types were small prominent chlorotic leaves. These leaves later turned necrotic (figure 1a). The internodes (figure 1b) are reduced in size and the plants became stunted. Such plants remained green for longer interval of time. In most cases the diseased plants did not show proliferation of the stem. The capitulum, instead of producing normal ray and disk flowers (figures 8 and 9) showed wedge-shaped sectors (figure 3) with hypertrophid flowers (figures 6 and 7). The ovary, calyx, corolla, anthertube and branches of styles showed green-coloured short rudimentary leaves. Further proliferation of the ovary style into branches of leaves as seen in cotton stenosis and other MLB diseases of the plants was not observed here[7]. These small rudimentary leaves formed in the disk flowers were of 0.3 × 0.2 to 0.5 × 0.3 cm size (figure 6a). The early infected plants showed stuntedness with a small abnormal capitulum without ray flowers. Although the late infected plants showed light green ray flowers they produced hypertrophid disk flowers (figures 7a, b, c). This phyllody disease caused stuntedness and sterility to sunflower resulting in economic loss as such plants do not produce seeds. Similar observations were also made by Zimmer and Hoes[1], and Signoret *et al*[5]. Natural occurrence of phyllody in *Helianthus* cultivars has not been reported earlier in Karnataka. Except for a mosaic report[2,4], no other viruses or virus-like diseases have been reported to occur extensively on cultivated sunflower in India.

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1. Zimmer, D. E. and Hoes, J. A., *Diseases in sunflower science and technology*, Madison, Wisconsin, USA, 1978, p. 537.
2. Uppal, B. N., *Indian Bull, Plant. Protect.*, 1933, **7**, 103.
3. Sackston, W. E., *33rd. Annu. Rep. Research Branch.* Canada Dept. Agric., Ottawa, 1954, p. 45.
4. Battu, A. N. and Phatak, H. C., *Indian Phytopathol.*, 1965, **18**, 317.
5. Signoret, P. A., Louis, C. and Alliot, B., *Phytopathol. Z.*, 1976, **86**, 186.
6. Kunkel, L. O., *Am. J. Bot.*, 1926, **13**, 645.
7. Bidari, V. B., Padaganur, G. M. and Hegde, R. K., *Mysore J. Agric. Sci.*, 1987, (in press).

OFF-SEASON SURVIVAL OF THE PREDATORY MIRID BUG, *CYRTORHINUS LIVIDIPENNIS* (REUTER)

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THE predatory mirid bug, *Cyrtorhinus lividipennis* is an effective natural enemy of rice hopper pests — mainly the brown planthopper (BPH), *Nilaparvata lugens* (Stål), whitebacked planthopper, *Sogatella furcifera* (Horvath) and the green leafhopper, *Nephotettix virescens* (Distant). Asynchrony in initial appearance of the predator with reference to pest and its sensitivity to chemical insecticides appear to be the main limitations for a complete expression of biocontrol potential of the mirid bug in nature. Thus conservation of the natural enemies, in general, has been proposed to be the main biocontrol tactic in hopper pest management[1,2].

Several factors influence survival of biocontrol agents during the off-season when the preferred insect host population drastically declines. In Solomon Islands, Stapley[3] documented higher population of the mirid bug in rice fields adjacent to grassy fallows especially those with *Digitaria* weed. He suggested natural multiplication of *Cyrtorhinus* on this weed prior to influx into rice fields. We also observed considerable number of mirid bugs on the weed *Cyperus difformis* during the off-season between *kharif* and *rabi* seasons (November–January) in the experimental farm of the Directorate of Rice Research, Hyderabad. This weed was also found infested with white striated planthopper, *Nisia atrovenosa*. Studies were, therefore, conducted to understand the inter-relationship between the weed, hopper and predator.

Closer examination of weeds during off-season showed that egg masses of *Nisia* were laid on leaf bases and possibly *Cyrtorhinus* adults and nymphs fed on these eggs and survived. To ascertain this, newly hatched mirid bug nymphs were caged in the greenhouse on *Cyperus* weed alone, with *Nisia* adults and on rice plant with BPH adults. Results (table 1) revealed that none of the nymphs could develop to adult stage on the weed alone whereas 23.3% of them became adults on the weed in the

Table 1 *Survival and development of the nymphs of the mirid bug, C. lividipennis on Cyperus weed infested with Nisia atrovenosa*

Mirid bug nymphs caged on	Nymphal survival* (days) Mean ± S.E.	Nymphal period (days) Mean ± S.E.	Percentage nymphs attaining adult stage
Cyperus difformis	2.8 ± 0.2[a]	–	0.0
Cyperus with *Nisia*	4.3 ± 0.3[b]	9.6 ± 0.4	23.3
Rice with *Nilaparvata*	8.0 ± 0.2[c]	9.3 ± 0.3	45.0

* Average of 6 replications with a total of 60 newly hatched nymphs. a–b, b–c: $P<0.01$ (t-test).

presence of *Nisia*. The mirid nymphs survived on an average for only 2.8 days on the weed in the absence of the hoppers. Nevertheless, greater percentage of nymphs reached adult stage in shorter period on rice plant with BPH adults than *Cyperus* with *Nisia* adults. Dissection of egg masses laid on the weed confirmed the predation by the mirid bug.

In another study feeding test was conducted with *Nisia* adults on *Cyperus* weed and rice variety (TN 1) to know whether the hopper is a potential pest on rice. A high insect mortality and only a trace amount of honeydew excretion were noted when *Nisia* adults were caged on TN 1 plants (table 2). This was in contrast to the large amount of honeydew excretion and relatively better survival on *Cyperus* weed. Further, even when 100 first instar nymphs of *Nisia* were separately caged on TN 1 rice plants and *Cyperus*, none could develop to adult stage on the former while 36 adults developed on the latter. Thus rice could not act as a host plant for the striated planthopper. The studies conducted at the International Rice Research Institute[4] confirm this finding.

Table 2 *Survival and feeding by adults of the white striated planthopper, Nisia atrovenosa on rice plant and weed Cyperus*

Mirid adults caged on	Mortality in 24 hr period* (%)	Amount of honeydew excreted (mm^2) Mean ± S.E.
Rice plant (cv.TN 1)	90.0	15.0 ± 8.6[a]
Cyperus difformis	30.0	225.0 ± 53.3[b]

* Average of 10 replications with a total of 50 adults; a–b: $P<0.05$ (t-test).

Some of the weeds have been reported to act as alternate hosts for the mirid bug *C. lividipennis*[3,5]. However, earlier greenhouse studies with 14 different rice varieties and 24 species of weeds did not show prolonged survival of the mirid bug on plant material alone in the absence of prey insects[6]. Survival of mirid nymphs to some extent in the studies reported by other workers[3,5] could be the result of either cannibalism in group rearing of test insects which we observed while rearing this predator or inadvertent presence of preys like aphids, mites etc. Mere oviposition in weeds like *E. crusgalli* and *C. diffusus*[5] would not suggest host status of these plants since *C. lividipennis* readily oviposited in filter paper folds in the laboratory rearing on *Corcyra* eggs[7].

Thus present observations suggest the survival of the mirid bugs during winter off-season (November–January) by feeding on eggs of *N. atrovenosa* laid on the weed *C. difformis*. But during summer off-season (May–June) no population of the mirid bug was observed even on this weed. Apparently, high ambient temperature (>40°C) might be adversely affecting the survival of this predator during this period in the region.

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1. Otake, A., *The rice brown planthopper*, Food and Fertilizer Technology Centre for the Asian and Pacific Region, Taipei, Taiwan, 1977, p. 42.
2. Anonymous, *Prospects for biological control of ricehoppers*, Status paper of Commonwealth Institute of Biological Control, Trinidad (mimeo.), 1979.
3. Stapley, J. H., *Rice Entomol. Newslett.*, 1975, **2**, 37.
4. Cruz dela, C. G. and Litsinger, J. A., *Int. Rice Res. Newslett.*, 1986, **11**, 26.
5. Sivapragasam, A., *Int. Rice Res. Newslett.*, 1983, **8**, 19.
6. Anonymous, *Proc. Third AICRP Workshop on Biological Control of Crop Pests and Weeds*, Indian Institute of Horticultural Research, Bangalore, 1980, p. 103.
7. Bentur, J. S. and Kalode, M. B., *Curr. Sci.*, 1985, **54**, 513.