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RESEARCH ARTICLE

Seasonal Dynamics of Pests of *pigeon pea* in Relation with Weather in High Altitude Zone of Andhra Pradesh

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ABSTRACT

Insect pests associated with crop and their incidence in different agro-climatic zones varies as they are influenced by the local environment. In view of this, the investigation of "seasonal Dynamics of insect pest's complex of pigeon pea" experiment was conducted at a research farm at Agricultural Research Station, Seethampeta, and Srikakulam during kharif season of 2017-2019. The studies on population dynamics indicated that the maximum population of H. armigera, E. atomosa and M. vitrata on pigeon pea to the extent of 3.43, 3.07 and 4.17 larvae per plant, respectively which was noticed during 45th, 49th and 47th standard meteorological weeks, respectively and population of G. critica, C. gibbosa, and plume moth on pigeon pea to the extent of 4.97 larvae/plant, 7.60 nymph and adults/plant, and 3.07 nymph and adults/plant was noticed during 47th, 52nd and 49th standard meteorological weeks, respectively. The peak incidence of SMD was observed during 3rd and 4th SMW with 4.00 per cent. Similarly, the sucking insect pest's aphids and jassids recorded peaks at 47th and 46th SMW. The correlation with the weather parameters indicated that the leaf folder has a positive significant correlation relative to relative humidity, and the same was the incidence of H.armigera and SMD. M. vitrata was positively correlated with maximum temperature and negatively with maximum relative humidity.

Keywords: *Dynamics, Pests, pigeon pea, Andhra Pradesh, population, pestst.*

INTRODUCTION

The pigeon pea [*Cajanus cajan* (L.) Millsp.] belonging to the family *Fabaceae* is originated from India. It is the second most crucial pulse crop grown in India after chickpea. As a legume, it occupies an important position in the diet of vegetarian people living in the subcontinent and has its own unique role in Indian agriculture. It is commonly known as arhar, red gram or tur and is a rich source of protein. There is the varying duration of maturity ranging from short duration to long-duration varieties. They are exposed to the different kinds of seasonal changes during the growth period. Consequently, insect pests associated with crop and their incidence in different agro-climatic zones y as they are influenced by the local environment [18]. Among the several factors responsible for low yields of pigeon pea, insect pests are major limiting factors. It is damaged by about 300 species of insect pests infesting at various growth stages [9].

Among the insect pests, pod borer complex *viz.,* pod borer (*H. armigera)*, plume moth (*E. atomosa*), spotted pod borer (*M. testulali,)*, tur pod fly (*M. obusta*) and blue butterfly (*L. boeticus)* are major pests of pigeon pea which causes considerable losses in yield [14]. [16] reported 32-37 insect pests attacking pigeon pea. [2] reported losses ranging from 48.75 per cent to 58.75 % in yield due to the pod borer complex in

pigeon pea. [20] observed that *C. cajan* is infested by insect pests belonging to 6 orders and 16 families. Of the 6 orders recorded, problems belonging to Lepidoptera cause maximum damage, followed by members of Caleoptera, Diptera, Hemiptera and Homoptera, in that order. *Helicoverpa armigera* was found to be the primary pest. [19] found that *M. obusta* had maximum contribution (36.94 %) among all the species of pod borers, followed by *Clavigrella gibbosa* (20.37 %), *L. boeticus* (15.43 %), *E. atamosa* (14.03 %) and *H. armigera* (12.93 %). Sujithra and Chander (2014) reported that the pod borer complex caused 19.11 % pod damage that could be attributed to *M.vitrata* (9.7 %), pod fly (5.3 %), gram pod borer (2.6 %) and leaf webber (2.3 %).

Therefore studies on seasonal incidence are aimed at providing an understanding of the causes of fluctuation in population density and of the determination of damage potential of insect pests. Seasonal incidence helps in planning need-based application of insecticides as it clearly reveals the insect peak activity as well as insect free period during crop growth. Hence, the seasonal incidence of major insect pests of pigeonpea was carried out.

MATERIALS AND METHODS

The present investigation was carried out at Agricultural Research Station Farm, Seethampeta, Srikakulam, ANGRAU, Andhra Pradesh starting from Kharif, 2017 to 2019. The seasonal incidence of insects was recorded on pigeon pea cultivar LRG-52. The variety was sown in pesticide-free area in a plot size of 1000 sq. m. Spacing maintained was 180 cm X 20 cm. All recommended management practices were followed for raising the crop except plant protection measures.

The flying and hopping insects were collected through the sweep net method by taking samples from 5 weeks after germination to maturity. The sweep net is having 70 cm long cloth bag, 38 cm diameter at the mouth and 70 cm long handle was used. One sweep consisted of one movement of the net on the left and the other on the right side of the crop row. Such 20 sweeps were made in each plot between 7 to 10 am. Insects collected in this way were transferred to polythene bags containing chloroform soaked cotton. The dead insects then transferred to homoeopathic vials containing 70 per cent ethyl alcohol. The vials were levelled, giving the date of collection, name of variety and replication number. The insects thus collected were separated into different groups and counted.

The larval population of the pod borer was recorded by taking absolute count on the plants. Ten plants were randomly selected from each plot, excluding border rows **[5]**. These plants were tagged and the numbers of larvae present on these plants were recorded at weekly interval from 50 per cent flowering to maturity. The same plants were used for recording the observations throughout the crop season. The seasonal populations of major insect pests were correlated with the meteorological weather parameters *viz*., maximum temperature (Max T), minimum temperature (Min T), rainfall (mm), morning relative humidity (RH1), evening relative humidity (RH2) and rainfall using standard statistical procedure to find out the specific impact of above mention weather parameters on insect pests infesting pigeon pea crop.

RESULTS AND DISCUSSION

Leaf folder

Pooled data on incidence of leaf folder indicated that the number of leaf folders per plant was highest during the 47th SMW with 4.97. Leaf folder population started noticed in the crop from 32nd SMW and continued up to 4th SMW with the lowest incidence of 0.03 larvae per plant. The incidence of leaf folders was more from 43rd SMW to 49th SMW (Table1). Correlation between leaf webber population on pigeon pea and maximum temperature (r= 0.240), minimum temperature (r= -0.324) were found non-significant, whereas with morning relative humidity (r= 0.492) found positive correlation (Table 2). Similar observations were also reported by Mahesh Ugale *et al.,* (2020) that the larval population of leaf folder population on pigeonpea and maximum and minimum temperature was found positively non-significant, where as with morning relative humidity found positive significant correlation and evening relative humidity were showed positive non-significant correlation.

Blister beetles

Adults of blister beetles feed on the flowers of program and incidence of these beetles were also recorded and observed that; the incidence ranged from 0.07 to 1.53 adults per plant, and the population was peak during the flowering period of pigeon pea (49th to 1st SMW) (Table 1). The adult's population were correlated with the weather parameters and revealed that maximum

Table:1 Incidence of different insect pests on pigeonpea during Kharif, 2017-2019 (Pooled data)

SMW	No. of leaf folder larvae /plant	No. of Blister beetles/ plant	No. of Plume moth larvae/plant	No. of ash weevils/ plant	No. of flea beetles/ plant	Pod bugs/plant			No. of cow bugs / plant/spot	No of Aphids/ 3 leaflets	No of mites/ 3 leaflets	SMD (%)	No of Jassids/ 3 leaflets	*H. armigera* (Larvae/ plant)	Moths/trap/ week(no.) *H. armigera*	*M. vitrata* (Larvae/ plant)
						Clavigralla spp.	*Riptortus spp.*	*Nezara spp.*								
28	0.00	0.00	0.00	0.17	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	0.00	0.00	0.00	0.20	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.00	0.00	0.00	0.30	0.70	0.00	0.00	0.00	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	0.00	0.00	0.00	0.40	0.30	0.00	0.07	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
32	0.07	0.00	0.00	0.70	0.53	0.00	0.00	0.00	0.30	0.00	0.00	0.00	0.00	0.00	0.13	0.00
33	0.07	0.00	0.00	0.40	0.27	0.00	0.07	0.03	0.00	0.00	0.00	0.00	0.10	0.00	0.20	0.00
34	0.03	0.00	0.00	0.87	0.20	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.33	0.00	0.70	0.00
35	0.27	0.07	0.00	0.23	0.07	0.00	0.43	0.13	1.43	0.27	0.27	0.00	0.40	0.23	0.37	0.00
36	0.37	0.10	0.03	0.23	0.07	0.00	0.60	0.33	1.20	0.20	0.00	0.00	0.53	1.00	0.83	0.00
37	1.27	0.10	0.03	0.23	0.13	0.00	0.23	0.27	2.00	0.07	0.40	0.00	0.87	1.20	0.40	0.00
38	1.90	0.00	0.07	0.30	0.00	0.00	0.37	0.17	3.00	0.07	0.17	0.00	0.43	1.27	0.97	0.43
39	1.53	0.03	0.03	0.43	0.00	0.00	0.57	0.23	3.93	0.23	0.07	0.00	0.33	1.47	1.57	0.56
40	2.30	0.10	0.03	0.27	0.00	0.00	0.67	0.37	4.83	0.33	0.03	0.00	0.40	1.07	1.77	0.63
41	2.63	0.03	0.27	0.53	0.00	0.00	0.53	0.40	5.20	0.60	0.13	0.00	0.47	2.33	2.23	1.27
42	3.50	0.30	0.37	0.37	0.00	0.37	0.60	0.87	5.90	1.60	0.30	0.67	0.57	2.00	2.63	1.67
43	4.13	0.20	0.50	0.53	0.00	0.63	0.83	0.97	5.43	1.23	0.30	0.33	0.63	2.40	2.57	2.70
44	4.03	0.37	0.60	0.43	0.00	1.07	0.60	0.83	5.87	2.00	0.00	0.33	1.07	2.57	3.03	2.73
45	4.27	0.50	1.47	0.30	0.00	1.13	0.40	0.80	6.43	2.67	0.27	1.00	1.80	3.43	3.67	2.83
46	4.77	0.13	1.53	0.17	0.00	2.30	0.70	0.60	7.07	3.27	0.37	1.33	2.53	3.00	4.23	3.50
47	4.97	0.37	2.47	0.07	0.00	2.90	1.13	0.23	6.33	3.70	0.27	2.00	2.43	1.93	4.37	4.17
48	4.20	0.43	2.67	0.03	0.00	5.00	1.27	0.27	3.93	3.20	0.47	2.00	1.93	1.83	3.17	3.40
49	4.30	1.10	3.07	0.10	0.00	5.83	0.87	0.67	3.57	1.90	0.07	2.00	1.30	1.70	2.27	3.93
50	3.57	1.33	2.17	0.00	0.00	6.27	1.03	0.53	2.53	0.37	0.27	2.67	0.43	1.53	1.03	2.67
51	1.90	1.53	2.67	0.07	0.00	7.23	1.03	0.17	1.77	0.43	0.60	3.33	0.47	0.93	0.60	1.87
52	1.67	0.90	2.50	0.03	0.00	7.60	2.13	0.17	0.60	0.13	0.93	3.33	0.17	0.27	0.40	1.17
01	0.47	0.87	1.47	0.00	0.00	6.47	1.40	0.07	0.33	0.00	1.53	3.67	0.07	0.27	0.13	0.73
02	0.47	0.57	0.50	0.00	0.00	5.47	0.97	0.00	0.10	0.00	0.90	3.67	0.00	0.07	0.20	0.50
03	0.23	0.23	0.10	0.00	0.00	4.30	1.13	0.00	0.00	0.00	0.27	4.00	0.00	0.53	0.30	0.40
04	0.03	0.33	0.00	0.00	0.00	3.27	0.53	0.00	0.00	0.00	0.33	4.00	0.00	0.20	0.03	0.07

Table 2: Correlation & Regression between weather parameters and incidence of insect pests in pigeonpea

Insect pests	Correlation coefficient values				
	Min. Temp. (^{O}C)	Max. Temp. (^{O}C)	Min. RH (%)	Max. RH (%)	Rainfall (mm)
Leaf folder	-0.324	0.240	0.419	0.323	-0.022
Blister beetles	0.262	-0.522**	0.389	0.614*	0.211
Plume Moth	0.431	-0.387	0.442	-0.157	0.204
Ashweevils	-0.236	0.522*	-0.128	0.425	-0.106
Pod bugs					
Clavigralla spp.	-0.645*	-0.352	-0.516*	-0.621**	0.041
Riptortus spp.	0.541**	0.451	0.334	-0.570*	-0.015
Nezara spp.	-0.812	-0.614*	-0.679*	-0.582*	0.116
SMD	-0.224	0.465	0.524*	0.721*	0.418
Aphids	-0.235	0.443	-0.241	0.126	-0.241
Jassids	0.144	0.239	-0.105	0.238	-0.548*
H.armigera	0.158	-0.427	0.478	0.822*	0.562**
M.vitrata	-0.284	0.785*	0.421	-0.524*	-0.168

Note: *Significant at 5% level **Significant at 1%

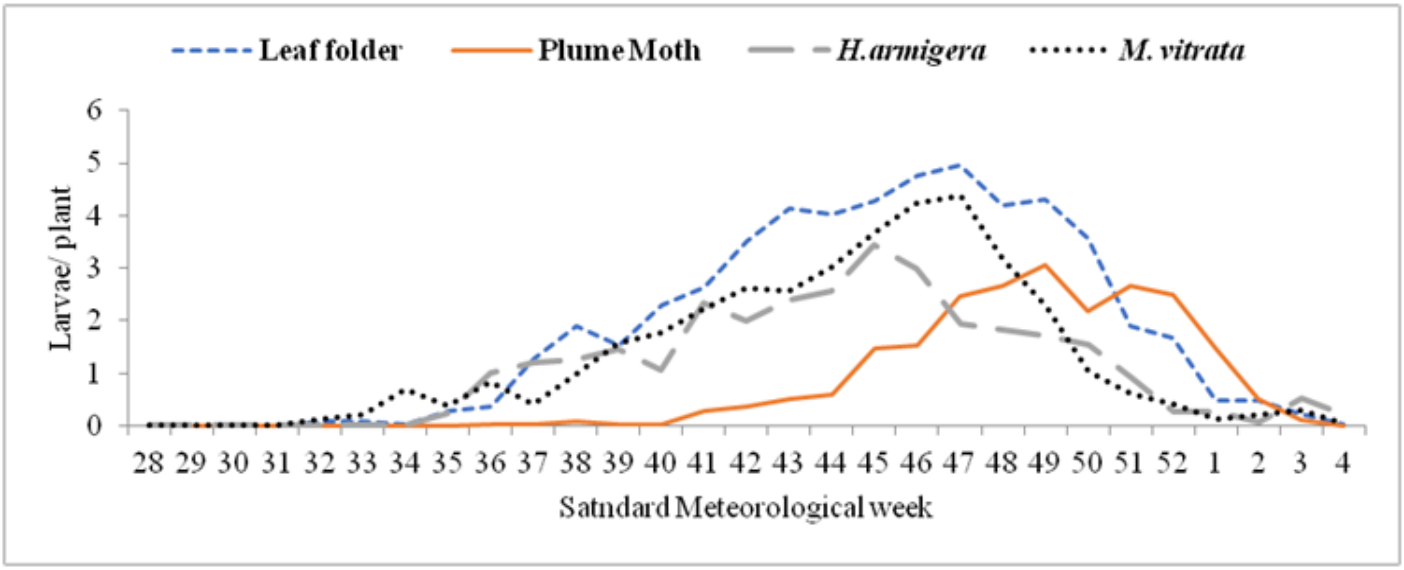

Fig. 1. Seasonal Incidence of Lepidopteran Insect pests in Pigeonpea

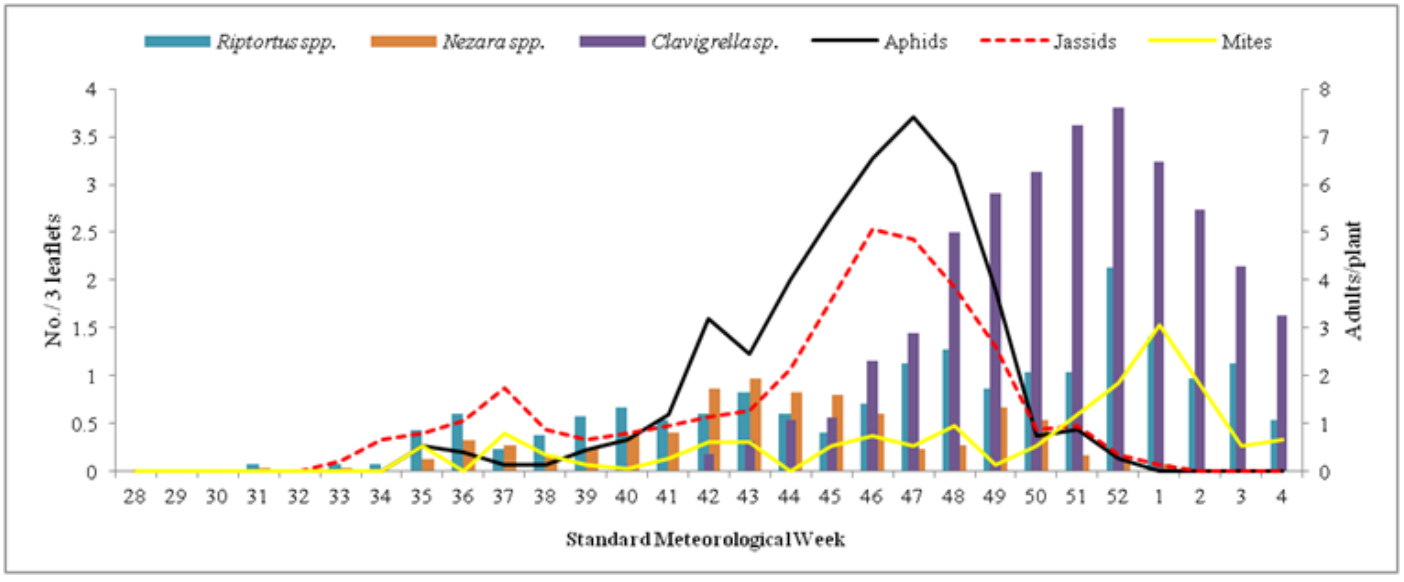

Fig. 2. Seasonal Incidence of Sucking Insect pests in Pigeonpea

temperature has a significant negative (r= -0.522**) impact on the population, and maximum relative humidity has a significantly positive effect (r= 0.614) (Table 2). Correlations of weather parameters with blister beetles abundance revealed that maximum temperature, minimum temperature and bright sunshine hours were significantly correlated in a negative manner. Morning relative humidity and evening relative humidity had a positive influence on blister beetle abundance. The peak abundance of adults during flowering phase is supported by [4], who reported blister beetle *Mylabris pustulata* activity from flowering to the harvest of Kharif brinjal, whereas, [5] reported peak incidence (12.3-19.4 beetles plant^{-1}) between August and October, which coincides with the flowering periods of pigeon pea. The number of rainy days and rainfall had a positive correlation with the seasonal abundance of the beetles, though the latter being statistically non-significant in green gram crop [12].

Plume moth

The incidence of the plum moth (*E. atomosa)* initiated in the 36th SMW *i.e.* 0.07 larvae/five plants, and continued till 3rd SMW (0.10 larvae/plant) (Table1). The pest population attained its peak (3.47 larvae/ plants) in the 39th SMW (Table 2). The pest population exhibited a non-significant positive correlation with temperature and non-significant negative correlation with relative humidity (Table 3). The findings of the present investigation is in close conformity with the earlier work carried out by **[7]** who observed that the larvae of *E. atomosa* were active from the 41st SMW to 49th SMW, with a peak in activity in the 45th SMW (2 larvae/5 plants) when the minimum and maximum temperature, morning and evening relative humidity and rainfall respectively. Similar results were reported by [14].

Pod bugs

The pod bug, *C. gibbosa* was first recorded during the first week of September (42nd SMW) with 0.37 bugs/plant. The activity of the pest continued from 30th October to fourth week of January. The peak population of the pest was observed during 51st to 5th SMW was (Table 1). It is evident that mean nymph and bug population was negatively correlated with maximum temperature (r= - 0.352), negatively correlated with minimum temperature (r= -0.682), negatively correlated with morning RH (r= - 0.621), negatively correlated with evening RH (r= - 0.516) (Table 2). Similarly, in *Riptortus spp.* The peak incidence was observed during 52nd SMW (2.13 bugs/ plant), and the incidence was less compared to that of *C. gibbosa,* and it was positively correlated with minimum temperature (r= 0.541) and negatively with maximum relative humidity (r= -0.570). The green stink bug, *N. viridula* was first recorded during the first week of July, i.e., on 31st SMW), and it was 0.03 bugs/plant. The activity of the pest continued from July to the first week of January. The peak population of the pest were observed during 43rd SMW with 0.97 bugs/plant. The results are in close conformity with [11], who reported that population of pod bug and *N. viridula* was negatively correlated with maximum and minimum temperature, negatively correlated with morning RH and evening RH and negatively non-significant correlated with rain fall respectively.

Aphids

The population of aphids was first observed in 35th standard meteorological week (0.27 aphids/ 3 leaflets) with its peak of 3.70 aphids per three leaflets in 43rd standard meteorological week. There was much influence of the weather parameters on the incidence of aphids in pigeonpea (Table 1 and 2). The present findings are in conformity with the findings of [13] who revealed that the peak population of soybean aphids was observed at late vegetative to pre-flowering stages. [10] demonstrated that the peak population was recorded in 35th SMW. [23] revealed non-significant correlation between the nymphal population.

Jassids

The population of jassids was initialed on pigeon pea on the early vegetative stage of the crop on 33rd SMW, and the population was very negligible with 0.10 adults per three leaflets, and the incidence of jassids continued up to the first week of January, and the peak was observed during 46th SMW (2.53/ 3 leaflets) (Table 1). The influence of weather parameters revealed that it was significantly negatively correlated with rainfall (r= -0.548*), and there was no influence of other weather factors significantly on the population of jassids (Table 2). These findings are in close agreement with [23], who indicated that maximum temperature, rainfall and rainy days were negatively correlated with the jassid population on soybean. [7] [1] revealed the non-significant correlation between the nymphal population of *A. biguttula biguttula* and weather factors on sunflower crop.

Mites and SMD

The earliest possible onset of SMD in fields of pigeon pea was in 42nd SMW and peak disease in incidence was observed during 3rd and 4th week of January. The disease incidence prolonged with the increase of mites population gradually. The mite population increased from 51st SMW (0.60 mites/ 3 leaflets) to 53rd SMW (1.53 /3 leaflets) (Table 1). Similarly, the disease incidence also increased from 51st SMW and continued to the last week of January. The disease incidence was positively correlated with minimum (r= 0.524) and maximum (r=0.721) relative humidity significantly and also favourable for mite population (Table 2). Similar observations were recorded by [8] where abiotic factors like temperature, relative humidity and rainfall had a significant effect on the mite population. [24] also reported that pigeon pea plants remain vulnerable to infection throughout the year.

Helicoverpa armigera

The incidence of *H. armigera* on pigeon pea was first noticed in 35th standard meteorological week 0.23 larvae/plant. Whereas, maximum incidence 3.43 (larvae/ plant) was noticed in 45th normal meteorological week. The incidence was more from 41st SMW to 46th SMW. Highest number of moths trapped in the pheremone traps was in 47th SMW (4.37 moths/trap/week) (Table 1 and 2). The data on the population of *H. armigera* infesting pigeonpea are in pursuant to the observations recorded by [6]. Who observed two peaks of I and III instar larvae *H. armigera,* first in 46th standard meteorological week and second in 48th standard meteorological week. [2] recorded peak population of *H. armigera* on pigeon pea in 47th normal meteorological week. The correlation of *H. armigera* population with maximum temperature, minimum temperature and afternoon relative humidity was positively non-significant whereas morning relative humidity negatively non-significant.

Maruca vitrata

The incidence of the spotted pod borer (*Maruca vitrata*) commenced in the 38th SMW (0.43 larvae/ plant) (Table 1). The population attained its peak in the 47th SMW (4.17 larvae/plant). The pest population was positive significant with temperature and significantly negatively correlated with relative humidity. This finding is in close conformity with to findings of [15], who also observed a positive correlation between populations of *M. vitrata, Callosobruchus maculates and Tanaostigmodes cajaninae* and the minimum, maximum and average temperatures.

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