# EFFECT OF WEATHER PARAMETERS ON ACTIVITY OF PSYLLA AND LEAF-MINER ON KAGZI LIME

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## *ABSTRACT*

***The investigation on population dynamics of Diaphorina citri Kuwayama and Phyllocnistis citrella Stainton infesting kagzi lime were carried out at Anand Agricultural University, Anand during 2011. The higher activity of D. citri was observed during 3rd week of March to 1st week of May (12-18th SMW) and 1st to 3rd week of August (31-33rd SMW), whereas P. citrella incidence was found during 1st to last week of February (6-9th SMW), 2nd and last week of June (24 and 26th SMW) and 1st week of July to last week of August (27-35th SMW). Both the pests reached at peak level two times, D. citri during 1st week of April (14th SMW) and 2nd week of August (32nd SMW), whereas P. citrella during 3rd week of February (8th SMW) and 3rd week of July (29th SMW). The significant positive relationship of rainfall, maximum and mean temperature with D. citri, whereas wind speed and minimum temperature with P. citrella activity on kagzi lime. The evaporation and maximum temperature had significant negative correlation with P. citrella population. The rainfall, morning, evening and mean relative humidity as well as morning, evening and mean vapour pressure had highly significant positive, whereas bright sunshine had highly significant negative correlation with P. citrella.***

***KEY WORDS:*** *C. aurantifolia, D. citri, P. citrella, population dynamics, weather parameters.*

## INTRODUCTION

Citrus occupies third position next to mango and banana. Citrus is not only delicious and refreshing to eat, but also provide vitamins, minerals and many other essential elements which are required for human health. In India, kagzi lime covers about 2.19 lac hectares area and about 21.08 lac tonnes production with an average productivity of 9600 kg/ha (Anonymous, 2011). In India, Gujarat is second largest producer with 19 per cent production of kagzi lime followed by Andhra Pradesh. In Gujarat, kagzi lime covers the area about 39200 hectares and production about 4.09 lac tonnes with an average productivity of 10400 kg/ha (Anonymous, 2011). Citrus trees are reported to be damaged by more than 250 insect species during different stages of crop growth from seedling in nursery till the plant exit (Butani, 1979). Loss due to psylla infestation ranged from 83-95 per cent (Randhava, 1974). The citrus leaf-miner, *P. citrella* cause severe damage to tender leaf which serve as an entry point for a number of plant pathogens which cause citrus canker (Butani, 1979).

## MATERIALS AND METHODS

With a view to know the effect of weather parameters on activity of *D. citri* and *P. citrella* on kagzi lime, a study was carried

out at Anand Agricultural University, Anand during the year 2011. For determination of pest population, 10 trees were selected randomly having uniform age, size and growth. From each tree 10 new tender twigs having 5 to 10 leaves were selected randomly, covering the whole canopy of plant and keep unsprayed during the study period. The nymphs of *D. citri* and *P. citrella* larvae were recorded from ten randomly selected fresh tender twigs of each plant of kagzi lime at weekly interval. Data, thus obtained were correlated with weather parameters to determine its effect on fluctuation of *D. citri* and *P. citrella* infesting kagzi lime.

## RESULTS AND DISCUSSION

### *Psylla*

The psylla activity (Table 1) was observed throughout the year except 1st week of January and last week of September (1st and 39th SMW). A less activity (0.08 to 0.84 nymph/twig) of *D. citri* was noted during 2nd week of January to 2nd week of February, 4th week of May to 3rd week of June (0.17 to 0.58 nymph/twig), 1st week of September to 1st week of October (0.21 to 0.93 nymph/twig), 3rd and 4th week of October (0.73 to 0.74 nymph/twig) and in November to December (0.17 to 0.87 nymph/twig). The psylla population was fluctuating between 1.00 and 2.00 nymph/twig during 3rd week of February to 2nd week of March (8-11th SMW), 2nd to 3rd week of May (19-20th SMW), last week of June (26th SMW), last two weeks in August (34-35th SMW), 2nd and last week of October (41st and 44th SMW). The pest incidence was noticed at higher level (2.00 to 9.00 nymph/twig) during 3rd week of March to 1st week of May (12-18th SMW), 1st week of July (27th SMW) and 1st to 3rd week of August (31-33rd SMW). The pest reached at peak level two times during the year, first (8.89 nymph/twig) on 1st week of April (14th SMW) and second (6.68 nymph/twig) on 1st week of August (31st SMW). Valand *et al.* (1991) observed peak population of *D. citri* during April. Ahmed *et al.* (2004) reported that psylla population peaked during April and August. Sharma (2008) found that *D. citri* population was very low during December to January but it was higher in July to August.

Correlation co-efficient studies (Table 2) between *D. citri* incidence and weather parameters indicated that nymphal population of *D. citri* had significant positive association with rainfall (r = 0.283*) and maximum (r = 0.338*) as well as mean (r = 0.293*) temperature. The bright sunshine (r = -0.149), morning (r = -0.257), evening (r = -0.044) and mean (r = -0.110) relative humidity and evening vapour pressure (r = -0.012) had negative association, whereas evaporation (r = 0.272), wind speed (r = 0.078), minimum temperature (r = 0.205), morning (r = 0.160) and mean (r = 0.074) vapour pressure had positive but non-significant relationship with *D. citri* on kagzi lime. Valand *et al.* (1991) noted that maximum temperature had significant positive correlation with *D. citri* population. The psylla had positive correlation with temperature and negative correlation with relative humidity (Arora *et al.*, 1997). The maximum and minimum temperature had significant positive influence with *D. citri* population (Patel and Patel, 2006). Patel (2007) reported that nymphal population of *D. citri* had significant positive correlation with rain fall, minimum temperature and mean temperature.

### *Leaf-miner*

The activity of leaf-miner was noticed (Table 1) throughout the year except 1st to 3rd week of April (14-16th SMW). A lower (< 1 larvae/twig) activity of *P. citrella* was noted during 1st fortnight of January (1-2nd SMW), 4th week of March to 4th week of May (13-21st SMW), last week of October (44th SMW), 2nd and 3rd week of November (46-47th

SMW) and 2nd to last week of December (50-52nd SMW). The leaf-miner population was observed between 1 and 5 per larvae/twig during 3rd to last week of January (3-5th SMW), 1st to 3rd week of March (10-12th SMW), last week of May to 1st week of June (22-23rd SMW), 3rd week of June (25th SMW), 1st week of September to 4th week of October (36-43rd SMW), 1st and last week of November (45 and 48th SMW) and 1st week of December (49th SMW). The pest incidence was noticed at higher level (5 to 10 larvae/twig) during 1st to last week of February (6-9th SMW), 2nd and last week of June (24 and 26th SMW) and 1st week of July to last week of August (27-35th SMW). The *P. citrella* population reached at peak level two times during the year, first (7.06 larvae/twig) on 3rd week of February (8th SMW) and second (9.36 larvae/twig) on 3rd week of July (29th SMW). Koli *et al.* (1981) observed maximum number of *P. citrella* larvae on citrus during February to March and August to October. Singh and Azam (1986) noted heaviest infestation of *P. citrella* occurred during February and March. Patel *et al.* (1994) recorded higher population of larvae during August. According to Lad *et al.* (2010), the larval incidence was minimum during 4th week of April. The incidence of *P. citrella* was severe during the month of July and August (Sreedevi, 2010).

The result of correlation co-efficient analysis (Table 2) revealed that the rainfall (r = 0.523**), morning (r = 0.573**), evening (r = 0.707**) and mean (r = 0.694**) relative humidity, morning (r = 0.454**), evening (r = 0.630**) and mean (r = 0.554**) vapour pressure had highly significant positive association, whereas bright sunshine (r = -0.681**) had highly significant negative correlation with *P. citrella* activity. The evaporation (r = -0.337*) and maximum temperature (r = -0.313*) had significant negative relationship with *P. citrella* population on kagzi lime, whereas wind speed (r = 0.307*) and minimum temperature (r = 0.326*) had significant positive association with this pest. The relationship between mean temperature (r = 0.077) and leaf-miner population was positive but non-significant. Patel *et al.* (1994) noted that minimum temperature had a positive association, while bright sunshine and vapour pressure deficit showed negative associations with leaf-miner population on kagzi lime. The evaporation and bright sunshine were showed negative effect, whereas rainfall, minimum temperature, relative humidity and vapour pressure had positive effect on activity of *P. citrella* on citrus (Patel and Patel, 2001). As per the report of Patel and Patel (2006), minimum temperature, relative humidity, wind velocity and rainfall had significant positive, whereas bright sunshine showed significant negative correlation with *P. citrella* on kagzi lime.

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**Table 1 : Population dynamics of *D. citri* and *P. citrella* infesting kagzi lime**

| SMW | Month and Week | | No. of Psylla / Twig | No. of Larvae / Twig | Abiotic factors | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | EP (mm/day) | BSS (hrs) | RF (mm) | WS (kmph) | Temperature (°C) | | | Relative humidity (%) | | | Vapour pressure (mm) | | |
| | | | | | | | | | Max | Min | Mean | Mor | Eve | Mean | Mor | Eve | Mean |
| 1 | Jan | I | 0.00 | 0.07 | 3.27 | 9.63 | 0.00 | 3.40 | 25.66 | 8.44 | 17.05 | 74.71 | 34.43 | 54.57 | 6.43 | 8.36 | 7.39 |
| 2 | | II | 0.08 | 0.56 | 2.99 | 9.89 | 0.00 | 2.34 | 27.83 | 8.26 | 18.04 | 80.71 | 38.29 | 59.50 | 7.67 | 9.69 | 8.68 |
| 3 | | III | 0.19 | 1.36 | 3.41 | 9.70 | 0.00 | 2.30 | 27.31 | 9.16 | 18.24 | 83.43 | 29.86 | 56.64 | 8.04 | 7.96 | 8.00 |
| 4 | | IV | 0.36 | 2.74 | 3.94 | 9.89 | 0.00 | 2.56 | 29.54 | 11.29 | 20.41 | 85.57 | 39.43 | 62.50 | 9.44 | 11.10 | 10.27 |
| 5 | | V | 0.46 | 4.32 | 3.31 | 9.83 | 0.00 | 2.53 | 29.56 | 11.60 | 20.58 | 85.86 | 37.57 | 61.71 | 9.73 | 11.50 | 10.61 |
| 6 | Feb | I | 0.69 | 5.98 | 4.13 | 9.79 | 0.00 | 2.21 | 31.31 | 13.19 | 22.25 | 89.86 | 37.86 | 63.86 | 11.31 | 12.21 | 11.76 |
| 7 | | II | 0.84 | 6.13 | 4.13 | 9.86 | 0.00 | 2.93 | 30.96 | 14.74 | 22.85 | 82.29 | 39.29 | 60.79 | 11.70 | 12.06 | 11.88 |
| 8 | | III | 1.02 | 7.06 | 5.11 | 10.47 | 0.00 | 3.54 | 31.16 | 13.09 | 22.12 | 75.71 | 27.86 | 51.79 | 9.89 | 9.46 | 9.67 |
| 9 | | IV | 1.20 | 6.29 | 5.61 | 10.16 | 0.00 | 3.19 | 33.40 | 14.10 | 23.75 | 77.43 | 30.43 | 53.93 | 10.99 | 11.26 | 11.12 |
| 10 | Mar | I | 1.69 | 4.02 | 6.76 | 9.81 | 0.00 | 3.51 | 34.29 | 15.26 | 24.77 | 68.57 | 20.43 | 44.50 | 10.44 | 8.13 | 9.29 |
| 11 | | II | 1.73 | 2.78 | 7.26 | 10.09 | 0.00 | 3.31 | 37.59 | 16.39 | 26.99 | 64.29 | 16.43 | 40.36 | 10.54 | 7.96 | 9.25 |
| 12 | | III | 2.12 | 1.26 | 7.04 | 9.53 | 0.00 | 3.80 | 36.86 | 17.33 | 27.09 | 78.29 | 23.00 | 50.64 | 14.53 | 10.26 | 12.39 |
| 13 | | IV | 4.67 | 0.03 | 8.47 | 9.31 | 0.00 | 3.64 | 39.01 | 18.86 | 28.94 | 65.57 | 19.14 | 42.36 | 18.36 | 10.34 | 14.35 |
| 14 | Apr | I | 8.89 | 0.00 | 8.63 | 9.27 | 0.00 | 3.70 | 37.83 | 18.97 | 28.40 | 72.14 | 21.29 | 46.71 | 14.54 | 10.01 | 12.28 |
| 15 | | II | 6.59 | 0.00 | 8.91 | 9.09 | 0.00 | 4.30 | 39.66 | 23.70 | 31.68 | 66.43 | 20.43 | 43.43 | 16.77 | 10.47 | 13.62 |
| 16 | | III | 4.53 | 0.00 | 9.67 | 9.31 | 0.00 | 3.40 | 40.04 | 21.27 | 30.66 | 67.14 | 21.86 | 44.50 | 16.24 | 11.20 | 13.72 |
| 17 | | IV | 3.43 | 0.05 | 10.41 | 10.56 | 0.00 | 5.47 | 42.11 | 23.34 | 32.73 | 68.14 | 18.29 | 43.21 | 17.86 | 10.67 | 14.26 |
| 18 | May | I | 2.61 | 0.24 | 10.29 | 10.43 | 0.00 | 6.49 | 39.60 | 24.77 | 32.19 | 68.29 | 31.00 | 49.64 | 19.99 | 15.51 | 17.75 |
| 19 | | II | 1.57 | 0.37 | 9.59 | 10.13 | 0.00 | 6.00 | 39.14 | 24.63 | 31.89 | 78.71 | 36.71 | 57.71 | 21.73 | 17.76 | 19.74 |
| 20 | | III | 1.11 | 0.08 | 9.97 | 10.50 | 0.00 | 6.24 | 40.17 | 25.84 | 33.01 | 76.86 | 37.00 | 56.93 | 22.50 | 18.69 | 20.59 |
| 21 | | IV | 0.17 | 0.17 | 9.30 | 9.43 | 0.00 | 9.37 | 37.69 | 27.27 | 32.48 | 75.14 | 43.71 | 59.43 | 23.11 | 20.51 | 21.81 |
| 22 | | V | 0.21 | 1.72 | 10.90 | 11.30 | 0.00 | 8.66 | 40.14 | 27.07 | 33.61 | 73.43 | 39.14 | 56.29 | 23.24 | 19.20 | 21.22 |
| 23 | June | I | 0.47 | 2.86 | 9.53 | 8.51 | 0.00 | 6.94 | 39.54 | 28.14 | 33.84 | 78.14 | 43.57 | 60.86 | 23.79 | 22.50 | 23.14 |
| 24 | | II | 0.25 | 5.77 | 10.76 | 9.16 | 0.00 | 8.87 | 37.89 | 27.60 | 32.74 | 80.71 | 47.00 | 63.86 | 24.41 | 21.93 | 23.17 |
| 25 | | III | 0.58 | 4.32 | 8.00 | 3.47 | 0.00 | 10.54 | 37.07 | 28.36 | 32.71 | 77.86 | 49.14 | 63.50 | 24.21 | 21.13 | 22.67 |
| 26 | | IV | 1.27 | 5.46 | 7.83 | 1.36 | 0.00 | 10.27 | 36.56 | 27.80 | 32.18 | 75.43 | 47.29 | 61.36 | 23.43 | 20.89 | 22.16 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 27 | July | I | 2.11 | 7.14 | 6.90 | 4.06 | 64.00 | 8.20 | 36.16 | 25.97 | 31.06 | 85.86 | 59.86 | 72.86 | 24.34 | 21.71 | 23.03 |
| 28 | | II | 1.71 | 8.56 | 2.74 | 1.29 | 44.70 | 6.43 | 30.09 | 24.99 | 27.54 | 95.86 | 82.00 | 88.93 | 24.80 | 24.84 | 24.82 |
| 29 | | III | 1.22 | 9.36 | 3.50 | 2.26 | 13.90 | 6.09 | 33.04 | 26.10 | 29.57 | 90.86 | 74.57 | 82.71 | 24.87 | 25.70 | 25.29 |
| 30 | | IV | 1.34 | 9.11 | 3.63 | 2.31 | 15.60 | 5.01 | 32.73 | 25.90 | 29.31 | 93.29 | 74.29 | 83.79 | 25.34 | 25.70 | 25.52 |
| 31 | Aug | I | 3.02 | 8.26 | 3.24 | 4.31 | 105.80 | 3.90 | 33.03 | 25.27 | 29.15 | 93.57 | 74.71 | 84.14 | 24.90 | 26.10 | 25.50 |
| 32 | | II | 6.68 | 7.93 | 2.40 | 0.64 | 147.10 | 5.83 | 30.44 | 25.40 | 27.92 | 94.86 | 89.57 | 92.21 | 25.23 | 25.30 | 25.26 |
| 33 | | III | 3.56 | 6.21 | 1.93 | 2.17 | 122.20 | 6.97 | 30.03 | 25.01 | 27.52 | 96.57 | 86.14 | 91.36 | 25.36 | 26.39 | 25.87 |
| 34 | | IV | 1.22 | 6.11 | 2.51 | 1.94 | 113.30 | 3.50 | 30.96 | 25.50 | 28.23 | 96.71 | 78.86 | 87.79 | 25.46 | 25.77 | 25.61 |
| 35 | | V | 1.13 | 5.07 | 2.29 | 2.46 | 114.80 | 5.37 | 31.41 | 24.94 | 28.18 | 98.14 | 85.43 | 91.79 | 25.43 | 25.69 | 25.56 |
| 36 | Sept | I | 0.93 | 4.23 | 2.80 | 2.93 | 99.40 | 6.66 | 30.74 | 25.27 | 28.01 | 96.57 | 79.57 | 88.07 | 24.86 | 24.46 | 24.66 |
| 37 | | II | 0.49 | 3.91 | 3.00 | 3.47 | 11.10 | 3.99 | 31.13 | 25.00 | 28.06 | 96.86 | 76.00 | 86.43 | 23.04 | 24.19 | 23.61 |
| 38 | | III | 0.28 | 4.19 | 4.01 | 6.97 | 24.90 | 4.69 | 31.54 | 24.36 | 27.95 | 96.43 | 65.86 | 81.14 | 23.30 | 23.09 | 23.19 |
| 39 | | IV | 0.00 | 3.83 | 4.66 | 8.01 | 1.00 | 3.74 | 33.04 | 23.94 | 28.49 | 88.29 | 56.43 | 72.36 | 21.93 | 20.30 | 21.11 |
| 40 | Oct | I | 0.21 | 4.71 | 5.74 | 9.20 | 0.00 | 3.96 | 34.34 | 23.80 | 29.07 | 83.86 | 45.00 | 64.43 | 20.44 | 17.99 | 19.21 |
| 41 | | II | 1.77 | 2.87 | 5.84 | 8.07 | 0.00 | 3.43 | 37.33 | 24.06 | 30.69 | 81.71 | 40.00 | 60.86 | 20.93 | 18.59 | 19.76 |
| 42 | | III | 0.74 | 2.24 | 5.16 | 8.57 | 0.00 | 2.11 | 37.90 | 21.97 | 29.94 | 89.00 | 34.00 | 53.64 | 18.41 | 14.46 | 16.44 |
| 43 | | IV | 0.73 | 1.76 | 4.27 | 9.80 | 0.00 | 1.71 | 36.87 | 18.37 | 27.62 | 81.43 | 26.57 | 54.00 | 14.80 | 11.61 | 13.21 |
| 44 | | V | 1.23 | 0.32 | 4.10 | 8.76 | 0.00 | 1.84 | 35.76 | 19.89 | 27.82 | 75.86 | 27.71 | 51.79 | 15.09 | 11.66 | 13.37 |
| 45 | Nov | I | 0.66 | 1.12 | 4.37 | 9.36 | 0.00 | 1.64 | 36.06 | 19.10 | 27.58 | 78.00 | 29.14 | 53.57 | 15.53 | 12.53 | 14.03 |
| 46 | | II | 0.48 | 0.26 | 3.87 | 9.53 | 0.00 | 1.43 | 35.34 | 17.40 | 26.37 | 86.86 | 31.43 | 59.14 | 14.59 | 12.97 | 13.78 |
| 47 | | III | 0.61 | 0.14 | 3.86 | 9.74 | 0.00 | 1.97 | 33.74 | 15.94 | 24.84 | 79.71 | 31.14 | 55.43 | 14.49 | 11.27 | 12.88 |
| 48 | | IV | 0.87 | 1.67 | 3.73 | 7.91 | 0.00 | 2.96 | 31.61 | 18.96 | 25.29 | 71.29 | 44.57 | 57.93 | 12.81 | 15.00 | 13.91 |
| 49 | Dec | I | 0.46 | 1.03 | 3.16 | 9.69 | 0.00 | 1.46 | 33.07 | 16.34 | 24.71 | 89.29 | 39.43 | 64.36 | 13.91 | 14.10 | 14.01 |
| 50 | | II | 0.37 | 0.79 | 2.94 | 9.40 | 0.00 | 2.76 | 30.01 | 12.89 | 21.45 | 81.29 | 35.43 | 58.36 | 9.96 | 10.36 | 10.16 |
| 51 | | III | 0.25 | 0.27 | 2.44 | 9.16 | 0.00 | 1.50 | 29.83 | 12.81 | 21.32 | 86.57 | 40.29 | 63.43 | 10.37 | 12.13 | 11.25 |
| 52 | | IV | 0.17 | 0.18 | 3.14 | 8.49 | 0.00 | 2.34 | 28.08 | 10.78 | 19.43 | 86.50 | 18.38 | 52.44 | 6.78 | 4.24 | 5.51 |

***SMW: Standard Meteorological Weeks, EP: Evaporation, BSS: Bright sun shine, RF: Rain fall, WS: Wind speed, Mor: Morning, Eve: Evening.***

**Table 2 : Correlation coefficient of *D. citri* and *P. citrella* population with weather parameters**

| Sr. No. | Weather Parameters | Population/Twig | |
|---|---|---|---|
| | | ***D. citri*** | ***P. citrella*** |
| 1 | Evaporation ($mmday^{-1}$) (EP) | 0.272 | -0.337* |
| 2 | Bright sunshine hours (hours) (BSS) | -0.149 | -0.681** |
| 3 | Rain fall (mm) (RF) | 0.283* | 0.523** |
| 4 | Wind speed (kmph) (WS) | 0.078 | 0.307* |
| 5 | Maximum temperature (°C) (MaxT) | 0.338* | -0.313* |
| 6 | Minimum temperature (°C) (MinT) | 0.205 | 0.326* |
| 7 | Mean temperature (°C) (MT) | 0.293* | 0.077 |
| 8 | Morning relative humidity (%) (RH1) | -0.257 | 0.573** |
| 9 | Evening relative humidity (%) (RH2) | -0.044 | 0.707** |
| 10 | Mean relative humidity (%) (MRH) | -0.110 | 0.694** |
| 11 | Morning vapour pressure (mm) (VP1) | 0.160 | 0.454** |
| 12 | Evening vapour pressure (mm) (VP2) | -0.012 | 0.630** |
| 13 | Mean vapour pressure (mm) (MVP) | 0.074 | 0.554** |

**** Significant at 5 per cent level***
***** Significant at 1 per cent level***

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