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# Status of insect pests of faba bean in the Mediterranean region and methods of control

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**SUMMARY** - In the Mediterranean region the faba bean crop is liable to attack by several insect pests in the field and during storage. Some of them cause extensive damage and require the development of control methods. The most important field insects are the black aphids, *Aphis fabae* and *Aphis craccivora*. Besides studies on chemical control, a laboratory screening of faba bean lines is conducted in Egypt as a part of a network and lines showing some degree of resistance have been identified. *Sitona* spp. weevil is a serious problem especially in North Africa and different methods of chemical control have been studied. High infestations of stem borers (*Lixus algirus*) were found in the European parts of the Mediterranean region and to some extent in North Africa. The most important storage pests are different species of *Bruchus* and *Callosobruchus*. Studies on host plant resistance to *Bruchus dentipes* revealed that some resistance found was only related to late flowering. For *Callosobruchus* spp. some variation in susceptibility between faba lines was observed but no acceptable degrees of resistance were found. Therefore cleanliness in storage, fumigation of seeds and in case of *Bruchus* spp. insecticide applications in the field are the most effective control methods.

**RESUME** - "Situation actuelle et méthodes de contrôle des insectes ravageurs de la fève dans la région méditerranéenne". Dans la région méditerranéenne, la fève est susceptible à l'attaque de plusieurs insectes parasites, dans les champs et pendant le stockage. Certains d'entre eux causent des ravages et le développement des méthodes de contrôle est donc requis. Parmi les insectes des champs, les plus importants sont les pucerons noirs, *Aphis fabae* et *Aphis craccivora*. Outre les études sur le contrôle chimique, des essais de laboratoire sur des lignées de fèves sont réalisés en Egypte dans le cadre d'un réseau de recherche, quelques lignées montrant un certain degré de résistance ayant été identifiées. Les charançons *Sitona* spp. représentent un problème sérieux, en particulier dans l'Afrique du Nord, contre lequel différentes méthodes de contrôle chimique ont été testées. Quelques zones de la rive Nord de la Méditerranée et même de l'Afrique du Nord ont souffert de grandes infestations d'insectes mineurs des tiges (*Lixus algirus*). Les fléaux les plus importants du stockage, sont différentes espèces de *Bruchus* et *Callosobruchus*. Des études sur la résistance de la plante hôte à *Bruchus dentipes* ont montré que les résistances trouvées étaient liées uniquement à une floraison tardive. En ce qui concerne *Callosobruchus* spp., on a observé un certain degré de variation de la susceptibilité entre lignées de fèves, mais non pas un niveau acceptable de résistance. Par conséquent, la propreté pendant le stockage, la fumigation des semences et dans le cas des *Bruchus* spp. l'application d'insecticides dans les champs sont les méthodes de contrôle les plus efficaces.

## Introduction

In the Mediterranean region faba bean (*Vicia faba* L.) is attacked by a number of insect pests which often cause extensive damage. Many of the major insect pests occur in all the growing areas of the region, the severity of damage caused and economic importance might vary, however. In this paper the main field and storage insect pests of faba bean and different approaches to control them are discussed.

## Field pests

The main field insect pests of faba bean occurring in the Mediterranean area causing economic damage are aphids, *Sitona* weevil and stemborer. Others like leafminer and cutworms are only minor pests, as heavier attacks of these are restricted to some regions and years.

## Aphids

### *Damage and life cycle*

The main aphid pests of faba bean are 2 green and 2 black species, of which the green species *Acyrtosiphon pisum* (Harris) and *Myzus persicae* Sulz. are only occasional pests. The most important are the black bean aphid, *Aphis fabae* Scop. and the cowpea aphid, *Aphis craccivora* Koch due to their high frequency and stronger deleterious effects on the plants.

Aphids cause plant damage by direct feeding and transmission of virus diseases. By piercing directly into the phloem, aphids are able to draw large quantities of soluble plant nutrients. Since these nutrients are needed for plant growth, aphid infestation slows the rate of stem elongation and leaf production and decreases flower production. Aphid feeding may also cause substantial water loss with subsequent wilting and collapse of the plant. Furthermore, the puncturing of tissues by stylets and the covering of the plant with honeydew reduce the photosynthetic activity and subsequent tissue formation. The extent of damage caused depends upon the time, size and duration of aphid infestation in relation to the stage of plant growth. Because of parthenogenesis and viviparity, aphids have a very high multiplication rate. Their infestations therefore often result in complete crop loss.

*A. fabae* causes severe crop losses mainly by direct feeding, and is less important in virus transmission, whereas *A. craccivora* causes damage by direct feeding as well as by transmission of such virus diseases as broad bean yellow mosaic and bean leafroll.

The two species show somewhat different climatic preferences. *A. fabae* dominates in cooler regions and is essentially a pest in temperate and Mediterranean countries, whereas in hot and dry climates *A. craccivora* becomes more dominant (Klingauf, 1981). In some areas, like the warmer regions of Europe and Asia both species occur together.

In a survey conducted in Syria 1981/82 the highest aphid infestations of mainly *A. fabae* were found in the coastal areas where all surveyed fields were infested and 59% of them had infestations of more than 40% (Steinmann-Oelk 1985). In Homs/Hama area infestations were high (mean of 45%) whereas in the south and east infestations were low. In Egypt *A. craccivora* is the dominant species, occurring in 37% of fields surveyed compared to only 3% infested by *A. fabae*. (Table 1) (Diekmann, 1982). In North Africa aphids also are a major pest of faba bean. In Tunisia high *A. fabae* infestations occurred in the north and *A. craccivora* was only found in the southern oasis, whereas in Morocco both species occurred in all regions with *A. craccivora* being dominant infesting 71% of the fields surveyed (Diekmann, 1982).

**Table 1. Aphid infestation of faba bean in the Mediterranean basin in 1981.**

Country	Percent fields infested with	
	<i>Aphis fabae</i>	<i>Aphis craccivora</i>
Syria	20	1
Egypt	3	28
Tunisia	69	9
Morocco	40	71

Source: Steinmann-Oelk (1985), Diekmann (1982)

### *Control methods*

#### – Host plant resistance

Although effective insecticides for aphid control are available, varietal resistance is desirable to stabilize yields where chemicals cannot be applied because of increased production costs as well as their adverse effects on beneficial insects. Host plant resistance in faba bean to aphids has been studied for many years by several researchers but so far higher levels of resistance have only been detected in some faba bean land races (Holt and Birch, 1984; Bond and Lowe, 1985; Birch, 1985). At ICARDA the aphid screening work is carried out in the Aphid Screening Laboratory at the Giza Research Station, Egypt, which has been developed in cooperation with the Agricultural Research Center of Egypt as a part of the Nile Valley Research Program. This laboratory is being used as a center for screening faba lines from Egypt, Sudan, Ethiopia and ICARDA on a continuing basis. In the screening, 7 seedlings of each line are infested with 5 adult aphids and the mean number of aphids per seedling 15 days after infestation is used as an indication for the degree of resistance or susceptibility. Seedlings having less than a mean of 20 aphid individuals are considered to have some degree of resistance, since 1 *A. craccivora* female produces a mean of 48 nymphs on a susceptible cultivar during this period. Promising faba bean lines are retested in the laboratory and then based on their origin are sent back to the respective national programs for field testing. The field testing is very important to enable establishment of correlation between resistance found in the laboratory and the field as conditions in these two situations are very different. Using the reconfirmed, field tested, promising lines a Regional Aphid Screening Nursery is being established for testing in the three countries.

Up to date 5364 genotypes have been tested in the laboratory, and only 64 were found to have low aphid infestation. Some of these lines together with 3 standard commercial cultivars were tested in the field in Egypt with and without insecticide protection for aphid infestation and yield parameters. In both seasons the 2 commercial varieties 'Giza 402' and 'Rebaya 40' had the highest number of aphids, whereas on the breeding lines (30/18/82 and (03/975/80) aphid populations were lowest in the first year and on the first (30/18/82) consistently so in the two years (Fig. 1) indicating that this line might have some traits of tolerance/resistance. The yield data were consistent with the number of aphids, as the seed yield in these 2 lines was reduced by only 4-8% when left chemically unprotected as compared to the protected plots. These lines need to be studied further for reconfirmation and to find out whether it is only due to non-preference or indeed because of chemical properties of the plant that these show resistance to aphids.

#### – Chemical control

In some years high aphid infestations make insecticide treatments necessary and reliable and practical recommendations for the proper timing are needed. Therefore critical damage and/or infestation levels for aphid control critical damage and/or infestation levels for aphid control were determined. The timing of one spray was based upon the visual damage score (VDS) on the scale of 1-4, where 1 refers to no damage, and on the percent aphid infestation. The highest yield was achieved with full protection, followed by spraying once at a VDS of 2 or when 5% of the stems were infested (Fig. 2). The yield losses of these treatments compared to full protection were 17.9% and 18.4%, respectively. These results illustrate that either the VDS or infestation levels might be used for timing the insecticide application and with the proper timing one application is sufficient for aphid control.

## Sitona weevil

### *Damage and life cycle*

*Sitona lineatus* L. is a widely distributed pest of faba bean in the whole Mediterranean region, whereas *Sitona limosus* Rossi only occurs in some areas. In this region with hot and dry summers the beetles aestivate and emergence starts with the appearance of the faba bean crop in October to December. The adults feed on the foliage in a characteristic manner, eating out the leaf edges in U-shaped notches. Depending upon prevailing temperatures the females start laying eggs on the plants or soil surface. About 1000 eggs are laid by each female before

laying ceases. The hatching larvae move into the soil and infest the root nodules reducing the nitrogen fixation ability of the plants. In case of severe attack foliage can assume the yellow appearance characteristic of nitrogen deficiency. The infestation causes yield losses not only in faba bean, but also in the following nonleguminous crop because of reduced nitrogen status of the soil. After pupation in the soil adults of the new generation emerge and feed on foliage but do not lay eggs before they aestivate in the soil.

Most of the damage is caused by the larvae; the adult feeding usually does not affect yields, except when growing conditions are extremely unfavourable for the small faba bean plants and they cannot quickly compensate the damage by regrowth of new foliage.

In Syria the highest mean infestation rate (59%) of *Sitona* spp. was found in the coastal area where no field was free of infestation and infestations of more than 40% were found in 77% of the fields (Steinmann-Oelk, 1985). Infestations were also high in Homs/Hama area (58%) and Southern Syria (43%), compared to a mean infestation rate of 27% in Aleppo/Idleb area and no *Sitona* spp. infestation was found in the east (Steinmann-Oelk, 1985). In Egypt only 10% of the fields surveyed showed *Sitona* damage, whereas in both Tunisia and Morocco it was found to be the dominant pest occurring in 86% and 94% of the fields, respectively, with almost 90% of the plants infested (Table 2) (Diekmann, 1982). In Portugal studies revealed infestation rates of almost 70% (Ilharco *et al.*, 1980).

### *Control methods*

The survey data clearly show, that in most countries of the Mediterranean basin *Sitona* infestations of faba bean are high and require the use of control measures, mainly chemical control. In order to be effective insecticidal treatments have to be properly timed based on the level of insect infestation and damage. In case of *Sitona* spp. however, it has not yet been possible to determine clear thresholds for control as it is very difficult to relate the intensity of adult attacks to subsequent losses caused by larval feeding. Apparently the mortality of eggs and larvae is very high but also very variable and cannot be readily determined. Two methods of using insecticides are possible: application of granular systemic insecticides at planting which will control both *Sitona* adults and larvae or application of foliar insecticide sprays to control the feeding and ovipositing adult weevils. Studies at ICARDA showed that treatment with the granular insecticide carbofuran (Furadan) at planting is more effective for *Sitona* control than the application of several sprays (Table 3). In experiments comparing selective control of *Sitona* spp. with carbofuran with selective aphid control even at a relatively high level of nodule damage (40%), *Sitona* control increased yield only by 28%. In the same situation aphid control increased yields by 60%, indicat-

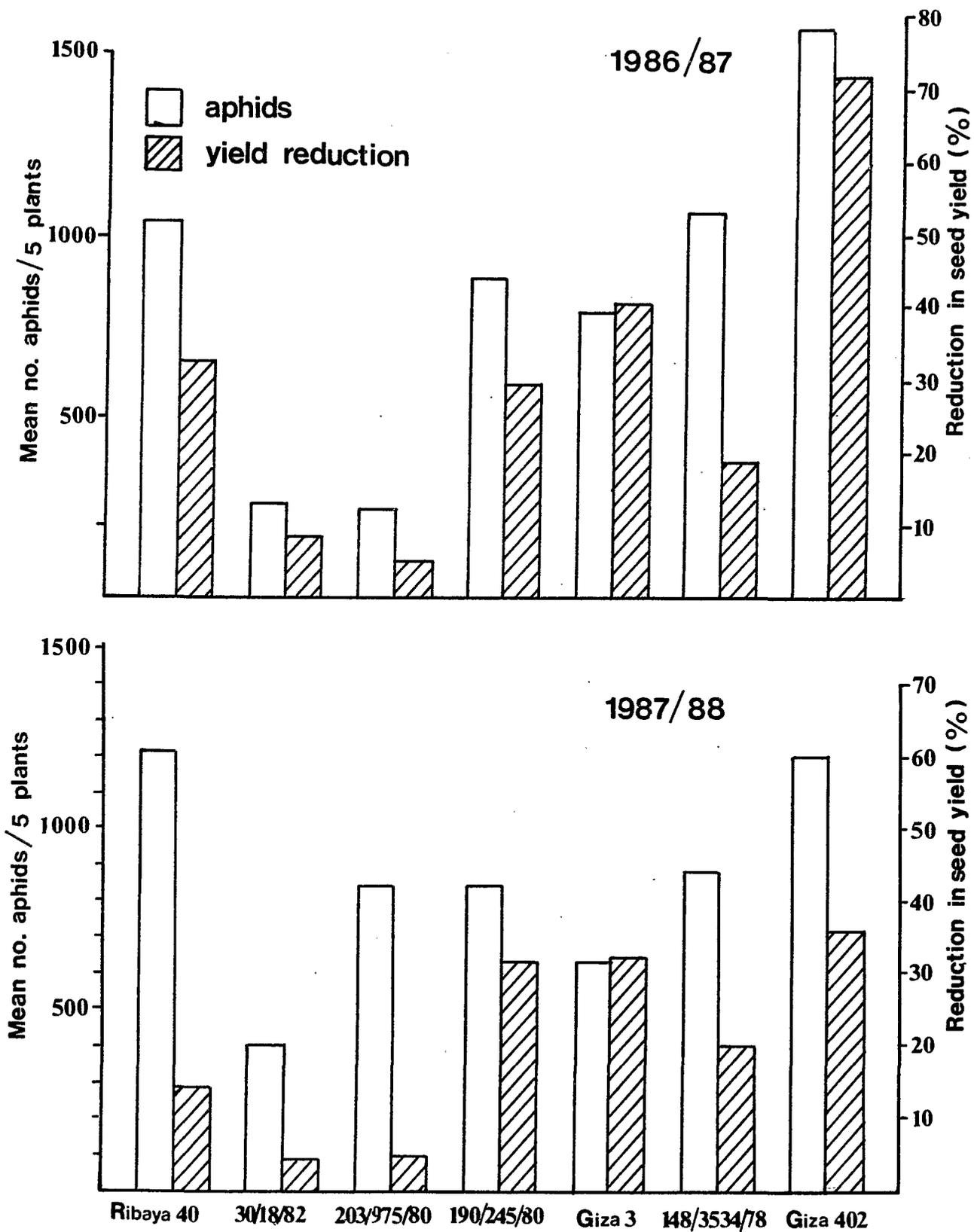


Fig. 1. Mean number of aphids/5 plants and percent reduction in seed yield on some selected faba bean cultivars in Egypt, 1986/87 and 1987/88.

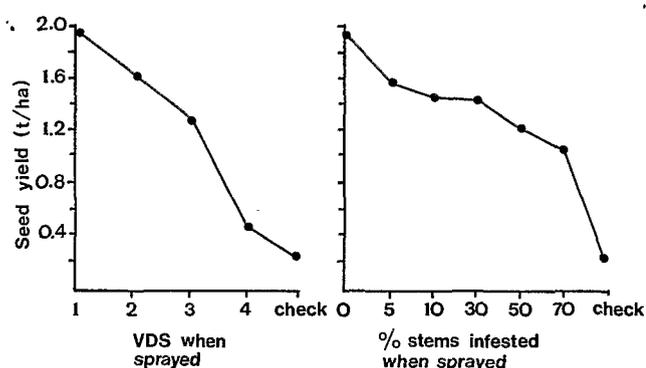


Fig. 2. Effect of scheduling insecticidal spray based on visual damage score (VDS, 1 = no damage, 4 = heavy damage) or percentage stem infection by aphids on seed yield of faba bean, Syria 1985/86.

Table 2. *Sitona* spp. infestations of faba bean in the Mediterranean basin in 1981.

Country	% fields infested	% infested plants/field
Syria	47	—
Egypt	10	9
Tunisia	86	88
Morocco	94	88

Source: Steinmann-Oelk (1985), Diekmann (1982)

ing that in this region aphids are more important (Table 4).

In Morocco, where *Sitona lineatus* is the dominant pest of faba bean, the application of different dosages of carbofuran did not result in effective control even at the highest dosage (Fig. 3). It is suspected that carbofuran applied at planting does not last for a sufficiently long period, and thus has to be complemented by additional insecticidal treatments later in the season. This aspect is under investigation at present.

## Stemborer

### Damage and life cycle

*Lixus algirus* L. is a serious pest in some areas of the Mediterranean. In Spain the adult beetles emerge in January/February and start feeding on the foliage. Eggs are laid from mid-March to mid-May in the faba bean stems.

Table 3. Effect of insecticidal combinations for *Sitona* spp. control on faba bean yields, Tel Hadya, Syria 1983/1984.

Adult control <sup>a</sup>	Larvae control <sup>b</sup>	Seed yield	
		Kg/ha	% increase
Yes	Carbofuran	2374	21.8
	No	2271	16.5
No	Carbofuran	2324	19.2
	No	1949	—
C.V.			25.5

<sup>a</sup>4 sprays of methidathion, 0.5 kg a.i./ha

<sup>b</sup>Carbofuran, 1.0 kg a.i./ha

Table 4. Effect of selective control of *Sitona* spp. and aphids on damage levels and yields of faba bean (syrian local medium), Tel Hadya, 1983/84.

Control of		% nodule damage	Aphid VDS	Seed yield	
<i>Sitona</i> spp. <sup>a</sup>	Aphids <sup>b</sup>			Kg/ha	% increase
Yes	Yes	2.2	1.0	2552	82.8
No	Yes	32.9	1.0	2234	60.0
Yes	No	0.3	3.8	1786	27.9
No	No	40.3	4.0	1396	—
S.E.		4.0	0.3	224.1	
C.V. (%)		55.5	31.7	22.5	

<sup>a</sup>Carbofuran, 1.0 kg a.i./ha at planting

<sup>b</sup>One spray of primicarb, 0.15 kg a.i./ha

The larvae feed inside the stems causing bending of the plants. After pupation the adult beetles enter diapause. Throughout its area of distribution it has only one generation a year (Isart, 1968).

In Syria higher infestations of 22% were only found on the coast, whereas in all other regions damage was negligible (Steinmann-Oelk, 1985), as is the case in Egypt. North Africa and Mediterranean Europe are the main geographical areas where stem borer is of common occurrence (Isart, 1968). In Morocco a mean infestation rate of 75% (Diekmann, 1982) and in Tunisia of 58.4% (Coers *et al.*, 1983) were found.

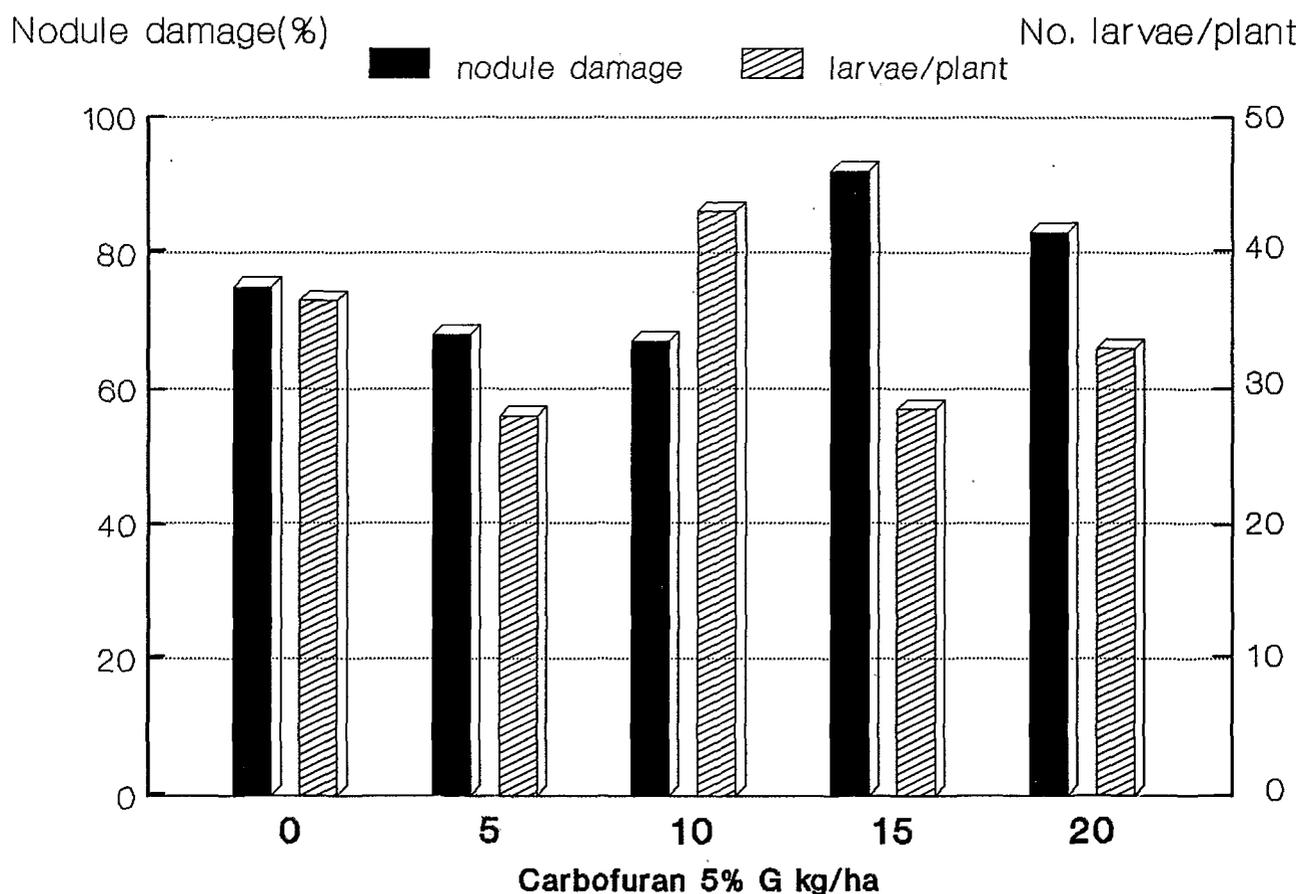


Fig. 3. Effect of 4 treatment levels of carbofuran on *Sitona* spp. infestation and damage in faba bean, Morocco, 1988.

### Control methods

In case of high infestations insecticide applications might be necessary. In Tunisia experiments were conducted to find the most effective way of chemical control using seed treatment with carbofuran, application of carbofuran at planting and foliar sprays of different insecticides. However, none of these treatments significantly reduced the stemborer infestations (Coers *et al.*, 1983). It was concluded that applications have to be directed to the adults while feeding and ovipositing since the larvae are well protected inside the stems and practically impossible to control.

### Storage insect pests

Considerable yield losses of faba bean occur during storage due to attack of seed beetles of the family Bruchidae. The bruchid larvae feed and develop inside

the seeds and thereby cause weight losses. The bruchids can be divided into 2 groups: the univoltine species which have one generation per year and do not reproduce in dry seed and the multivoltine species which have several generations per year and reproduce in dry seeds. The main storage pests of faba bean are *Bruchus* spp. and *Callosobruchus* spp.

### *Bruchus* spp.

*Bruchus dentipes* Baudi (toothed-leg faba bean seed beetle) and *Bruchus rufimanus* (Boheman) (large broad bean beetle) are the major *Bruchus* species attacking faba bean in the Mediterranean region.

### Damage and life cycle

*Bruchus* spp. adults emerge from hibernation in spring and after feeding on pollen and nectar lay eggs on the immature faba bean pods. The larvae bore a small round hole through the pod coat and enter the first avail-

able developing seed. Most of the larval development and pupation occurs in the hard seeds after harvest in the store. The mature larvae bite a hole from inside almost to the seed surface leaving only a transparent epidermal seed membrane, which are called 'windows'. The adults remain in the seeds and only emerge through the 'windows' after sowing. If the seeds are not sown, but stored for another season the adults will die (Bishara *et al.*, 1967; Tahhan, 1986).

### Control methods

Since the infestation of *Bruchus* spp. starts in the field control methods should aim at reducing the population in the field before the larvae penetrate the seed.

Several cultural measures can be used to reduce *Bruchus* spp. infestations:

- Deep ploughing after harvest.
- Use of uninfected or treated seeds for sowing which has to be followed by all farmers to avoid immigration of the flying beetles from infested to uninfested fields.
- Storage of seeds for 2 successive seasons, so that all adults are dead at the time of sowing.
- Late sowing also reduced *Bruchus* spp. infestations. Because of the shorter growing period however, yields are also reduced (Fam, 1983).

With regard to chemical control insecticides such as endosulfan can be applied in the field at early pod setting or harvested seeds can be fumigated with phosphine or methyl bromide. The annual routine fumigation conducted in Egypt decreased the infestation from more than 12% to less than 1% within 5 years (Kamel, 1982).

Screening of large numbers of germplasm for host plant resistance to *B. dentipes* only revealed reduced infestation in the genotypes that are late in flowering and pod setting (Tahhan, 1986).

### *Callosobruchus* spp.

*Callosobruchus maculatus* (F.) (cowpea seed beetle) and *Callosobruchus chinensis* (L.) (Adzuki bean beetle) are the most common *Callosobruchus* species attacking faba bean seeds in the store.

### Damage and life cycle

The females lay eggs on the seed coat and the larvae feed inside the seeds. Damaged seeds have eggs attached to the seed coat and 'windows' and adult emergence holes. In contrast to *Bruchus* spp. *Callosobruchus* spp. is multivoltine and reproduces in storage producing several generations per year. Therefore even small initial

populations can build up to high numbers causing considerable damage as the infestation can spread throughout the store.

### Control methods

Cleanliness in post harvest handling and storage is the most important factor for control. Clean threshers, sacks, containers, should be used and stores be kept clean and free of residues to prevent infestations. High humidity and temperatures enhance *Callosobruchus* spp. populations, thus seeds and stores should be kept dry, well ventilated and protected from sun.

Fumigations with methyl bromide or phosphine or treatment with insecticides are the most common methods for control of *Callosobruchus* spp. Seeds stored for sowing can be treated with pirimiphos methyl 2% at 1 g/kg seeds and k-othrin 2% at 0.5 g/kg seeds.

Several characters of the faba bean seeds like seed coat thickness might have negative effects on *Callosobruchus* spp., as the initial penetration of newly hatched larvae and the emergence of adults were found to be the limiting factors in population development of *C. chinensis* (Podoler and Applebaum, 1968). In Egypt the screening of different faba bean lines revealed some variation in their susceptibility to infestation by *C. chinensis* (Fam, 1983), however so far no faba bean genotype with an acceptable degree of resistance has been found.

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