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The Impact of Winter-Sown Chickpeas on Insect Pests and their Management

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Recent research has shown that in and around Syria, winter-sown chickpea substantially outyields the spring-sown crops. It is expected that there will be a substantial adoption of this practice in farmers' fields in the near future.

Any substantial change in the sowing date of a crop that is already well established in a traditional cropping system can bring about some changes in pest incidence, not only on that crop but also on other crops in the system. Although it is probable that winter-sown chickpea will suffer no greater pest attack than the spring-sown, it is possible that the introduction of a winter-sown crop might provide an earlier buildup of pests that will then disperse to subsequent spring-sown crops including chickpea. Alternatively, a relatively unimportant insect might become important either on the winter or succeeding crop, and so cause problems for the farmers.

This possibility should be neither overestimated nor ignored. From our present knowledge it would appear likely that the yield benefits that will be gained from winter-sown chickpeas will greatly outweigh any consequent changes in pest problems. However, our knowledge of pests and their management, even on spring-sown chickpea, is inadequate and there is an urgent need to investigate in depth the present and potential pest problems, both on winter- and spring-sown crops. This paper is intended to briefly summarize the current state of our knowledge and speculation in this area and to suggest the needs for future research, with particular regard to the impact of large-scale cultivation of winter chickpea.

Chickpea Pests and their Potential for Damage

The insect pests that have been recorded on chickpea crops in the eastern Mediterranean region are listed in Tab. 1. As for chickpeas grown in other areas of the world, the pest list is surprisingly short. Chickpea is relatively free from many potential pests, probably because of the very acid droplets exuded from the glandular hairs which cover these plants. By far the most important pests listed are the pod borers (*Heliothis* spp.) and the leaf miner (Hariri 1979).

Table 1
Insect pests reported on chickpea in the eastern Mediterranean region.

Insect pest	Family	Damage	Reference
LEPIDOPTERA:			
Heliothis armigera (HB.)	Noctuidae	Pod borer	1,2,3*,4
H viriplaca (Hufn.)	Noctuidae	Pod borer	1
H peltigera (Schiff)	Noctuidae	Pod borer	1
Marasmarcha echrenbergiana Zell	Pterophoridae	Leaf/Pod?	NR
Agrotis ypsilon (Hufn.)	Noctuidae	Leaf/Stem	4
A. segetum (Schiff)	Noctuidae	Leaf/Stem	1
Autographa gamma (L 0	Noctuidae	Leaf	1
Trichoplusia ni (Hb.)	Noctuidae	Leaf	1
DIPTERA:			
Liriomyza cicerina Rond.	Agromyzidae	Leaf miner	1
L. congesta (Beck).	Agromyzidae	Leaf miner	5
COLEOPTERA:			
Sitona crinitus Hbst.	Curculionidae	Leaf	1
HEMIPTERA:			
Acyrthosiphon pisum (Harr.	Aphididae	Sap feeder	1
Aphis craccivora Koch	Aphididae	Sap feeder	1

1 = Hariri (1979); 2 = Talhouk (1969); 3 = Moradeshaghi (1977–); 4 = Kawar (1979); 5 = Jaffari (1975)

NR = New record; ? = To be confirmed.

* = This report lists *H. obsoleta* which is considered to be a synonym of *H. armigera*.

There is little information available on the extent of losses caused by the insect pests. Kawar (1979) recorded about 6% pod damage by *Heliothis* in March- and April-sown crops in Lebanon, and later-sown crops had even less damage. There are reports of leaf miner being "important" in Syria (Hariri, 1979 and Kemkemian, 1979), in Turkey (Gentry 1965; Giray 1970) and in Spain, Israel and USSR (Kay 1979). However, an estimate of yield loss is only available from Tadzhikistan (USSR) where Koinov (1968) estimated the loss to range from 10–40%. In Spain, Cubero (1975) reported that yield loss estimates were inadequate, in spite of several years of study on leaf miner.

At ICARDA preliminary attempts have been made to quantify the yield losses caused by the pests, through observation and through pesticide trials on winter- and spring-sown crops. It was hoped to partition the losses caused by leaf miner and *Heliothis* spp. by differentially controlling these pests. Unfortunately, it was not possible to identify pesticides that would adequately control either pest and not affect the other. Also inter-plot effects, largely caused by the dispersal of the mobile pests, obscured any differences in these replicated, small plot trials. It was found that methidathion at 0.5 kg a.i./ha gave good control of both *Heliothis* spp. and leaf miner. However, the yields from treated and pesticide-free plots were disappointingly low and differences were not consistent (Tab. 2). The cultivar used was Syrian Local, which is susceptible to ascochyta blight. This disease was particularly damaging in the large, pesticide-protected, winter-sown block. These obviously affected the comparisons of yields. This data, however, indicate that factors other than pests may be the major determinants of yield and that the unprotected winter crop gave yields equal to, or better than, those obtained from the protected spring crop.

Pod damage by *Heliothis* spp. was greater in the pesticide-free winter crop as compared with the spring crop. *Heliothis* spp. are generally attracted to well grown crops and presumably the better crop growth in this limited unprotected area of winter crop was more attractive to the insect and so the damage was greater.

The leaf miner attack apparently starts in March-April in most years in the Aleppo area. Then, the winter-sown crop is well established with good growth, but the spring-sown crop is only in the seedling stage. In May 1980 there was a moderate attack of leaf miner across all plots of chickpea at the ICARDA Center (Tel Hadya), Aleppo, both on winter and spring sown. By this time, however, the wintersown crop was in the late podding stage and it is unlikely that the foliar damage by leaf miner would result in much yield loss, if any. Presumably such leaf miner attacks would be more damaging to the spring-sown crop which was in the early pod stage at that time.

The other insects listed in Tab. 1 were either not found or were relatively rare, during the 1980 observations, and were not important. However, while consider-

Table 2
Estimates of pod damage and grain yield in protected and unprotected winter- and spring-sown chickpeas (cv: Syrian Local), Tel Hadya, Syria, 1979–80.

	Expt.*	Winter crop		Spring crop	
		Protected	Unprotected	Protected	Unprotected
Pods/plant	1	11	10	7	6
	2	11**	15	6	4
% bored pods	1	0.4	4.0	2.0	2.7
	2	0.6	16.3	0.3	1.6
Grain yield	1	805	685	662	548
	2	749**	956	491	284

* 1 = four replicated small plots – three sprays of methidathion at 0.5 kg toxicant/ha each;
2 = Unreplicated large plots – soil application of carbofuran at planting followed by three sprays of methomyl (dose as above).
** = *Ascochyta* damaged.

ing the potential role of winter-sown chickpea in changing the incidence of insects, due attention must be given to all of these insects, some of which may become important.

The cutworms (*Agrotis* spp) feed voraciously on the foliage and the later instars can cut the stems, thus leading to plant mortality. *A. segetum* which is common in this region is known to attack both winter and spring crops and has been recorded as causing severe damage to chickpeas, maize and cotton. The polyphagous semiloopers (*Autographa gamma* and *Trichoplusia ni*) have caused damage to chickpeas and lentils in some years, particularly in the spring months. Plume moth (*Marasmarcha ehrenbergiana*) larvae on chickpea foliage were observed in the Aleppo area. This is the first record of this insect on this crop.

The aphids (*Aphis craccivora* and *Acyrthosiphon pisum*) are often found on chickpeas in this area, but they do not generally build up to damaging populations. However, they may cause substantial crop loss, by acting as vectors of stunt virus which has been recorded in this region. The weevils (*Sitona crinitus*) feed on the leaves of chickpea as well as on lentil, vetch and lucerne, and cause damage to young plants (Hariri 1979).

Seasonality and Carryover

The greatest limitation in foreseeing the potential pest problems of winter-sown chickpea is the inadequate knowledge about the survival, buildup and carryover

of the major and minor pests in this area. A summary of the available knowledge is given in Tab. 3.

On spring-sown chickpea the major pests, *Heliothis* spp. and leaf miner, first appear in low numbers in April, during the seedling stage. They may then build up to damaging populations in May-June during the podding stage. This was the case in 1980, but that year was unusual in having a relatively cool spring. In such a year the winter-sown chickpea will merely act as an alternative to the spring-sown chickpea as a host for the pests from April to June. The cold winter through which the early-sown chickpea grows, albeit slowly, would preclude the early buildup of pests. A similar situation is apparent in northern India where winter-sown chickpea has a very low infestation of almost all pests until the warmer weather arrives.

Table 3
Seasonal incidence and carryover potential of some of the common pests on chickpea in the eastern Mediterranean region.

	Known period of occurrence on 'spring' chickpea	Generations per year (duration from egg to adult)	Carryover potential	
			Diapause	Other host plants
POD BORERS: *Heliothis armigera*	Apr–June	Many (4–8 weeks)	Yes	Yes
LEAF MINERS: *Liriomyza cicerina*	Apr–June	2–4 (2–4 weeks)	Not clear	Yes
CUTWORMS: *Agrotis* spp.	Spring season	At least 6 (5–10 weeks)	Yes	Yes
APHIDS: *Acyrthosiphon pisum* *Aphis craccivora*	Apr–June	Many (2–3 weeks)	Not clear	Yes
LEAF WEEVILS: *Sitona crinitus*	Nov–Dec/ (early) Apr	One	Yes	Yes

There is an obvious danger from the *Heliothis* spp. in Syria in years when a mild winter or an early spring allows the moths to emerge in February-March, as recorded by Hariri (1979). Most plants are attractive to *Heliothis* spp. egg-laying only during the flowering and fruiting period and there are unlikely to be many such hosts in February-March in the Aleppo area. However, chickpea is an exception, for it is attractive to *Heliothis* spp. egg-laying moths from the seedling stage and so could act as a host for an early buildup of these pests.

We do not yet know whether most *Heliothis* spp. infestations in Syria originate from diapausing pupae which survive the winter within the country (diapause has been reported by Talhouk 1969), or from immigrants from southern countries, or from the coast, where the winter is not severe enough to prevent this pest from feeding and breeding through the year. If *Heliothis* spp. have previously failed to establish in Syria in February-March in warm years because of the lack of a suitable host at that time, the winter-sown chickpea could fill this niche. This might allow an extra generation of this pest and so multiply the subsequent attack on spring-sown chickpea and on other crops such as cotton.

If the major source of the *Heliothis* spp. moths is from diapausing pupae, the lack of an early host will give selective advantage to late emergents, for early emergence would be suicidal. The availability of an early host would give selective advantage to the early emergents and the pattern of emergence from diapause could rapidly change to take advantage of this new opportunity.

Similarly, little is known about the carryover of the leaf miner from season to season. In 1980, it was first noticed in early April and at that time the spring-sown chickpea was already available as a host. So, here, as with *Heliothis*, the winter-sown crop appeared to give no earlier buildup opportunity for this pest. It is suspected that overwintering in the pupal stage may be one means of carryover. However, if there is an early emergence from these puparia in February or March, or an immigration from other areas at that time, the winter-sown chickpeas might be hit by one or two extra generations. Also, this may greatly enhance the attack on the spring crops in the region.

Similar possibilities obviously exist for an earlier establishment of most or all of the other insects that have been recorded on this crop in this region. There is also a small possibility that other insects that have not yet been recorded on the crop will find an opportunity to build up on the winter-sown crop.

Possible Effects of Differing Proportions of Winter- and Spring-Sown Crops

Up to now the vast majority of the chickpea crop grown in the area has been spring sown and the experimental sowings of winter crop can hae no effect on this. On Tel Hadya farm, however, one-third or more of the chickpeas in 1980 were winter sown and there was no obvious detriment to the spring-sown crop. If, as expected, the advantages of winter-sown chickpea soon become apparent to several farmers, then a substantial proportion of the Syrian crop could be winter sown within the next few years. During the transitional stage the threat to the spring-sown chickpea may well increase. If all the crop is eventually winter sown then there will be no spring-sown crop to threaten. At that stage, the *L. cicerina* leaf miner problem will be of little or no extra concern for it is not known to attack any other important crop plants; it is suspected that it will cause little yield loss on the well grown winter-sown chickpea. The polyphagous pests, including *Heliothis armigera* will feed on other crops including cotton and maize, and there is a faint possibility of increased pest problems on such crops.

Research Requirements for Pest Management on Winter-Sown Chickpeas

The spring-sown crop has not been very high yielding, and pesticide use on the crop has not given substantial yield increases. The leaf miner damage often looks serious but there is no evidence that it has caused substantial yield loss. In some areas and years the *Heliothis* spp. attacks can damage a substantial proportion of pods and several farmers apply "cotton dust" (DDT/BHC) to control such attacks, particularly in sourthern Syria.

If the winter sowing proves successful, then yields will be increased and the losses due to pests may, at the worst, increase only proportionately. Pesticide use may be the simplest and cheapest means of reducing such losses. There is a need to improve upon the present practice of dusting with the polluting chlorinated hydrocarbons. Heavy doses of methidathion are effective against the chickpea pests but such treatment may be too costly. Pesticide experimentation, with emphasis upon cost: benefit ratios and upon safety for man and his environment, is of obvious priority.

Search for alternative means of pest management should not be neglected. Host-plant resistance has already proved to be a promising means of reducing the *Ascochyta* threat to the winter-sown crop. It may be possible to reduce the insect pest attacks by a similar means. Preliminary data indicate that there are differences in susceptibility to pests. It is unlikely that a high level of resistance to the pest complex or to individual pests will be rapidly or easily found or exploited. However, the cost of a modest screening program for resistance is infinitesimal when compared with the potential benefits. Monitoring/screening of breeding materials is essential, at least to ensure that more susceptible materials do not emerge from breeding programs. There is always a danger of this happening wherever much, or all, of the breeding and testing is done under a pesticide umbrella.

It is possible to change the susceptibility of chickpea crops to pests by changing the agronomic conditions. For example, at ICRISAT it has been found that greater populations of *Heliothis armigera* larvae per unit area are associated with increased plant density but with little effect on the percentage of pods damaged or yield. A winter-sown trials at ICARDA in the 1979–80 season showed that an increase in plant density from 33 to 50 plants/m^2 gave substantial increases in yield for most cultivars tested. This work should be followed with