Thrips, *Thrips tabaci* Lind.

This thrips is a polyphagous pest which attack many agricultural crops (Ghaban, 1948).

In Jordan, Mustafa (1986) reported that the insect is found most of the year, especially in late autumn, winter and early spring.

2:1.6 Aphid, *Aphis* sp.

This aphid has not been recorded to infest grapevines in Jordan.

2:1.7 The mealybug *Planococcus vitis* N. was reported by Madi (1988) as a pest of grapevines in Jordan Valley. Also, Ghayyada (1988) studied the life table of the grape mealybug on grapevines at Deir Alla.

2:2 FUNGAL DISEASES

2:2.1 Powdery Mildew, *Uncinula necator* (schw) Burr.

The powdery mildew is an important and widespread fungal disease of grapevines.

Abu-Blan and Al-Momany (1987) reported that the disease is widespread and important pest of grapevines in all parts of Jordan where grapevines are cultivated.

Various workers tested several fungicides and made observations on its control (Sudah, 1966, Alsannea, 1970, and Sudah *et al.*, 1977). Other studies on susceptibility of various cultivars to the disease have been carried out (Sudah, 1966, Al-Momany and Shattat, 1990).

2:2.2 Fungi Associated with Bunch Rots of Grapes :

Bunch rots are caused by one or more of many different organisms, most of them are secondary invadors capable only of infecting plant tissue that has been damaged in some way (Hewitt, 1974, and Falherty *et al.* 1982).

No work has been carried out on these fungi in Jordan.

2:3 FACTORS AFFECTING ARTHROPODS AND DISEASES

2:3.1 Aboitic Factors

Temperature, relative humidity, soil or water conditions may all influence community members (Metcalf and Luckmann, 1975). Also, weather conditions influence the incidence of disease by favoring the growth of the pathogen itself and increasing the plant susceptibility (Hartmann *et al.*, 1981).

No work has been carried out on these factors in Jordan.

2:4 CATEGORIES OF PESTS

Smith and van den Bosch (1967) divided pests into four categories as follows :

1. **Key Pests** : These are serious species occurring in regular basis and require control measures to be taken regularly. Usually there are only a very few key pests (some times only one or two) in any agroecosystem. The integrated pest control approach is mainly concerned with the key pests.

2. **Secondary pests** : These are relatively minor pests that occasionally rise to economically damaging levels. The integrated pest control approach is aimed to prevent these occasional outbreaks.

3. **Potential pests** : These cause no significant damage, under the conditions currently prevailing in the agroecosystem. Utmost care must be taken not to disrupt the ecosystem to prevent potential pests from becoming key pests.

4. **Pests of non-significance** : these are present in the agroecosystem but cause no damage and considered as non pests.

MATERIALS AND METHODS

3:1 LAYOUT OF THE EXPERIMENT

Seventy two grapevine trees each of Darawishi and Salti Cultivars (thereafter in the thesis will be referred to as Darawishi and Salti) were chosen in a grapevine orchard for this study. The trees had been planted eight years ago at the university farm in Central Jordan Valley. They were planted in rows (2X2) m. and each row contained 24 trees. Surface irrigation was practiced in the vineyard and fertilizer was applied as practiced in commercial grapevine production. The vineyard was kept free from pesticide use during the study. The experiment started in March, 1989 and ended in July, 1990, covering two growing seasons.

3:2 ARTHROPOD PESTS

3:2.1 Insects and Mites :

To study the population trends of these pests, samples of 30 leaves of each cultivar were taken at random from different sites of the grapevines twice a week. Moving stages of mites, thrips leafhoppers found on both sides of each leaf were counted in the field under a magnifying lens and by visual observation. For eriophid mite the number of galls on each leaf were counted. To study the population trends of the grape berry moth a sex pheromone trap (obtained from Biological Control Systems, England) was installed in the vineyard on May 13, 1989 and continued until July, 1990.

The trap is made of weather proof cardboard with changeable plate lined with

adhesive substance, and open into a triangle shaped tunnel. The pheromone (E,Z-7,9-dodecadienyl acetate) was dispensed from polyethylene vials containing one milligram of the pheromone. The pheromone vials were purchased from Biological Control Systems, England. The vial was replaced in the trap every 20-30 days, because of rapid dissipation of compounds under high temperature conditions. The trap was suspended on a pole 80 cm above ground. Male moths caught in the trap were counted twice a week. Also, infested bunches and berries of 50 bunches of each cultivar selected at random in the field were recorded twice a week. The infested berries are those which have point of entrance on berries skin and surrounded by a patch of reddened skin.

3:3 FUNGAL DISEASES ASSESSMENT

3:3.1 Diseases :

Disease incidence was recorded as percent of infected grapevines out of 50 vines of each cultivar twice a week. Disease severity was determined by selecting 25 leaves of each cultivar at random twice a week and the mean infected leaf area was taken according to Horsfall and Heuberger (1942) method. Also numbers of diseased berries in 50 bunches selected at random for each cultivar were counted twice a week.

3:3.2 Bunch Rots of Grapes :

Fungi associated with rotted bunches of grapevines were studied. Numbers of rotten berries in 50 bunches selected at random for each cultivar were counted twice a week. Samples were brought to the laboratory, plated on Potato Dextrose

Agar medium, and then incubated at 25.0 C^{o} for three days. Temporary slides were made from pure cultures for identification of the fungi. The method of Barnett and Barry (1972), Clements and Shear (1973) and Talbot (1971) were followed in identification.

3:4 PLANT GROWTH AND DEVELOPMENT

The annual cycle of grapevine growth and development may be divided into four periods. The first of these is the bud burst and shoot growth which occurs between the bud burst and appearance of the first flower. At this period, plants are in the vegetative growth and shooting pattern. The second period is that of fruit formation, which begins with the appearance of the first flower and continue until berry set and fruit formation. The third period is that of fruit maturation and ripening. This period starts from the veraison of berries, softening of skin and accumulation of sugars in berries and continue until harvest time. The fourth period is that of post harvest which starts after fruit picking till leaves defoliation.

To determine the yield, the bunches on twenty grapevines of each cultivar selected at random were picked, cleaned and weighed. Also, the average number of berries per twenty buches of each cultivar were determined.

3:5 FACTORS AFFECTING ARTHROPODS AND DISEASES

3:5.1 Abiotic Factors :

Records of temperature and relative humidity were obtained from the metero - logical station at the university farm in Central Jordan Valley.

3:5.2 Biotic Factors

3:5.2.1 Parasites :

Infested grape berries were collected from the vineyard and taken to the laboratory for parasite emergence. Each infested berry was placed in a glass vial covered with muslin cloth. Berries were inspected daily and fresh grape berries was provided as needed. In addition, small pieces of grape leaves were provided to serve as possible loci for pupation. The parasite obtained was identified to species by the Commonwealth Institute of Entomology.

3:5.2.2 Predators :

Samples of 50 sweeps were taken with 30 cm-diameter sweep net. This was carried out to search for predators on the grapevines. In addition, the samples taken to assess the number of insects and mites as mentioned previously (Section 3:2.1) were examined for the presence of predators.

RESULTS AND DISCUSSION

4:1 ARTHROPOD PESTS

The numbers of arthropod pests found on each 30 leaves examined twice a week for the duration of the study are shown in Figures 3,4,5 and 6. The periodic counts were related to the periodic mean temperature and the periodic mean relative humidity. These were derived by averaging the daily mean temperature and daily mean relative humidity during the count intervals.

Results obtained are discussed as follows :

4:1.1 Grape Berry Moth; *Lobesia (polychrosis) botrana* Schiff.

Figure 1 and 2 show weekly numbers of male moth caught per trap. In 1989 the sex pheromone trap was installed in the vineyard late in the season because of un-availability of the pheromone in time. Large numbers of moths were caught in the trap mid May then numbers decreased sharply until early July, then started to increase from early July until it became low starting mid August to early September then an increase in number occurred from early September until no moth found in late November and December (Fig. 1). In 1990 moths appeared in the trap in mid February and numbers increased through February and reached a peak in mid March. This indicate that the population was primary exogenous in origin, because at this time grapevines were in the dormant stage. The numbers then fell off to a low level in mid April and started to increase again and reached a second peak in early May. The numbers then decreased gradually with very low numbers till end July (Fig.

2). Figure 1 indicates that from early July to mid November 1989 two small peaks exist. In 1990, figure 2 shows that from mid February to early July two large peaks of population occurred. We could conclude that the insect has two major peaks of activity representing two generations, while the other two small peaks represent fluctuation in the population and may represent two other generations a year in Central Jordan Valley. The first generation appeared in mid February and ended mid April. At this time grapevines were in the dormant stage which indicates the presence of secondary hosts for the insect. The second generation started to appear in the field in late April and continued until early July. Probably, the third generation started early July and ended early September, and the fourth generation occurred between early September and mid November. It is to be mentioned that Kabour and Sudah (1983) reported that the insect has four generations a year in the uplands.

Figures 1 and 2 also show the average numbers of infested berries in both cultivars. Infestation in the two seasons started early and mid May on both cultivars and the numbers increased appreciably as the season progressed and reached a peak when berries started to mature and ripe. It is to be noted that the occurrence of infested berries in both cultivars coincided with the second peak of adult population (Fig. 1), which indicates that this peak, represents the second generation of the moth is the important generation on grapevines culture in Central Jordan Valley. The numbers of infested berries (Fig. 1,2) substantiate the finding that the insect has only one important generation on berries since larvae started to infest grapevines early May and a peak was reached in mid June and the crop was harvested early July. The other generations are relatively not important, because they most probably are found on secondary hosts. Tzanakakis (1986) reported that grape berry moth are

polyphagous and found to feed on 25 plant species besides grapevines. In Egypt, besides grapevines it attacks plum, apricot and grasses. (Hammad and Al-Menshawi,1983).

Both temperature and relative humidity seem to have marked effects on the grape berry moth. Low temperature and high humidity (Fig.1,2) seem to have detrimental effect on the insect since no adults were found from mid November to early February. During this period the average mean temperature and average relative humidity were 14.68C° and 66.56%, respectively. Moderate temperature and relative humidity which occurred from mid February to late May seems to be favorable to insect since most of adults emergence occurred during this period where the average mean temperature and relative humidity were 22.19C° and 51.75%, respectively. Also high mean temperature seems to be not favorable to the insect since average mean temperature and relative humidity from early June to mid November were 28.33C° and 47.17%, respectively, and during this period insect activity was low. Therefore, it may concluded that low temperature accompanied by high relative humidity and high temperature accompanied by low relative humidity have negative effects on the insect. These results are to certain extent in agreement with results obtained by Dirimanov and Kharizanov (1964) who reported that temperature and humidity for the first generation were 16.0-20.2C° and 67.4-73.0%, while for the second and third generation were 20.7-24.2C° and 61-71%. Ali *et al.* (1978) in Egypt reported that temperature of 25.0C° combined with 55-65% relative humidity were the most favorable conditions for the grape berry moth.

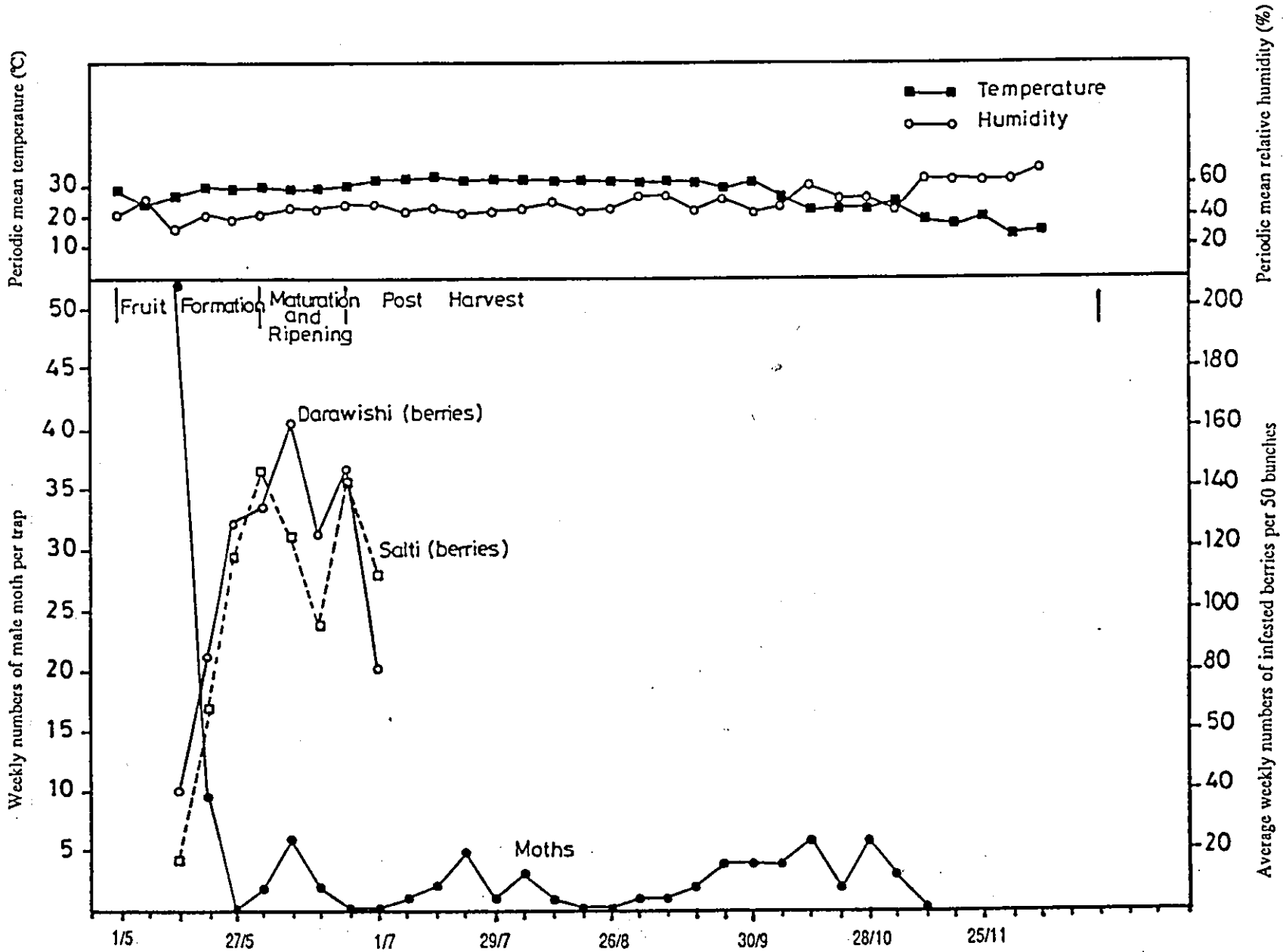

Fig. 1: Numbers of grape berry moth and numbers of infested berries, 1989.

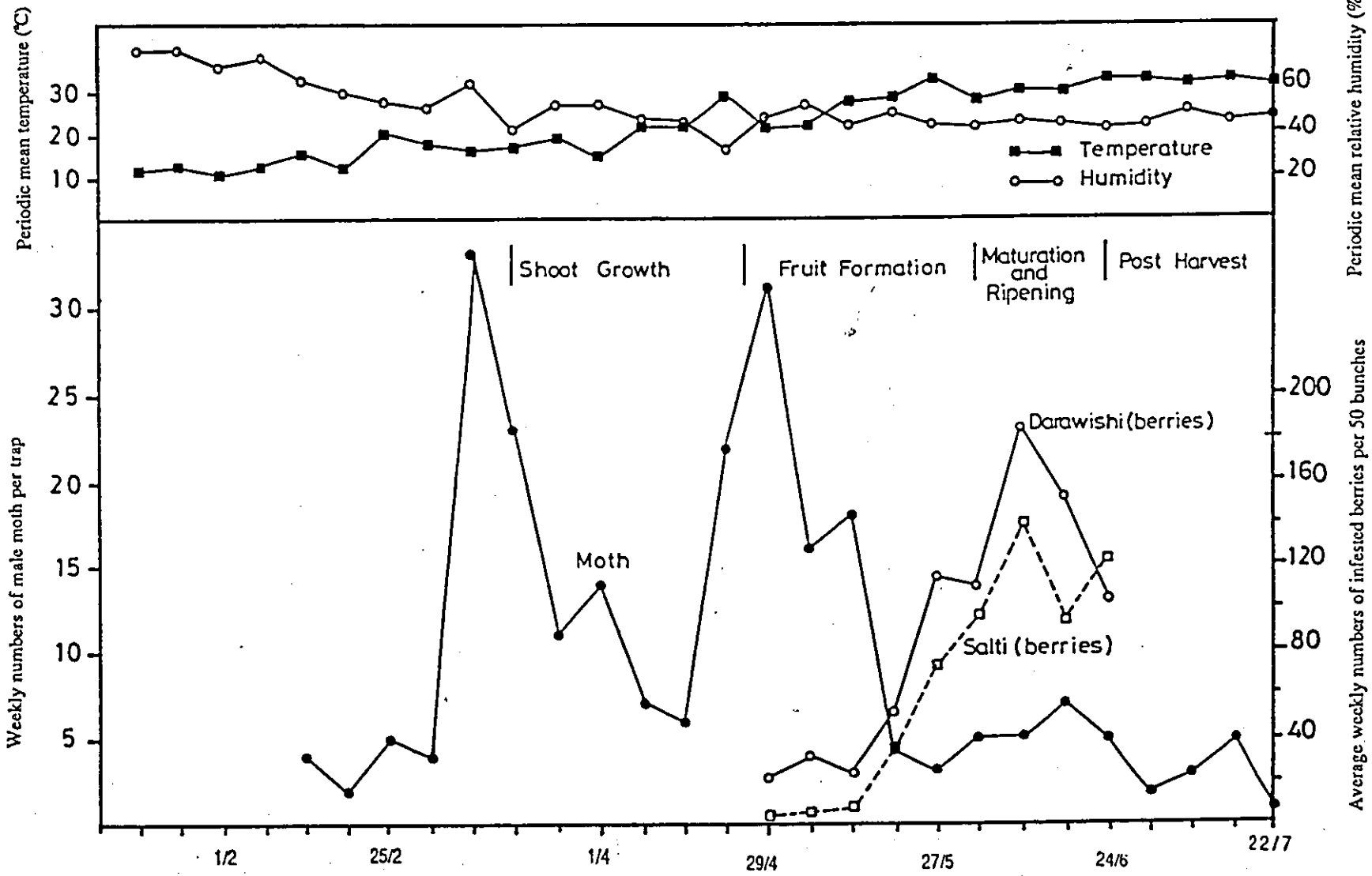

Fig. 2: Numbers of grape berry moth and numbers of infested berries, 1990.

4:1.2 Importance of Grape Berry Moth on Grapevines :

The average weekly percentage of infestation in each 50 bunches are shown in tables 1 and 2. The tables show that the maximum weekly percentage of infestation with the grape berry moth was high in case of bunches and low in berries. For example, in 1990 the maximum percentage of infestation of bunches reached 74% in Darawishi and 59% in Salti. As for berries, infestations were 3.23% and 2.77% on Darawishi and Salti, respectively. This indicate that the insect is important because it infests a large proportion of bunches. Also the importance of the insect comes from infestation of fruits, which make berries vulnerable for attack by other organisms and this will increase its importance in inducing more damage to the fruits (Tzanakakis, 1986). In addition, infestations with the berry moth reduce the quality of fruits which in turn affect its marketing value.

4:1.3 Black vine thrips; *Retithrips syriacus* Mayet.

The insect appeared in the vineyard in late June on Darawishi and in late July on Salti (Fig. 3,4) in 1989. The numbers then increased and reached a peak in early August on both cultivars, then numbers fell off to low levels in early September and remained so until end of the growing season in December. In 1990 the insect appeared in the vineyard early June on both cultivars. The numbers then increased and reached fairly large numbers in early July on Darawishi followed by a sharp decline. The numbers then increased and reached a second peak late July. On Salti, the insect was in limited numbers (Fig 5,6). Although results show that the insect infest Darawishi late in the season and causing discoloration of the leaves, it is considered of no significant importance. On Salti infestation was low and the insect

Table 2 : Average weekly percentages of infested bunches and berries caused by grape berry moth on Salti* per 50 bunches.

1989			1990		
Date	bunch %	berry %	Date	bunch %	berry %
13-19/5	11	0.34	2-7/5	1.0	0.05
20-26/5	48	1.35	8-14/5	3.0	0.12
27/5-2/6	51	2.34	15-21/5	8.0	0.14
3-10/6	65	2.90	22-29/5	20	0.70
11-16/6	58	2.46	30/5-4/6	44	1.46
17-23/6	55	1.86	5-11/6	54	1.94
24-30/6	72	2.83	12-18/6	52	2.77
1-7/7	68	2.30	19-25/6	54	1.85
			26/6-2/7	59	1.46

* Average number of berries in one bunch of Salti 101.

Table 1 : Average weekly percentages of infested bunches and berries caused by the grape berry moth on Darawishi* per 50 bunches.

1989			1990		
Date	bunch %	berry %	Date	bunch %	berry %
13-19/5	21	0.7	2-7/5	14	0.36
20-26/5	48	1.49	8-14/5	26	0.58
27/5-2/6	68	2.26	15-21/5	24	0.47
3-10/6	65	2.35	22-29/5	32	0.90
11-16/6	74	2.84	30/5-4/6	57	2.11
17-23/6	66	2.18	5-11/6	67	2.02
24-30/6	69	2.58	12-18/6	71	3.23
1-7/7	58	1.42	19-25/6	74	2.71
			26/6-2/7	66	1.99

* Average number of berries in one bunch of Darawishi 114.

may be considered of no economic importance.

Black vine thrips seems to be positively influenced by high temperature. Average mean temperature of 32.0C° accompanied by 45.66% relative humidity which occurred between early July until late August caused sharp increase in population (Fig. 3.4). As the temperature started to decrease begining early September the population was adversely affected accordingly. This indicate strongly that high temperature is preferable for the insect (Fig. 3,4).

4:1.4 Leafhopper; *Empoasca lybica* Berg .

The leafhopper was present in the vineyard in low numbers. In 1989 season it appeared in early April on Darawishi and early May on Salti and continued in low numbers on both cultivars until it terminated at the end of October (Fig. 3,4). In 1990 season (Fig. 5,6) the insect appeared end of March on Darawishi and a peak was reached in mid May then numbers fell off to low levels at the end of May and continued till August. On Salti it appeared in early April with low numbers and remained so until August. From the foregoing it is clear that the leafhopper is present in the vineyard in limited numbers during the whole season and may be considered of no economic importance.

High mean temperature accompanied by low relative humidity which occurred from late April till August were most favorable for the leafhopper. During this period average mean temperature and relative humidity were 30.1C° and 42.77%, respectively. This is in agreement with Avidov and Harpaz (1969) who reported that maximum infestation occurred during mid summer. As average mean temperature

decreased and the relative humidity increased from mid March to early May and from early September till early November the numbers of leafhopper were low. During these periods the average mean temperature and relative humidity were 19.75 C° and 47.4%, respectively and 26.0C° and 49.0 %, respectively in 1989.

4:1.5 Eriophid Mite; *Eriophyes vitis* Pangest.

Figures 4 and 6 show the population trends of the eriophid mite in 1989, 1990 on Salti. The periodic counts show that a general rise in the mite population started at the end of August and a peak was reached in mid October followed by a decrease in population through October and November then numbers fell off early December. In 1990 season convexties started to appear on grape leaves in mid May then the numbers increased gradually and reached a peak in mid July then started to decrease then followed by an increase in numbers at the end of July. As Figures 3 and 5 indicate Darawishi was not attacked by the mite which indicates that it is not a preferable host.

The mite seems to be influenced by temperature. Figures 4 and 6 show that the mite population increased during high temperature period from early September till late October. The average mean temperature at this period was 29.37C° accompanied by 49.0% relative humidity. This is in agreement with Avidov and Harpaz (1969) who reported that optimum temperature of mite activity is from 26.0-32.0C°. A reduction in population occurred after a decrease in temperature and increase in relative humidity during the period from late October till mid December. During this period the average mean temperature and relative humidity were 19.15C° and 63.46%, respectively.

This mite may be considered of no economic importance, since it occurred late in the seasons.

4:1.6 Thrips; *Thrips tabaci* Lind.

Thrips appeared in the two seasons on both cultivars between the end of March and early April (Fig. 3, 4, 5, 6). In 1989 season a peak was reached in mid April on Darawishi then number fell off at end of April and early May then another small peak was reached in mid May then numbers fell off and terminated at the end of May. On Salti of same season the insect started to infest grape leaves in early April and reached a peak at the end of April then numbers fell off and another peak was reached late May then numbers fell off again and terminated at end of May (Fig. 3,4). In 1990 season infestation on Salti started end March and a peak was reached in late April. The numbers then fell off and terminated in mid May. On Darawishi, thrips appeared end March then numbers increased through April and a peak was reached late April followed by a reduction in numbers till it terminated mid May (Fig. 5,6).

Both temperature and relative humidity have marked effects on the insect. Moderate temperature and relative humidity which occurred from end March till late May, seems to be favorable to the insect, during this period average mean temperature and relative humidity were 24.57C° and 44.71%, respectively. Also high temperature accompanied by low relative humidity seems not to be favorable to the insect, since average mean temperature and relative humidity from late May to late September were 31.24C° and 45.58%, respectively, and during this period no insects were found.

4:1.7 Aphids, *Aphis* sp.

Figures 5 and 6 show the population trends of aphids. These figures show that aphids occurred in low numbers in 1990 season only on both cultivars. On Darawishi the insect appeared late May in low numbers then terminated in mid June. On Salti a general rise in aphids population occurred in mid May and a peak was reached in late May followed by a reduction in numbers through June and terminated end June.

The insect is considered of no significance to grapevine culture in Central Jordan Valley.

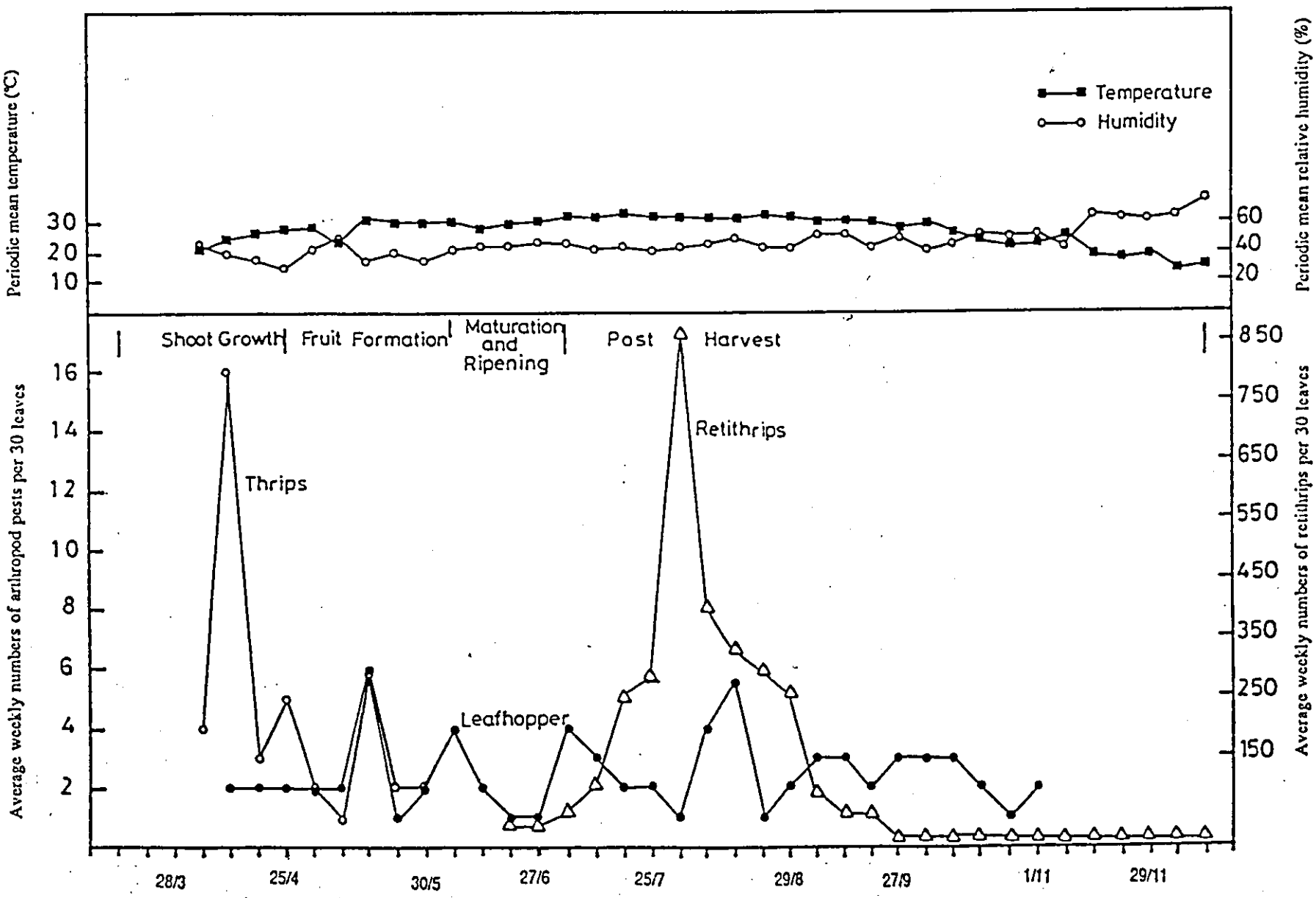

Fig. 3: Population trends of various arthropod pests on Darawishi cultivar,1989 .

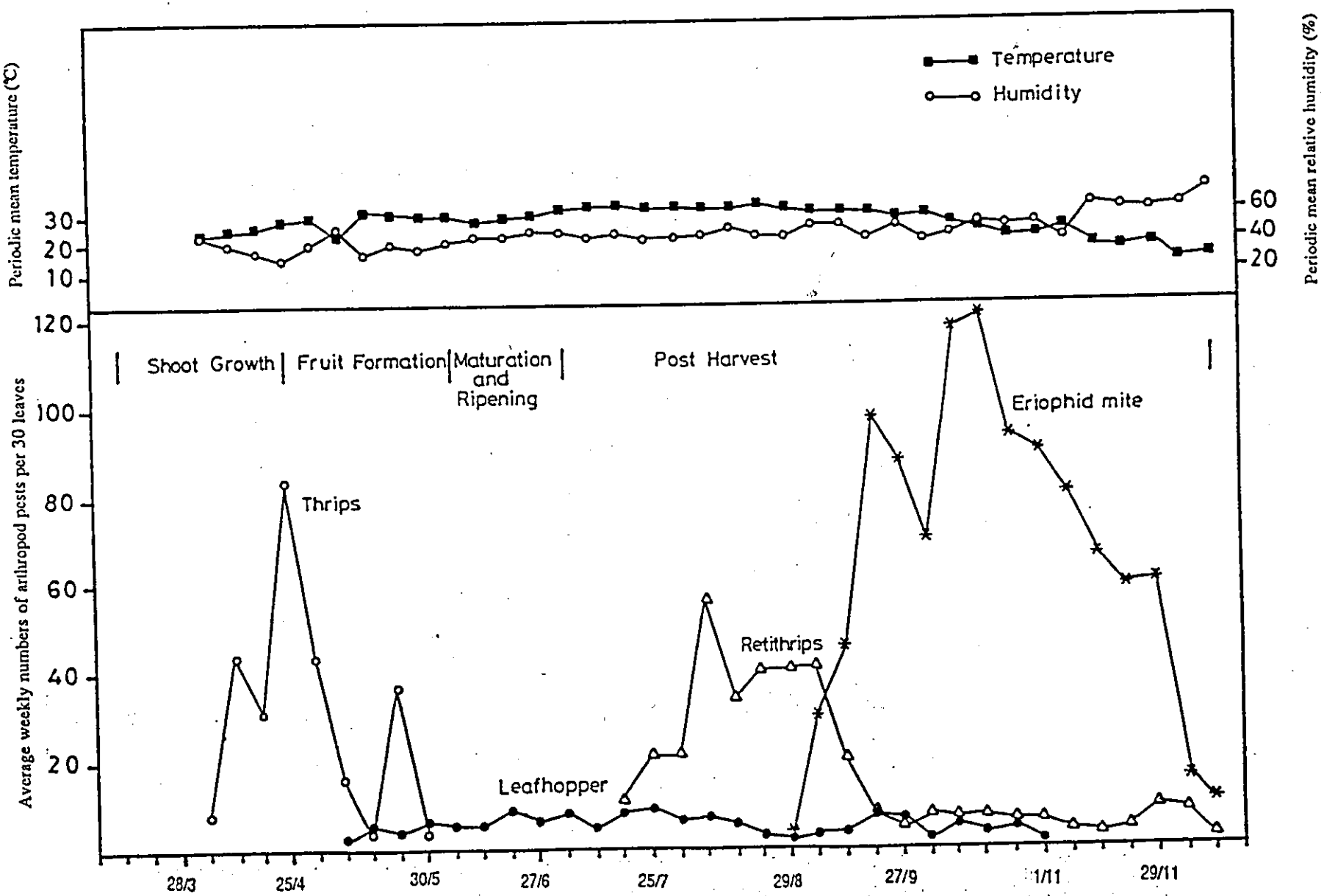

Fig. 4: Population trends of various arthropod pests and number of convexties (eriophid mite) on Salti cultivar, 1989 .

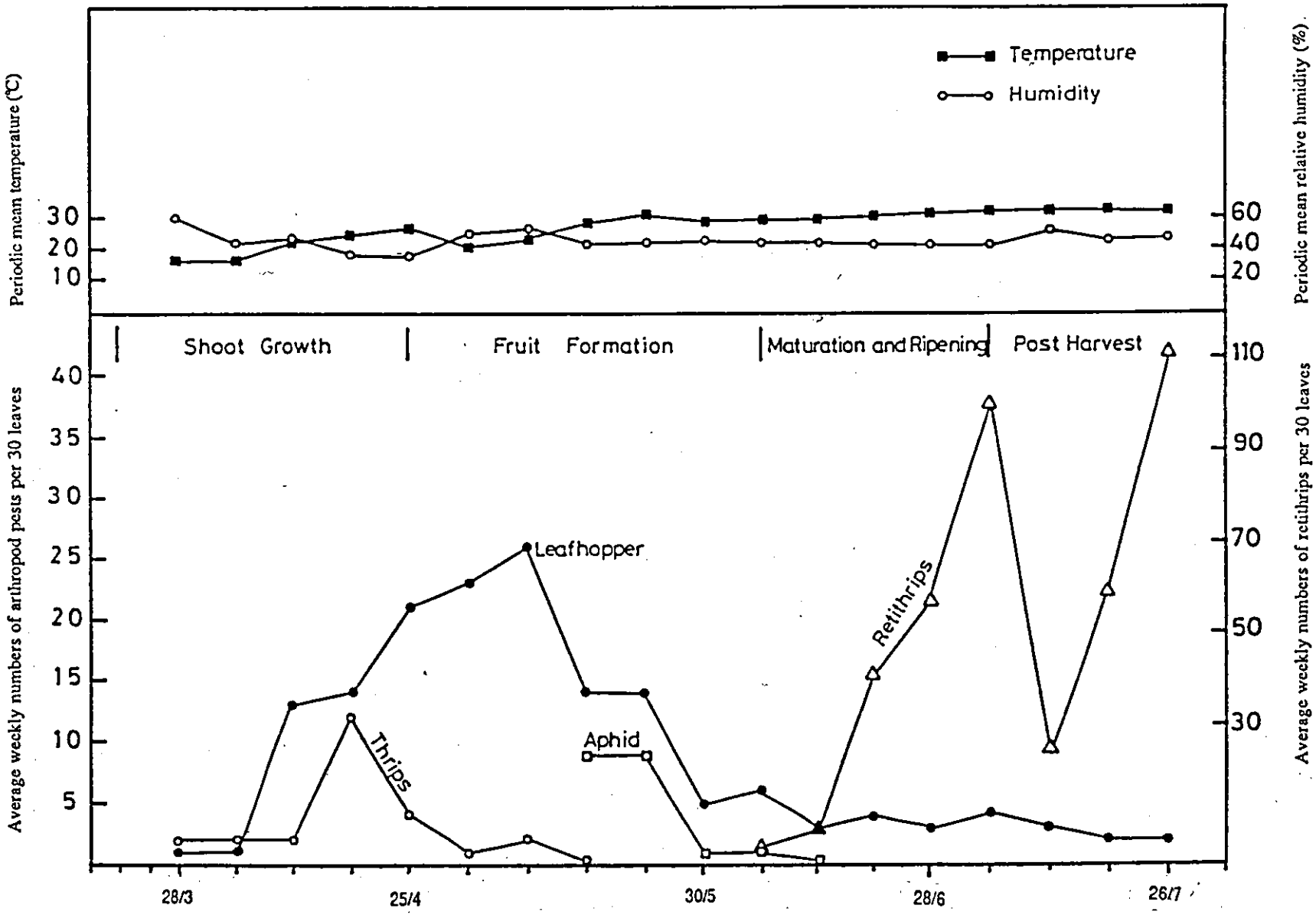

Fig. 5: Population trends of various arthropod pests on Darawishi cultivar, 1990 .

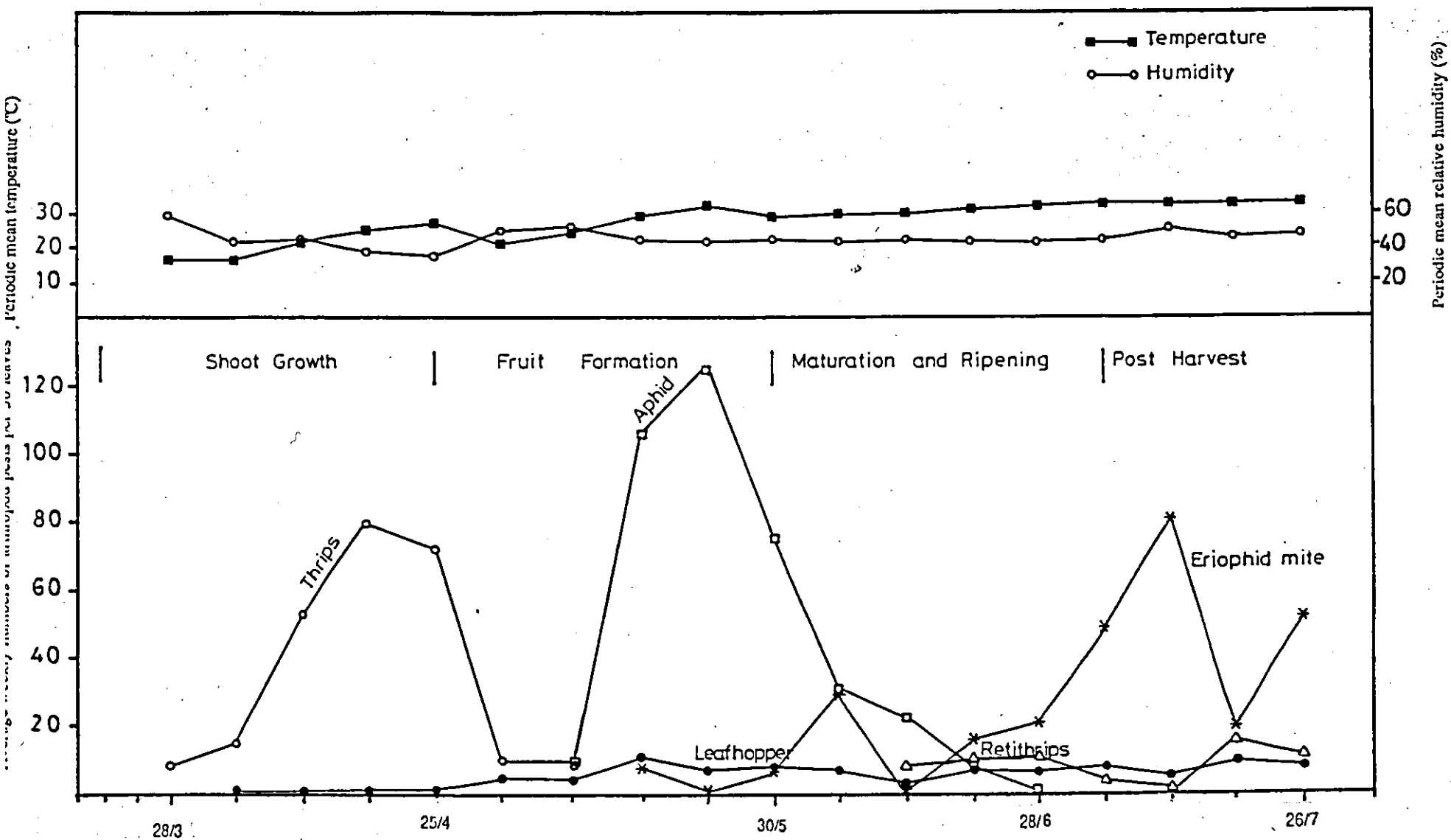

Fig. 6: Population trends of various arthropod pests and number of convexties (eriophid mite) on Salti cultivar, 1990 .

4:2 FUNGAL DISEASES

4:2.1 Powdery mildew; *Uncinula necator* (Bur.) Sch.

The percentages of infected grapevines taken twice a week for the duration of the study are shown in figures 7,8. These figures show that the disease in 1989 appeared late April on Darawishi and mid May on Salti. Then gradual increase of infection occurred and a peak was reached early September on Darawishi and mid October on Salti. At this period disease incidence and severity reached 100% and 91%, respectively on Darawishi, 100% and 59%, respectively on Salti. In 1990 season, disease assessment (Fig. 9,10) showed that the disease appeared mid April on Darawishi and early May on Salti. The disease then gradually increased through the season and incidence reached 100% in late May on Darawishi and mid June on Salti. At this time, disease severity reached 91% and 76% on Darawishi and Salti, respectively.

Temperature and relative humidity seem to have marked effect on the disease. Low temperature accompanied by high relative humidity (Fig. 8,10) seems to have negative effects on the disease development. This is illustrated in the period from mid March to late April in 1989 where the average mean temperature and relative humidity were 21.79C° and 50.67%, and in 1990 the average mean temperature and relative humidity were 16.5C° and 52.5% from mid March until early April. During these periods the disease did not develop. Also, a decline in disease severity occurred from late September to early December in 1989, where average mean temperature and relative humidity were 19.5C° and 57.75%, respectively. This indicates strongly that low temperature accompanied by high relative humidity

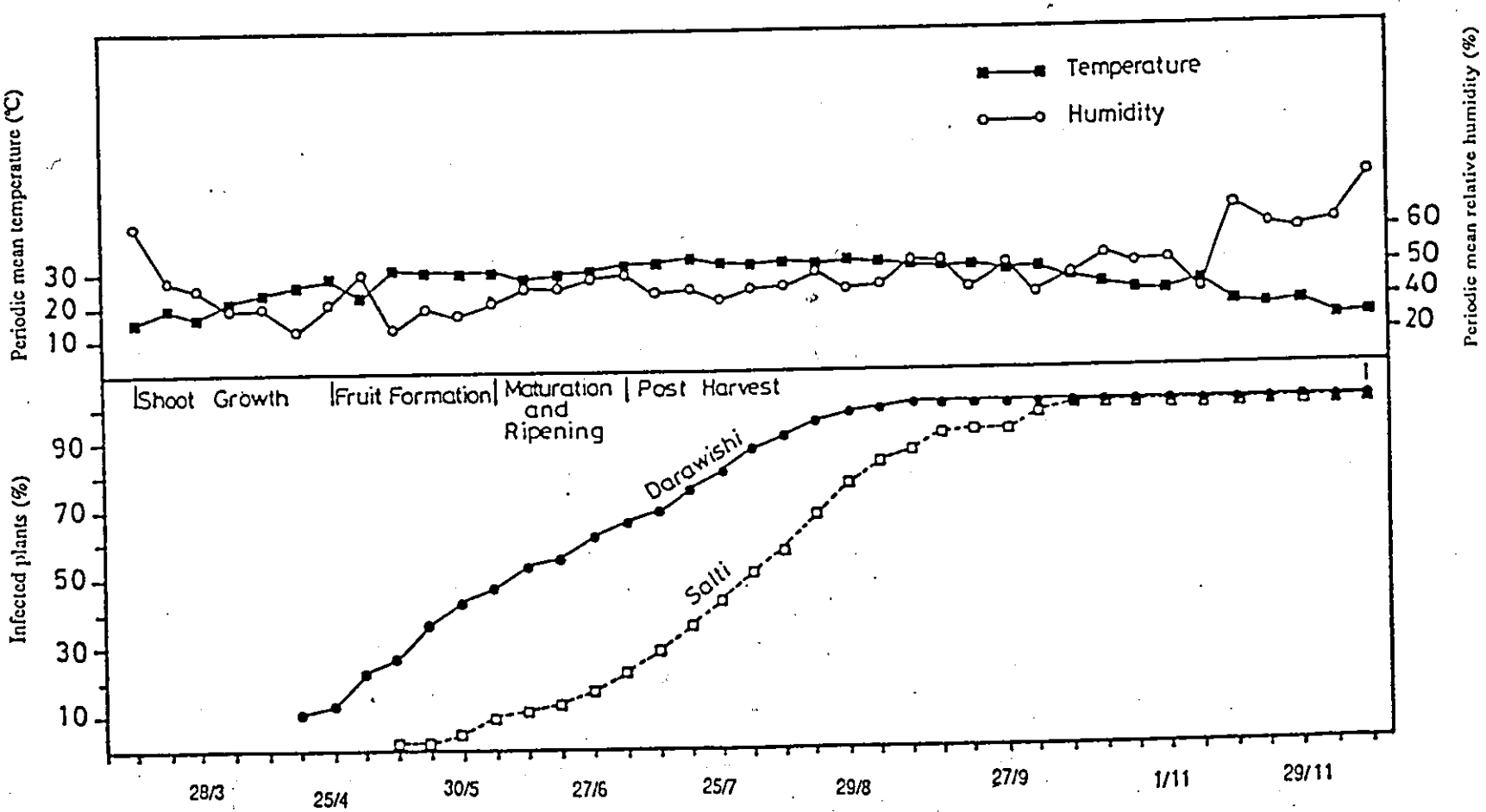

Fig. 7: Disease incidence of powdery mildew on Darawishi and Salti cultivars, 1989.

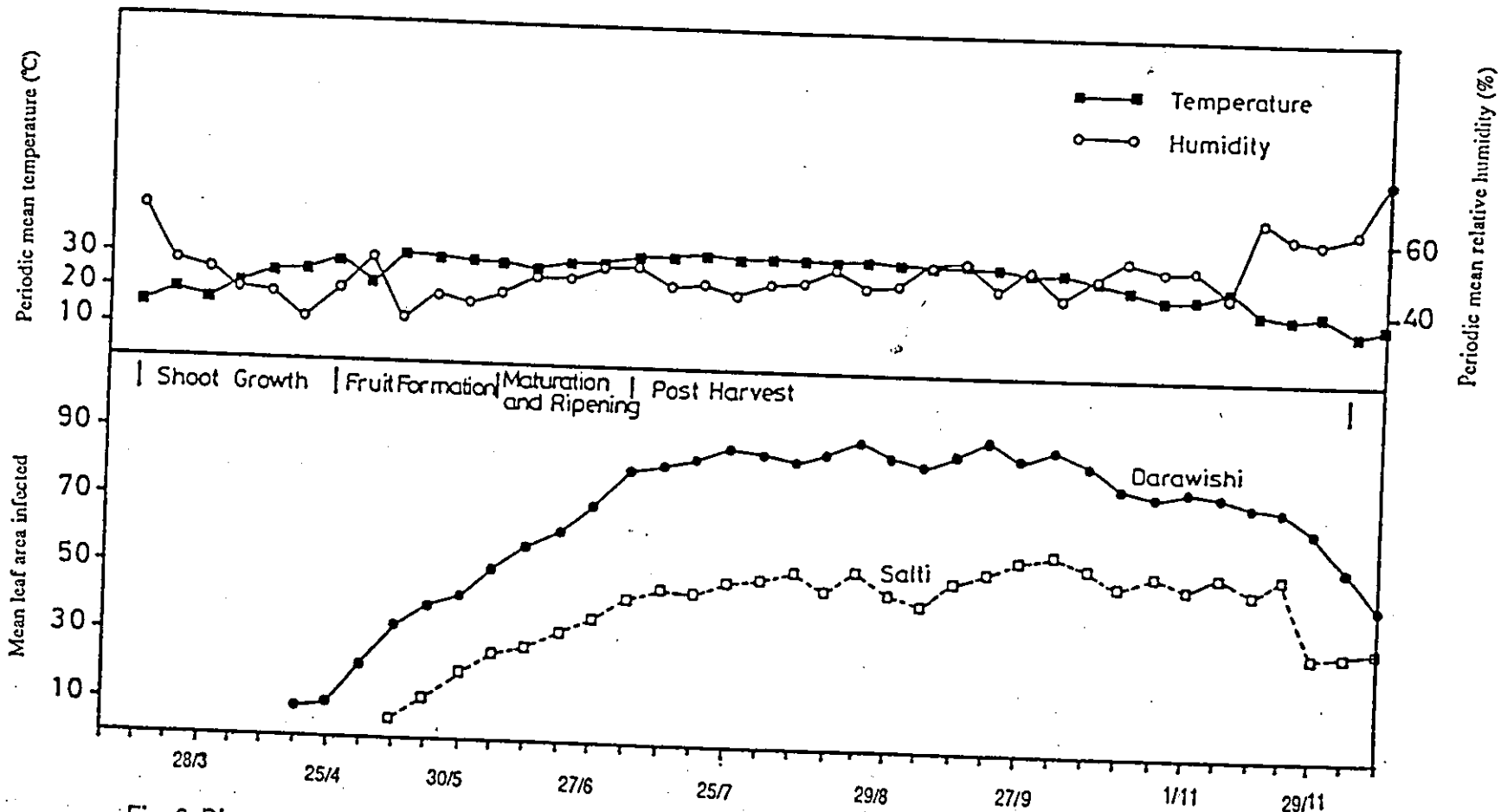

Fig. 8: Disease severity of powdery mildew on Darawishi and Salti Cultivar, 1989 .

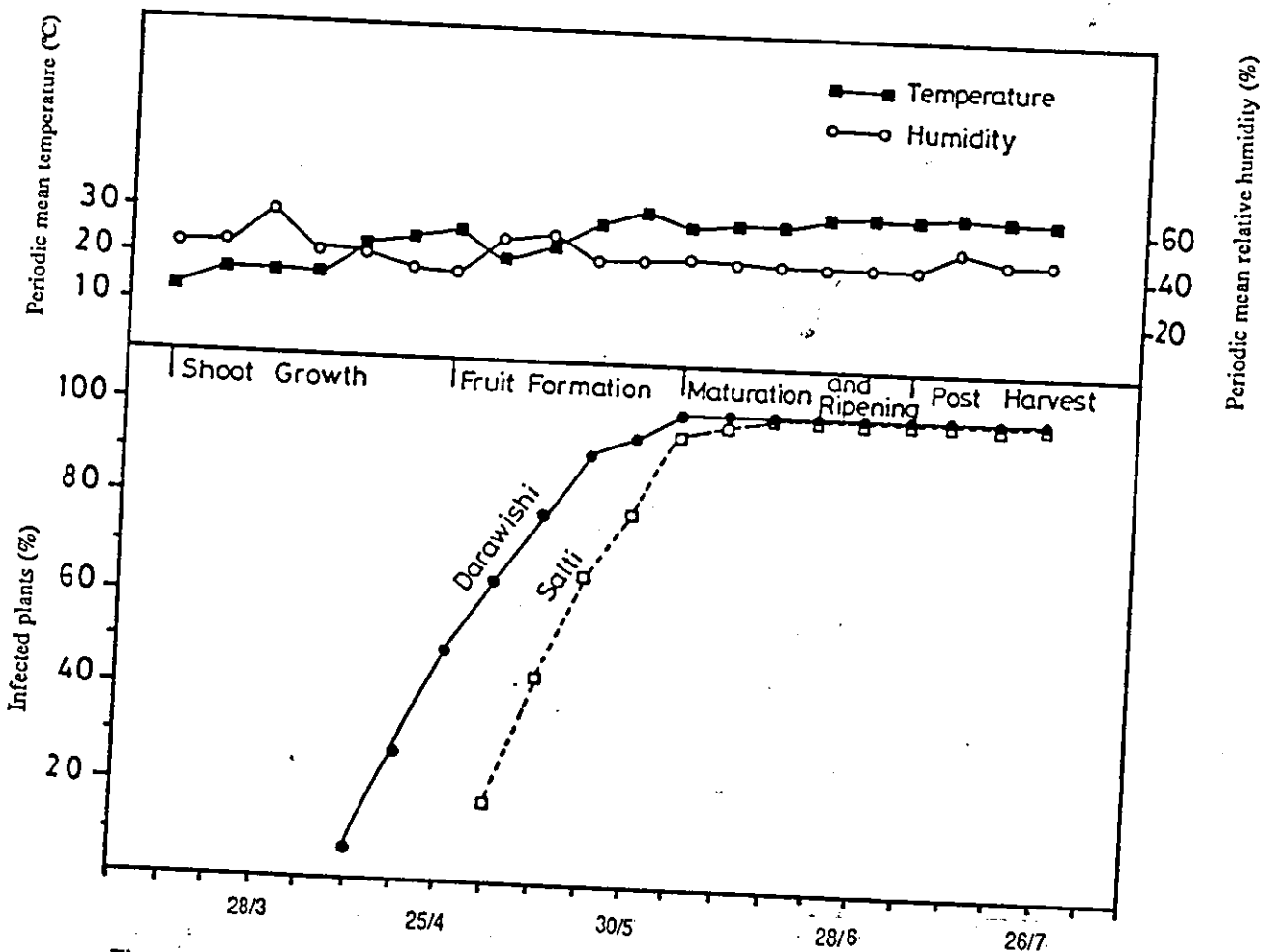

Fig. 9: Disease incidence of powdery mildew on Darawishi and salti cultivars, 1990 .

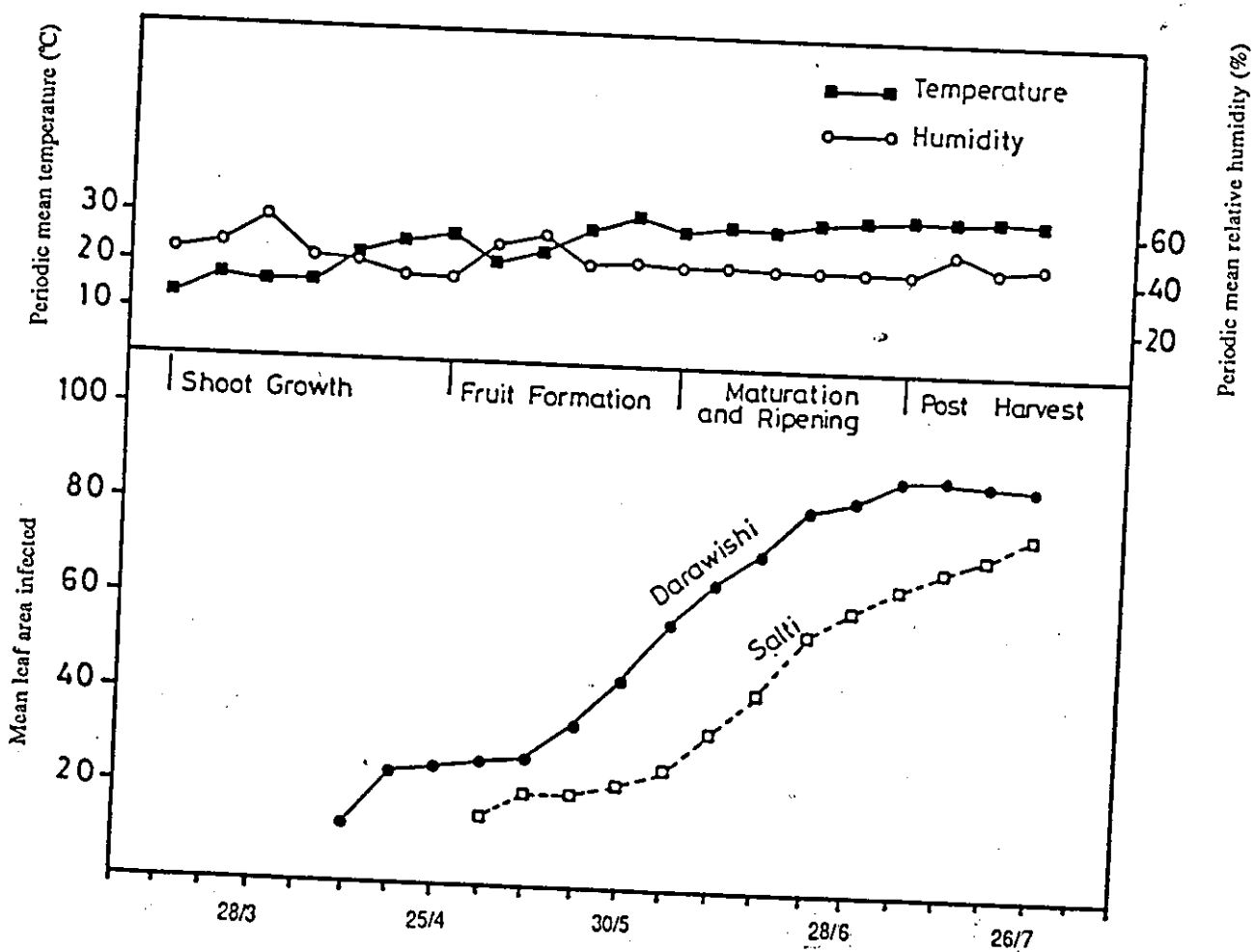

Fig. 10: Disease severity of powdery mildew on Darawishi and Salti cultivars, 1990 .

have negative effects on the disease development. In 1989 and 1990 seasons, and as the temperature started to increase, the disease developed and increased. This is illustrated in the period from late and early April to early June. During this period the average mean temperature and relative humidity were 28.68C° and 40.46%, and 26.2C° and 45.0%, respectively. High temperature accompanied by low relative humidity seems to be favorable to the disease development, since the average mean temperature and relative humidity through mid June to late September in 1989 were, 31.0C° and 47.0%, respectively. At this period maximum disease severity was recorded. These results are in agreement to certain extent with work of Sall (1980) and Delp (1954) who reported that grape powdery mildew developed between 21.0-30.0C°. Also Oku *et al* (1975) and Bulit and Lafon (1978) reported that the optimum temperature for conidial germination, growth and penetration was 25.0C°.

4:2.2 Importance of Powdery Mildew on Grapevine :

Tables 3 and 4 show the average weekly percentages of infected bunches and berries during 1989 and 1990 seasons on Darawishi and Salti. The tables show that infection occurred during critical periods of plant growth, namely, fruit formation, and fruit maturation and ripening. For example, maximum infection on Darawishi reached 100% on bunches and 37.37% on berries in 1990 (Tab. 3). On Salti, maximum infection in the same year reached 60% and 4.7% on bunches and berries, respectively (Tab. 4). Although the infection is high on both cultivars it is more severe on Darawishi. This high percentages of infection coupled with the fact that the powdery mildew contributes to splitting and rapturing fruits (Barbetti, 1980)

Table 3 : Average weekly percentages of infected bunches and berries caused by the powdery mildew on Darawishi* per 50 bunches.

1989			1990		
Date	bunch %	berry %	Date	bunch %	berry %
13-19/5	29	2.10	28/4-1/5	4.0	0.31
20-26/5	33	4.10	2-7/5	10	0.79
27/5-2/6	43	6.30	8-14/5	43.5	4.35
3-10/6	40	5.50	15-21/5	100	11.39
11-16/6	53	7.10	22-29/5	100	19.42
17-23/6	49	7.73	30/5-4/6	100	30.11
24-30/6	67	7.78	5-11/6	100	34.15
1-7/7	60	8.22	12-18/6 19-2516	100 100	34.66 37.37
8-11/7	76	10.37	26/6-2/7 3-7/7	100 100	32.10 31.84

* Average number of berries in one bunch of Darawishi 114.

Table 4 : Average weekly percentages of infected bunches and berries caused by the powdery mildew on Salti* per 50 bunches.

1989			1990		
Date	bunch %	berry %	Date	bunch %	berry %
13-19/5	1.0	0.09	15-21/5	8.0	0.14
20-26/5	1.0	6.11	22-29/5	27	0.73
27/5-2/6	6.0	0.09	30/5-4/6	39	1.69
3-10/6	4.0	0.10	5-11/6	58	2.91
11-16/6	6.0	0.21	12-18/6	39	2.14
17-23/6	9.0	0.25	19-25/6	60	3.39
24-30/6	7.0	0.25	26/6-2/7	47	4.39
1-7/7	20.0	0.74	3-7/7	52	4.70
8-11/7	21.0	0.67			

* Average number of berries in one bunch of Salti 101.

and opens the way for bunch rots attack makes it a very important disease.

4:2.3 It is to be mentioned that other grapevine diseases may be present in the Central Jordan Valley but were not observed in the experimental site.

2:2.4 Fungi Associated with Bunch Rot of Grapes : Aspergillus niger

The different fungi isolated from berries during the maturation and ripening period are presented in tables 5 and 6. These fungi are *Aspergillus* sp. *Penicillium* sp., *Rhizopus* sp., and *Fusarium* sp. It appears that *Aspergillus* sp. was the most prevalent. It amounted to 11.74% and 7.89% in 1989 and 1990 on Darawishi, respectively. Also, it reached 4.67% and 3.66% in 1989 and 1990 on Salti, respectively. Other fungi were found in low percentages. Nair (1985), and Jarvis and Traquair (1984) reported that bunch rots caused by several fungi such as *Botrytis cinerea*, *Alternaria* sp., *Rhizopus* sp., *Aspergillus niger*, *Cladosporium* sp., *Fusarium* sp., *Penicillium* sp. It seems that Darawishi suffer more from bunch rots fungi because of its tight bunches. This is in agreement with Hewitt (1974) who reported that losses from bunch rot are greater in grapevines with tight bunches than with loose bunches.

4:3 PLANT GROWTH AND DEVELOPMENT

The annual cycle of growth and development of grapevine is divided into four periods (Fig. 1,2). The first of these is bud burst and shoot growth, this period lasted 39 and 41 days in Darawishi and Salti, respectively in the two seasons. The second period is that of fruit formation which lasted 45 and 48 days in Darawishi and Salti, respectively in the two season. The third period is that of fruit maturation and

Table 5 : Percent of rotten berries per 50 bunches on Darawishi* cultivar.

1989					1990				
Date	% Aspergillus	% Penicillium	% Rhizopus	% Fusarium	Date	% Aspergillus	% Penicillium	% Rhizopus	% Fusarium
13/6	0.07	0.0	0.0	0.0	9/6	0.12	0.0	0.0	0.02
17/6	0.21	0.04	0.0	0.0	12/6	0.42	0.02	0.0	0.02
19/6	0.30	0.0	0.0	0.04	16/6	0.77	0.07	0.0	0.05
24/6	1.30	0.0	0.04	0.56	19/6	0.91	0.18	0.04	0.04
27/6	1.65	0.19	0.0	0.07	23/6	2.47	0.26	0.37	0.21
1/7	1.30	0.26	0.04	0.04	26/6	3.35	0.53	0.0	0.04
4/7	3.50	0.33	0.0	0.07	31/6	4.21	0.79	0.02	0.0
8/7	6.50	0.40	0.0	0.19	3/7	6.14	1.40	0.04	0.0
11/7	11.74	0.79	0.14	0.46	7/7	7.89	1.58	0.0	0.0

* Average number of berries in one bunch of Darawishi 114.

Table 6 : Percent of rotten berries per 50 bunches on Salti* cultivar.

1989					1990				
Date	% Aspergillus	% Penicillium	% Rhizopus	% Fusarium	Date	% Aspergillus	% Penicillium	% Rhizopus	% Fusarium
13/6	0.04	0.0	0.0	0.0	9/6	0.16	0.0	0.0	0.0
17/6	0.10	0.02	0.0	0.0	12/6	0.12	0.04	0.0	0.0
19/6	0.30	0.0	0.02	0.04	16/6	0.53	0.0	0.0	0.0
24/6	0.20	0.0	0.0	0.06	19/6	0.22	0.20	0.0	0.0
27/6	0.48	0.18	0.0	0.0	23/6	0.18	0.0	0.0	0.06
1/7	0.50	0.02	0.0	0.02	26/6	0.30	0.30	0.0	0.06
4/7	3.64	0.12	0.0	0.06	31/6	2.48	0.40	0.0	0.0
8/7	1.25	0.13	0.0	0.12	3/7	2.87	0.60	0.0	0.02
11/7	4.67	0.0	0.0	0.18	7/7	3.66	1.21	0.04	0.02

* Average number of berries in one bunch of Salti 101.

ripening. In Darawishi it lasted 36 and 32 days in 1989 and 1990 seasons, respectively. In Salti it lasted 34 and 33 days in 1989 and 1990 seasons, respectively. The last period is the post harvest. In Darawishi it lasted 152 days and for Salti 147 days in 1989 season.

Accordingly, the length of the annual growth cycle of grapevine was 272 days in Darawishi cultivar and 270 days in Salti cultivar.

Falcon and Smith (1973) reported that it is important to know the periods of growth and fruit production so pest control programs can be adjusted accordingly in the overall insect, disease, and crop management system. These phases not only describe the different phases of plant growth and development, but also conform to the changing patterns of insect pest problems and provide a basis for pest control decision making in integrated control systems.

4:3.1 Phases of Plant Growth and Development in Relation to Patterns of Pest Problem :

This refers to the chronology of various pests according to phases of growth and development of grapevine. Since the length of the different periods of grapevine growth and development for the two cultivars are close in number of days, it is fit to discuss the chronology of various pests according to phases of growth and development of growth and development for Salti cultivar. As figure 11 indicates, thrips, leafhopper were present at the shoot growth period, and since these two insect are of no economic importance no control measures is suggested. Powdery mildew and grape berry moth were present in addition to the two previously mentioned pests at the fruit formation. Because of the economic importance of the

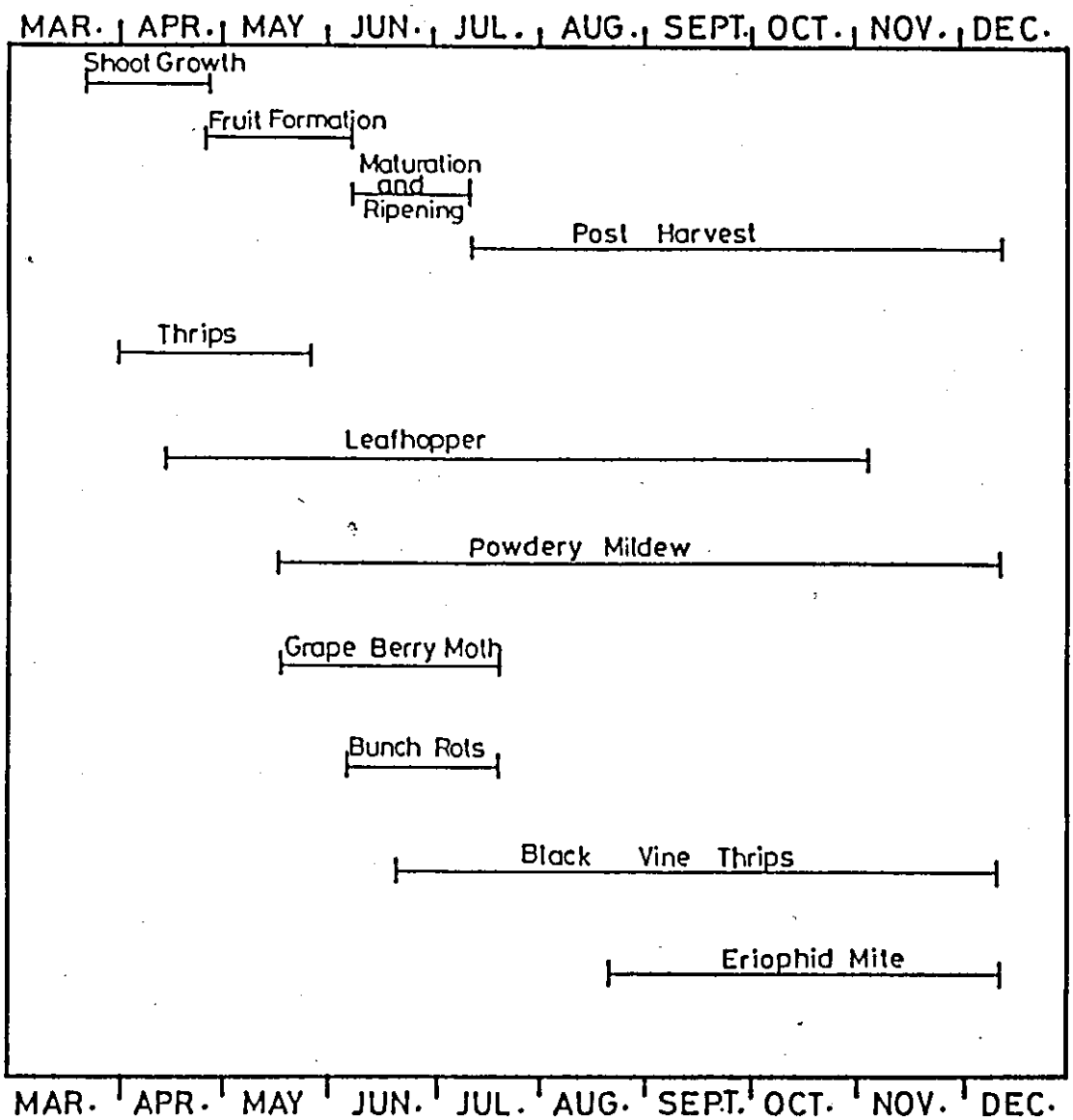

Fig. 11: General limits of growth and fruiting periods for Salti cultivar and general periods of activity of insects and mite pests and diseases in Central Jordan Valley, 1989 .

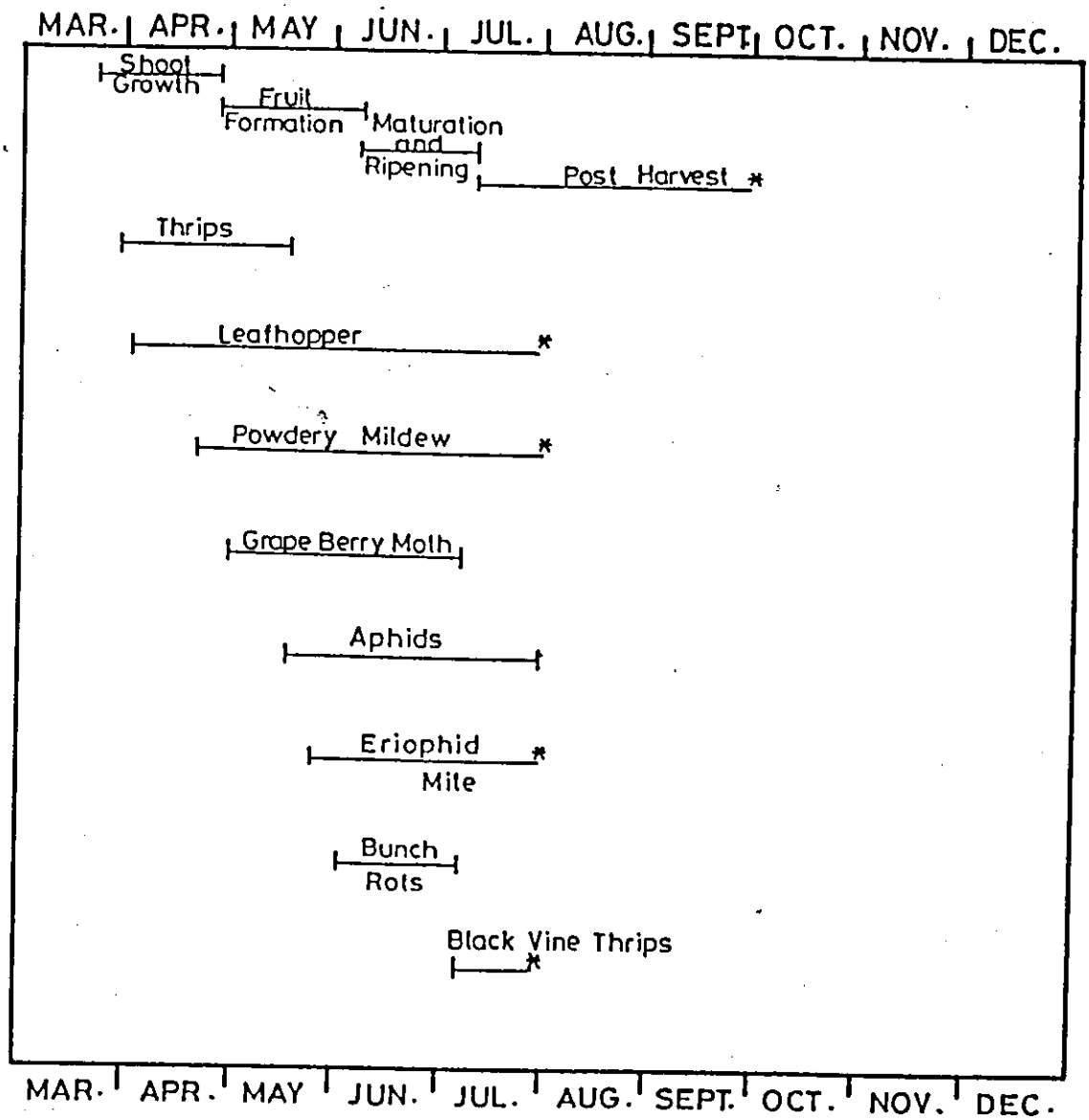

Fig. 12: General limits of growth and fruiting periods for Salti cultivar and general periods of activity of insects and mite pests and diseases in Central Jordan Valley, 1990 .

* The experiment finished.

powdery and grape berry moth control measures may be contemplated at this time with long residual chemical, since the period is relatively long. At maturation and ripening period, in addition to the pests mentioned previously, bunch rots and blackvine thrips were present. At this period of plant growth and development the use of long residual pesticides may be considered since this period is around 35 days. At the post harvest period, in addition to the previously mentioned pests eriophid mite were present, and since this period is relatively not important, chemical control may be not needed. In 1990 season and as Figure 12 shows, Thrips, leafhapper and powdery mildew occur during shoot growth period. In addition to the previous pests grape berry moth, aphid, eriophid mite and bunch rots were present in fruit formation period. At the fruit maturation and ripening, black vine thrips appeared in addition to the previous pests. At post harvest period most of the previous mentioned pests were present.

4:3.2 Fruit Weight :

Fruit weight obtained in 1989 from each 20 grapevines sampled were 130 kg and 113 kg for Darawishi and Salti, respectively. This means that production per donum is equivalent to 1625 kg and 1413 kg for Darawishi and Salti, respectively. In 1990 season production per donum was 1663 kg and 1625 kg for Darawishi and Salti, respectively. It is known that commercial production of head trained grapes for Darawishi and Salti amount to approximately 1500-2000 kg per donum (Shattat, personal communication). Therefore, production in experimental field is comparable to minimum commercial production. In addition, the qualtiy of fruits were low which contributes considerably to economic loss. These losses are attributed to the arthropod pests and diseases, especially the grape berry moth, powdery mildew and

fruit rot fungi.

4:4 PARASITES AND PREDATORS

Various parasites and predators species were present in the vineyard in central Jordan valley. The significance of these parasites and predators are summarized as follows :

4:4.1 Parasites :

A. The braconid parasite, *Ascogaster quadridentata* Wesmael, was reared from grape berry moth larvae collected from infested berries. As shown in table 7, parasitism in 1989 was 27.7% and 28.95% in 1990. This parasite may have a potential importance as biological control agent for this insect, and more future work is suggested on this line.

B. Ichneumonid sp. Only 5 parasites of this species were obtained from 151 larvae reared in 1989 and 1990. This indicates that the parasite is of little importance.

It is to be noted that in 1990, a sample of 28 larvae were obtained from Sewieleh area to detect the presence of parasites. In this sample parasitism was 52.2% caused by *Ascogaster quadridentata* W. This indicates that the parasite may have potential importance in the uplands than Jordan valley area. A point which merits more investigation.

4:4.2 Predators :

A. The phytoseiid mite, *Euseius scutalis* A.H. is the most prevalent predator

Table 7 : Numbers of larvae reared, moth emerged, parasites, dead larvae* and percent parasitism.

Year	Larvae reared	Moth emerged	Dead larvae	Parasite emerged	% parasitism
1989	100	52	30	18	27.7
1990	51	24	13	11	28.95

* unknown causes.

found in the vineyard. Figures 13 and 14 show its population trends on both cultivars in 1989 and 1990, respectively.

In 1989 season it started to appear in mid May and continued to increase and reached a peak in mid June on both cultivars. On Darawishi the numbers decreased and remained at low levels till the end of November. On Salti the numbers fell off and followed again by a second peak at the end of July then the numbers fell off and started to increase again and reached a third peak mid October. Then gradual decline in numbers occurred until it terminated at the end November. In 1990 season the predator started to appear on both cultivars end of March and continued increasing through April and May and reached a peak at the end of June then numbers fell off at the end of June on both cultivars.

It is known that the phytoseiid mite is a general feeder of various pests and also feed on pollen. The mite also is widely distributed through Africa and the Middle East, and is adapted to arid and hot areas (Bounfour and McMurtry, 1987). The importance of this mite in Jordan Valley may be attributed to its long period of activity throughout the season.

B. The green lacewing, *Chrysopa* sp. This predator appears in the vineyard in mid April in both seasons in small numbers and lasts up to late June.

C. The seven spotted lady beetle, *Coccinella septempunctata* L., *mantid* sp. and *Araneida* sp. (spiders). These predators are found in the vineyard in rather small numbers.

4:5 CATEGORIES OF PESTS

In the present work a good insight has been obtained in regard to status and importance of pests on grapevine. Concerning arthropod pests figures 1 to 6 show

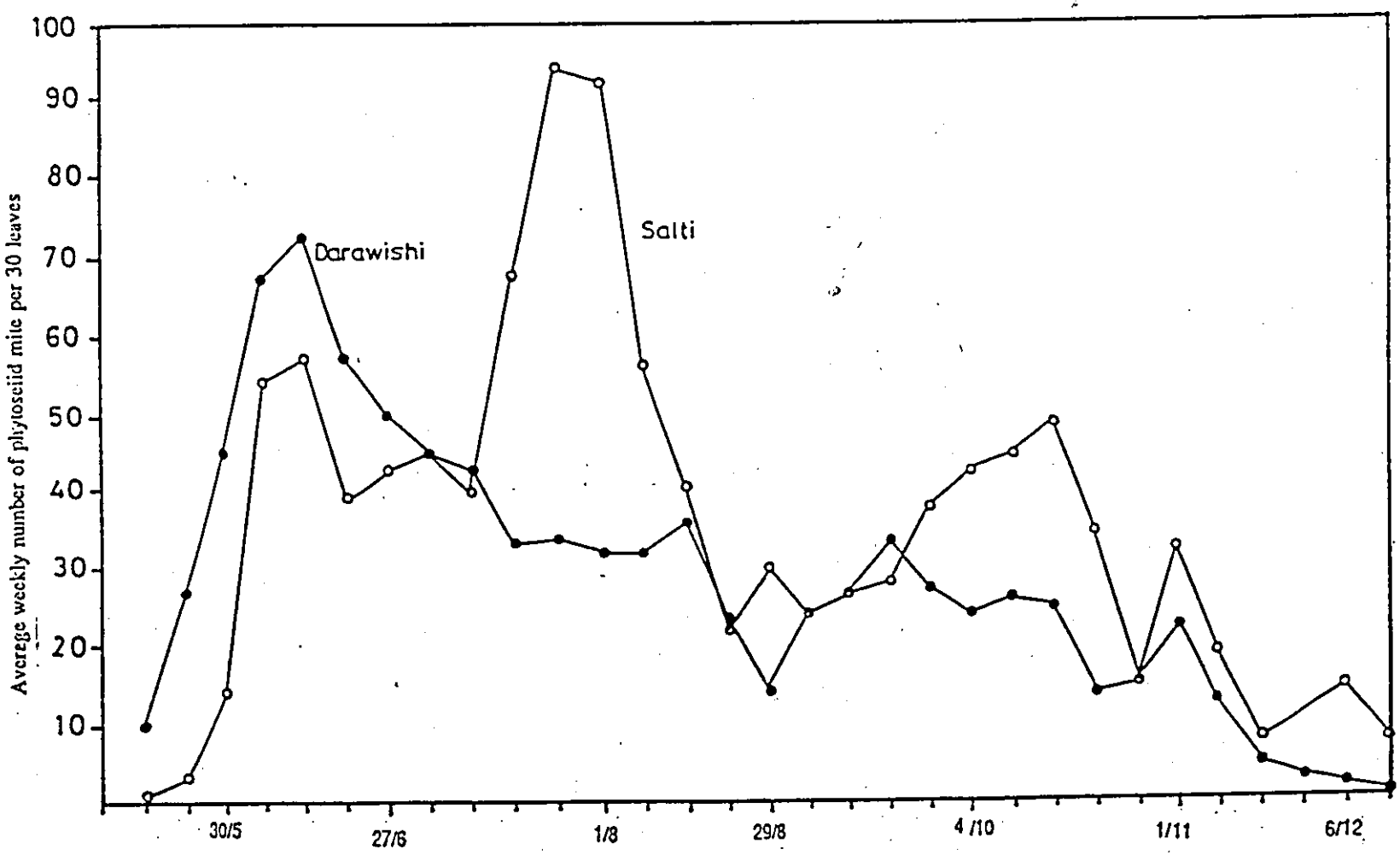

Fig. 13: Population trends of phytoseiid mite, 1989.

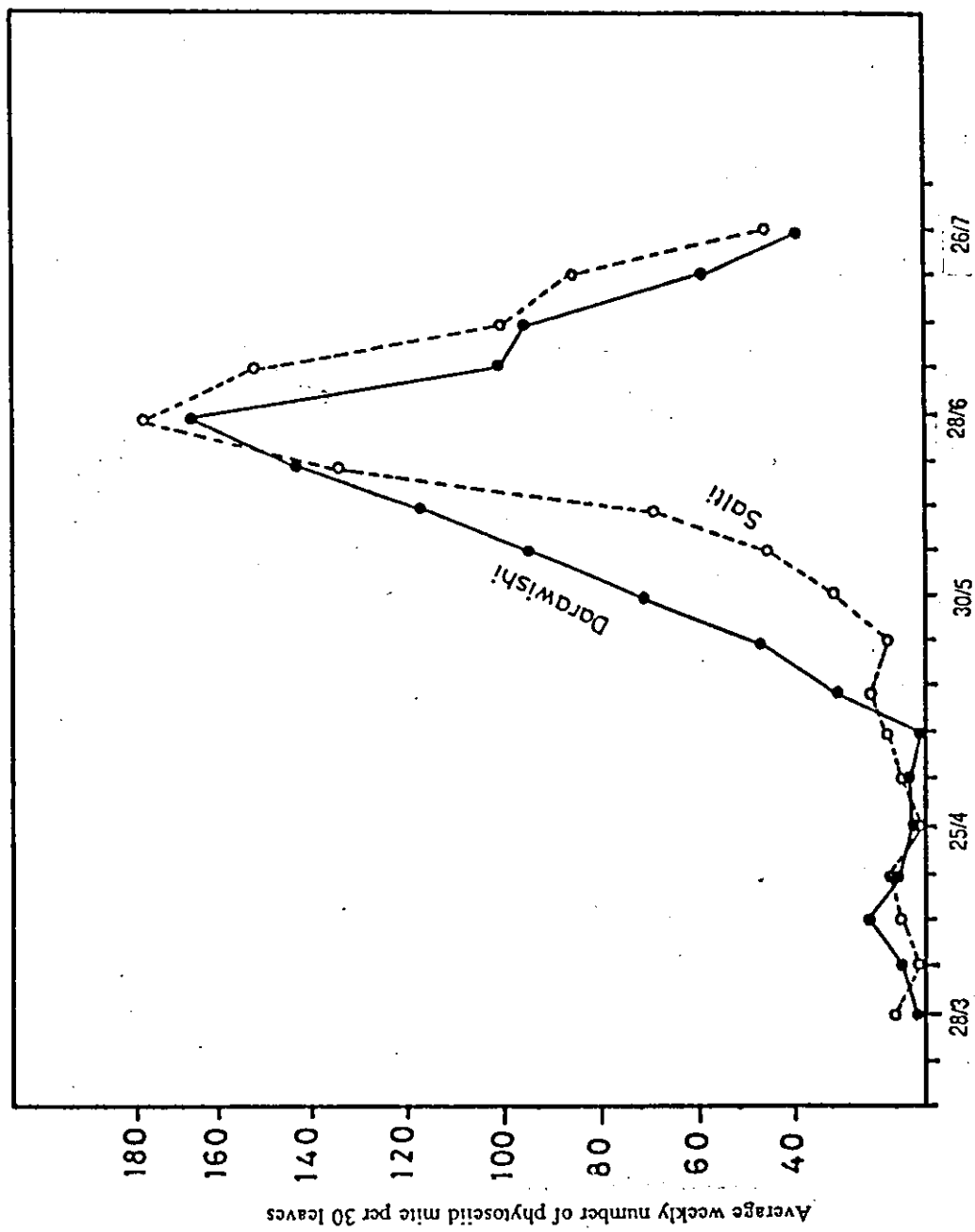

Fig. 14: Population trends of phytoseiid mite, 1990 .

the following :

GRAPE BERRY MOTH. This insect appeared in both growing seasons, causing damage to the yield on both cultivars and requires control measures. The insect is of economic importance and is considered a key pest.

BLACK VINE THRIPS. Although this insect appeared in large numbers on Darawishi in both growing seasons, it is considered a non-significant, becuase it infest Darawishi later in the season. Also on Salti the insect appeared late in both seasons in small numbers. Therefore, it is considered non-significance pest.

LEAFHOPPER. It appeared in the two growing season in small numbers on both cultivars. Accordingly, it is considered a non-significant pest.

ERIOPHID MITE. This mite attacked Salti in fairly large numbers late in both growing seasons and not at all on Darawishi in both growing seasons. Therefore, it is considered a non-significant pest.

THRIPS. The insect infested both cultivars in two growing seasons in small numbers for short period of time. Therefore, it is considered a non-significant pest.

APHIDS : The insect appeared only in 1990 growing season on both cultivars in very small numbers. Therefore, it is considered of non-significant.

In regard to plant diseases, figures 7, 8, 9 and 10 show the following :

POWDERY MILDEW. This disease occurred regularly with high severity and incidence in both growing seasons on both cultivars. Therefore, it is considerd a key pest.

BUNCH ROTS. These fungi occurred in both growing seasons on both cultivars with moderate severity levels. Therefore, they are considered secondary pests.

CONCLUSIONS AND RECOMMENDATIONS

1. Basic information were obtained on the population trends of arthropod pests, severity and incidence of fungal diseases especially the powdery mildew. It is recommended that more work should be oriented in this direction.

2. The grape berry moth appeared regularly in the vineyard and considered of economic importance. Also, the powdery mildew infected grapes regularly with high degree of severity and incidence. Therefore, they are considered key pests.

Since the integrated pest control approach mainly concern the key pests and aims to prevent the occasional outbreaks of secondary pests, it is recommended that priority in future work should be given to key pests.

3. The bunch rots fungi infected grapes in moderate severity in both growing seasons and considered as secondary pests.

4. Infestation with thrips and leafhopper were low. Accordingly, they are considered of no sigificance, if they are not associated with diseases transmission.

5. Although the eriophid mite and the black vine thrips infested the vineyard in relatively large numbers, infestations occurred late in the seasons and therefore, the insects are considered non-significant pests.

6. The parasite, *Ascogaster quadridentata* W. was found to be of a potential importance on the grape berry moth larvae. It is recommended that more work on the parasite should be carried out.

7. The respective arthropod pests and fungal diseases were affected either positively or negatively with prevailed temperature and relative humidity. It is recommended that these factors should be taken into consideration in applying

control measures.

8. Eriophid mite attacked Salti cultivar but not Darawishi. This indicates that the latter may be resistant to the mite.

9. Powdery mildew severity was higher on Darawishi than Salti, which shows that the latter is less susceptible to the disease.

ملخص

تم اجراء دراسة على صنفين من العنب المحلي هي الدراويشي والسلطي ، وذلك لمعرفة التغير في اعداد الحشرات ، الحلم ، الأعداء الحيوية ولتحري نسبة وشدة الإصابة بالأمراض الفطرية في الموسمين الزراعيين ١٩٨٩ و ١٩٩٠. كذلك درست مراحل نمو نبات العنب .

أظهرت نتائج الدراسة تواجد كل من عثة ثمار العنب ، التربس ، قفاز الأوراق ، تربس العنب الأسود، وحلم العنب خلال الموسمين الزراعيين .ومع أن عثة ثمار العنب تواجدت طيلة الموسم الاّ انها كانت خطرة في نهاية مرحلة تكوين الثمار وخلال مرحلة النضج . وقد وجد ان لهذه الحشرة فترتين رئيسيتين من النشاط والتي تمثل جيلين وايضاً فترتين اخريين هما عبارة عن تقلبات في نشاط الحشرة خلال السنة والتي يمكن ان تمثل جيلين اخريين. الجيل الثاني هو الجيل الخطر على زراعة العنب في منطقة الغور الأوسط . اعتبرت هذه الحشرة من الآفات الرئيسة خلال الموسمين الزراعيين بسبب الخسارة التي تسببها للمحصول وبسبب تواجدها باستمرار. التربس والقفاز وجدت باعداد قليلة خلال الموسمين الزراعيين . ولذلك اعتبرت من الآفات الغير مهمة اقتصادياً اذا لم يكن لها علاقة بنقل الأمراض . تربس العنب الأسود والذي وجد بأعداد كبيرة خاصة على صنف الدراويشي ، ونتيجة لتواجده في مرحلة متأخرة خلال الموسم فقد اعتبر غير مهم اقتصادياً . أما حلم العنب فقد ظهر بأعداد عالية خلال الموسمين الزراعيين ، وخصوصاً على صنف السلطي ، ونتيجة لظهوره في وقت متأخر من الموسم فقد اعتبر غير مهم اقتصادياً .

بالنسبة للأمراض الفطرية فقد اظهرت النتائج تواجد مرض البياض الدقيقي بشكل منتظم وشدة اصابة عالية ويسبب خسائر للمحصول . كما أظهرت النتائج أن شدة الإصابة كانت أعلى في صنف الدراويشي من صنف السلطي . اعتبرت الحشرة آفة اقتصادية رئيسة .

مرض تعفن الثمار ظهر خلال الموسمين الزراعيين خلال مرحلة نضج الثمار سبّب خسارة

للمحصول واعتبر آفة ثانوية .

ثم ربط تأثير درجات الحرارة والرطوبة النسبية على اعداد الحشرات والحلم وعلى شدة الاصابة بالأمراض الفطرية . كان لمعدل درجة الحرارة والرطوبة النسبية المعتدلة تأثير ايجابي على حشرة عثة ثمار العنب ، حيث سجلت اعلى تواجد لها ، بينما كان لدرجات الحرارة العالية والرطوبة النسبية المنخفضة ، وكذلك الحرارة المنخفضة والرطوبة النسبية العالية تأثير سلبياً على اعدادها .

أظهر تربس العنب الأسود وقفاز الأوراق استجابة ايجابية وذلك بزيادة اعدادهما خلال الفترة التي كان فيها معدل درجات الحرارة عالياً يرافقه رطوبة نسبية منخفضة . أما حلم العنب فقد دلت النتائج على انه يفضل درجات حرارة عالية نسبياً مع رطوبة نسبية منخفضة .

أظهرت النتائج ان البياض الدقيقي أظهر زيادة في شدة ونسبة الاصابة خلال الفترات التي كانت فيها معدلات درجات الحرارة معتدلة الى عالية نسبياً ورطوبة منخفضة .

اطوار النمو في نبات العنب تقسم الى اربعة مراحل كالآتي : مرحلة خروج البراعم ونمو الأفرع ، مرحلة تكوين الثمار ، مرحلة النضج ، ومرحلة ما بعد النضج . استغرقت المرحلة الأولى ٣٩ و ٤١ يوماً.المرحلة الثانية ٤٥ و ٤٨ يوماً . المرحلة الثالثة ٣٦ و ٣٤ يوماً والمرحلة الرابعة ١٥٢ و ١٤٧ يوماً ، على صنفي الدراويشي والسلطي على التوالي. وعلى ذلك تكون طول فترة النمو ٢٧٢ و ٢٧٠ يوماً لصنفي الدراويشي والسلطي على التوالي خلال موسم ١٩٨٩.

أظهرت نتائج الدراسة وجود جنسين من الطفيليات التي تتطفل على يرقات عثة ثمار العنب حيث تبين ان الجنس براكونيدي يسبب نسبة تطفل عالية ، بينما كانت نسبة تطفل الجنس اكنيمونيد منخفضة .

خمسة أجناس من المفترسات وجدت في الحقل . هي الحلم المفترس والذي اعتبر من أهم المفترسات بسبب اعداده الكبيرة وطول فترة نشاطه . أما باقي المفترسات هي أسد المنْ ، خنفساء ابو العيد ، فرس النبي ، والعناكب ، حيث وجدت هذه المفترسات باعداد قليلة .

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