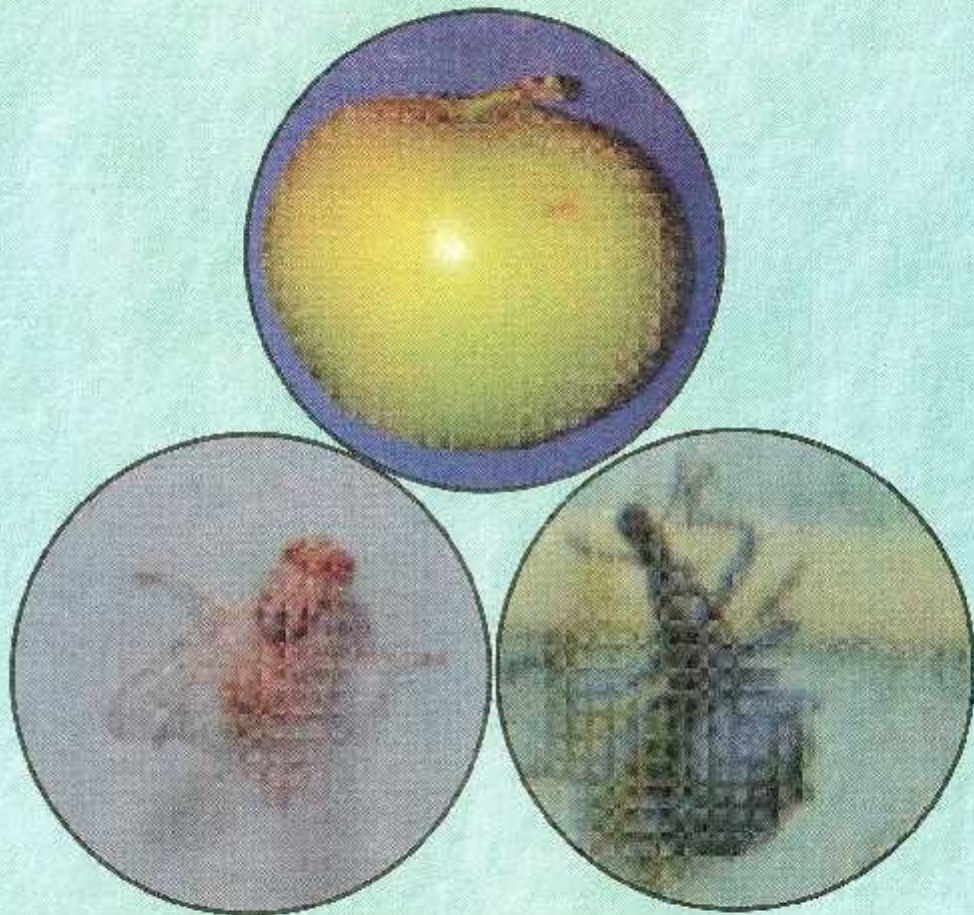


Technical Bulletin No.51

# PESTS OF BER AND THEIR MANAGEMENT



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## **Foreword**

Ber (*Ziziphus mauritiana* Lamk) is an important fruit crop of arid and semi-arid region and its plantation is increasing gradually every year in India. It is grown mostly under water deficit areas of Rajasthan, Gujarat, Punjab, Haryana, Uttar Pradesh, Maharashtra and some parts of Southern India. Ber cultivation on marginal land with poor soil conditions can give very good revenues with less input. However, the major constraints in higher production have been the attack of insect pests and diseases in addition to adverse effect of abiotic stresses. It has been observed that pests like fruit fly and fruit borer are the major pests of ber throughout India and recently fruit/stone weevil was also found to be serious in western part of Rajasthan.

Although ber is considered as an ancient crop of arid and semi-arid regions, detailed work on insect pests and their seasonal dynamics, extent of damage is very few. Presently, most of the available works are related to fruit borers and systematic work on other important pests like leaf feeders and stone weevil is negligible and therefore, systematic work and their compilation is essential for the successful management of these emerging pests under the scenario of climate change. Further, in the absence of scientific and authentic information, it is difficult to formulate any management strategies and therefore, it was felt that a research bulletin on Pests of ber and their management should be brought out. The authors have compiled all the available information as well as research outcome from this institute which includes some of the new emerging pests with self-explanatory illustrations like coloured photographs. I am sure that this bulletin would be very much useful as reference guide to the farmers, researchers, students, extension personnel and all other agencies involved in ber cultivation in the country. I would like to congratulate the authors for bringing out such comprehensive information which would significantly contribute in production of pest free ber fruits in India.

**February, 2014**  
**CIAH, Bikaner**

  
**S.K. Sharma**  
Director

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## 1. Introduction

Ber (*Zizyphus mauritiana* Lamark) popularly called as 'desert apple' is an important fruit crop grown under arid and semi-arid region of India. Most of the cultivated areas are confined to Rajasthan, Haryana, Punjab, Gujarat, Maharashtra and Uttar Pradesh. To some extent its cultivation is also done in the states of Tamil Nadu, Andhra Pradesh, Karnataka, Bihar, Chhattisgarh, Madhya Pradesh, Assam and West Bengal. The crop is gaining popularity among the growers because of its adaptability to adverse climatic condition and good returns under water deficit condition.

In India, ber occupies about 8.7 lakh ha with an annual production of 8.9 lakh tonnes in India (Baloda, 2012). However, the avoidable loss is more due to insect pests and diseases. Adoption of improved varieties and irrigation leads unpredictable change in insect pest dynamics in arid ber eco-system. Pests such as fruit fly, stone weevil, chafer beetles, and bark eating caterpillars, ber butterfly, leaf webber, ash weevil and termite are the important pests of ber in arid region causing significant yield loss. Attack of fruit fly reduces the fruit yield from 13 to 20% (Bagle, 1992) and stone weevil causes damages upto 43% of fruits per plant (Karuoppaiah *et al.*, 2010). Timely detection of pest infestation through periodical monitoring is essential to achieve the expected level of control at field level. However, there is no comprehensive information about these pests especially the pest like stone weevil which is more prevalent to arid region of Rajasthan. Therefore, information on biology, nature of damage, seasonality and management options given in this bulletin will be highly useful for ber growers, extension workers and researchers.

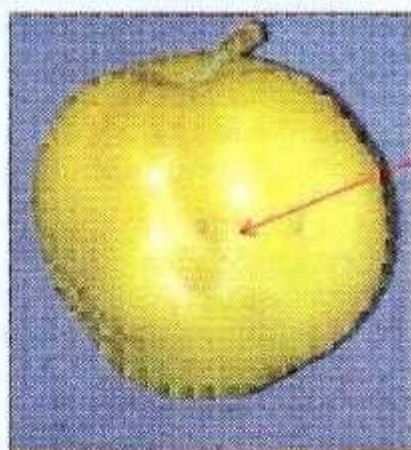
## 2. Fruit fly

Fruit fly, *Carpomyia vesuviana* Costa (Diptera: Tephritidae) is the most destructive pest infests only on *Zizyphus* species. It contributes towards low yield and poor quality of fruits and up to 80% loss under severe infestation (Batra, 1953). Adults are small yellowish brown in colour and little smaller than housefly, having brownish bands on hyaline wings and black spots on the thorax.

### 2.1. Nature of damage

Adult lays their eggs singly on pea size fruits. Upon hatching, the maggots start to feed on the pulp and make galleries with accumulated excreta and finally turn to fruit rot. Infested fruits develop into deformed one and their growth becomes arrested and severe cases a large number of such fruits drop off. Female oviposit in the central distal part fruit also retard the growth of surrounding tissues causing

depression in the fruits, deformity is most apparent in young fruits with oviposition holes.

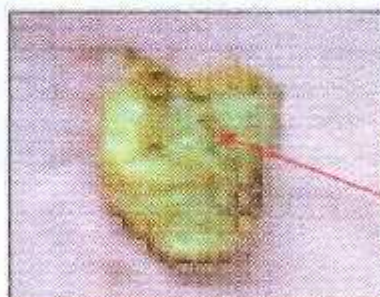


Irregular surface as mark of infestation

Fruit fly infested fruit

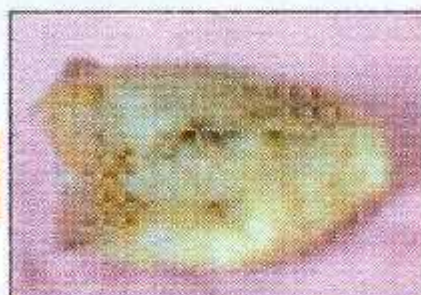


Normal ber fruit



Fruit showing internal damage by maggot

Internal furrows



Rotten fruits with internal furrows

## 2.2. Seasonality

Seasonality of the pest varies from region to region. In Northern India the infestation starts during November to April and incidence was most abundant in December and least in March and there may be a 2 to 3 generation during the active period (Larka and Singh, 1989). In Central India (Gujarat), the fruit fly attack starts around mid October and increased abruptly in mid November and continues till December (Bagle, 1992). In southern states like Andhra Pradesh, Karnataka



and Tamil Nadu the infestation found to be prevalent from fortnight of December to fortnight of February. The damage intensity of fruit fly is depends on the external factors like, rainfall, relative humidity and temperature. The pupa hibernates in soil during April to August shows unusual activity of fly during off season, fruits of *Z. zizyphus* at Punjab (Sohi *et al.*, 1990). Likewise, the physical factors like soil moisture, soil temperature and soil depth also play crucial role in the adult fly emergence from the site of pupation. The optimum temperature for pupal development found as 30° C which leads to high adult emergence (74%) and short pupal duration (15.65 days). Temperature at 10, 16 and 40° C there would be no adult emergence upto 50 days and 3-6 cm pupation depth was ideal for adult emergence (Sangawan and Lakra, 1992). The pest incidence and temperature reveals positive relation whereas it shows negative relation with relative humidity, wind speed and cloud cover (Nandihalli *et al.*, 1996).

### **2.3. Biology**

Mated female starts to lays their eggs after 3-7 days and an average of 22.99 eggs and egg stage lasted after 1-4 days. The larval period is 7-24 days; pre-pupal stage is 3-8 hr (short 5-42 days) long (43-122 days). The pupal duration is lengthy in November, December and April. Adult longevity varies from 2 to 5 days (Lakra and Singh, 1989).

### **2.4. Management strategies**

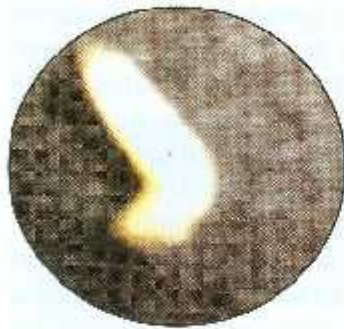
The fruit fly *C. vesuviana* cause internal damage and it is very difficult to mange this pest without insecticides. However, integrated approaches would give better control over single control approach with low cost and environmentally safe.

#### **2.4.1. Growing resistant varieties**

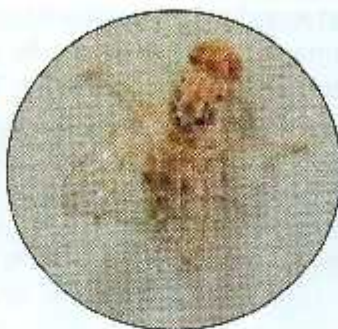
Ber varieties with soft skin and more sweet taste are found to be more susceptible to fruit fly. The infestation of fruit fly is correlated positively with fruit weight, pulp stone ratio, total soluble solids and total sugars and negatively correlated to acidity, vitamin C and total phenol. Cultivar with round fruits and early varieties contributes higher infestation (Singh and Vashishtha, 2002). The varieties such as Meharun, Tikadi, Dodhia, Umran, Mundia, Banarasi and Chhuhara found to be less susceptible to *C. vesuviana*.

#### **2.4.2. Clean cultivation**

Clean cultivation surrounding the orchard through destruction of pruned parts of cultivated as well as the wild bushes. Deep and through raking up of soil/ploughing



Fly maggot



Adult fruit fly



Fly pupa

the orchards during hot summer to expose the residual pupa to hot summer. Collection of all fallen, bird damaged and infested fruits at periodical interval and proper destruction of such fruits or bury them at least on one meter deep in compact soil can avoid the fly's emergence. Harvesting of green colour matured fruits before the colour change into yellow.

#### 2.4.3. Biological control

There is no successful record of parasitoids, predators and pathogens against the *C. vesuviana*. Singh (1989) reported that the braconid, *Bioctres vandenboschi*, *Bracon fletcheri*, *Opius carpomyia* and *Omphalia* sp on ber fruitfly. The wasp parasitoid, *Fopius carpomyia* was found at larval stage of fruit fly and the ovipositor is very suitable to parasitize the hidden host in fruits. The rate of parasitization was 28.8% under natural condition (Karuppalah *et al.*, 2010). The selective application of synthetic chemicals also would help to conserve the existing natural enemies under arid ecosystem.

#### 2.4.4. Chemical control

The proper insecticide schedule is pre-request for the successful management of this pest. Two application of 0.2% dichlorvos at the pea stage of the fruits and 15 days later gave the better control (Ragumoorthy and Arumugam, 1992). The synthetic pyrethroids fenvalerate 0.005% and decamethrin 0.0015 found to be most effective and consistent in action against the fruit fly activity (Bagle, 1992). The schedule comprising of 0.03% dimethoate in late October and early November and second spray after 45 days followed by 0.1% carbaryl, later 0.05% malathion with 1% sugar solution at 10 days interval proved effective against this pest (Lakra *et al.*, 1991). Spray schedule consist of fenthion 0.1% at pea stage, at 30 days later showed

least fruit damage and extract of azadiractin 1% and *Ocimum sanctum* 1% were effective up to 10 days after spraying (Rajaram and Siddeshwaran, 2006).

### 3. Fruit borer

The fruit borer, *Meridarchis scyroides* (Lepidoptera: Carposinidae) is a serious pest in Southern and Western India. The moths lays their eggs on fruits at pea stage and upon hatching the newly emerged caterpillars bore into fruits and feed on the pulp near seed and accumulate fecal (Pareek and Nath, 1996). Adult is small, dark insect brown in colour with fringed wings. Early instar larva is light yellowish and full-grown larva is red in colour.

#### 3.1. Nature of damage

The borer causes yield loss upto 70% under severe infestation (Sonawane, 1965). The first and second instar larva feeds on the fruit superficially but third to fifth instar larvae feeds internally and damages the pulp around the seed. At initial stages of fruit development, the full grown larvae found to feed on soft immature seed.

#### 3.2. Seasonality

The infestation starts during month of November and the peak incidence occurs during end of December and it found be positively correlated with the temperature and negatively correlated with the relative humidity and wind speed (Gopali *et al.*, 2003).

#### 3.3. Biology

Adult female lays an average of 13.29 eggs and incubation period found to be 4-5 days. The larval and pupal stage is 14-18 and 8-9 days, respectively. Total life cycle completes within 26-32 days. Longevity of adults observed to be 3-5 days (Jothi and Tandon, 1993).

#### 3.4. Management

1. Growing of resistant cultivars like Gola Gurgaon, Jhajjar Special, Kadaka, Banarasi Pewandi and Derakhi. Cultivars viz., Dandan, Seb, Elaichi, Jogia and Manuki had infestation levels of <10% (Patil and Patil, 1997).
2. Removal of wild ber trees present around or near to the ber orchard.
3. Soil under the tree or near the trees should be raked to destroy the maggots and residual pupae present in the soil.

4. Collection and destruction of all fallen fruits.
5. Harvest of fruits at early stage when they are still green but fully mature.
6. Spray schedule comprises of malathion at 2 ml or fenvalerate at 0.5 ml or carbaryl at 4 g /lit of water or neem seed kernel extract (NSKE) 5%; first spray at marble stage, second spray at 15 days later and third spray at fruit ripening stage, by alternate use of insecticides would be effective against the fruit borer.
7. Methanol extracts of *Annona reticulata*, *Azadirachta indica* and *Ocimum sanctum* recorded 60-70% mortality after 48h with 1.0% (Dhembare *et al.*, 1998). Application of fenthion at 0.1% showed the lowest mean fruit damage of 36.46 (Rajaram and Siddeswaran, 2008).

#### 4. Ber stone weevil

The stone weevil, *Abeus himalayanus* Voss (Curculionidae: Coleoptera) is recorded as a new pest of ber for the first time from Andhra Pradesh state of India (Gour and Sriramulu, 1994). Later in Karnataka, Maharashtra and recently at Bikaner, Rajasthan (Karuppaiah *et al.*, 2010).

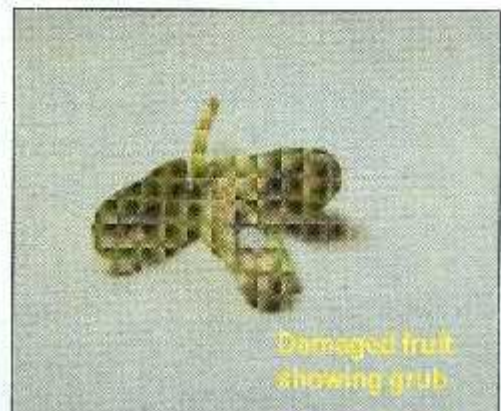
The adult weevils are small dark in colour with snout. The grubs are white in colour with red marking on the body, which are present inside the seeds. The activity of adult beetle could be observed in the field during morning and evening hours and the biology of this pest is not studied so far.

##### 4.1. Nature of damage

The adult female weevil lays their eggs on the stylar end of fruits and newly hatched grubs enter into seed by making puncture in endocarp at immature stage and starts feeding on soft seed coat and later it enters into endosperm moving downward. After entering into the seed, it starts feeding on inner content of the seed, and pupates within the seed by making hollow galleries. The weevil completes its life within a single fruit. The developing seed was completely eaten away by the pest. The infested fruits were round in shape and varied in size ranging from pea to pebble. The infested fruits fails attain complete maturity and never increased in size more than pebble. This is because of the fact that the pest feed only on the seed portion of developing fruit and arrested further development of attacked fruit. The entry hole was healed up and closed while the exit hole was clearly seen. Looking to the nature of damage and its incidence pattern, it can be concludes that the pest enters into the fruits in the early stage of its development and entry hole gets healed up. The egg laid punctures also could observed on matured fruits.

#### 4.2. Seasonality

The adult weevil starts to lay the eggs from glooming stage onwards and severe damage could be observed during October month of fruiting. The incidence could be noticed still end of fruiting from October to February. The pest was initially recorded during the first fortnight of October. The greater infestation occurs during the first fortnight of December. Immature fruit drop was most pronounced during second fortnight of November (Karuppaiah *et al.*, 2010). The damage was noticed during July to August in Karnataka. The maximum damage observed during July and August. Irrespective of varieties, the incidence was recorded during the months of July, August, September, October and November (Balikai, 2009).



#### 4.3. Management

1. Collection and destruction of infested fruits around the trees.

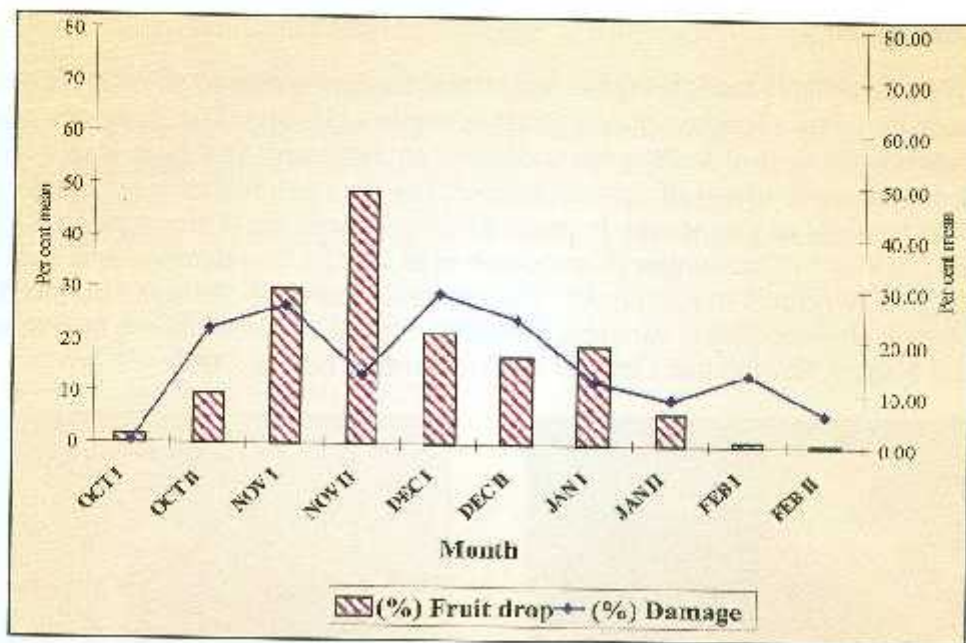


Fig.1. Fruits drop Vs Stone weevil incidence on ber (Gola)

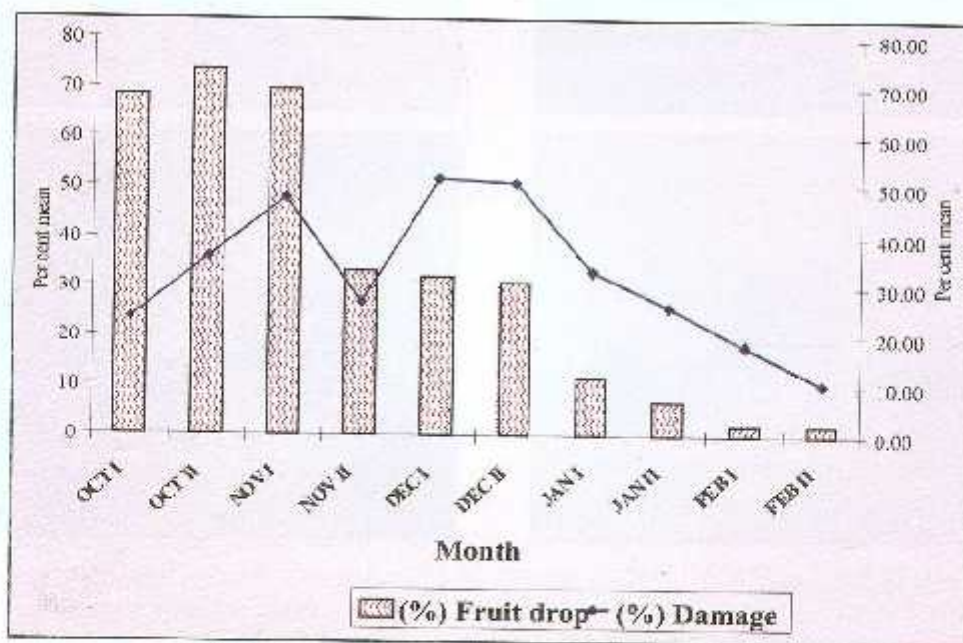
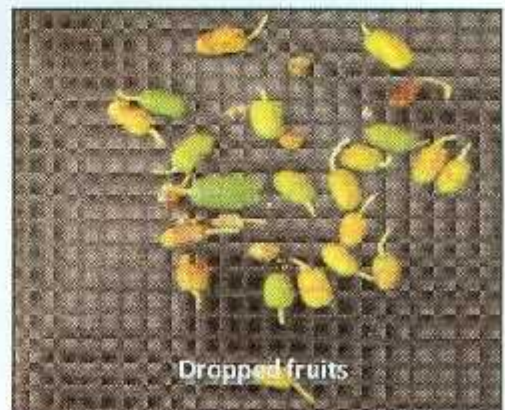
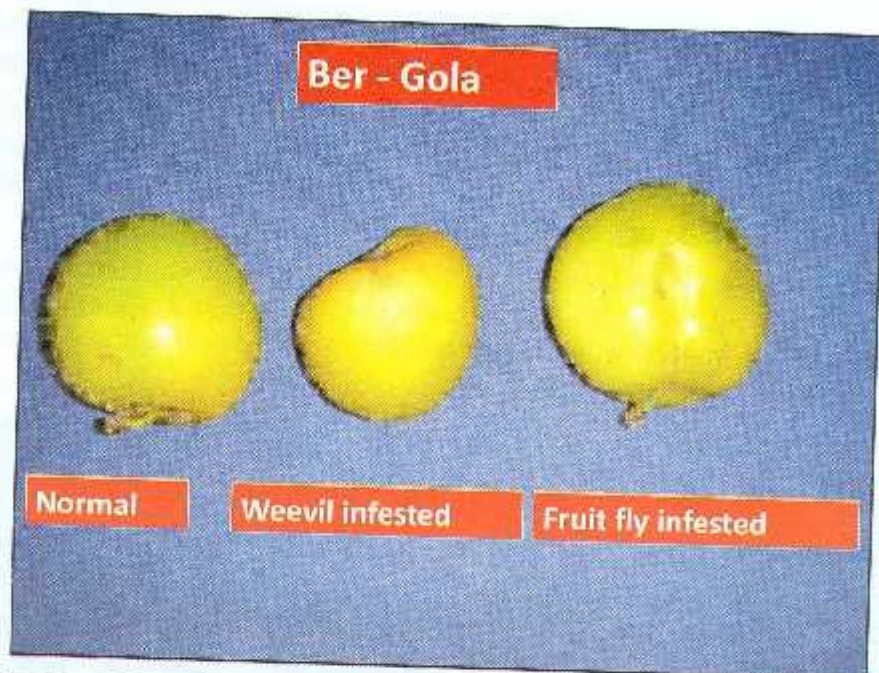


Fig. 2. Fruits drop Vs Stone weevil incidence on ber (Seb)

2. Manual collection and destruction of adult weevil during morning and evening hours especially in the month of September and October will reduce the population.
3. The variety with high pulp stone ratio is attracted more than that of varieties which are having lower pulp stone ratio. The varieties Umran and Seb are attracted more for the egg laying (Karuppaiah *et al.*, 2010).
4. Spray schedule must be started from flowering to fruit set stage only. Spraying of Carbaryl 50 WDP at 0.1% just before the fruit setting and repeat the sprays at three weeks interval was found as effective and it showed least adverse effect on honey bees activity.





Stone weevil infested fruit showing black mark



## 5. Ber butterfly

Blue butterfly, *Tarucus theophrastus* (Lycanidae: Lepidoptera) is an important defoliator pest of ber cause the leaf damage upto 25-40% during the sprouting of new shoots (Karuppaiah *et al.*, 2010). The larvae also damage the flower buds. The butterfly is metallic blue in colour having the wing tail at posterior end of hind wing. The larvae are small flat, green in colour with sparse hairs on their body. Most of time larvae are associated with the ant due their sugary secretion from anus.

### 5.1. Nature of damage

Larva feeds on newly sprouting tender shoots, leaves and flower buds. Infested leaves gives whitish look due to chlorophyll feeding, finally the leaves remain with long streaks. The larvae cause the leaves damage upto 25-40%.

### 5.2. Seasonality

The infestation starts from June and peak incidence occurs during third week of October with a peak population in the first week of August. The population showed positive correlation with maximum and minimum temperatures and negative correlation with relative humidity and rainfall (Kavitha and Savithri, 2001).



### 5.3. Management

Spraying of cypermethrin 0.005%, deltamethrin 0.0014%, fluvalinate 0.0075% and fenvalerate 0.0005% was most effective against 3<sup>rd</sup> to 6<sup>th</sup> instar larvae (Bhatnagar and Lakra, 1992). A spray consists of 0.05% monocrotophos and 0.2% carbaryl (carbaryl 50 WP) showed promising in controlling this pest (Parock and Nath, 1996). Quinalphos (0.05%) and triazophos (0.1%) were effective in reducing larval population and damage to leaves (Sharma and Pal, 2009).

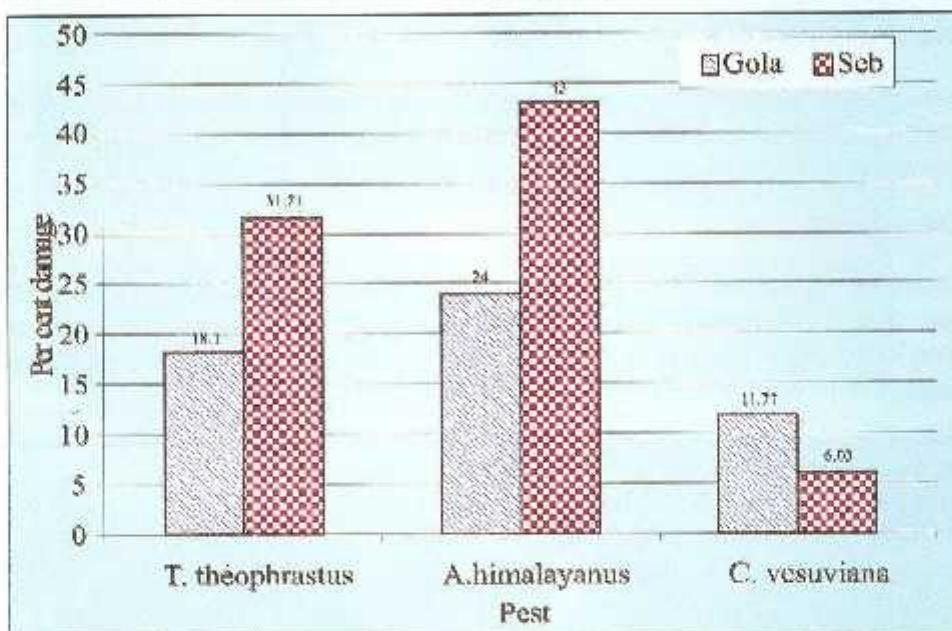


Figure 1. Status of Major pests of ber in the cultivars Gola and Seb

### 6. Ber leaf webber

The ber leaf webber, *Synclera univocolis* Walker (Pyraustidae: Lepidoptera) causes damage to the young growing leaves and upto 10-13% of leaves found to be affected during vegetative phase. The larva is brown in colour with well developed head capsule.

#### 6.1. Nature of Damage

The newly hatched caterpillar attacks unopened and partially opened leaves and leaf folding with silken threads. The larvae consumes green matter by scrapping, leaving behind the papery epidermis. In severe state, the tree gives unhealthy appearance and stunted growth on growing point.

### 6.2. Seasonality

The infestation occurs during the month of August to September on new sprouting leaves.

### 6.3. Management

Spraying of 0.05% dichlorvos or quinalphos during August to September will give good control. Carbaryl found to be moderately effective. The larval parasitization by braconid parasitoid *Apanteles* sp and activity of *Ichneumonids* has been observed on leaf webber larva at Bikaner, Rajasthan. Likewise, the activity of *Chrysoperla carnea* activity also been noticed when the leaf webber damage was prominent (Karuppaiah *et al.*, 2010). Therefore, application of botanicals and chemicals which are safer to these natural enemies would pave the way for natural mortality under field condition.



The incidence of caterpillar, *Indarbela tetraonis* Moore; *Indarbela quadrinotata* (Lepidoptera: cossidae) Walker would be more in the old orchards and trees which are in poor maintenance. Bark eating caterpillar attacks on ber cause heavy losses

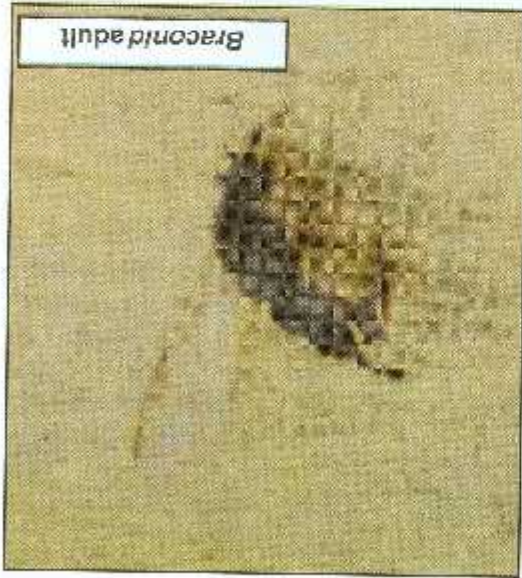
### 7.1. Bark eating caterpillar



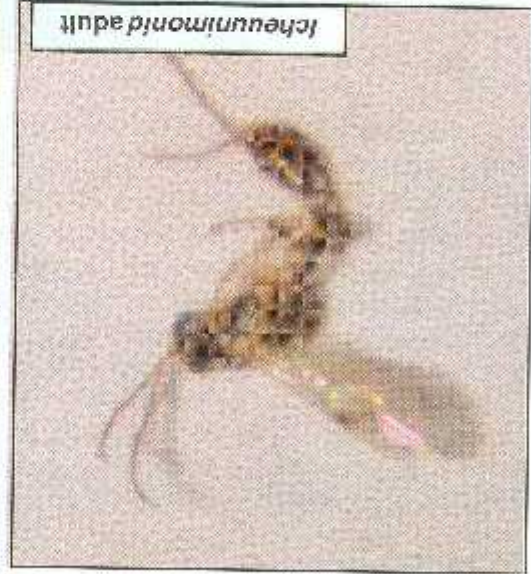
*Chrysoperla*egg



*Chrysoperla*sp



*Braconid* adult



*Ichneumonid* adult

if the damage is severe. The adult moths are pale in colour and with grey colour markings on the forewings. Eggs are brown in colour and oval in shape. The full grown larvae dark brown in colour and 37-50 mm long with dark head and body is covered with long thin hairs (Singh 2008).

### 7.2. Nature of Damage

The presence bark eating caterpillar damages can easily detected by presence of frassy webs at forks or angle.

The moth lays their eggs on bark of the branches, upon hatching they settle at forks or angles of branches and feeds on bark during night, remaining concealed during day time in tunnel made at junction of branches. Feeding on bark hardly affects plants, it is tunnel made by larva for its shelter, which inflicts the actual loss. The junction point is rendered weak due to tunnel. During bearing period when fruits develop, pressure at forks is greatly increased due to weight of fruits, resulting in cleavage of branch at fork or angle and its drying. Thus, a single larva can spoil the produce of entire branch.



Bark eating caterpillar web



Broken tree branch due to caterpillar damage

### 7.3. Biology

The moth starts lays eggs onset of rainy season in batches of 15-25 eggs and a moth lays about 300 eggs and the incubation period lasts 8-10 days. Early instars are brown in colour and matured larvae are dark brown in colour. The caterpillars pupate during the summer for about four weeks and from the pupae adult moths emerge, mate and lay eggs again.

### 7.4. Management

1. Periodical cleaning of orchard and removal of webs around affected portion at the time of pruning.

2. The cultivars such as Rohtak Gola, Laddu Glory, Chuhara and Desi Alwar are found to be tolerant to bark eating caterpillar. However no cultivars found to be resistant (Verma and Singh, 1974).
3. Removal of frassy galleries and destruction of caterpillar using iron spike in hole. Painting of monocrotophos 0.05% on the bark would be effective (Verma and Singh, 1975).
4. Inject the holes with quinalphos at 0.01% or fenvalerate at 0.05% and alternate spray of carbaryl at 2.5 g/litre of water or quinalphos at 2ml/litre of water or methomyl at 3.5 g/litre of found to be effective in controlling the caterpillar damage (Singh, 2008). Cotton swab soaked in petrol or kerosene also can place in the holes and sealed with mud.

## 8. Chafer beetles

Ber is one of the most preferred hosts to the adult chafers. They cause heavy damage to developing foliage of ber during June to August. There are large numbers of species among these *Holotichia consanguinea*, *Anomala* sp and *Adoretus* sp (Coleoptera: Scarabidae) are the major causing considerable defoliation.

### 8.1. Nature of damage

The adult beetles devour the ber leaves mainly during the night. The peak activity occurs during onset of rainy season when the new sprouts are coming. The damaged leaves become like sieves, in severe cases, whole tree rendered leafless. They also found to be damage the nursery, where adults defoliate the leaves and grubs griddle the main roots causing seedlings to die (Singh, 2008).

### 8.2. Biology

Mated females lays on an average 20 eggs starting from third day after mating. They are laid in the soil in the depth of 6-10 cm during the early part of the rainy season (May to August). Eggs are white, elliptic shape and mature eggs are brownish black in colour. The incubation period under laboratory conditions ranges from 7-13 days. Upon hatching the creamy white grubs feeds on organic matter. Total grub duration ranges from 82-113 days. Adults emerge with the onset of rains and only one generation per year.

### 8.3. Management

1. Collection and destruction of adult beetle through manually by jerking the plants.

2. Use light traps at different locations and kill trapped beetle especially during rainy season when the adults are emerge out from the soil and kill them with kerosene.
3. Beetles can be controlled effectively by spraying 0.2% carbaryl 50 WP and 0.05% monocrotophos.
4. Spray of methyl parathion (0.05%) or quinalphos (0.05%) is very effective.
5. Seedling treatment with synthetic chemicals or plant origin insecticides protects them from the attack of chafers (Singh, 2008).

### 9. Ash weevil

The activity of ash weevil, *Myliocerus* sp (Curculionidae: Coleoptera) adults and nymphs are more during July to July to September. Ash colour weevil feeds on young leaves, flowers and buds. The damaged leaves are with the serrated margin especially tender leaves. The nymphs are covered with silken web within the rolled leaves.



### 10. Termite

Termite, *Odontotermes obesus* (Termitidae: Isoptera) causes damage to the seedlings and budded plants. In the ber orchard of Central Institute for Arid Horticulture, Bikaner about 49% of the tree found to be infestation of termite (Karuppaiah *et al.*, 2010 and 2012). The activity is mainly on the bark main trunk.



The damage is more prevalent in aged trees. Cleaning of termite mounts and application of chlorpyrifos around the tree would give better protection.

## 11. Mites

There are three different mite species viz., *Eriophyes cernus* Masee, *Larvacarus transitans* Ewing, *Eutetranychus orientalis* Klein (Acari: Tetranychidae) found to be associated with ber trees in India. The activity of mite species, *Eriophyes cernus* occurs in India throughout the year (Pareek and Nath, 1996).

### 11.1. Nature of Damage

Mites produce galls on twigs, branches in floral buds. The malformation occurs during periods of new growth, i.e., a month after pruning, continuing for 3-4 months. On average, there were 10-15 galls/plant 30-35% infestation and about 90% incidence with 1-2 galls/plant in a newly established plot, based on in situ budding (Ravikumar *et al.*, 1999). The incidence of mite, *L. transitans* also recorded on ber with the peak activity during June.

### 11.2. Management

The galls can be removed manually at regular interval. It can be managed by growing of pest tolerant varieties. Cultivar Seb found to be most susceptible least on the leaves of cultivar Kaithali (Pareek and Nath, 1996). Among the ber cultivars evaluated against, *E. orientalis*, 'Chomu' local was the least susceptible, while 'Gola' was the most susceptible, whereas 'Jogia', 'Umran', 'Muncia' and 'Seb' were moderately susceptible. Treatment with 0.04 % dicofol will give best control. Monocrotophos 0.03% was the most effective in reducing this mite followed by phosphamidon at 0.03% and ethion at 0.03% (Yadav *et al.*, 2003; Singh, 2008).

## 12. Other insect pests

Hairy caterpillar,	<i>Euproctis fraterna</i>
Hairy caterpillar,	<i>Thiacidas postica</i>
Green striped leaf hopper,	<i>Eurybrachys tomentosa</i>
Jassid,	<i>Amrasca biguttula biguttula</i>
Spittle bug,	<i>Machaerota planitiae</i>
Cow bug,	<i>Tricentrus bicolor</i>
Thrips,	<i>Scirtothrips dorsalis</i>
Leag gall,	<i>Phyllodiplosis jujubae</i>
Weevil,	<i>Xanthachelus superciliosus</i>

The management practices employed against major pests also effective against these pest.



Table 1. Major pests of ber in hot-arid ecosystem of Bikaner, Rajasthan

Sl. No.	Name of the Pests	Scientific name	Family	Order
1	Ber butter fly	<i>Tarucus theophrastus</i> Fab.	Lycaenidae	Lepidoptera
2	Leaf webber	<i>Synclera univocolis</i> Walker	Pyraustidae	Lepidoptera
3	Stone weevil	<i>Aubeus himalayanus</i> Voss	Curculionidae	Coleoptera
4	Fruit fly	<i>Carpomyia vesuviana</i> Costa	Tephritidae	Diptera
5	Bark eating caterpillars	<i>Indarbeia</i> sp	Cossidae	Lepidoptera
6	Grey weevil	<i>Myllocerus</i> sp	Curculionidae	Coleoptera
7	Termite	<i>Odontotermes</i> sp	Termitidae	Isoptera

Karuppaiah *et al.* (2010)

Table 2. Nature of damage of major pests of ber of Bikaner, Rajasthan

Sl. No.	Pest	Symptoms and intensity of damage
1	Ber butter fly <i>Tarucus theophrastus</i>	Larvae feed on sprouting tender shoots, leaves and flower buds. Infested leaves gives whitish look due to chlorophyll feeding finally the leaves remain with long streaks.
2	Leaf webber <i>Synclera univocolis</i>	The newly hatched caterpillar attacks unopened and partially opened leaves and leaf folding with silken threads. The larvae consumes green matter by scraping, leaving behind the papery epidermis. In severe state, the tree gives unhealthy appearance and stunted growth on growing point.
3	Stone weevil <i>Aubeus himalayanus</i>	Black colour egg laid marking in the styler end of fruits. Misshaping, fruit dropping immature ripening, shrinking due to endosperm damage and drying of fruits also the mark of infestation.
4	Fruit fly <i>Carpomyia vesuviana</i>	Maggot starts feed on pup and the infested fruits packed with excreta of maggot. Severe condition, fruits drop off.
5	Bark eating caterpillars <i>Indarbeia</i> sp	Presence of webs at angles weakening and cleavage of branches at fruit development stages.
6	Grey weevil	Damaged leaves with serrated margin and webbed leaves
7	Termite	Main trunk with termite mounts

Karuppaiah *et al.* (2010)

**Table 3. Seasonality of major pests and their damage intensity**

Name of the Pests	Feeds on	Intensity of damage (%)	Season
Ber butter fly <i>Tarucus theophrastus</i> Fab.	Leaves	25 - 40	June- Sep
Leaf webber <i>Synchlora univocalis</i> Walker	Leaves	10 - 13	Aug - Sep
Stone weevil <i>Aubeus himalayanus</i> Voss	Stone	24 - 43	Oct - Feb
Fruit fly <i>Carpomyia vesuviana</i> Costa	Pulp	5.48 - 6.73	Nov - Feb
Bark eating caterpillars <i>Indarbella</i> sp	Branches axis	50 - 75	Aug - Feb
Grey weevil <i>Mylocerus</i> sp	Leaves	5 -13	Sep - Dec
Termite <i>Odentotermes</i> sp	Main trunk	49	Feb - April

Karuppaiah et al. (2010)

**Table 4. Status of natural enemies in ber in hot arid eco-system**

Sl. No.	Name of beneficial insect	Nature of parasitoid	Host	Season
I	Parasitoids (Hymenoptera)			
	<i>Fopius</i> sp. (Braconidae)	Egg pupal	Ber fruit fly	Nov-Feb
	<i>Apanteles</i> sp. (Braconidae)	Larval	Ber leaf webber/roller	Aug-Nov
	Ichneumonids	Larval	Leaf webber/roller	Aug-Nov
			?	
II	Predators (Neuropterans) <i>Chrysoperla</i> sp	Prey of soft bodied insects	?	Aug-Dec
III	Non-insect predators (Spiders)	Prey of soft bodied insects	All soft bodied insects	June- Mar

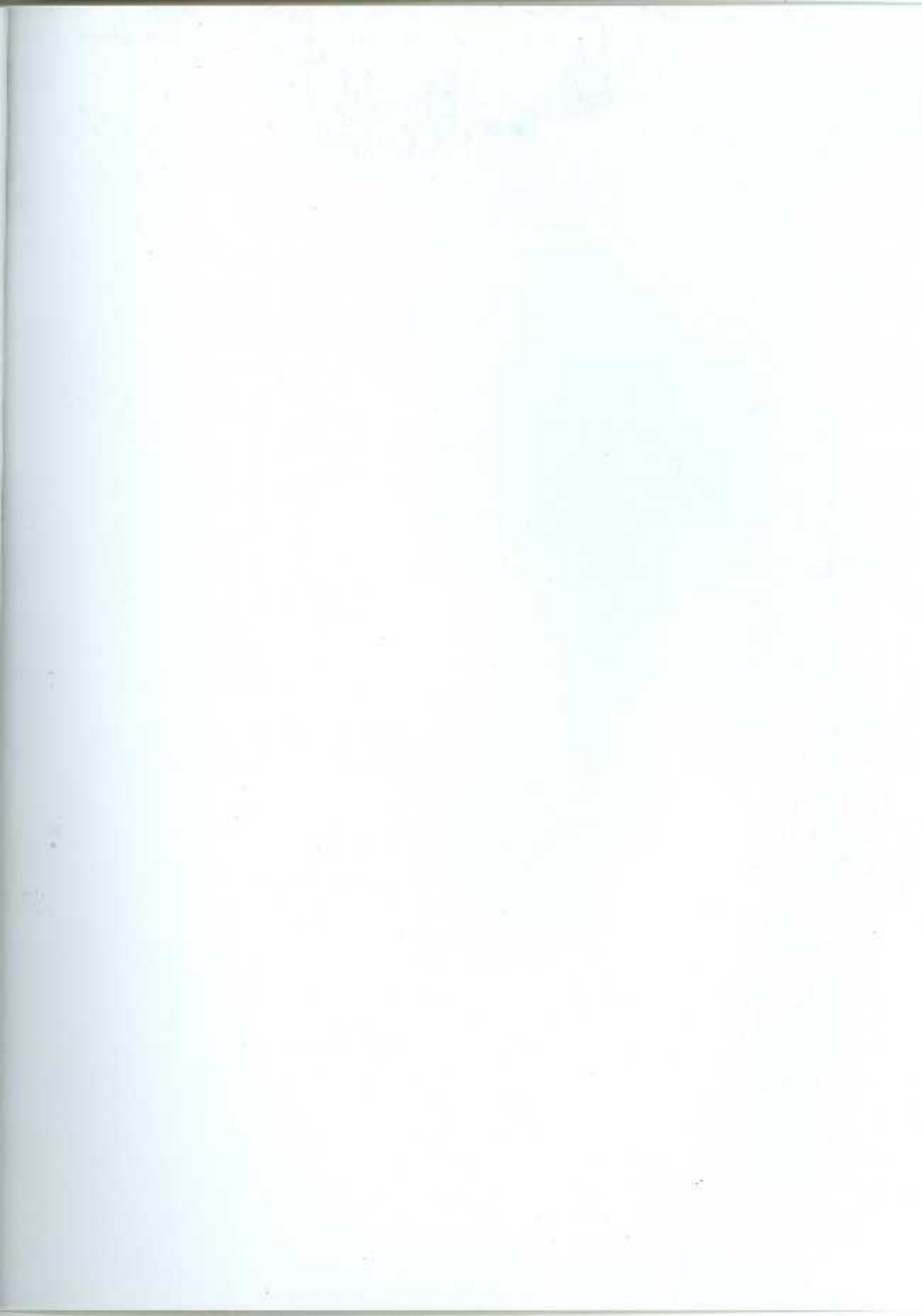
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