

## FURTHER STUDY ON THE ASPECTS OF POPULATION FLUCTUATIONS OF PHLEBOTOMID SANDFLIES (DIPTERA : PHLEBOTOMIDAE) IN NORTH BIHAR

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### ABSTRACT

This paper deals with the continued study of numerical fluctuation of populations of phlebotomid sandflies of Darbhanga, Sitamarhi, Samastipur and Muzaffarpur districts of North Bihar for two more years, i.e., from November 1979 to September 1981. A total number of 14,587 flies belonging to *Phlebotomus argentipes* Annandale and Brunetti, *Phlebotomus papatasi* Scopoli and *Sergentomyia babu* (Annandale) were collected, the increase and decrease of their populations are discussed in relation to abiotic factors, and the cause for the spurt in population is also discussed.

### INTRODUCTION

In the earlier paper (1981), I had given in detail the significance of the study, a brief description of the nature of the terrain along with a map showing the collection localities, an account of the different kinds of houses of North Bihar, the mode of collection of phlebotomid sandflies, a graphical representation of the flies collected, their seasonal abundance for one year, etc. The present paper deals with the continuation of this study for two more years, i.e., from November 1979 to September 1981, and regular bimonthly collections of flies were made per man hour from all the same eleven localities—three each from Muzaffarpur (Chapralasgipur, Sipahapur and Pirocha), Sitamarhi (Gotbavadevpur, Sakanbavadevpur and Thumma) and Samastipur (Tajpur, Adharpur and Shambu Patti) districts and two from Darbhanga (Derhar and Khansi Simidi) district.

### RESULTS

A total number of 14,587 flies belonging to *Phlebotomus papatasi* Scopoli, *P. argentipes* Annandale and Brunetti and *Sergentomyia babu* (Annandale) were collected from Darbhanga, Sitamarhi, Samastipur and Muzaffarpur districts (Table I-VIII). It can be seen from the tables that as in the first year *P. papatasi* is the predominant species followed by *S. babu* and *P. argentipes*. In cases of *P. papatasi* and *S. babu* the females outnumbered the males whereas in *P. argentipes* both sexes are almost equal in number (total number of females 256, total number of males 250). However, in the first year study (1978-79) in the case of *P. argentipes* it was observed that the females were lesser (48) than the males (82). Overall analysis shows that the total population contains 87.34% *P. papatasi*, 2.43% *P. argentipes* and 10.23% *S. babu* in 1979-80, and 84.88% *P. papatasi*, 4.44% *P. argentipes* and 10.68% *S. babu* in 1980-81, the only notable

TABLE I.—*Phlebotomid sandflies collected per man hour from indoors in Darbhanga District from November 1979 to September 1980 along with climatological data*

Name of species	Nov. 79			Jan. 80			March 80			May 80			July 80			Sept. 80			Total	% of the grand total
	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T		
<i>P. papatasi</i>	33	81	114	1	—	1	22	68	90	83	138	221	187	322	509	147	309	456	1391	82.36
<i>P. argentipes</i>	7	8	15	—	—	—	3	—	3	—	—	—	4	2	6	12	21	33	57	3.37
<i>S. babu</i>	12	23	35	1	1	2	10	13	23	24	26	50	38	56	94	15	22	37	241	14.27
Grand total	52	112	164	2	1	3	35	81	116	107	164	271	229	380	609	174	352	526	1689	100.00
Temp. Mean maxi °C	29.7			23.6			32.2			35.0			33.6			32.6				
Temp. Mean mini °C	18.7			12.5			19.8			26.1			27.9			27.1				
Mean monthly rainfall (mm)	2.6			0.1			0.8			4.8			13.8			5.5				
Mean monthly humidity (%) at 17.30	70.4			70.4			52.8			63.8			82.7			81.3				
Mean wind velocity (Km. p. h) at 08.30	0.0			0.3			0.8			2.7			1.4			1.3				

TABLE II.—*Phlebotomid sandflies collected per manhour from indoors in Darbhanga District from November 1980 to September 1981 along with climatological data*

Name of species	Nov. 80			Jan. 81			March 81			May 81			July 81			Sept. 81			Total	% of the grand total
	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T		
<i>P. papatasi</i>	16	52	68	—	—	—	18	25	43	67	140	207	184	306	490	162	317	479	1287	71.86
<i>P. argentipes</i>	46	70	116	—	—	—	22	13	35	6	14	20	15	11	26	5	—	5	202	11.28
<i>S. babu</i>	7	12	19	—	—	—	26	37	63	21	41	62	43	68	111	19	28	47	302	16.86
Grand total	69	134	203	—	—	—	66	75	141	94	195	289	242	385	627	186	345	531	1791	100.00
Temp. mean maxi °C	26.5			16.7			27.3			33.8			28.5			29.8				
Temp. mean mini °C	20.0			8.6			18.7			24.6			25.6			25.6				
Mean monthly rainfall (mm)	0.0			0.6			1.2			1.7			20.2			7.1				
Mean monthly humidity (%) at 17.30	63.3			72.8			45.3			62.1			81.9			78.2				
Mean wind velocity (Km. p. h) at 08.30	0.0			0.3			1.3			2.0			1.8			3.3				

TABLE III.—*Phlebotomid sandflies collected per man hour from indoors in Sitamarhi District from November 1979 to September 1980 along with climatological data*

Name of species	Nov. 79			Jan. 80			March 80			May 80			July 80			Sept. 80			Total	% of the grand total
	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T		
<i>P. papatasi</i>	65	160	225	—	—	—	152	142	294	198	294	492	382	473	855	276	364	640	2506	87.26
<i>P. argentipes</i>	2	1	3	—	—	—	1	3	4	1	2	3	3	1	4	14	17	31	45	1.57
<i>S. babu</i>	16	19	95	—	—	—	27	32	59	27	33	60	36	78	114	22	31	53	321	11.18
Grand total	83	180	263	—	—	—	180	177	357	226	329	555	421	552	973	312	412	724	2872	100.01
Temp. mean maxi °C	29.7			23.6			32.2			35.0			33.6			32.3				
Temp. mean mini °C	18.7			12.5			19.8			26.1			27.9			27.1				
Mean monthly rainfall (mm)	2.6			0.1			0.8			4.8			13.8			5.5				
Mean monthly humidity (%) at 17.30	70.4			70.4			52.8			63.8			82.7			81.3				
Mean wind velocity (Km. p. h) at 08.30	0.0			0.3			0.8			2.7			1.4			1.3				

 TABLE IV.—*Phlebotomid sandflies collected per man hour from indoors in Sitamarhi District from November 1980 to September 1981 along with climatological data*

Name of species	Nov. 80			Jan. 80			March 81			May 81			July 81			Sept. 81			Total	% of the grand total
	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T		
<i>P. papatasi</i>	45	115	160	—	—	—	105	91	196	217	291	508	407	529	936	338	474	812	2612	86.49
<i>P. argentipes</i>	3	3	6	—	—	—	9	7	16	7	7	14	21	14	35	4	1	5	76	2.52
<i>S. babu</i>	28	41	69	—	1	1	29	34	63	20	26	46	35	59	94	22	37	59	332	10.99
Grand total	76	159	235	—	1	1	143	132	275	244	324	568	463	602	1055	364	512	876	3020	100.00
Temp. mean maxi °C	26.5			16.7			27.3			33.8			28.5			29.8				
Temp. mean mini °C	20.0			8.6			18.7			24.6			25.6			25.6				
Mean monthly rainfall (MM)	0.0			0.6			1.2			1.7			20.2			7.1				
Mean monthly humidity (%) at 17.30	63.3			72.8			45.3			62.8			81.9			78.2				
Mean wind velocity (Km. p. h) at 08.30	0.0			0.3			1.3			2.0			1.8			3.3				

TABLE V.—*Phlebotomid sandflies collected per man hour from indoors in Samastipur District from November 1979 to September 1980 along with climatological data*

Name of species	Nov. 79			Jan. 80			March 80			May 80			July 80			Sept. 80			Total	% of the grand total
	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T		
<i>P. papatasi</i>	22	37	59	—	—	—	11	19	30	43	52	95	76	133	209	78	124	202	595	81.84
<i>P. argentipes</i>	2	4	6	—	—	—	5	3	8	2	11	13	6	8	14	9	9	18	59	8.12
<i>S. babu</i>	2	3	5	—	—	—	4	6	10	7	7	14	12	16	28	3	13	16	73	10.04
Grand total	26	44	70	—	—	—	20	28	48	52	70	122	94	157	251	90	146	236	727	100.00
Temp. mean maxi °C	29.3			23.0			31.2			34.6			32.3			32.7				
Temp. mean mini °C	17.9			8.9			14.7			21.5			25.5			25.2				
Mean monthly rainfall (mm)	2.9			0.1			0.5			2.7			15.4			5.7				
Mean monthly humidity (%) at 17.30	79.7			69.7			47.9			73.6			83.4			79.9				
Mean wind velocity (Km. p. h) at 08.30	0.6			1.3			2.4			3.6			2.5			2.5				

TABLE VI.—*Phlebotomid sandflies collected per man hour from indoors in Samastipur District from November 1980 to September 1981 along with climatological data*

Name of species	Nov. 80			Jan. 81			March 81			May 81			July 81			Sept. 81			Total	% of the grand total
	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T		
<i>P. papatasi</i>	29	54	83	—	—	—	14	27	41	37	49	86	88	163	251	91	148	239	700	85.89
<i>P. argentipes</i>	3	4	7	—	—	—	2	1	3	—	—	—	9	7	16	8	3	11	37	4.54
<i>S. babu</i>	—	4	4	—	—	—	2	8	10	7	4	11	9	21	30	7	16	23	78	9.57
Grand total	32	62	94	—	—	—	18	36	54	44	53	97	106	191	297	106	167	273	815	100.00
Temp. mean maxi °C	31.4			22.3			28.6			35.0			33.2			33.5				
Temp. mean mini °C	21.9			10.2			17.0			23.1			27.3			28.5				
Mean monthly rainfall (mm)	0.0			0.8			1.3			1.8			17.5			6.5				
Mean monthly humidity (%) at 17.30	71.6			75.1			48.9			61.3			83.8			81.3				
Mean wind velocity (Km. p. h) at 08.30	0.4			1.4			1.9			3.3			2.5			5.8				

TABLE VII.—*Phlebotomid sandflies collected per man hour from indoors in Muzaffarpur District from November 1979 to September 1980 along with climatological data*

Name of species	Nov. 79			Jan. 80			March 80			May 80			July 80			Sept. 80			Total	% of the grand total
	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T		
<i>P. papatasi</i>	63	92	155	1	—	1	47	91	138	105	156	261	223	385	613	192	296	488	1656	94.57
<i>P. argentipes</i>	—	—	—	—	—	—	2	—	2	—	2	2	1	1	2	3	1	4	10	0.57
<i>S. babu</i>	3	5	8	—	2	2	4	7	11	9	11	20	13	20	33	3	8	11	85	4.85
Grand total	66	97	163	1	2	3	53	98	151	114	169	283	242	406	648	198	305	503	1751	99.99
Temp. mean maxi °C	29.3			23.0			31.2			34.6			32.3			32.7				
Temp. mean mini °C	17.9			8.9			14.7			21.5			25.5			25.2				
Mean monthly rainfall (mm.)	2.9			0.1			0.5			2.7			15.4			5.7				
Mean monthly humidity (%) at 17.30	79.7			69.7			47.9			73.6			83.4			79.9				
Mean wind velocity (Km. p. h) at 08.30	0.6			1.3			2.4			3.6			2.5			2.5				

TABLE VIII.—*Phlebotomid sandflies collected per man hour from indoors in Muzaffarpur District from November 1980 to September 1981 along with climatological data*

Name of species	Nov. 80			Jan. 80			March 81			May 81			July 81			Sept. 81			Total	% of the grand total
	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T		
<i>P. papatasi</i>	80	135	215	—	—	—	73	126	199	143	201	344	224	356	580	173	297	470	1808	94.07
<i>P. argentipes</i>	—	—	—	—	—	—	5	1	6	1	—	1	4	3	7	3	3	6	20	1.04
<i>S. babu</i>	5	11	16	—	—	—	11	4	15	7	12	19	11	19	30	6	8	14	94	4.89
Grand total	85	146	231	—	—	—	89	131	220	151	213	364	239	378	617	182	308	490	1922	100.00
Temp. mean maxi °C	31.4			22.3			28.6			35.0			33.2			33.5				
Temp. mean mini °C	21.9			10.2			17.0			23.1			27.3			28.5				
Mean monthly rainfall (mm.)	0.0			0.8			1.3			1.8			17.5			6.5				
Mean monthly humidity (%) at 17.30	71.6			75.1			48.9			61.3			83.8			81.3				
Mean wind velocity (Km. p. h) at 08.30	0.4			1.4			1.9			3.3			2.5			5.8				

TABLE IX.—*Relationship between sandflies and variables (temperature, rainfall and humidity)*

	Correlation coefficient between number of sandflies and variables	Regression line of number of sandflies (Y) on variables (X) Y = a + bx
<i>Darbhanga District</i>		
<i>P. papatasi</i>		
Temperature	0.6131**	Y = -601.16 + 31.43 x
Humidity	0.7942*	Y = -641.39 + 12.94 x
<i>S. babu</i>		
Rainfall	0.8423*	Y = 28.98 + 4.16 x
<i>Samastipur District</i>		
<i>P. papatasi</i>		
Temperature	0.8084*	Y = -463.64 + 21.75 x
Rainfall	0.8193*	Y = 63.91 + 11.73 x
Humidity	0.7777*	Y = -215.53 + 4.85 x
<i>P. argentipes</i>		
Temperature	0.7421*	Y = -19.63 + 1.12 x
Rainfall	0.6293**	Y = 7.85 + 0.50 x
Humidity	0.6599**	Y = -5.94 + 0.23 x
<i>S. babu</i>		
Temperature	0.6576**	Y = -36.13 + 1.88 x
Rainfall	0.9179*	Y = 8.61 + 1.28 x
<i>Sitamarhi District</i>		
<i>P. papatasi</i>		
Humidity	0.6353**	Y = -1548.89 + 32.92 x
<i>Muzaffarpur District</i>		
<i>P. papatasi</i>		
Temperature	0.8643*	Y = -685.76 + 38.20 x
Rainfall	0.8621*	Y = 169.76 + 28.73 x
<i>S. babu</i>		
Temperature	0.6886**	Y = -20.40 + 1.4 x
Rainfall	0.8284*	Y = 9.39 + 1.28 x

\*Significant at 1% level.

\*\*Significant at 5% level.

variation being the increase in the population of *P. argentipes* in the third year of the study.

*Relationship between sandfly population and climatological factors*: Data pertaining to climatological factors and population density

of sandflies were subjected to statistical analysis for finding out regression correlation and dependence of the number of sandflies (Y) on each variable (temperature, rainfall and humidity) considered here (Table IX).

It has been found that in Darbhanga district the population of *P. papatasi* has shown significant correlation with temperature and humidity, and *S. babu* with rainfall; in Samastipur district the population of *P. papatasi* and *P. argentipes* with temperature, rainfall and humidity, and *S. babu* with temperature and rainfall; in Sitamarhi *P. papatasi* with humidity; and in Muzaffarpur *P. papatasi* and *S. babu* with temperature and rainfall.

Regression line were obtained by pooling together the data obtained during two years. The combined regression lines drawn along with respective scattered diagrams are shown in figures 5-20.

#### SEASONAL ABUNDANCE

The incidence of sandflies is similar to that of first year study, in extreme winter the flies are practically absent and their peak season in monsoon, i.e., from July to October. In summer the population is comparatively lower than in the monsoon. The number of flies caught per man hour varies from 0 in January to 437 in July 1981. As in the first year, sandfly activity is maximum in Sitamarhi district.

#### DISCUSSION

The pattern of seasonal abundance of *P. papatasi*, *P. argentipes* and *S. babu* for two years is similar to that of the first year. As pointed out in my earlier paper (1981), it is to be ascertained whether *P. argentipes* or *P. papatasi* is the vector of kala-azar in North Bihar or both of them are vectors side by side.

The application of insecticides was slowed down by the beginning of 1980 due to the decrease in the number of cases of kala-azar,

consequent to which there is a sudden increase in the fly activity. There is 30.47% increase in the number of flies in the second year and only a slight increase (7.23%) in the third year from the preceding year thus showing that the fly activity is more or less steady in the absence of systematic application of insecticides. Consequent to the spurt in fly activity we are sitting on a 'live volcano' which can erupt at any moment causing another outbreak of the dreaded kala-azar.

#### ADDITIONAL OBSERVATIONS

It has been found that the flies prefer moderately dirty or shabby corners to the extremely dirty or clean corners of the rooms. It may be due to the thick cobweb (on the contrary a little cobweb helps their resting) or a thick coat of dust present in the dirty corners which makes their resting difficult as they get entangled in the cobweb or their body gets covered with dust. Similarly the flies detest the extremely clean corners of the rooms, the reason of which is difficult to understand, perhaps it may be due to their difficulty in resting for longer periods on smooth surfaces.

Sandflies have been found hanging on the cobweb, which the collector may mistake for dead ones. When disturbed they dart and hang themselves again in cobweb, if available. While using the aspirator, if it is not sucked in with force, often the flies cling on to the surface and may escape as soon as the suction is over.

As mentioned in the earlier paper, flies are seldom found in brick-walled houses. Curiously enough, on two occasions from this type of houses also considerable number of flies have been collected during the peak season. The favourite resting places of the

flies are the dark corners of mud-walled houses, but in a few cases they have been found to occur in abundance in open rooms

with three or even two walls. Generally the flies are scarce or absent in cooking rooms because of the heat and smoke but exceptio-

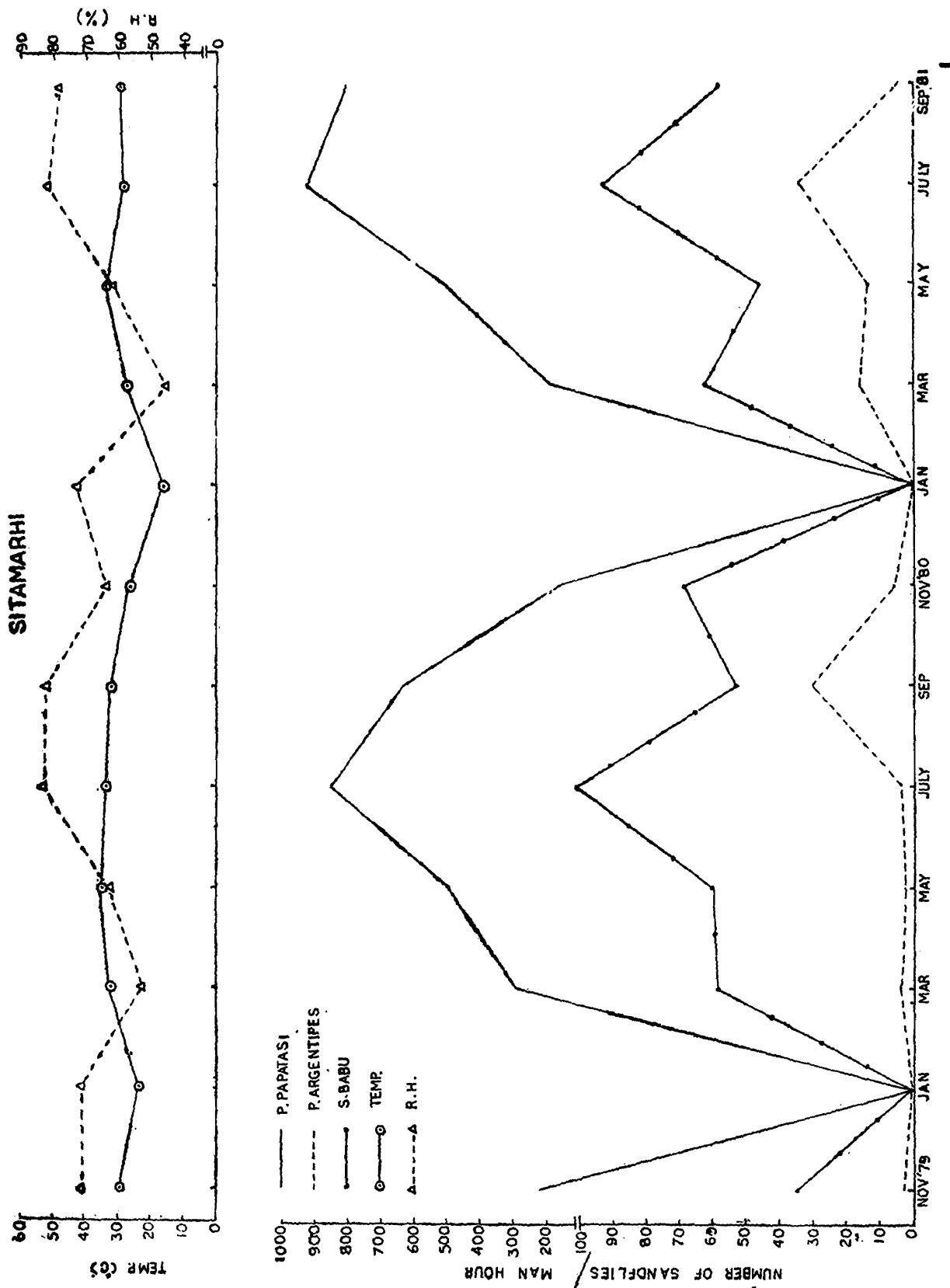


Fig. 1. Bimonthly fluctuation of sandfly population in relation to temperature and relative humidity in Darbhanga District.

nally in the peak periods they may be seen on the walls opposite to hearth, even while the cooking is on.

On the whole it can be summarised that the flies are found in the dark corners of the mud-walled houses. At the same time

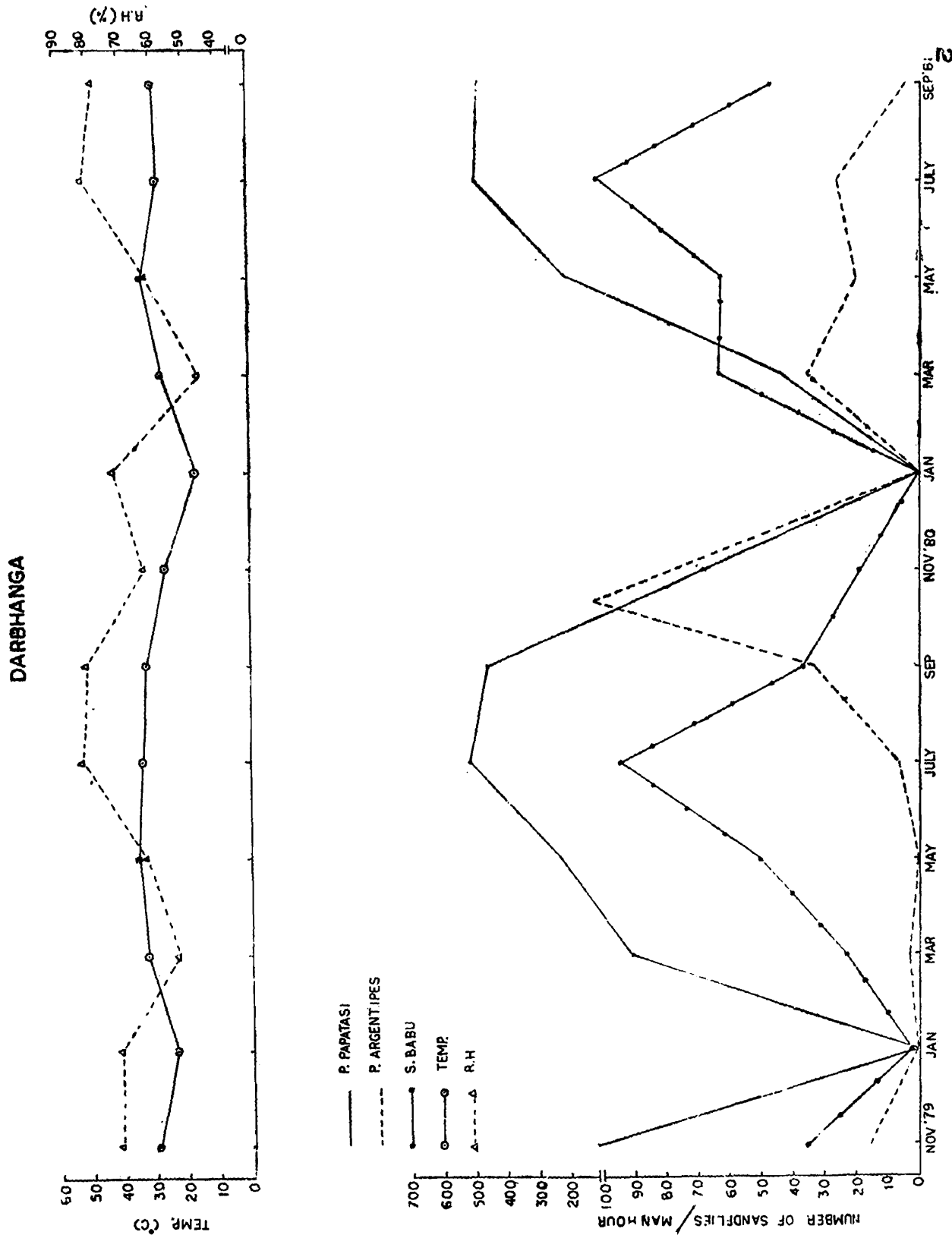


Fig. 2. Bimonthly fluctuation of sandfly population in relation to temperature and relative humidity in Sitamarhi District.

some of the microhabitats which cannot be explained are : (1) in one corner of a room the flies may be abundant whereas in the other corners only sparsely present or absent ;

and (2) in houses possessing apparently similar habitats their occurrence varies from sparse to abundance.

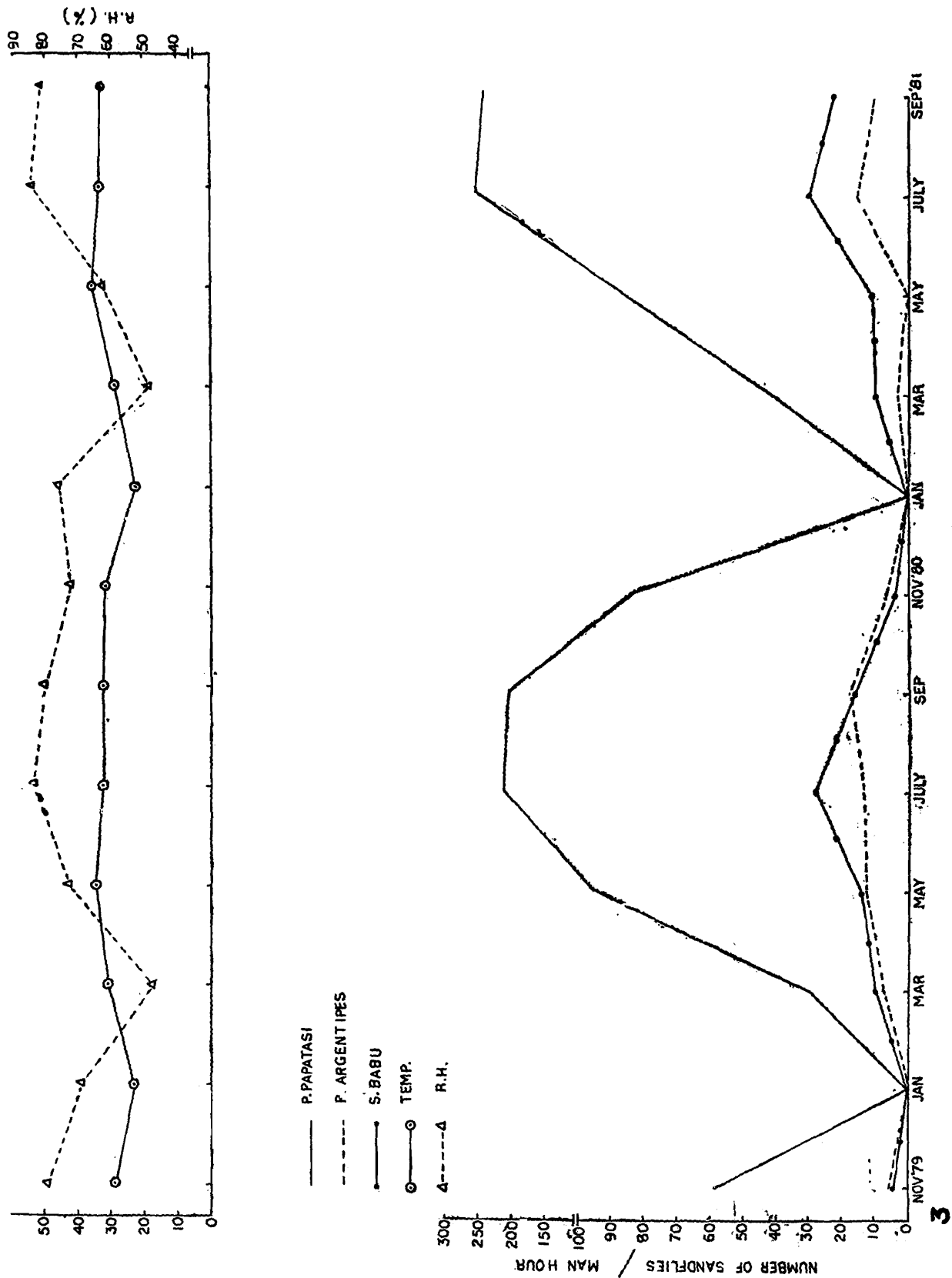


Fig. 3. Bimonthly fluctuation of sandfly population in relation to temperature and relative humidity in Sarnastipur District.

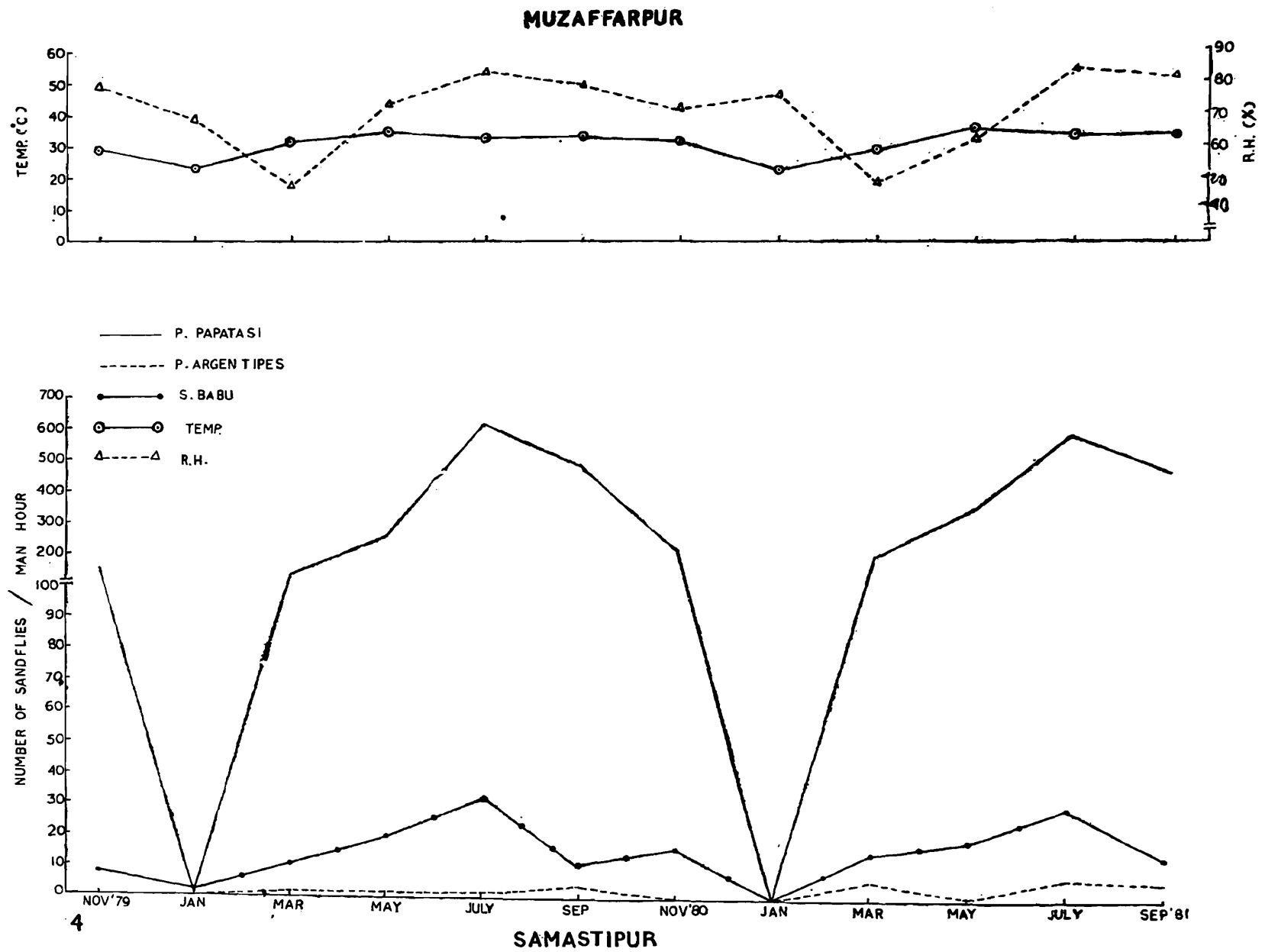


Fig. 4. Bimonthly fluctuation of sandfly population in relation to temperature and relative humidity in Muzaffarpur District.

DARBHANGA

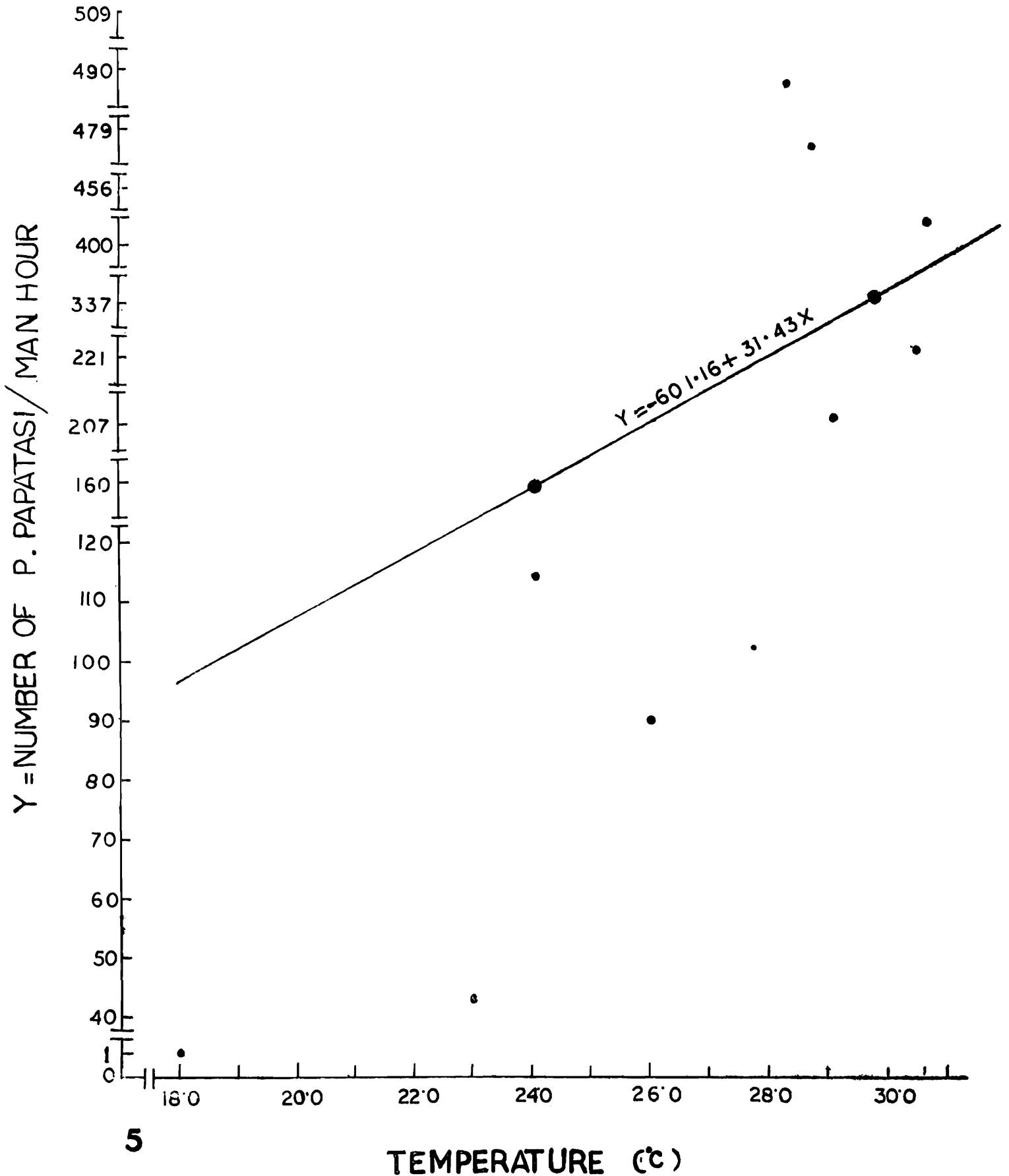


Fig. 5. Regression line with scattered diagram of *P. papatasi* (per manhour) on temperature (°C), in Darbhanga District.

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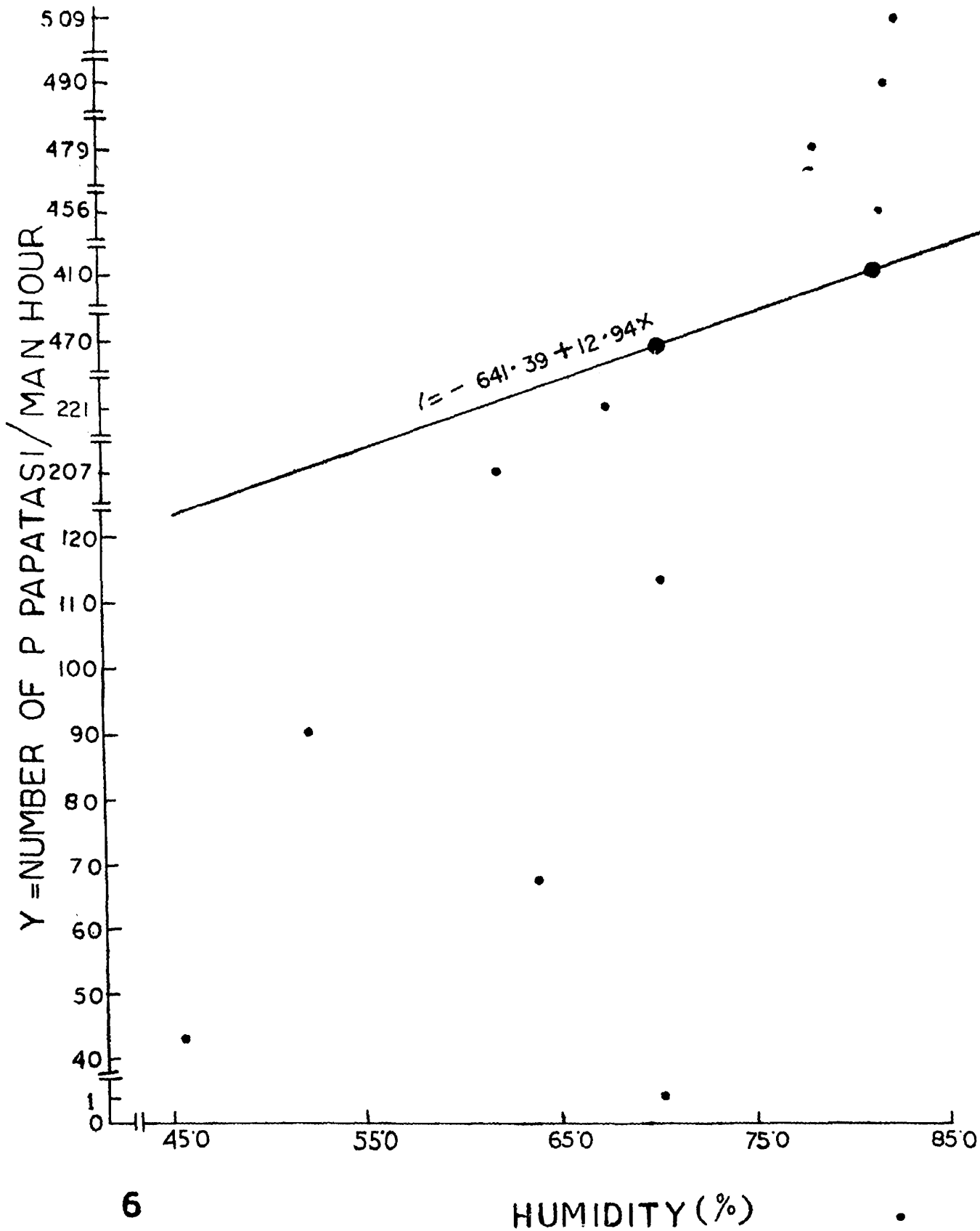


Fig. 6. Regression line with scattered diagram of *P. papatasi* (per manhour) on humidity (R/H) in Darbhanga District.

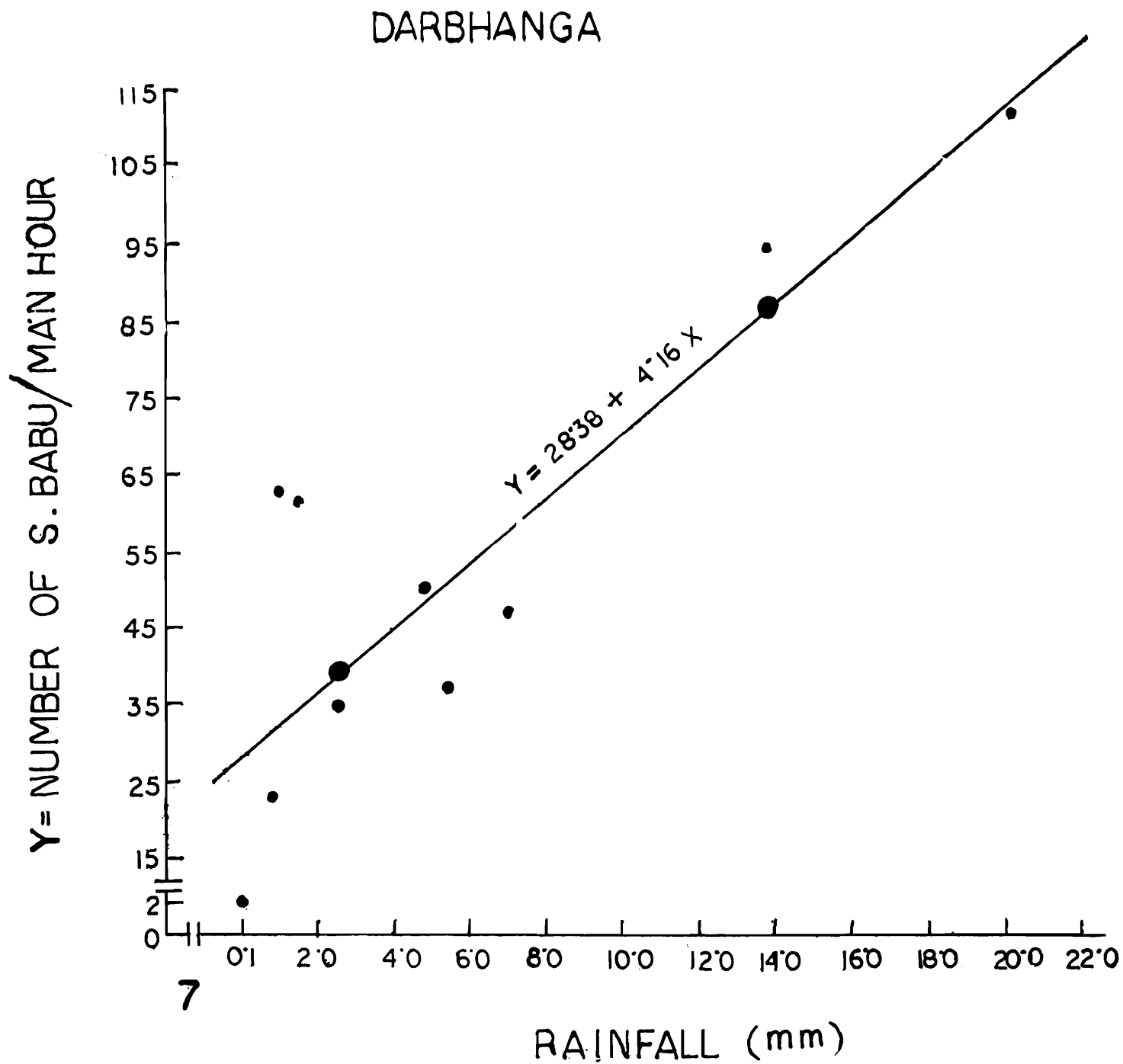


Fig. 7. Regression line with scattered diagram of *S. babu* (per manhour) on rainfall (mm) in Darbhanga District.

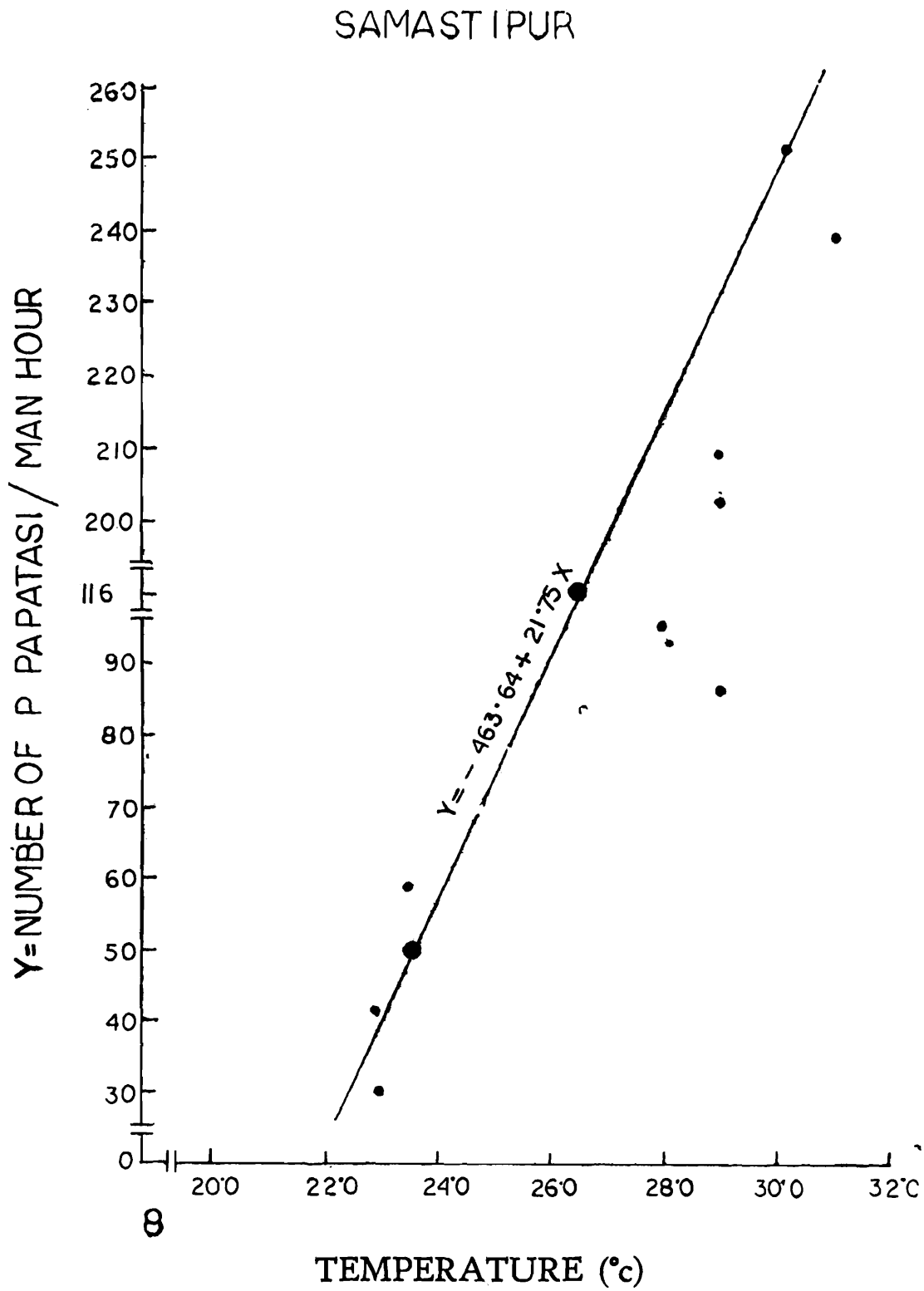


Fig. 8. Regression line with scattered diagram of *P. papatasi* (per manhour) on temperature (°C) in Samastipur District.

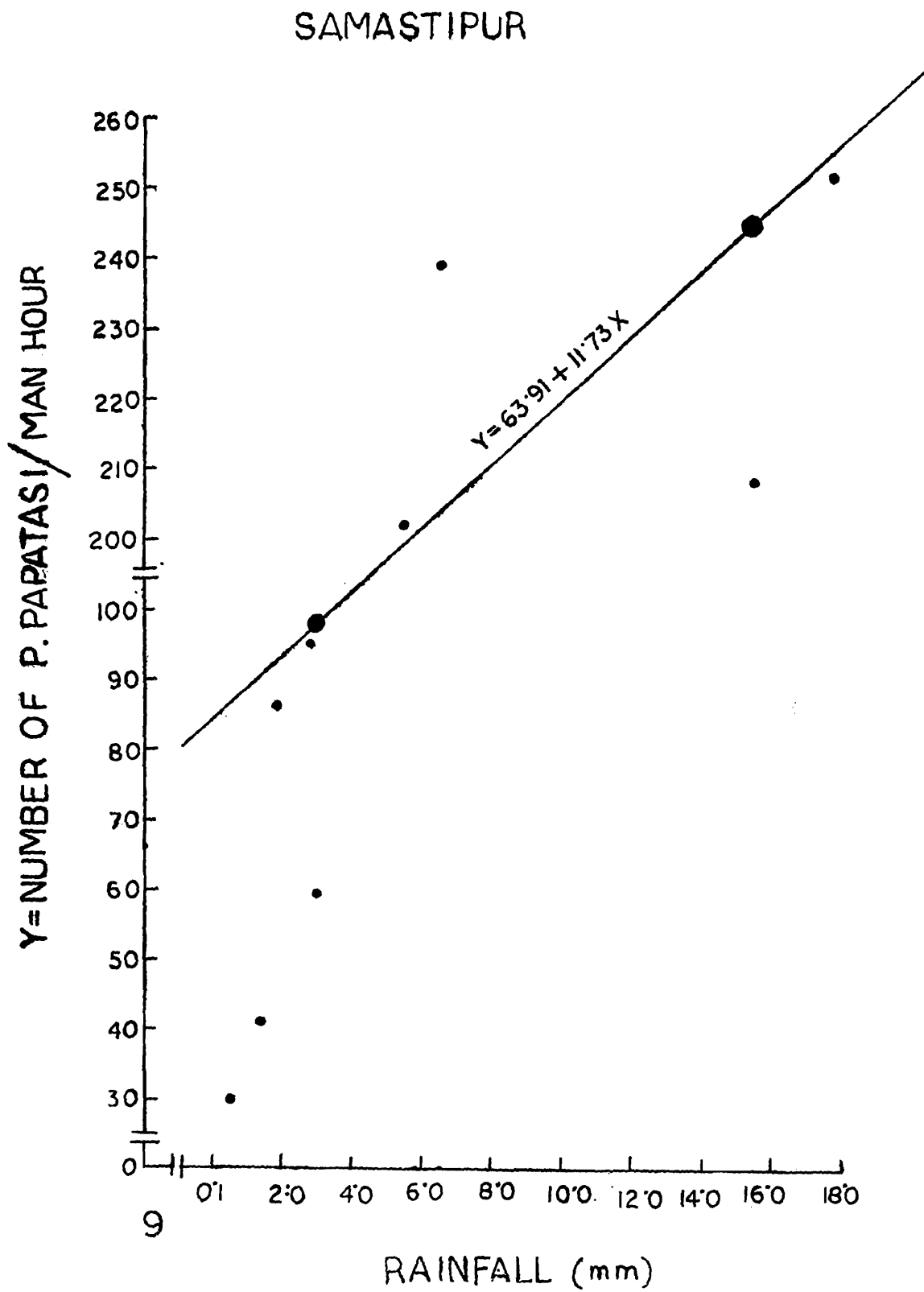


Fig. 9. Regression line with scattered diagram of *P. papatasi* (per manhour) on rainfall (mm) in Samastipur District.

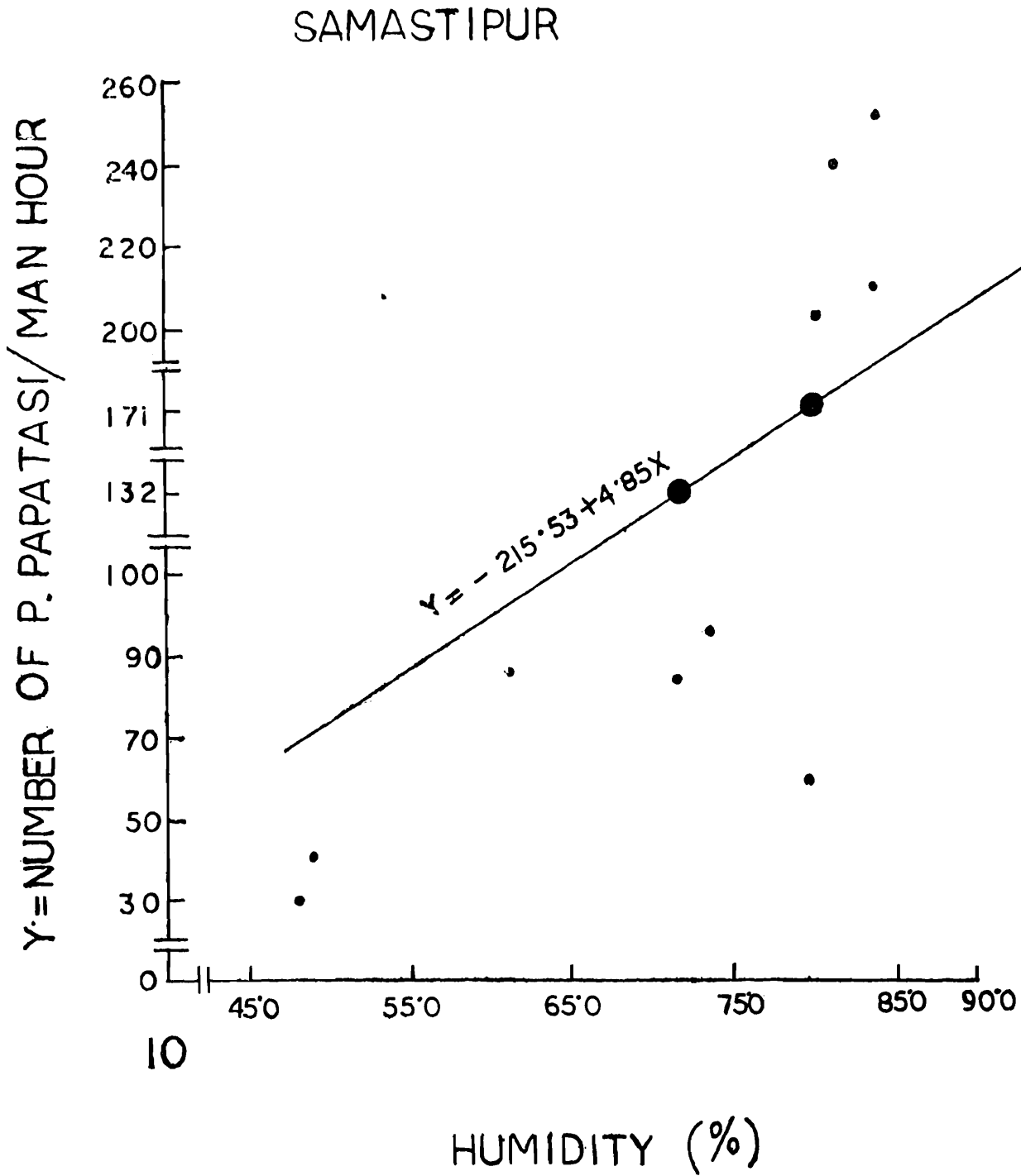


Fig. 10. Regression line with scattered diagram of *P. papatasi* (per manhour) on humidity (R/H) in Samastipur District.

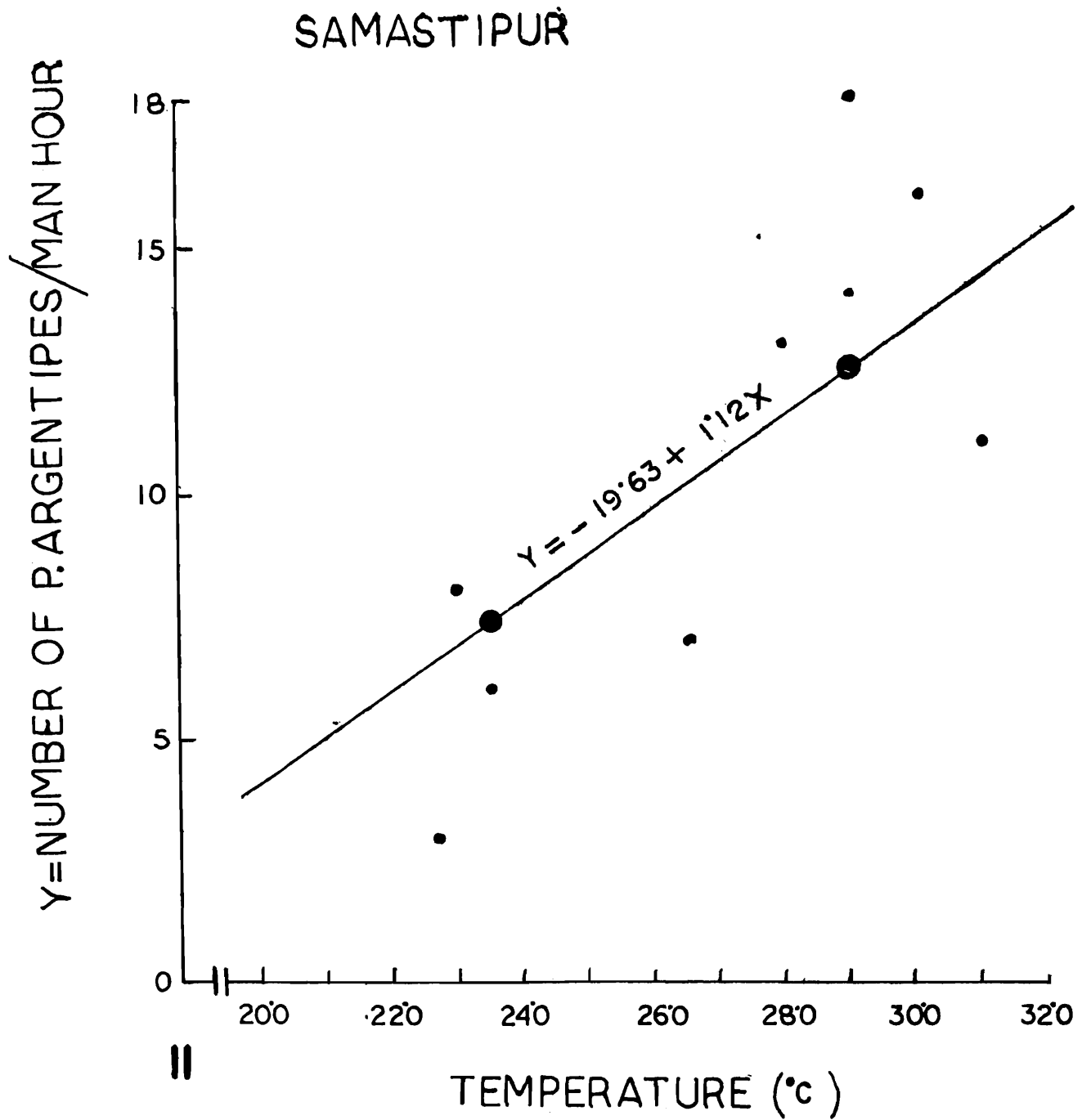


Fig. 11. Regression line with scattered diagram of *P. argentipes* (per man-hour) on temperature (°C) in Samastipur District.

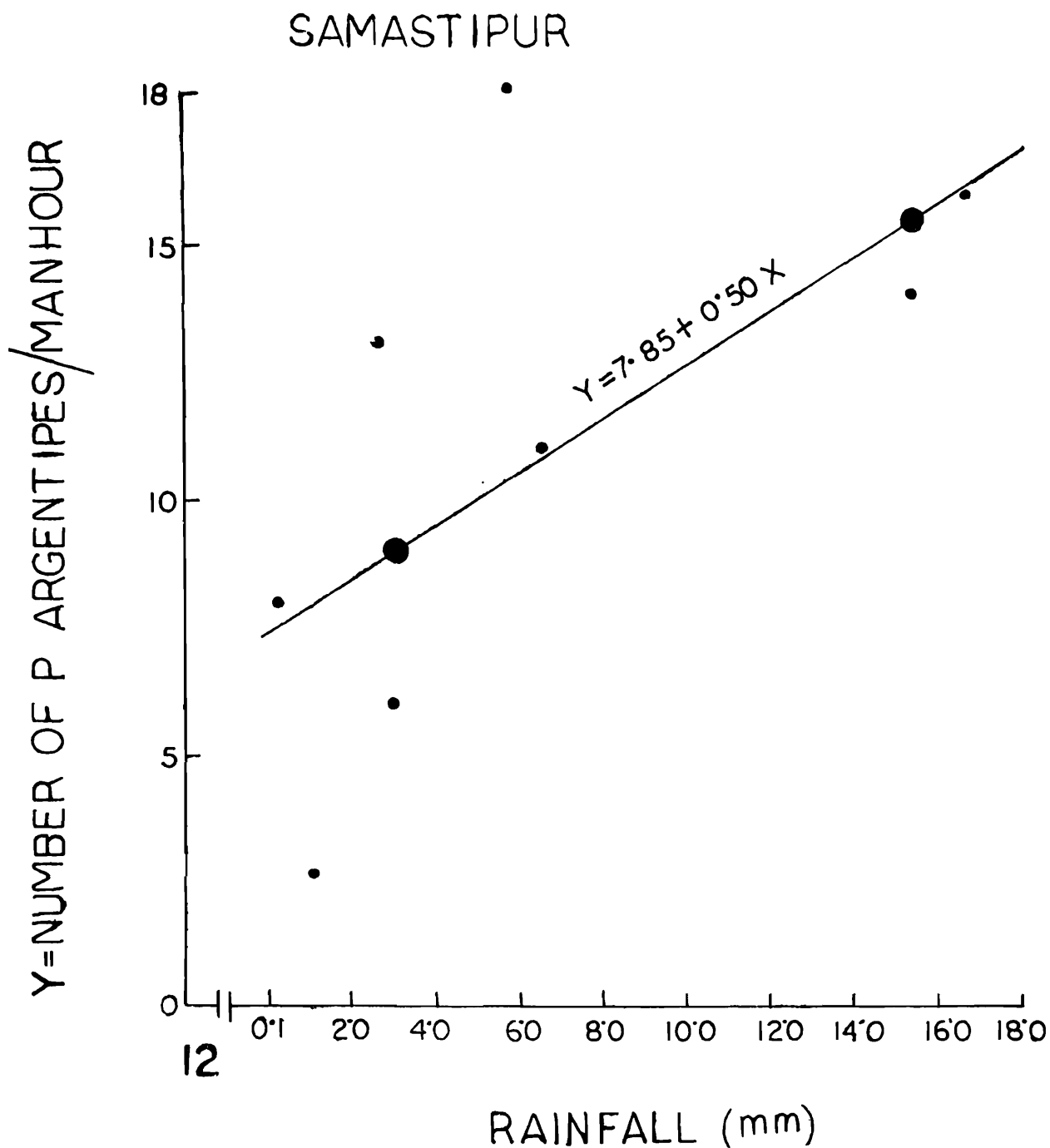


Fig. 12. Regression line with scattered diagram of *P. argentipes* (per manhour) on rainfall (mm) in Samastipur District.

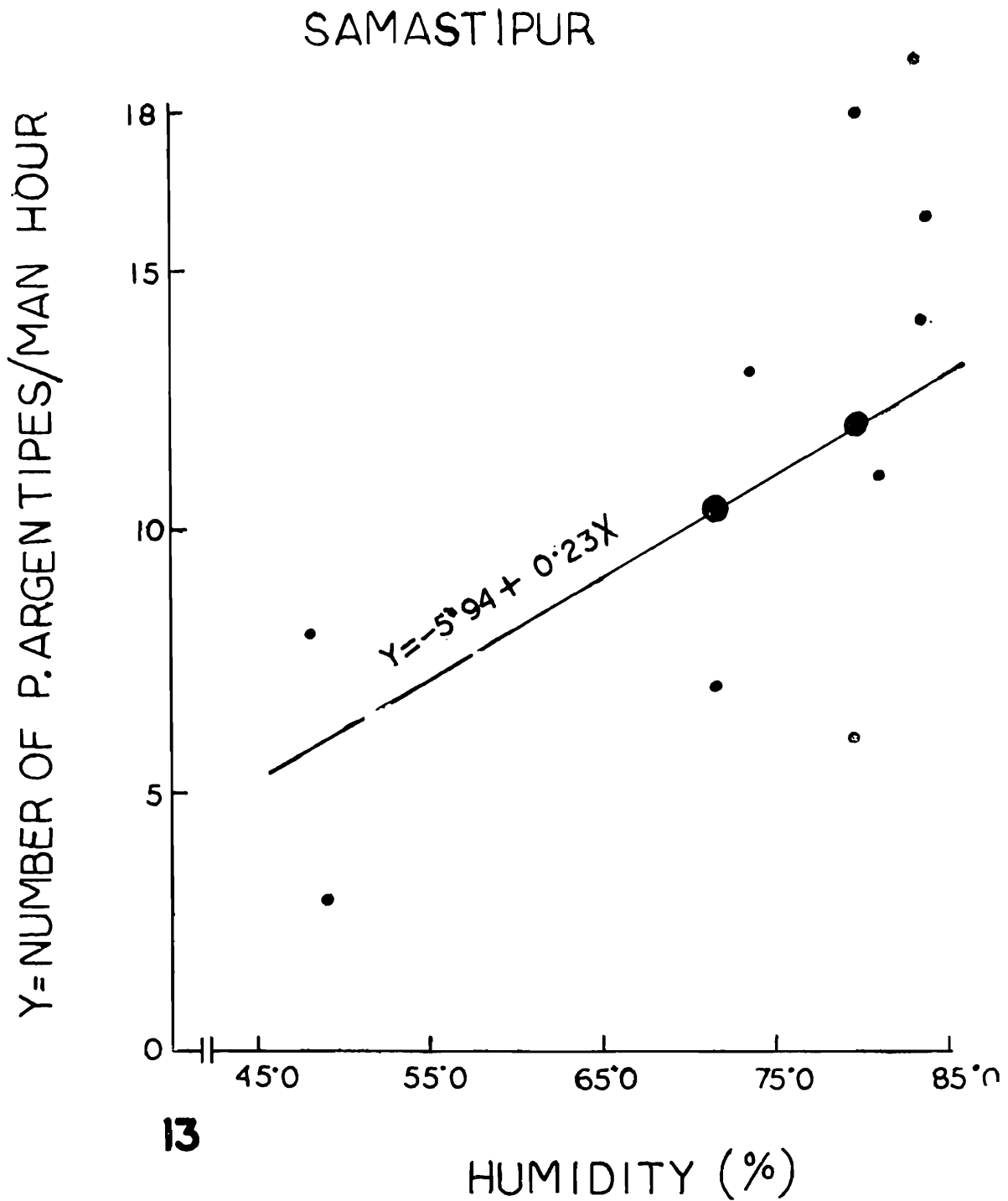
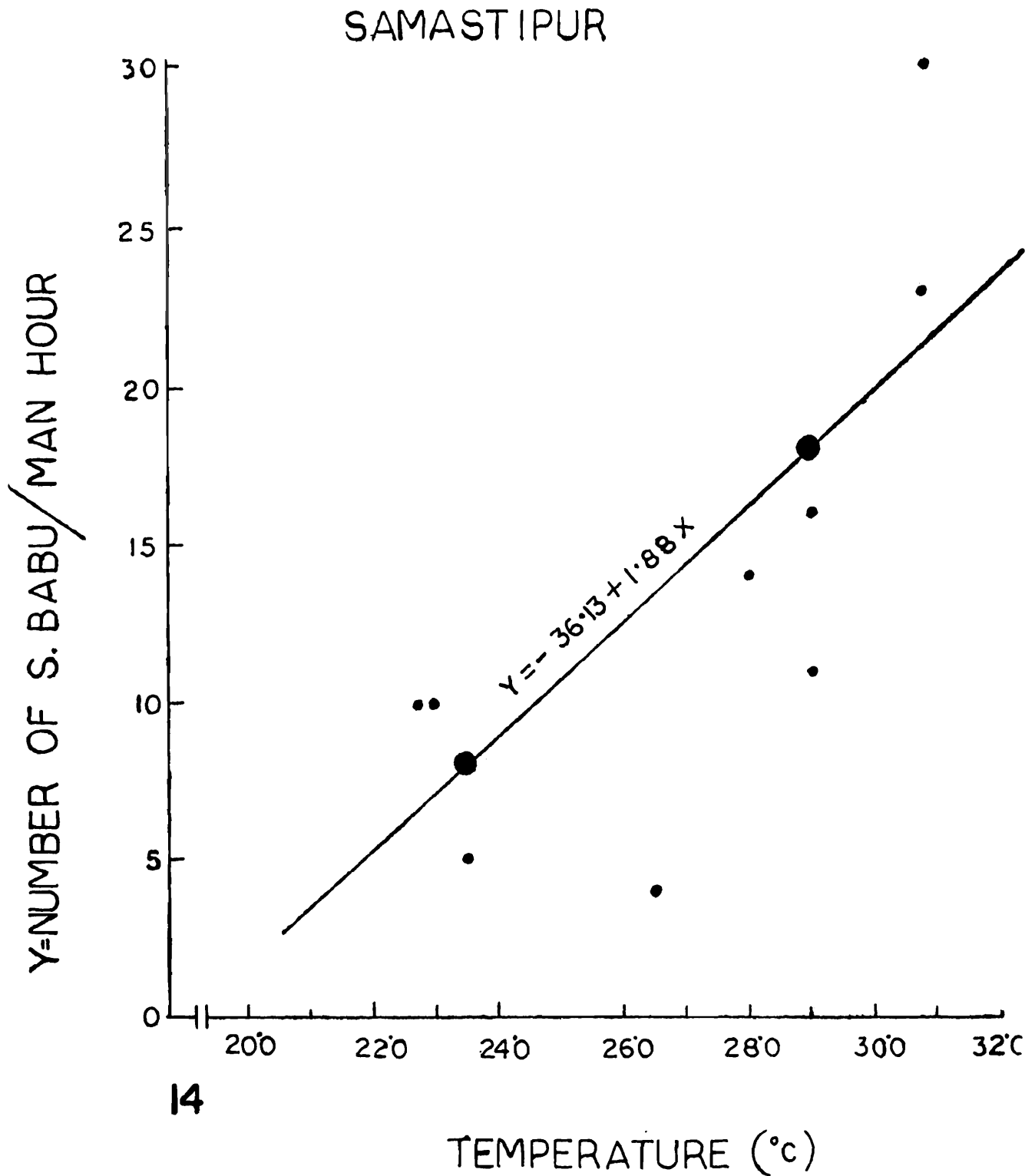


Fig. 13. Regression line with scattered diagram of *P. argentipes* (per manhour) on humidity (R/H) in Samastipur District.



14

Fig. 14. Regression line with scattered diagram of *S. babu* (per manhour) on temperature (°C) in Samastipur District.

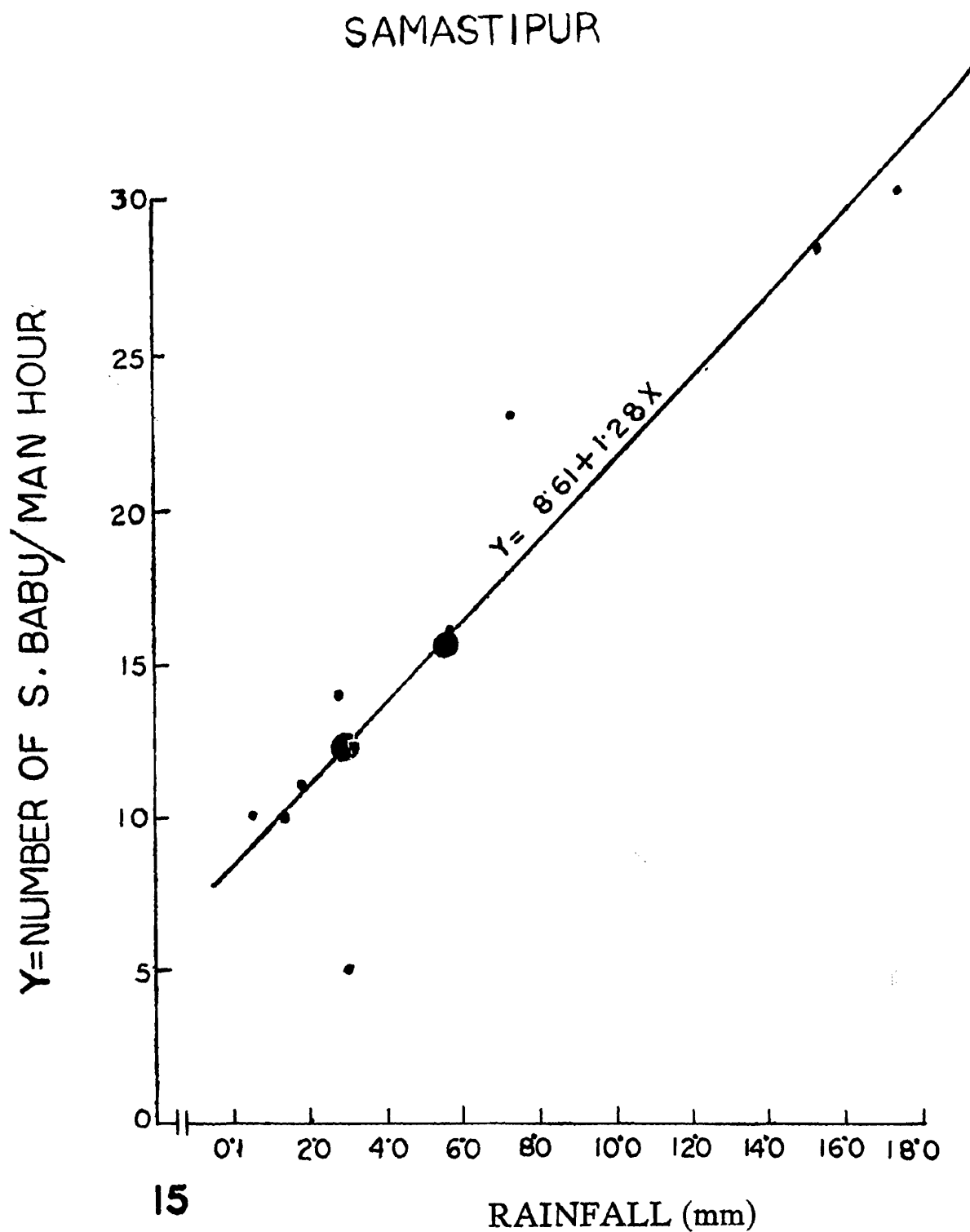


Fig. 15. Regression line with scattered diagram of *S. babu* (per manhour) on rainfall (mm) in Samastipur District.

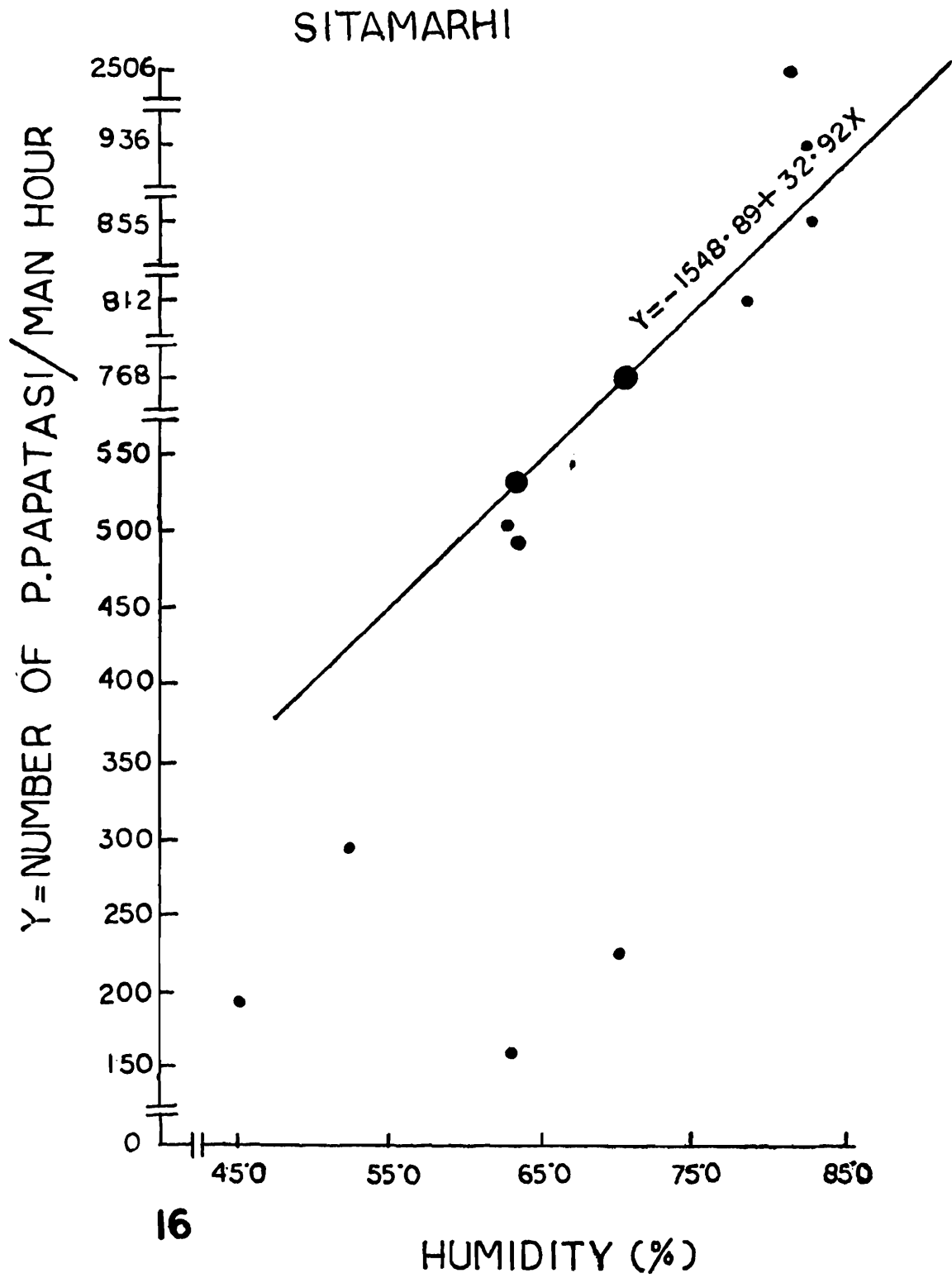


Fig. 16. Regression line with scattered diagram of *P. papatasi* (per manhour) on humidity (R/H) in Sitamarhi District,

## MUZAFFARPUR

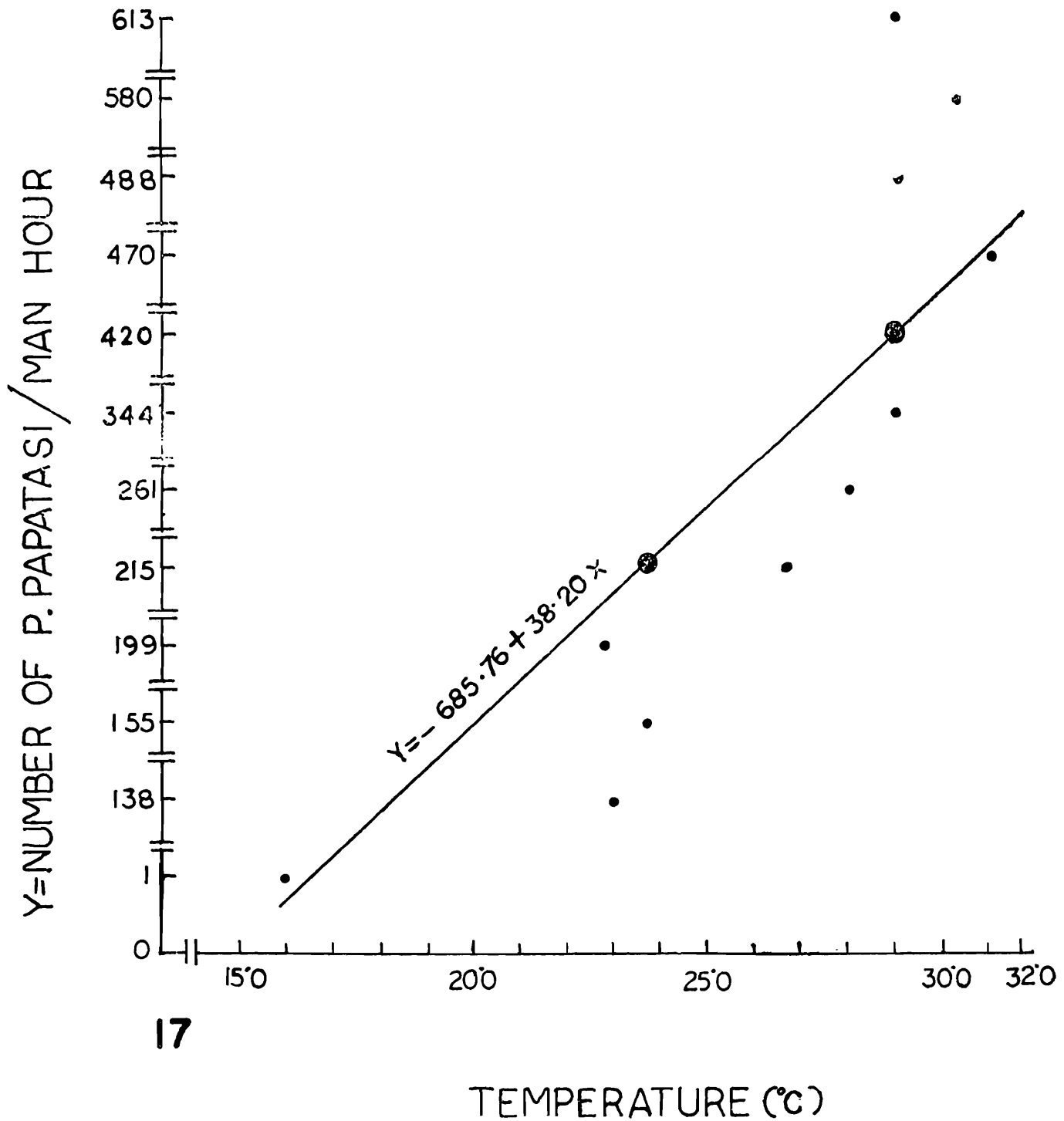


Fig. 17. Regression line with scattered diagram of *P. papatasi* (per manhour) on temperature (°C) in Muzaaffarpur District,

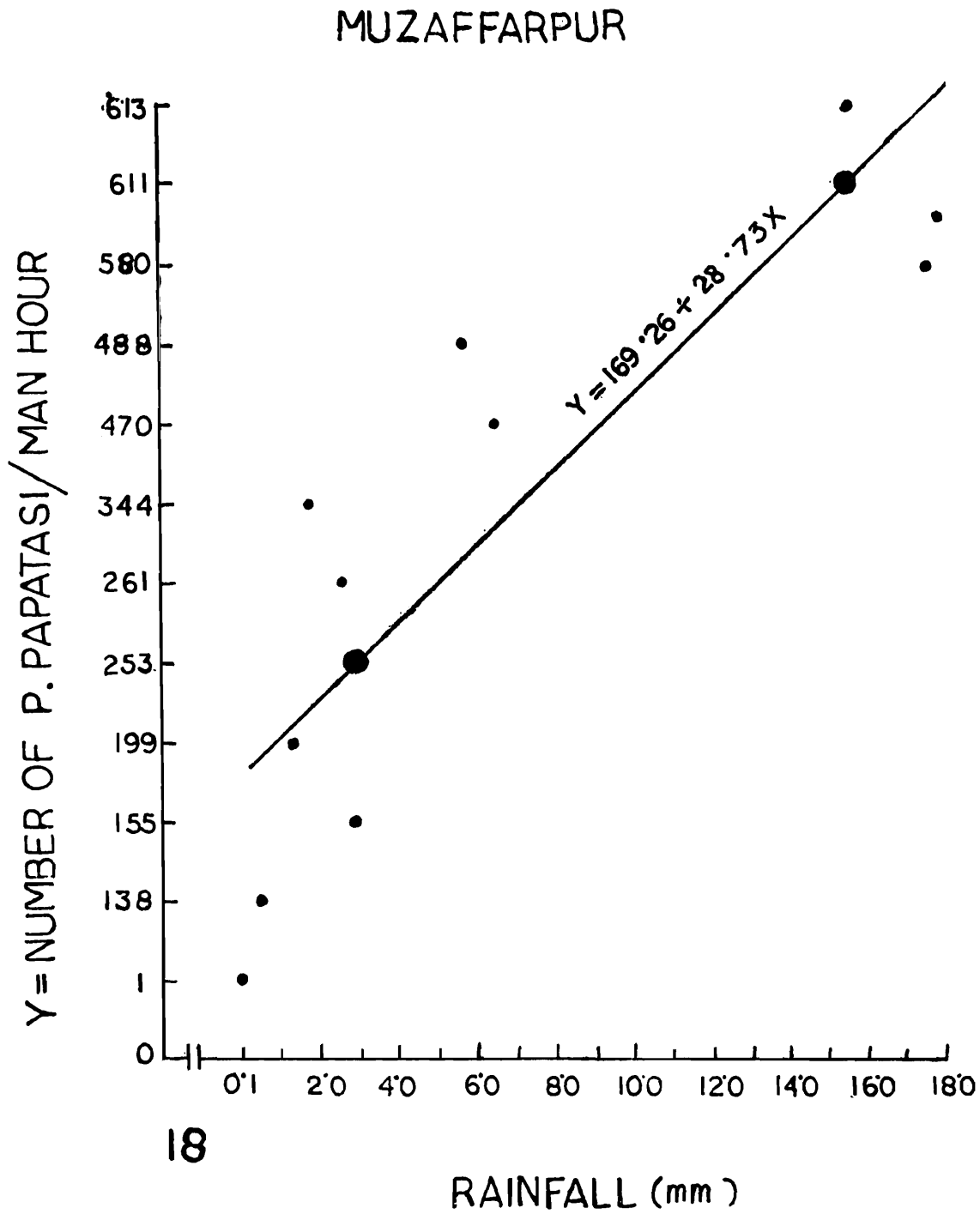


Fig. 18. Regression line with scattered diagram of *P. papatasi* (per manhour) on rainfall (mm) in Muzaffarpur District.

## MUZAFFARPUR

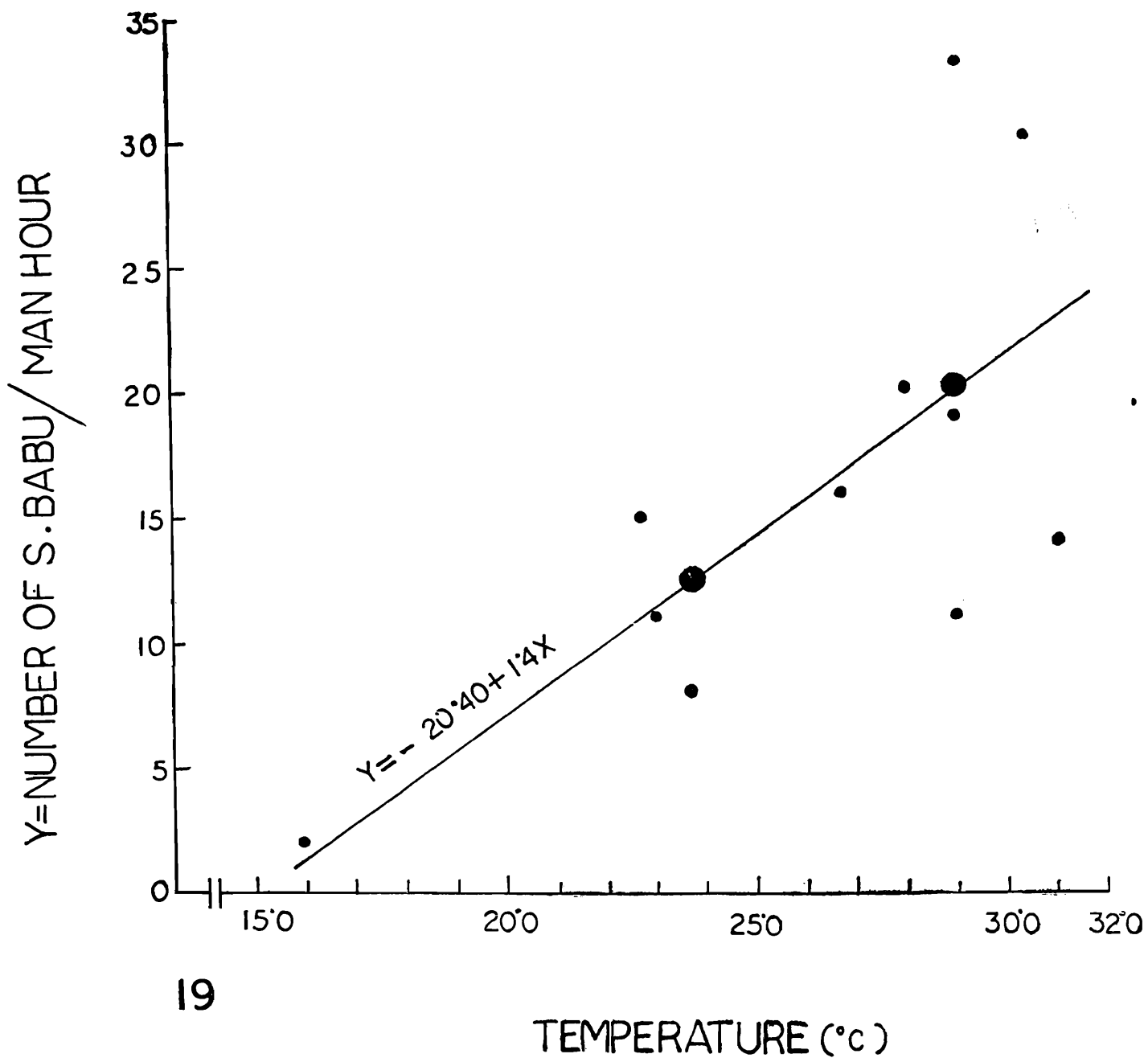


Fig. 19. Regression line with scattered diagram of *S. babu* (per manhour) on temperature (°C) in Muzaffarpur District.

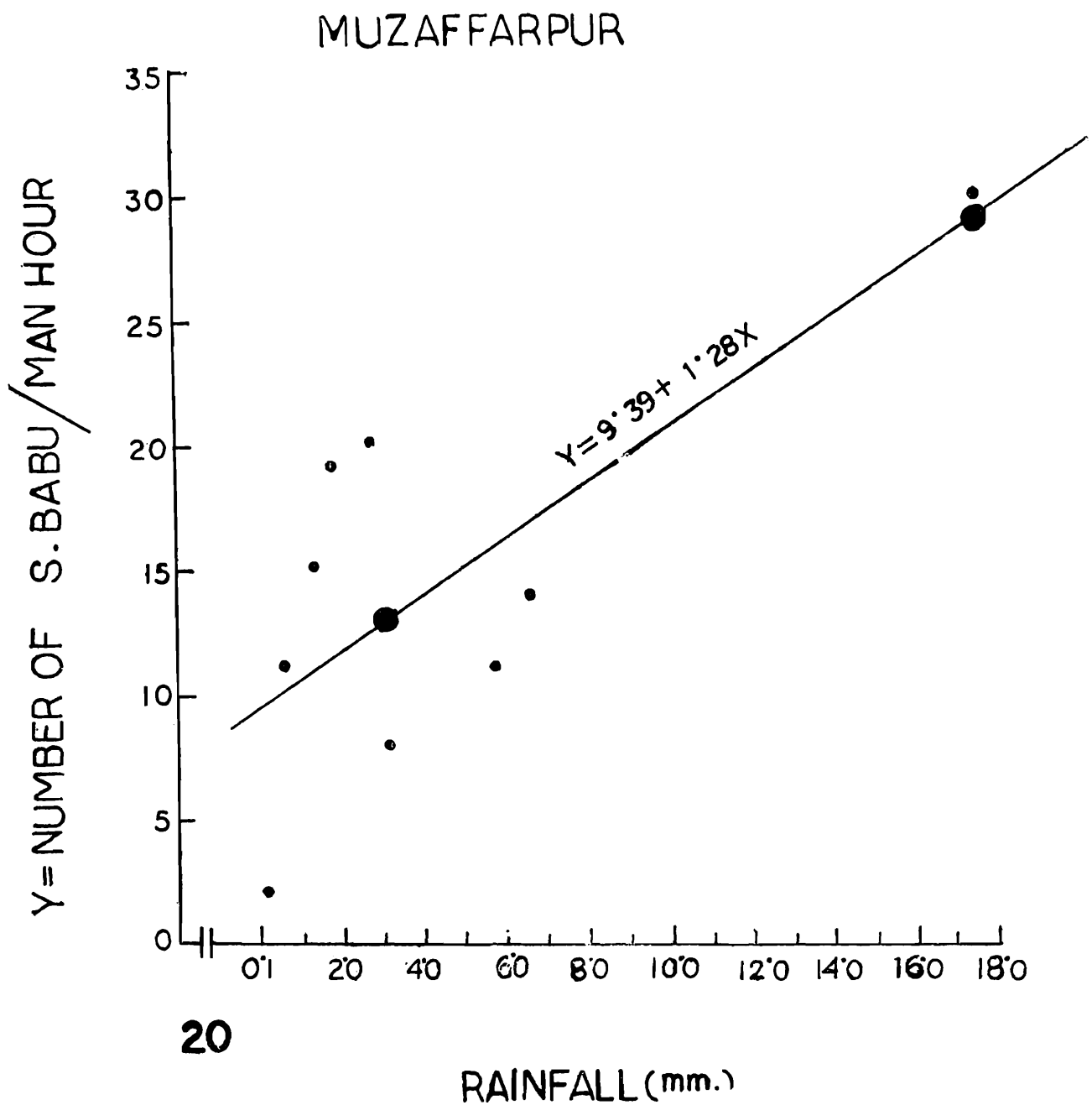


Fig. 20. Regression line with scattered diagram of *S. babu* (per manhour) on rainfall (mm) in Muzaffarpur District.

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