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POPULATION DYNAMICS OF RED ANT *DORYLUS ORIENTALIS* IN POTATO GROWN UNDER FLOOD FREE/ PRONE CONDITIONS

Elangbam Bidyarani Devi*, Badal Bhattacharyya and Sudhansu Bhagawati

Department of Entomology, Assam Agricultural University, Jorhat 785013, Assam, India
*Email: bidyaranielangbam@gmail.com (corresponding author)

ABSTRACT

Experiments were carried out in the farmer's field at Jorhat during 2015-16 and 2016-17 to study the population dynamics of red ant *Dorylus orientalis* Westwood in potato crop. The incidence of *D. orientalis* was observed both under flood free/ and prone conditions in three villages each, during potato growing season. These data were correlated with weather factors. The effect on population buildup was studied with observations at fortnightly interval starting from 1st fortnight of October to 2nd fortnight of February through fixed plot surveys. The observations revealed that maximum incidence (36.5, 33.2 and 30.1; 35.2, 32.5 and 29.8/ pit) was observed in Charaibahi, Karangia and Hokai Khangia villages, respectively during the 1st fortnight of January. In contrast, in the flood prone villages, incidence was observed to be negligible. Correlation coefficients of incidence with weather factors revealed that minimum temperature, soil temperature (morning and evening) and evaporation rate show a significantly negative correlation; whereas relative humidity (RH) (morning and evening) exhibited significant positive correlation in flood free villages. In flood prone villages minimum temperature as well as morning soil temperature showed significant negative correlation (2015-16); in contrast, in flood prone villages, RH (morning and evening) showed significant positive correlation (2016-17).

Key words: *Dorylus orientalis*, population dynamics, fixed plot survey, flood free/ prone, potato, temperature, relative humidity, soil temperature, evaporation rate

Red ant *Dorylus orientalis* Westwood (Formicidae: Hymenoptera) is generally a subterranean ant and occurs in a wide range of habitats, including cultivated lands (Wilson, 1964). Occurrence of *D. orientalis* as a pest has been reported throughout India in various economically important crops. It has long been considered to be a major insect pest of potato both in plains and hills (Fletcher, 1914). In Assam, *D. orientalis* is popularly known as "red ant" (Rahman, 1967). Potato being an important cash crop and major food item of Indian diet for both vegetarian and non-vegetarian is extensively cultivated in both plains and hills of Assam with a production of 1072780 tonnes (Anon., 2017). There are numbers of biotic and abiotic factors that lead to reduction of potato production and among the various biotic constrains insect pest problems are the major ones. Considering various insect pests, *D. orientalis* causes extensive damage mainly on underground potato tubers and the damaged tubers exhibit minute holes (2-3 mm dia). Highest infestation is recorded at the time of harvesting which reduces tuber quality as well as market price, as it makes them unfit for human consumption (Bhandari, 2011). In severe cases, the tuber infestation exhibited was high as 51.77- 61.50% (Chowdhury, 1997). In Bihar, the potato crop showed around 70-90% of tuber damage by *D. orientalis* (Roonwal, 1976).

The pest generally appears during December and remains active until April, causing > 10% tuber damage in irrigated potato (Bhandari, 2011). The biology and seasonal abundance of *D. orientalis* extremely depend on the prevailing atmospheric conditions. High temperature followed by dry weather favour development, population build up and damage severity of this obnoxious pest. Various weather parameters affect insect population dynamics as increasing temperature induces faster developmental rates whereas heavy rain or extreme temperature and low moisture induced low survival rate (Hespenheide, 1991; Nestel et al., 1994; Tipping et al., 2005). Seasonal variations in weather factors such as rainfall and temperature might be the most important causes of dramatic changes in insect abundance. Weather and climatic conditions are known to significantly affect the population dynamics of insect pests (Kennedy and Storer, 2000). Knowledge of abiotic conditions such as temperature, day length, rainfall and relative humidity can be used as important components in forecasting and predicting the severity of insect pests (Milford and Dugdale, 1990). This study explores the population dynamics of *D. orientalis* in potato crop grown under flood free and flood prone conditions and its correlates the incidence with weather factors.

MATERIALS AND METHODS

The experiments were carried out in the farmer's field of Charaibahi, Karangia, Hokai Khangia, Karatipar, Kartik chapori and Aruna chapori villages, Jorhat, Assam during 2015-16 and 2016-17. The population dynamics was studied under both flood free and flood prone conditions in potato growing fields. For this, five pits/village (size: 30 cm × 30 cm × 30 cm) were dug randomly through fixed plot survey and the population of red ants were counted. Observations was recorded at fortnightly interval from October to February in six villages, three each in both the conditions. Meteorological parameters *viz*., temperature (maximum and minimum), soil temperature (morning and evening), relative humidity (morning and evening), total rainfall, number of rainy days, bright sunshine hours (BSSHs) and evaporation rate during the period of investigation were collected from the Meteorological Observatory of the Department of Agrometeorology, Assam Agricultural University, Jorhat. Influence of these factors on *D. orientalis* was assessed by correlation and regression analysis. A simple correlation analysis was made between the mean incidence of *D. orientalis* with weather factors to find out their influence.

RESULTS AND DISCUSSION

Population dynamics of red ant *D. orientalis* studied in six villages (3 flood free and flood prone each) in potato growing fields during 2015-17 is depicted in Table 1. The buildup of *D. orientalis* was observed from 1st fortnight of November to 2nd fortnight of February. The incidence was observed from the 1st fortnight of November, 2015 with a very low population of 8.6, 7.2 and 5.00/ pit; 7.8, 6.2 and 5.5/ pit during the 1st fortnight of November 2016 in Charaibahi, Karangia and Hokai Khangia villages, respectively under flood free conditions. The peak incidence was in the 1st fortnight of January, 2016 with a mean of 36.5, 33.2 and 30.1/ pit in Charaibahi, Karangia and Hokai Khangia villages, respectively; 35.2, 32.5 and 29.8/ pit was observed in all the flood free villages during 1st fortnight of January, 2017. The incidence showed a gradual decreasing

Table 1. Incidence of *D. orientalis*/ 30 cm^3 - in flood free/ prone areas (2015-16, 2016-17)

Month	Observation	Incidence or counts/ 30 cm^3											
		Flood free villages						Flood prone villages					
		Charaibahi		Karangia		Hokai Khangia		Karatipar		Kartik chapori		Aruna chapori	
		2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17
October	1st Fortnight	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2nd Fortnight	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
November	1st Fortnight	8.6	7.8	7.2	6.2	5.0	5.5	0.0	0.0	0.0	0.0	0.0	0.0
	2nd Fortnight	10.4	21.2	8.1	19.0	6.1	16.8	0.0	0.0	0.0	0.0	0.0	0.0
December	1st Fortnight	21.2	27.5	19.5	24.3	16.5	22.6	0.0	0.0	0.0	0.0	0.0	0.0
	2nd Fortnight	29.7	30.2	26.7	27.3	23.7	26.4	2.2	2.2	2.8	2.6	3.2	1.8
January	1st Fortnight	36.5	35.2	33.2	32.5	30.1	29.8	1.2	3.9	1.6	4.5	2.1	3.5
	2nd Fortnight	31.2	33.2	28.3	30.1	25.6	27.9	1.0	2.5	1.2	2.9	1.9	2.1
February	1st Fortnight	29.4	26.5	26.3	23.6	22.5	22.3	0.0	0.0	0.0	0.0	0.0	0.0
	2nd Fortnight	24.5	18.6	21.2	15.9	17.2	14.2	0.0	0.0	0.0	0.0	0.0	0.0

*Mean of 5 observations

trend from the 2nd fortnight of January. However, very negligible counts were observed in all the three flood prone villages (Karatipar, Kartik Chapori and Aruna chapori) as compared to flood free villages. Maximum numbers of red ants in flood prone areas observed was 2.2, 2.8 and 3.2/ pit in Karatipar, Kartik Chapori and Aruna Chapori villages, respectively during the 2nd fortnight of December, 2015; 3.9, 4.5 and 3.5/ pit during the 2nd fortnight of December, 2016 where only negligible counts were obtained. Earlier reports reveal that the chronically flood affected areas on the two sides of the river Brahmaputra were free from red ant infestation (Khaund, 1979).

The correlation of weather factors such as temperature (maximum and minimum), soil temperature (morning and evening), relative humidity- RH (morning and evening), total rainfall, number of rainy days, bright sunshine hours and evaporation rate with incidence of ants during 2015-17 is depicted in Table 2. These reveal that morning RH (r = 0.869** and r = 0.840** in Charaibahi, r = 0.868** and r = 0.849** in Karangia and r = 0.859** and r = 0.850** in Hokai Khangia villages) during 2015-16 and 2016-17 and evening RH (r = 0.577* and r = 0.649* in Charaibahi, r = 0.599* and r = 0.688* in Karangia and r = 0.625* and r = 0.660* in Hokai Khangia villages) showed significant positive correlation, in all the three flood free villages. Minimum temperature showed significant negative correlation in Charaibahi (r = -0.922** and r = -0.906**), Karangia (r = -0.916** and r = -0.899**) and Hokai Khangia (r = -0.910** and r = -0.899**) villages, respectively. Similarly, a negative and significantly relation with morning soil temperature in Charaibahi (r = -0.942** and r = -0.948**), Karangia (r = -0.936** and r = -0.940**) and Hokai Khangia villages (r = -0.926** and r = -0.937**), evening soil temperature (r = -0.945** and r = -0.928** in Charaibahi, r = -0.940** and r = -0.915** in Karangia and r = -0.927** and r = -0.915** in Hokai Khangia villages) and evaporation rate (r = -0.861** and r = -0.870** in Charaibahi, r = -0.862** and r = -0.879** in Karangia and r = -0.863** and r = -0.875** in Hokai Khangia villages) were observed.; however, maximum temperature (r = -0.775* in Charaibahi, r = -0.726* in Karangia, r = 0.718* in Hokai Khangia villages) showed negative correlation but bright sunshine hours (r = 0.811* in Charaibahi, r = 0.812* in Karangia and r = 0.797* in Hokai Khangia villages showed positive correlation.

Data in Table 2 reveal that minimum temperature showed significant negative correlation in all the three flood prone villages *viz.*, Karatipar (r = -0.687**), Kartik Chapori (r = -0.693**) and Aruna Chapori (r = -0.784**) villages. Similarly, morning soil temperature had significant negative correlation in Karatipar (r = -0.617*), Kartik Chapori (r = -0.624*) and Aruna Chapori (r = -0.636*) villages during 2015-16. Morning RH (r = 0.711* in Karatipar, r = 0.711* in Kartik Chapori and r = 0.711* in Aruna Chapori villages and evening RH (r = 0.895** in Karatipar, r = 0.893** in Kartik chapori and r = 0.899** in Aruna chapori villages during 2016-17. The significant relationship between *D. orientalis* incidence and weather factors was also subjected to regression analysis. These results are in accordance with the findings of Kishore et al. (1989) who observed that the weather between 44 and 51 standard weeks with weekly maximum and minimum temperatures ranging respectively, between 26°C-31.4°C and 10.4°C-17.1°C with 80.0-90.0% morning and 37.0-49.0% RH with no rains in between had jointly favoured the multiplication of *D. orientalis* on potato. Similarly, high temperature and dry weather was also found to favour their population buildup (Kishore et al. 1990).

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Table 2. Correlation coefficient (r) and regression equation-*D. orientalis* incidence vs. weather factors (2015-16)

Sampled villages	Temperature (°C) Maximum	Temperature (°C) Minimum	Soil Temperature (°C) Morning	Soil Temperature (°C) Evening	Relative Humidity (%) Morning	Relative Humidity (%) Evening	Total rainfall (mm)	No. of rainy days	BSSH	Evaporation rate (mm)
2015-16										
Flood free villages										
1. Charaibahi	0.032^{NS}	-0.922** y=-2.749x+57.87	-0.942** y=-3.289x+82.91	-0.945** y=-3.147x+91.61	0.869** y= 3.697x-337.8	0.577* y=2.279x-143.2	-0.193^{NS}	-0.400^{NS}	0.135^{NS}	-0.861** y=-17.02x+50.31
2. Karangia	0.042^{NS}	-0.916** y=-2.492x+52.13	-0.936** y=-2.982x+74.85	-0.940** y=-2.856x+82.79	0.868** y=3.37x-308.3	0.599* y=2.157x-136.6	-0.166^{NS}	-0.409^{NS}	0.140^{NS}	-0.862** y=-15.56x+45.53
3. Hokai Khangia	0.072^{NS}	-0.910** y=-2.243x+46.26	-0.926** y=-2.674x+66.49	-0.927** y=-2.553x+73.44	0.859** y=3.024x-277.3	0.625* y=2.043x-130.8	-0.142^{NS}	-0.438^{NS}	0.183^{NS}	-0.863** y=-14.12x+40.51
Flood prone villages										
1. Karatipar	0.081^{NS}	-0.687** y=-0.177x+2.097	-0.617* y=-0.123x+2.838	-0.545^{NS}	0.529^{NS}	0.350^{NS}	-0.186^{NS}	-0.587^{NS}	0.431^{NS}	-0.533^{NS}
2. Kartik Chapori	0.092^{NS}	-0.693** y=-0.154x+2.750	-0.624* y=-0.162x+3.729	-0.553^{NS}	0.537^{NS}	0.367NS	-0.182^{NS}	-0.586^{NS}	0.452^{NS}	-0.546^{NS}
3. Aruna Chapori	0.117^{NS}	-0.704** y=-0.188x+3.377	-0.636* y=-0.199x+4.59	-0.568^{NS}	0.554^{NS}	0.407^{NS}	-0.163^{NS}	-0.580^{NS}	0.501^{NS}	-0.567^{NS}
2016-17										
Flood free villages										
1. Charaibahi	-0.775* y=-5.212x+171.8	-0.906** y=-2.904x+67.63	-0.948** y=-2.948x+79.93	-0.928** y=-3.732x+112.7	0.840** y=6.461x-606	0.649* y=2.625x-155.1	-0.430^{NS}	-0.624^{NS}	0.811* y=5.929x-15.49	-0.870** y=-23.20x+68.29
2. Karangia	-0.726* y=-1.090x+43.04	-0.899** y=-2.635x+61.08	-0.940** y=-2.675x+72.24	-0.915** y=-3.366x+101.5	0.849** y=5.970x-560.6	0.688* y=2.472x-147	-0.432^{NS}	-0.622^{NS}	0.812* y=5.432x-14.64	-0.879** y=-21.45x+62.52
3. Hokai Khangia	-0.718* y=-1.011x+39.87	-0.899** y=-2.466x+56.97	-0.937** y=-2.498x+67.31	-0.915** y=-3.152x+94.87	0.850** y=5.598x-525.9	0.660* y=2.286x-135.9	-0.417^{NS}	-0.613^{NS}	0.797* y=4.977x-13.38	-0.875** y=-20.00x+58.15
Flood prone villages										
1. Karatipar	-0.455^{NS}	-0.425^{NS}	-0.526^{NS}	-0.386^{NS}	0.711* y=0.677x-64.89	0.895** y=0.398x-25.7	-0.175^{NS}	-0.256^{NS}	0.441^{NS}	-0.560^{NS}
2. Kartik chapori	-0.461^{NS}	-0.427^{NS}	-0.526^{NS}	-0.398^{NS}	0.711* y=0.697x-66.56	0.893** y=0.460x-29.71	-0.160^{NS}	-0.255^{NS}	0.436^{NS}	-0.559^{NS}
3. Aruna chapori	-0.434^{NS}	-0.415^{NS}	-0.517^{NS}	-0.376^{NS}	0.711* y=0.525x-50.15	0.899** y=0.349x-22.55	-0.164^{NS}	-0.256^{NS}	0.438^{NS}	-0.559^{NS}

* Significant at p=0.05, ** Significant at p=0.01, NS-Non significant

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