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A Note on the Outbreak of American Serpentine Leaf Miner, *Liriyomyza trifoli* Burges (Diptera: Agromyzidae) with Particular Reference to Cotton

During August 1991, there was an outbreak of an unknown pest on cotton throughout the cotton growing areas of north Karnataka. Young leaves of 1 to $1^1/_2$ months old cotton plants showed serpentine like mines. Close observations of leaves revealed the presence of tiny maggots and the excreta. Further, the pupae of maggots were found in the "hood" like expansion of the mines. The affected leaves were covered with the net work of mines exhibiting very less greenness, became dried . and withered ultimately. However, the plant growth was not much affected. The affected leaves were brought

to the laboratory and kept in the ventilated glass jars to obtain adults and the identity of the adults was established. It was identified as *Liriyomyza trifoli* (Diptera: Agromyzidae), commonly known as American serpentine leaf miner. The pest has recently been introduced into India, accidentily. The pest did not regenerate on the young leaves as the plant grew older. It survived on younger leaves of 1–1$^1/_2$ months plants only. During 1992 rainy season, the pest appeared again in a full swing. Observations made around Agricultural Research Station, Dharwad revealed that this pest also appeared on sunflower, marigold, okra, potato, cucurbits, fenugreek and castor plants.

The following preliminary observations were made during 1991 and 1992 rainy seasons:

During 1991 season, 219 cotton genotypes were observed for the incidence of this pest, under unprotected conditions of which TKA–283 and DHH–16 recorded a minimum (5.8) and maximum (25.9) per cent damaged leaves. During 1992 season, the incidence was very high damaging 25.0 to 88.2% leaves, under unprotected conditions and out of 43 genotypes screened under unprotected conditions, DHH–509 and Savitha recorded the lowest (30.7%) and the highest (56.6%) damage. In both the years, *Gossypium arboreum* and *Desi* hybrid cotton recorded lower per cent damaged leaves as compared to *G. hirsutum* varieties and intra–specific hybrids of *G. hirsutum* (Table 1) under unprotected conditions. During 1992 rainy season, eleven promising *G. hirsutum* and *G. arboreum* genotypes were screened under randomised block design for their reaction to leaf miner both under protected and unprotected conditions. The plot size in these experiments was 1.8 m x 3 m with a spacing of 60 cm x 30 cm. The crop received recommended agronomic practices. In one of the experiments, the crop was protected against sucking pests with two sprays of Dimethoate 30 E.C. Observations were recorded on the number of leaves damaged out of total leaves produced by a plant on 10 randomly selected plants per entry and per cent leaves damaged was worked out. The statistical analysis of the results (Table 2) indicated that under unprotected conditions, AKA–8713 and AKA–8307 recorded significantly less damage than the rest of entries. The genotypes

Table 1. Percent leaves damaged by *L. trifoli* in different cotton varieties and hybrids

Varieties / Hybrids	Species	% leaves damaged		
		Unprotected conditions		Protected conditions
		1991	1992	1992
Hirsutum varieties	*G. hirsutum*	7.8 to 25.9	41.37 to 88.23	37.07 to 53.50
Intra–specific hybrids	*G. hirsutum*	8.2 to 15.5	46.66 to 78.37	30.66 to 49.20
Arboreum varieties	*G. arboreum*	5.8 to 13.4	25.0 to 50.0	45.48 to 56.60
Male sterile based hybrids	*G. hirsutum*	11.8 to 20.8	45.16 to 74.27	30.48 to 41.91
Desi hybrids (Inter–specific)	*G. herbacium* X *G. arboreum*	6.1 to 8.5	40.0 to 52.44	32.4 to 39.71
Jayadhar	*G. herbaceum*	31.15	41.91	—

Table 2. Per cent leaves damaged by *L. trifoli* in different cotton varieties and hybrids under protected and unprotected conditions

Varieties / hybrids	% Leaves damaged (Angular values)	
	Unprotected conditions	Protected conditions
AKA-8713	38.98[a]	42.66
AKA-8307	37.83[a]	47.60
CMH-171	45.71[b]	46.64
BCS-23-18-7	46.34[b]	40.86
JK-260-2	48.14[b]	46.24
CMH-34	49.15[b]	46.76
DHH-11	50.09[b]	43.31
JK-276-8-2	50.60[bc]	48.96
DHH-509	53.09[bc]	43.09
DHH-511	53.35[c]	45.25
SPVR-1	54.52[c]	44.99
S.Em±	1.81	3.89
CV %	6.54	14.93
CD (5%)	5.34	NS

CNH-171, BCS-23-18-7, JK-260-2, CNH-34 and DHH-11 were on par with each other and differed significantly from JK-276-8-2 and DHH-509 which in turn were on par with each other. DHH-11 and SPUR-1 recorded significantly highest damage and were on par with each other. The results under protected conditions were non-significant indicating the control of this pest by systemic insecticidal sprays. Observations were also recorded on the damage caused by this pest on different hosts and it was found that sunflower recorded lowest (11.03%) damaged leaves compared to marigold (32.44%); okra (34.73%) and potato (72%). Observations were also recorded on the incidence of this pest in an intercropping experiment of cotton with groundnut, chilli, onion and greengram. The pest did not appear on any of the intercrops but interestingly the intercrops had an influence on the appearance of this pest on cotton. The intercrops of onion, greengram and groundnut effectively checked

Table 3. Per cent leaves damaged by *L. trifoli* on cotton grown with different intercrops

Treatment	% Leaves damaged (Angular values)
Cotton + Onion in *kharif* and Wheat in *rabi*	42.89[a]
Cotton + Groundnut in *kharif* and Bengalgram in *rabi*	45.19[ab]
Cotton + Greengram	46.53[abc]
Cotton + Groundnut in *kharif* and Wheat in *rabi*	47.85[bcd]
Entire cotton (120 cm x 15 cm)	48.55[bcd]
Cotton + Onion	49.11[bcd]
Cotton + Groundnut	49.34[bcd]
Cotton + Onion in *kharif* and Bengalgram in *rabi*	50.09[cd]
Cotton + Chilli	50.85[cd]
Entire cotton (60cm x 30 cm)	51.86[cd]
S.Em ±	1.6
C.D. (5%)	4.69
CV %	5.77

the significant damage by the pest on cotton as compared to entire cotton with lesser spacing (Table 3).

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Performance of Indian Hive Bee, *Apis cerana* F. in Dharwad, Karnataka (India)

The success of beekeeping at a place depends upon the performance of the colonies into pollen and nectar collection which in turn determines the build up activity of a colony. The breeding performance of a colony vary according to the availability of food in different seasons. Normally, an average sized honey bee colony requires about 20 kg of pollen in the active season (Deodikar, 1962) which serves as a rich source of protein for the bees. Such studies are totally lacking in case of Indian hive bee, *Apis cerana* F. under Dharwad conditions. However, reports are available from other parts of Karnataka (Reddy, 1980, Viraktamath *et al.*, 1990). Therefore, present investigations were taken up to know the brood rearing activities of Indian hive bee at Dharwad, Karnataka.

Five colonies of *Apis cerana* F. of uniform strength were selected for the study at the University of Agricultural Sciences, Dharwad. The observations were made on the number of brood comb and broodless comb which contained honey, pollen and empty cells. Further, on each brood comb, five spots of one sq. inch area were selected and observations were made on number of cells with brood and without brood which included food and empty cells at weekly intervals for three years from Feb., 1990 to Jan., 1993. Later, the averages for each colony and for month were calculated.

The average number of combs with brood in a hive varied from 4 to 5 throughout the investigation period in all the seasons except from May to July which recorded 2 to 3 brood combs in a colony. But, the area covered by the brood on each comb did vary from season to season which was more during honey flow season as compared to lean period in each colony. On the contrary, combs without brood which included honey, pollen and empty combs varied from 3 to 4 in all seasons except from May to July which varied from 4 to 6 combs (Table 1). The brood rearing activity and pollen collection was found throughout the year with certain degree of variation in different seasons. This is in agreement with the report of Viraktamath *et al.* (1990). The average number of brood cells/inch^2 was highest from January to March with least number of non–brood cells. It was