planktonic and benthic cyanobacterial mats consisting only of non-heterocystous forms. The nitrogen fixation rate by planktonic cyanobateria was 41.1 nmol/l/day and that by the benthic cyanobacteria 3.54 μ mol/cm^2/day.

The ability of these organisms to switch over to other plausible mode of existence depending upon exigencies of natural circumstances as in a reducing environment has enabled improvement of their physiological mechanism by successful evolution over the millennia.

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Importance of immigrant alatae on the population development of mustard aphid *Lipaphis erysimi* (Kaltenbach)

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Aphids are pests of major agricultural crops. Since aphids move from plant to plant mainly by flight, the alate or winged morph is important in initiation of new colonies in their distribution between plants[2]. Temperature and host quality have been shown to influence the production of alatae[3]. A knowledge of the factors responsible for and the time of immigration of aphids to crops is important in deciding when the crop should be sampled or control should begin. This was examined in the context of the mustard aphid *Lipaphis erysimi* (Keltenbach) which is a proven menace in different mustard growing states of India[4].

IMMIGRATION of *L. erysimi* was monitored by collecting air-borne aphids at 8 a.m. on alternate days from yellow pan water traps (YPT). Four YPTs, each 51 × 30 × 13 cm in size and painted bright yellow inside and bottle green outside, were placed 3 feet from ground level, one in each direction of the periphery of a plot measuring 20 × 15 m^2. The study plot was located in a mixed agricultural habitat. Adjacent crops included potato (Solanaceae), cabbage and radish (Cruciferae), and cowpea and groundnut [Fabaceae (= Leguminosae)]. YPTs were placed on the edge of the study plot. The YPTs were made operational three weeks in advance of sowing of the mustard crop till harvest.

The plot was prepared for a commonly grown mustard variety of *Brassica juncea* M27 adopting the recommended agronomic practices. No insecticide was applied to the crop. The study was conducted in the cropping seasons of 1990–91 and 1991–92. Crop infestation of *L. erysimi* was monitored by recording the total number of nymphs and adults, both non-winged and winged, from terminal 10 cm shoot portion of each of the 100 plants selected at random at weekly intervals between 8 a.m. and 12 noon on the day of counting. The aphid population was monitored throughout the crop period commencing on the 7th day after sowing.

The first aphids in the mustard crop were noticed in the seedling stage which is three weeks from the date of sowing. However, the first migrate alatae of *L. erysimi* was collected in YPT in the third week of its operation, i.e. in the week of crop sowing and 20 days in advance of actual settling of aphids in the crop (Figure 1). Total YPT-catch in the first two weeks (before setting on crop) was higher than the succeeding two weeks (after settling on crop) in both years (Fisher Exact test, 1990–91: $P < 0.02$; 1991–92: $P < 0.06$).

First crop infestation, as evident by the collection of the first adult aphid, was noticed in the third week in both the years. The YPT catch in the first four weeks of crop age (seedling phase) was positively and significantly correlated with the crop samples by a two week lag (1990–91 : $r = 0.89$, $P < 0.007$; 1991–92 : $r = 0.75$, $P < 0.02$) (Figure 2). As the crop entered the vegetative phase of growth in the fifth week, the propor-

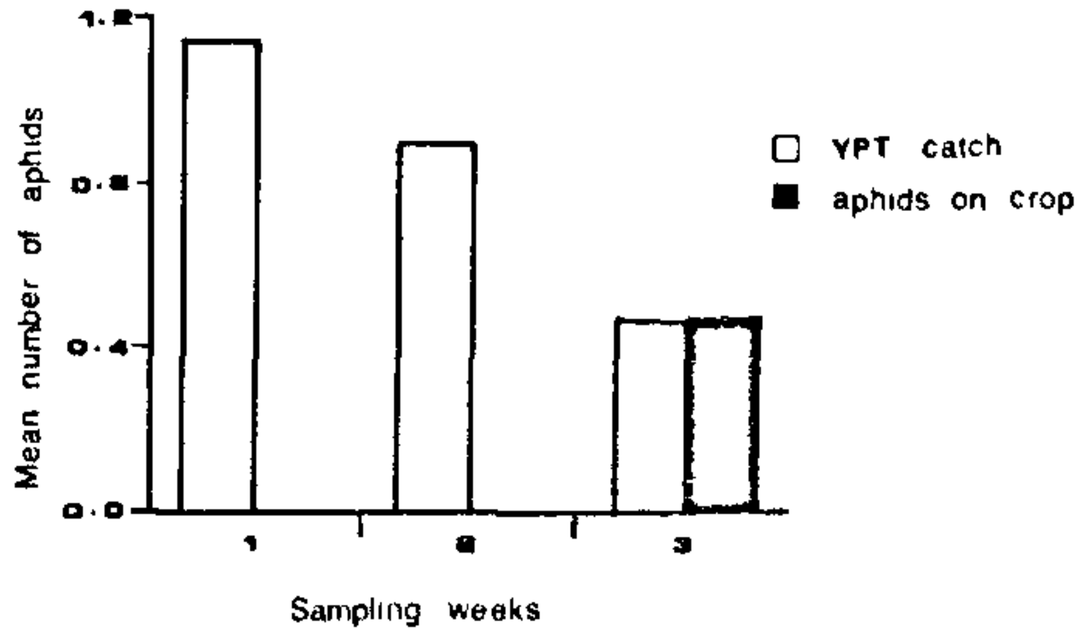

Figure 1. Mean number (of 1990–91 and 1991–92) of the mustard aphid collected in YPT ($n = 4$) and on 100 plants of mustard crop in the first three weeks of sowing

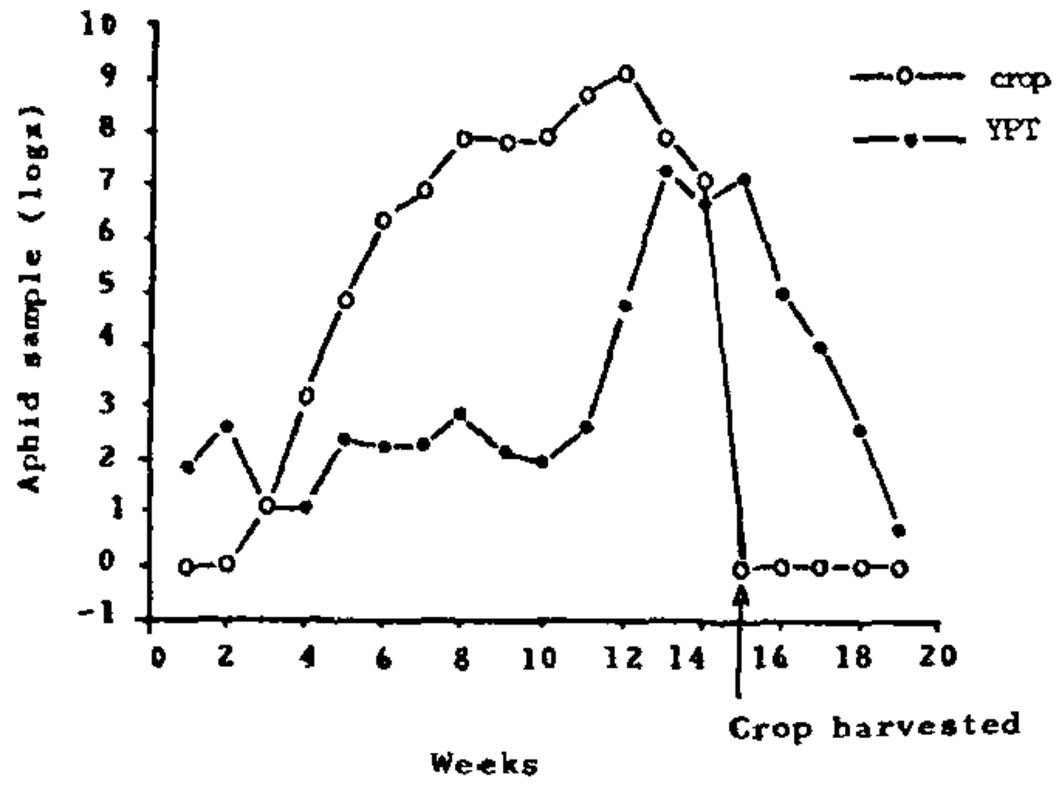

Figure 2. Aerial density of immigrant alatae and population trend of crop samples of the mustard aphid in relation to weekly sampling of mustard crop (1990–91).

tion of immigrant alatae in the crop sample declined compared to those in the earlier week (1990–91 : Z value = 2.92, $P < 0.003$; 1991–92 : Z value = 1.84, $P < 0.06$). A positive and significant correlation was observed between YPT catches during first four weeks and minimum temperature by one week lag in both the years (1990–91 : $r = 0.89$, $P < 0.04$; 1991–92: $r = 0.89$, $P < 0.03$).

The establishment of relationship between the aerial density (measured by the YPT-catch) and that on host plants is a key step in the interpretation of immigrant samples[2]. The quantitative comparison of YPT catch with those on the mustard crop showed a positive influence on the time of crop infestation. A similar result was suggested earlier for *L. erysimi* on *B. campestris* using yellow adhesive traps in Delhi[4].

A good relationship between the timing of immigrant *L. erysimi* in YPT and its subsequent detection on crops (Figures 1 and 2) give a good indication of sensitivity of the crop-age suitable for settling of aphids. However, perhaps the more important are factors which cause the immigrant alatae to take off from their off-season habitat in autumn which comprises of neglected and cropping areas in the agricultural habitat where *L. erysimi* take shelter on a variety of plants, viz. Crucifereae (*Cardamine hirsuta*, *Nasturtium* spp., *Raphanus sativus*), Compositae (*Lactuca sativa*), Tropaeolaceae (*Tropaeolum majus*), Cucurbitaceae (*Momordica charantia*) and Chenopodiaceae (*Beta vulgaris*). Duration of photoperiod and/or temperature is considered to be responsible for this[5]. Analysis of weather factors in the present study suggests that lowering of temperature in autumn has a positive effect on the take-off of alatae from off season host in search of seasonal host[3]. A profile of the relationship of timing of immigrant alatae of *L. erysimi* with the weather factors and timing of crop samples in large areas over many years may become a reliable basis to forecast aphid infestation in mustard crop.

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