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POPULATION DYNAMICS OF GIANT AFRICAN SNAIL, *ACHATINA FULICA* BOWDICH (STYLOMMATOPHORA: ACHATINIDAE) AND ITS CORRELATION WITH WEATHER PARAMETERS

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ABSTRACT
Maximum giant African snail, *Achatinafulica* population(94.20 snails/25 m^2) was recorded in 39th standard week of 2008 and subsequently a decrease in snail population was recorded which reached to its lowest level (4.20 snail/25 m^2) by 47th standard week. Combined effect of weather factors on *A. fulica* population was 74 per cent (R^2 = 0.74).Pest population was positively correlated with maximum and minimum temperatures(r = 0.203 and 0.659**). Similarly humidity also showed a positive and significant relationship with snail population (r = 0.367* and 0.687**). In 2009 snail population showed similar trend as that of previous year and cumulative effect of weather factors on population dynamics of *A. fulica* was 62 per cent (R^2 = 0.74). Optimum conditions of good summer rainfall and increase relative humidity provided favourable environment for multiplication of snail

INTRODUCTION

The giant African snail, *Achatinafulica* Bowdich is an important non-insect pest of agri-horticultural crops in many parts of the world. In India, this pest causes severe devastation to a number of vegetable and plantation crops. A prolific breeder, each individual is capable of laying eggs, and soon rehabilitates itself by rebuilding its population, spreads over all around and becomes a menace for vegetation.Climatic conditions, viz. rainfall, humidity, optimum temperature had a pronounced influence on snail population and are indispensable factors for rapid multiplication of the pest (Gupta and Doharey, 1985). Raut and Ghose (1984) recorded that humidity (80-90 per cent) as most important factors for the survival and biological activities of *A.fulica*. Srivastava(1992) reported snail infested pockets from several places in Bihar with an average population ranging from 6 to 32 snails/m^2. Thakur (2003) reported maximum snail population during rainy season and population density reached its peak during the third week of September. Ravi kumara *et al*. (2007) recorded snail population (1.00 to 91.25 snails per 10 m^2) throughout the year and the population had highly significant negative correlation with maximum temperature and a highly significant positive correlation with relative humidity. Justin *et al*. (2008) observed that snail incidence remained low between January and March but increased later to reach a peak at 12.2 snails/m2 area by July and remained steady till October but declined thereafter on

vanilla vines in Kanya kumari (Tamil Nadu). Chandaragi and Patil (2014) reported highest snail population during second fortnight of October and lowest during March in betelvine ecosystem. They reported highly significant positive correlation with rainfall (r = 0.652**) and minimum relative humidity (r = - 0.407**) exerted negative and highly significant association with population build up of snail. Silva and Omena (2014) reported an apparent annual cycle for *A. fulica*in Salvador – Bahia with a recruitment period covering the end of rainy season and the dry season. The regression between precipitation and sexual activity was significant showing that the higher rainfall increased sexual activity.The present paper summarizes the population fluctuation of *A. fulica* and its correlation with abiotic factors in north Bihar conditions.

MATERIALS AND METHODS

The present experiment was carried out in and around Rajendra Agricultural University Campus, Pusa (Samastipur). Five sites were selected randomly ,each of about 25 m^2 to determine number of snails. Observations were recorded at weekly interval, beginning from 20th standard week during May 2008 and 2009 in crop fields. Data pertaining to meteorological parameters, viz. temperature (^{0}C) relative humidity (%) and rainfall were obtained from Department of Agro-meteorology, RAU, Pusa. Snail population was correlated with abiotic factors and correlation and regression coefficients, coefficient of determination (R^2) and multiple regression equation were determined in order to establish the relationship between pest population and abiotic factors.

RESULTS AND DISCUSSION

Data pertaining to mean number of snail/25 m^2 and weather conditions prevailing during the year 2008 issu mmarised in Table 1. The snail pest appeared one week after first monsoon shower (17 mm rainfall in 1stweek of June) and after subsequent gradual increase its population reached at its peak in 39th standard week, *i.e.* 94.20 snails/25 m^2 at maximum temperature 30.85ºC, minimum temperature 25.17ºC, maximum relative humidity 92.0 per cent, minimum relative humidity 75 per cent and rainfall 145.7 mm.There after, the population decreased gradually to its lowest level (4.20 snail/ 25 m^2) by 47th standard week. During the 48th standard week, the pest remained almost untraceable in the crop fields. Estimation of giant African snail population from second fortnight of May 2008, to second fortnight of November revealed that population occurred in a range of 4.20 snail/25 m^2 to 94.20 snail/25 m^2. Therefore, it can be predicted that optimum conditions of good summer rainfall and increase relative humidity provided favourable environment for growth and abundance of the snail.

During 2009 snail population showed similar trend as that of previous year (Table 2). In this year 4.20 snail/25 m^2were recorded in 21st standard week (2ndweek of May) and after gradual increase their number reached at maximum (91.50 snail/25 m^2) during 38th standard week (2ndfortnight of September) at an average temperature, *i.e.* 26.10-34.70ºC, average relative humidity, 92 to 63 per cent and rainfall 9.6 mm. There after, the pest population declined gradually and reached minimum (2.10 snails/25 m^2) when average temperature and average relative humidity were 11.58-26.58ºC and 74 to 28 per cent, respectively. The present findings corroborate earlier results of Ravi kumara *et al*. (2007) and Justin *et al*. (2008) who reported that rainy season was most favourable for snail's activity and amongst all factors, humidity played a significant role in population build up of *A. fulica*. Besides, very law temperature did not favour the activity of pest and compelled the snails to hibernate during winter season. The snail population increased during rainy season thereby indicating that high humidity and rainfall resulted in its increased sexual activity, thus the results of present study are in accordance with findings of Silva and Omena (2014).

The quantitative relationship between snail population and weather parameters was determined by correlation and regression analysis and correlation coefficient (*r*) and regression coefficient (*b*) and regression equation between pest population versus weather parameters are depicted in Tables3 and 4. In 2008 both maximum and minimum temperature exhibited a positive correlation with pest population (*r* = 0.203 and 0.659**). The minimum temperature significantly influenced development and survival of snail. Besides, maximum and minimum relative humidity also showed a positive and significant correlation with snail population (*r* = 0.367* and 0.687**). The findings indicated that humidity conditions prevailing during the period of study were quite favourable for quick multiplication and development of snail. Rainfall was also found to had a positive correlation with snail population (*r* = 0.244). Combined effect of weather

Table 1: Seasonal fluctuation in population of *Achatinafulica* Bowdich during 2008.

Standard week	Mean no. of snails/25m^2	Temperature (ºC) Maximum	Minimum	Relative humidity (%) At 7 hrs	At 14 hrs	Total rainfall (mm)
20	0.00	35.13	21.13	80	50	17.00
21	6.30	32.47	24.13	84	58	29.00
22	19.47	37.81	26.17	77	42	4.00
23	28.65	34.37	25.51	85	60	105.50
24	34.53	32.92	26.84	89	69	114.00
25	40.23	31.55	26.46	89	77	35.00
26	44.46	33.85	26.96	89	71	127.00
27	45.36	31.63	26.73	92	73	159.00
28	45.75	33.00	26.73	90	77	105.50
29	55.83	30.78	26.70	94	83	174.90
30	68.43	31.00	27.03	90	79	70.00
31	72.00	32.80	27.76	86	67	0.00
32	75.00	32.75	27.08	86	72	36.00
33	78.30	30.94	26.39	94	82	110.00
34	81.00	32.31	27.66	88	70	25.70
35	84.00	33.08	26.10	92	71	116.50
36	87.60	32.81	26.60	87	67	15.60
37	89.43	33.88	27.63	87	68	10.00
38	92.1	32.38	26.40	87	71	0.00
39	94.2	30.85	25.17	92	75	145.70
40	91.5	31.87	24.90	93	72	86.60
41	77.13	32.10	24.10	91	59	12.00
42	60.12	32.37	22.20	91	50	0.00
43	42.75	31.04	20.94	89	50	0.00
44	32.10	30.48	19.66	93	47	0.00
45	20.73	30.40	15.32	92	47	0.00
46	9.21	28.98	15.51	91	40	0.00
47	4.20	27.01	13.73	88	42	0.00
48	0.00	26.10	12.60	78	42	0.00

Table 2: Seasonal fluctuation in population of *Achatinafulica*Bowdich during 2009

Standard week	Mean no. of snails/25m^2	Temperature (^{0}C) Maximum	Minimum	Relative humidity (%) At 7 hrs	At 14 hrs	Total rainfall (mm)
20	0.00	34.15	21.58	82	51	0.00
21	4.20	31.08	24.11	86	71	125.70
22	15.60	33.58	24.34	86	54	44.40
23	21.90	31.25	24.67	77	50	44.50
24	30.33	36.51	26.34	71	50	0.00
25	36.12	39.70	23.97	82	42	0.00
26	42.15	30.44	23.15	88	62	30.50
27	45.00	32.12	26.42	89	69	35.20
28	48.00	30.67	27.17	82	59	0.00
29	51.03	35.6	24.48	82	59	0.00
30	68.13	35.75	26.75	91	66	49.50
31	70.53	33.67	26.26	92	67	73.40
32	75.03	33.10	26.57	89	76	95.80
33	78.00	31.91	26.17	93	80	91.40
34	81.15	32.38	25.02	92	70	45.10
35	81.27	32.57	23.04	89	71	31.00
36	84.21	32.94	25.55	84	77	65.60
37	87.63	32.77	25.75	92	71	36.40
38	91.50	34.70	26.10	92	63	9.60
39	90.00	30.38	25.85	89	56	0.00
40	75.15	32.78	25.24	90	72	21.40
41	60.18	31.32	22.38	91	53	17.00
42	54.15	32.42	19.05	87	46	0.00
43	33.33	27.17	15.91	86	33	0.00
44	25.56	31.08	16.55	89	44	0.00
45	19.50	30.32	16.58	89	37	0.00
46	8.10	29.11	19.90	88	60	0.00
47	2.10	26.58	11.58	74	28	0.00
48	0.00	26.78	10.03	77	36	0.00

Table 3: Correlation and regression coefficients of population of *Achatinafulica* with weather parameters

Year	2008		2009	
Weather variables	*r*	*b*	*r*	*b*
Maximum temperature (X_1)	0.203	1.366	0.332	-4.629
Minimum temperature (X_2)	0.659**	4.995	0.619**	1.954
Maximum relative humidity (%) (X_3)	0.367*	4.894	0.611**	1.965
Minimum relative humidity (%) (X_4)	0.687**	0.577	0.655**	0.961
Rainfall ((X_5)	0.244	-0.285	0.251	-0.280
Intercept		-568.491		-212.543
F ratio		12.88		7.51
R^2		0.74		0.62

r = Correlation coefficient ; *b* = Regression coefficient; * = Significant at 1 per cent; ** = Significant at 5 per cent

Table 4: Coefficient of determination (R^2) and multiple regression equation in relation to weather components and population of *A. fulica*

Year	Multiple regression equation	R^2
2008	$Y_1 = -568.49 + 1.366\ X_1 + 4.995\ X_2 + 4.894\ X_3* + 0.5774\ X_4 - 0.2854\ X_5*$	0.74
2009	$Y_1 = -212.543 - 4.629X_1 + 1.954\ X_2 + 1.965X_3* + 0.961\ X_4 - 0.280X_5$	0.62

* Significant at 5 per cent

factors on *A. fulica* population was worked out through coefficient of determination(R^2 = 0.736) and regression equation (regression coefficient : 1.366X_1, 4.995 X_2, 4.894 X_3, 0.577 X_4 and -0.285 X_5).

In 2009, maximum temperature was observed to had positive and non-significant correlation (*r* = 0.332) with snail population, but minimum temperature was observed positively and significantly correlated (*r* = 0.611**). Results obtained in this year were in accordance as that of previous year.Maximum and minimum relative humidity were found to be positively and significantly correlated with snail population (*r* = 0.619** and 0.611**). Rainfall was showed a positive correlation with snail population (*r* = 0.252). The cumulative effect of weather factors on population dynamics of *A. fulica* was 62 per cent (R^2 = 0.620). Regression coefficient (*b*) for various weather components were: -0.0462X_1, 1.954 X_2, 1.965 X_3, 0.961 X_4 and 0.280 X_5.

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