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## Influence of weather parameters on incidence of cowpea pod borer in central zone of Kerala

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**Abstract**

Cowpea is an annual herbaceous legume and is a main crop across Africa and Asia. It can be grown in sandy soil and is susceptible to low rainfall conditions. Cowpea pod borer (*Muraca vitrata*) is the main pest of cowpea. Weather factors affect different crops in many ways. Changing weather pattern over different regions affect host plants and pests. Total variability of pest populations in crops is determined by the natural growth of population and the influence of weather on activity and rate of multiplication of the insects (Kirk, 1997). Increased temperature increases productivity of cowpea if sufficient water is available, they also afford many insect species. Study conducted to examine the pest weather relationship of cowpea pod borer. Investigation was carried out on pod borer attack in cowpea [*Vigna unguiculata* (L.) Walp.] in five different stations of Thrissur, Kerala for three years from 2012-14. The study revealed that cowpea pod borer incidence had positive correlation with maximum temperature and diurnal temperature range, whereas, pod borer incidence showed a negative correlation with rainfall, number of rainy days and afternoon relative humidity. Step-wise regression analysis showed that maximum temperature and afternoon relative humidity experienced in prior week and rainfall and number of rainy days in prior two weeks are the significant weather factors for predicting pod borer infestation in cowpea.

**Keywords:** correlation, regression, pod borer

**Introduction**

In Indian agriculture, pulses play an important role as it is rich in protein. Cowpea [*Vigna unguiculata* (L.) Walp.] is one of the important pulse crops. Mandal *et al.* (2009) <sup>[6]</sup> observed that area under cowpea in India is 3.9 million hectares with a production of 2.21 million tonnes with the national productivity of 683 kg ha<sup>-1</sup>. Cowpea grain contains about 25% protein and 64% carbohydrate (FAO, 2004) <sup>[1]</sup>. However, crop yields remain very low, which is mainly due to biotic and abiotic factors including pest, diseases, parasitic weeds, drought and low soil fertility (Singh and Jackai 1985) <sup>[10]</sup>. Yield of cowpea significantly reduced due to damage by legume pod-borer, *Maruca vitrata* (Lepidoptera: Crambidae). Larval feeding damage to cowpea plants occurs on flower buds, flowers, seed pods, tender leaves and terminal shoots and losses in grain yield of 20–80 per cent have been estimated from infestation by this pest alone (Sharma *et al.* 1999; Singh *et al.* 1990; Machuka *et al.* 1999) <sup>[8, 11, 5]</sup>. A study conducted by Kanhere *et al.* (2013) at Instructional Farm, College of Agriculture, Junagadh Agricultural University in *kharif* 2009 showed that maximum temperature has positive correlation and afternoon relative humidity is having negative correlation with pod borer incidence. Kumar *et al.* (2017) <sup>[4]</sup> studied population dynamics of major insect pest of cowpea and they observed that pod borer population showed significant negative correlation with minimum temperature, relative humidity and rainfall and significant positive correlation with maximum temperature. Present study can be used to develop suitable management strategies for suppressing the pest population.

**Materials and Methods**

The experiment on the pest weather relationship of cowpea pod borer was carried out by using data collected from six different stations of Thrissur, Kerala (Kodassery, Chalakkudy, Kadukkutty, Pudukkad and Vellanikkara) for three years from 2012-2014. The number of plants infested by cowpea pod borer was taken for respective standard meteorological week. Numbers of plants infested by pod borer were correlated with different weather parameters like rainfall, number of rainy days, afternoon relative humidity, diurnal temperature range, maximum temperature and minimum temperature experienced in prior week and two prior week of pest infestation. Regression analysis also done for both prior week and two prior weeks.

## Results and Discussion

Results of the correlation study were presented below. Table 1 represents correlation between weather parameters during prior week and cowpea pod borer incidence in the year 2012. In Kodassery, prior week rainfall has negative correlation and diurnal temperature range and maximum temperature had positive correlation with pest incidence in the year 2012. Chalakkudy and Pudukkad station showed negative correlation with prior week diurnal temperature range and maximum temperature and a negative correlation with afternoon relative humidity in the year 2012.

Correlation between weather parameters during two prior weeks and cowpea pod borer incidence in the year 2012 is given in Table 2. Rainfall, number of rainy days and afternoon relative humidity experienced in two prior week of infestation showed a negative correlation with pest incidence in Kodassery. Whereas, diurnal temperature range and maximum temperature during two prior week of pest infestation showed a positive correlation with pod borer attack in Kodassery and Pudukkad. Maximum temperature in prior two weeks showed positive correlation with pest incidence in Kodassery, Chalakkudy, Kadukkutty and Pudukkad stations.

Table 3 showed correlation between weather parameters and cowpea pod borer incidence in the year 2012 and 2013. Number of rainy days and afternoon relative humidity experienced in both prior week and two prior week had negative correlation with pest incidence. Pod borer attack showed positive correlation with diurnal temperature range and maximum temperature experience in prior and two prior weeks in pooled analysis.

Correlation between weather parameters during prior week and cowpea pod borer incidence in the year 2014 given in Table 4. Rainy days in prior week showed negative correlation with pest incidence in Kodassery and afternoon relative humidity in prior week negatively correlated with pest incidence in Pudukkad. In Chalakkudy and Pudukkad stations, diurnal temperature range during prior week showed a positive correlation with pod borer incidence. Maximum temperature showed a positive correlation and minimum temperature showed a negative correlation with pod borer attack in Pudukkad station.

Table 5 represents correlation between weather parameters during two prior week and cowpea pod borer incidence in the year 2014. Rainfall, rainy days and afternoon relative humidity had negative correlation with pest incidence in Kodassery station. In Pudukkad station, minimum temperature and afternoon relative humidity had a negative correlation, whereas, maximum temperature and diurnal temperature range had a positive correlation with pest incidence.

Pooled correlation between weather parameters and cowpea pod borer incidence in the year 2014 is shown in Table 6. Rainfall and number of rainy days experienced in prior week and two prior week showed a negative correlation with pod borer incidence. Diurnal temperature range experienced in prior week showed a positive correlation with pest incidence and minimum temperature had a negative correlation with pest incidence.

Correlation between weather parameters during prior week and cowpea pod borer incidence in the year 2013 and 2014 given in Table 7. Rainfall, number of rainy days, afternoon relative humidity and minimum temperature in prior week had negative correlation with pest incidence and diurnal temperature range and maximum temperature had positive

correlation with pod borer attack in Kodassery and Chalakkudy stations.

Table 8 shows correlation between weather parameters during two prior weeks and cowpea pod borer incidence in the year 2013 and 2014. In Kodassery and Chalakkudy stations, rainfall, rainy days, afternoon relative humidity and minimum temperature in two prior week had negative correlation with pest incidence and diurnal temperature range and maximum temperature had positive correlation with pod borer attack.

Pooled correlation between weather parameters and cowpea pod borer incidence in the year 2013 and 2014 presented in Table 9. Number of rainy days and afternoon relative humidity had negative correlation with pod borer attack, whereas, maximum temperature and diurnal temperature range had positive correlation with pod borer attack in both prior week and two prior week.

Table 10 represents correlation between weather parameters during prior week and cowpea pod borer incidence in the year 2012, 2013 and 2014. Rainfall, number of rainy days and afternoon relative humidity had negative correlation with pest incidence, whereas, diurnal temperature range and maximum temperature had positive correlation with incidence of pod borer in Kadukkutty and Chalakkudy stations.

Correlation between weather parameters and cowpea pod borer incidence in the year 2012, 2013 and 2014 presented in Table 12. Number of rainy days and afternoon relative humidity in both prior week and two prior week showed negative correlation and diurnal temperature range and maximum temperature showed positive correlation with pest incidence in both prior week and two prior week.

Table 13 represents correlation between weather parameters during prior week and cowpea pod borer incidence in the year 2012 and 2014. In Kodassery station, rainfall, number of rainy days and afternoon relative humidity had negative correlation, whereas, diurnal temperature range and maximum temperature had positive correlation with pod borer infestation. Afternoon relative humidity had negative correlation, whereas, diurnal temperature range and maximum temperature had positive correlation with pod borer infestation in Chalakkudy station. In Kadukkutty, number of rainy days negatively correlated and diurnal temperature range positively correlated with pod borer infestation. Rainfall, number of rainy days, afternoon relative humidity and minimum temperature had negative correlation, but diurnal temperature range and maximum temperature had positive correlation with pod borer infestation in Pudukkad station.

Correlation between weather parameters during prior two week and cowpea pod borer incidence in the year 2012 and 2014 is given in Table 14. Rainfall, number of rainy days, afternoon relative humidity and minimum temperature had negative correlation, but diurnal temperature range and maximum temperature had positive correlation with pod borer infestation in Kodassery and Pudukkad station. In Chalakkudy station, afternoon relative humidity had a significant negative correlation, whereas, diurnal temperature range and maximum temperature had significant positive correlation with pod borer infestation. Rainfall and number of rainy days had significant negative correlation and maximum temperature had significant positive correlation with pod borer infestation in Kadukkutty. Afternoon relative humidity had a significant negative correlation with pod borer infestation in Vellanikkara station.

Pooled correlation between weather parameters and cowpea pod borer incidence in the year 2012 and 2014 is given in

Table 15. Rainfall and number of rainy days had negative correlation and diurnal temperature range and maximum temperature had positive correlation with pod borer infestation in both prior week and two prior week. Minimum temperature experienced in prior two weeks had significant negative correlation with pod borer infestation.

Fig. 1. and 2 showed cowpea pod borer incidence in Kodassery plotted against maximum temperature experienced during prior week in the year 2012 and cowpea pod borer incidence in Kodassery plotted against maximum temperature experienced during two prior week in the year 2012 respectively. As the maximum temperature increases, pod borer incidence increases in prior week and two prior weeks. Fig. 3 and 4 represents cowpea pod borer incidence in Kodassery plotted against rainfall experienced during prior week in the year 2012 cowpea pod borer incidence in Kodassery plotted against rainfall experienced during two prior weeks in the year 2012. Pod borer attack decrease with increase in rainfall in both prior week and two prior weeks. Fig. 5 and 6 cowpea pod borer incidences in Pudukkad plotted against maximum temperature experienced during prior week in the year 2012 and cowpea pod borer incidence in Pudukkad plotted against maximum temperature experienced during two prior weeks in the year 2012.

Stepwise regression analysis showed that the afternoon relative humidity and maximum temperature in prior week and rainfall and number of rainy days in prior two weeks are the significant weather variables that could predict pod borer population in cowpea.

Prior week,  $R^2 = 0.076$ ,  $Y = -36.329 + 1.017 T_{max} + 0.107 RH_2$

Prior two weeks,  $R^2 = 0.082$ ,  $Y = 3.489 - 0.591 RD + 0.01 Rainfall$

This is in agreement with findings of Singh *et al.* (2012) [9], who found that temperature favoured the multiplication of gram pod borer and with the findings of Patel *et al.* (2010) [7], who found significant negative correlation with population build up of pod borer and relative humidity, whereas temperature exhibited positive influence. Yadav *et al.* (2015) [12] observed that among various weather parameters, evening relative humidity showed a significantly negative influence on population of almost all pests of cowpea and minimum temperature showed a significantly negative correlation with cowpea pod borer population.

**Table 1:** Correlation between weather parameters during prior week and cowpea pod borer incidence in the year 2012

Station	Prior week					
	Rainfall	Rainy days	RH2 (%)	TR	Tmax	Tmin
Kodassery	-0.549*	-0.488	-0.455	0.571*	0.690**	0.095
Chalakkudy	-0.068	-0.089	-0.643*	0.585*	0.578*	-0.138
Kadukkutty	-0.37	-0.284	-0.277	0.523	0.500	-0.311
Pudukkad	-0.391	-0.411	-0.767**	0.707**	0.729**	-0.162
Vellanikkara	-0.317	-0.404	-0.326	-0.069	-0.060	0.048

**Table 2:** Correlation between weather parameters during two prior weeks and cowpea pod borer incidence in the year 2012

Station	2 prior week					
	Rainfall	Rainy days	RH2 (%)	TR	Tmax	Tmin
Kodassery	-0.643*	-0.575*	-0.663**	.742**	.638**	-0.443
Chalakkudy	-0.178	-0.205	-0.376	0.385	.576*	0.337
Kadukkutty	-0.408	-0.32	-0.347	0.519	.633*	-0.189
Pudukkad	-0.437	-0.421	-0.734**	.733**	.750**	-0.225
Vellanikkara	-0.356	-0.367	-0.523	0.393	0.265	-0.347

**Table 3:** Correlation between weather parameters and cowpea pod borer incidence in the year 2012 and 2013

	Rainfall	Rainy days	RH2	TR	Tmax	Tmin
Prior week	-0.069	-.183**	-.155*	.193**	.233**	0.008
2 Prior week	-0.093	-.209**	-.171*	.218**	.246**	-0.035

**Table 4:** Correlation between weather parameters during prior week and cowpea pod borer incidence in the year 2014

Station	Prior week					
	Rainfall	Rainy days	RH2	TR	Tmax	Tmin
Kodassery	-0.472	-.548*	-0.474	0.436	.538*	-0.219
Chalakkudy	-0.497	-0.366	-0.457	0.585*	0.409	-0.372
Kadukkutty	-0.368	-0.462	-0.299	0.364	0.215	-0.454
Pudukkad	-0.401	-0.436	-0.768**	0.807**	.789**	-.548*
Vellanikkara	-0.32	-0.285	-0.086	-0.187	0.124	0.312

**Table 5:** Correlation between weather parameters during two prior week and cowpea pod borer incidence in the year 2014

Station	2 Prior week					
	Rainfall	Rainy days	RH2	TR	Tmax	Tmin
Kodassery	-.556*	-.627*	-.537*	0.474	0.484	-0.339
Chalakkudy	-0.363	-0.387	-0.486	.550*	0.366	-0.4
Kadukkutty	-0.444	-.556*	-0.224	0.218	0.201	-0.159
Pudukkad	-0.402	-0.487	-.793**	.795**	.763**	-.648**
Vellanikkara	-0.376	-0.325	-0.409	0.247	0.083	-0.246

**Table 6:** Pooled correlation between weather parameters and cowpea pod borer incidence in the year 2014

	Rainfall	Rainy days	RH2	TR	Tmax	Tmin
Prior week	-.301*	-.341**	-0.12	.265*	0.218	-0.2
2 Prior week	-.351**	-.396**	-0.131	0.23	0.151	-.251*

**Table 7:** Correlation between weather parameters during prior week and cowpea pod borer incidence in the year 2013 and 2014

Station	Prior week					
	Rainfall	Rainy days	RH2	TR	Tmax	Tmin
Kodassery	-.427**	-.643**	-.657**	.635**	.647**	-.408*
Chalakkudy	-.329*	-.494**	-.642**	.673**	.622**	-.523**
Kadukkutty	.405*	0.006	-0.086	0.028	0.1	0.165
Pudukkad	-.296*	-0.202	-0.139	0.238	0.129	-.389**
Vellanikkara	0.262	0.116	0.11	-0.238	-0.155	0.217

**Table 8:** Correlation between weather parameters during two prior weeks and cowpea pod borer incidence in the year 2013 and 2014

Station	2 Prior week					
	Rainfall	Rainy days	RH2	TR	Tmax	Tmin
Kodassery	-.483**	-.730**	-.673**	.655**	.611**	-.460**
Chalakkudy	-.357**	-.529**	-.648**	.662**	.598**	-.520**
Kadukkutty	0.317	-0.068	-0.148	0.072	0.216	0.262
Pudukkad	-0.241	-0.185	-0.096	0.199	-0.017	-.489**
Vellanikkara	0.237	0.079	0.01	-0.046	-0.086	-0.099

**Table 9:** Pooled correlation between weather parameters and cowpea pod borer incidence in the year 2013 and 2014

	Rainfall	Rainy days	RH2	TR	Tmax	Tmin
Prior week	-0.07	-.205**	-.136*	.164*	.174*	-0.079
2 Prior week	-0.094	-.236**	-.147*	.164*	.159*	-0.108

**Table 10:** Correlation between weather parameters during prior week and cowpea pod borer incidence in the year 2012, 2013 and 2014

Station	Prior week					
	Rainfall	Rainy days	RH2	TR	Tmax	Tmin
Kodassery	-.451**	-.620**	-.614**	.636**	.667**	-0.266
Chalakkudy	-.333**	-.458**	-.635**	.638**	.602**	-.380**
Kadukkutty	.303*	-0.033	-0.112	0.111	0.151	0.023
Pudukkad	-0.249	-0.186	-0.224	.268*	0.206	-.329**
Vellanikkara	0.172	0.036	-0.012	-0.126	-0.071	0.163

**Table 11:** Correlation between weather parameters during two prior weeks and cowpea pod borer incidence in the year 2012, 2013 and 2014

Station	2 Prior week					
	Rainfall	Rainy days	RH2	TR	Tmax	Tmin
Kodassery	-.504**	-.697**	-.683**	.692**	.636**	-.455**
Chalakkudy	-.361**	-.493**	-.593**	.602**	.600**	-.245
Kadukutty	0.216	-0.097	-0.169	0.151	0.259	0.125
Pudukkad	-0.217	-0.193	-0.202	.258*	0.139	-.421**
Vellanikkara	0.142	-0.004	-0.11	0.072	0.013	-0.161

**Table 12:** Correlation between weather parameters and cowpea pod borer incidence in the year 2012, 2013 and 2014

	Rainfall	Rainy days	RH2	TR	Tmax	Tmin
Prior week	-0.115	-.234**	-.174**	.229**	.247**	-.075
2 Prior week	-.142*	-.267**	-.186**	.239**	.243**	-.116*

**Table 13:** Correlation between weather parameters during prior week and cowpea pod borer incidence in the year 2012 and 2014

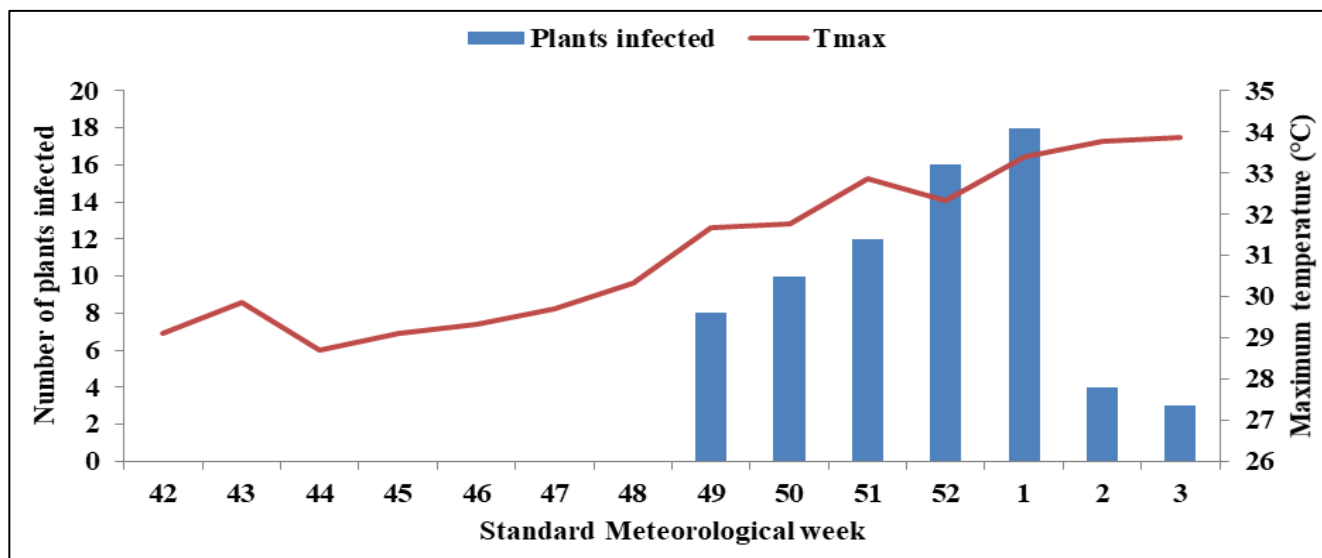
Station	Prior week					
	Rainfall	Rainy days	RH2	TR	Tmax	Tmin
Kodassery	-.507**	-.518**	-.444*	.495**	.566**	-0.074
Chalakkudy	-0.152	-0.178	-.536**	.580**	.450*	-0.227
Kadukutty	-0.369	-.382*	-0.285	.437*	0.335	-0.368
Pudukkad	-.394*	-.422*	-.743**	.741**	.707**	-.363*
Vellanikkara	-0.306	-0.302	-0.194	-0.113	0.008	0.185

**Table 14:** Correlation between weather parameters during prior two week and cowpea pod borer incidence in the year 2012 and 2014

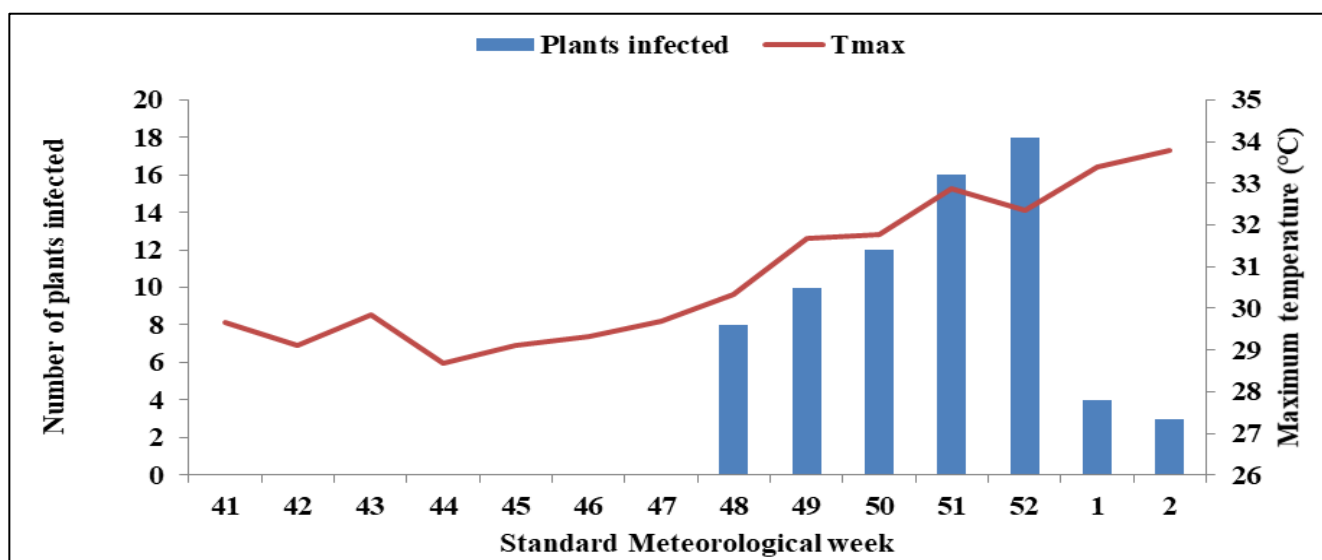
Station	2 Prior week					
	Rainfall	Rainy days	RH2	TR	Tmax	Tmin
Kodassery	-.590**	-.601**	-.588**	.602**	.514**	-.376*
Chalakkudy	-0.276	-0.298	-.424*	.465*	.441*	-0.01
Kadukutty	-.421*	-.447*	-0.28	0.367	.406*	-0.174
Pudukkad	-.417*	-.455*	-.731**	.744**	.690**	-.446*
Vellanikkara	-0.366	-0.342	-.436*	0.305	0.169	-0.287

**Table 15:** Pooled correlation between weather parameters and cowpea pod borer incidence in the year 2012 and 2014

	Rainfall	Rainy days	RH2	TR	Tmax	Tmin
Prior week	-.308**	-.308**	-0.131	.296**	.296**	-0.109
2 Prior week	-.358**	-.357**	-0.147	.298**	.271**	-.173*



**Fig 1:** Cowpea pod borer incidence in Kodassery plotted against maximum temperature experienced during prior week in the year 2012



**Fig 2:** Cowpea pod borer incidence in Kodassery plotted against maximum temperature experienced during two prior week in the year 2012

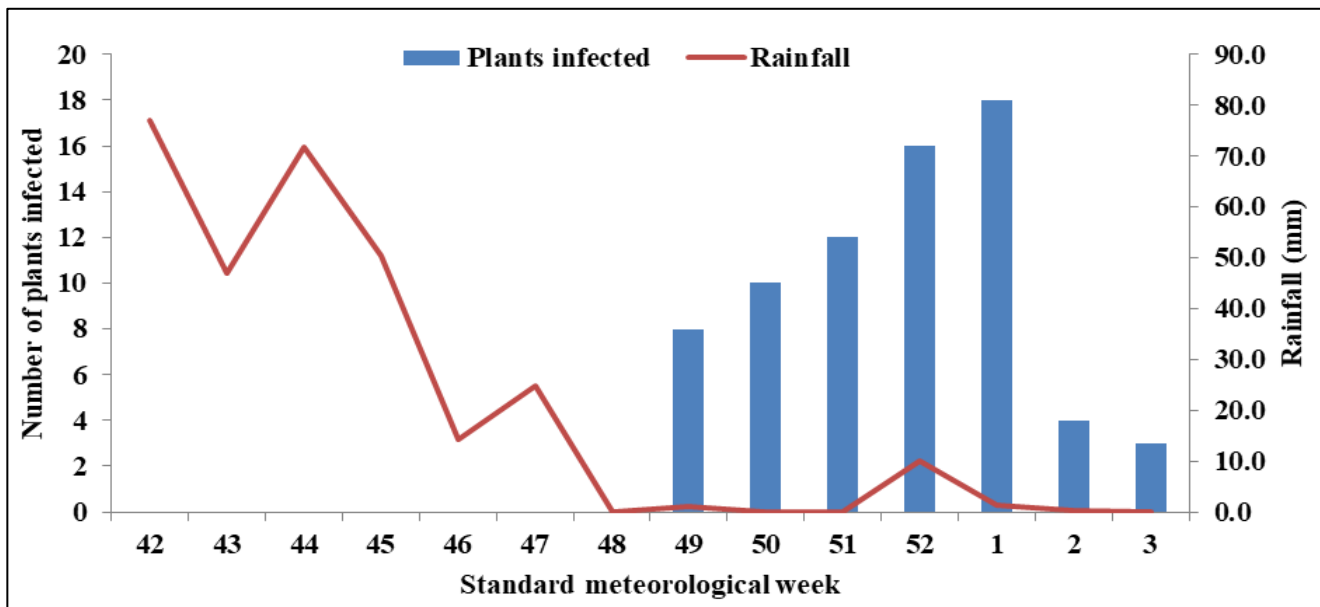


Fig 3: Cowpea pod borer incidence in Kodassery plotted against rainfall experienced during prior week in the year 2012

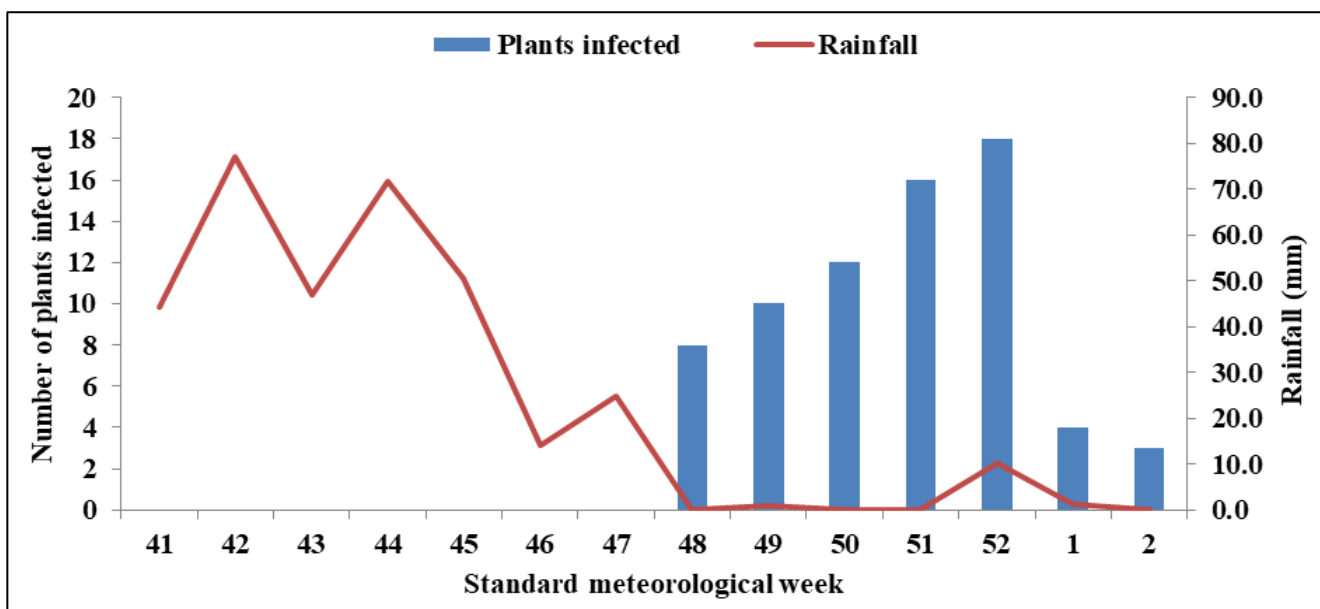


Fig 4: Cowpea pod borer incidence in Kodassery plotted against rainfall experienced during two prior weeks in the year 2012

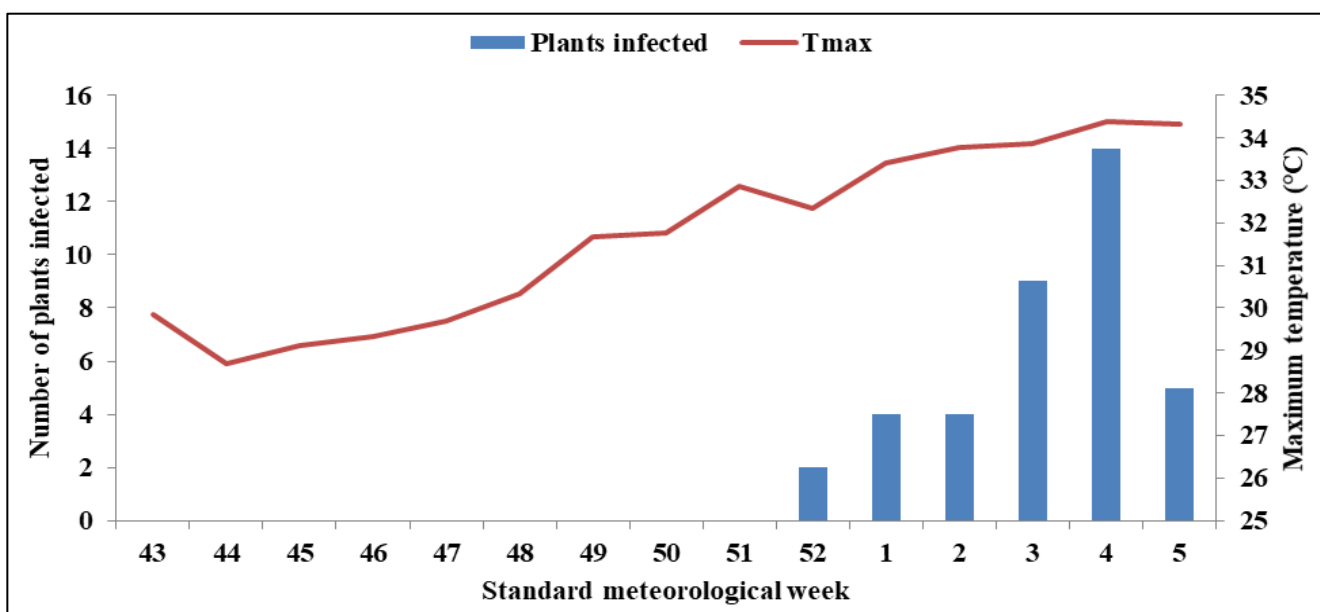


Fig 5: Cowpea pod borer incidence in Pudukkad plotted against maximum temperature experienced during prior week in the year 2012

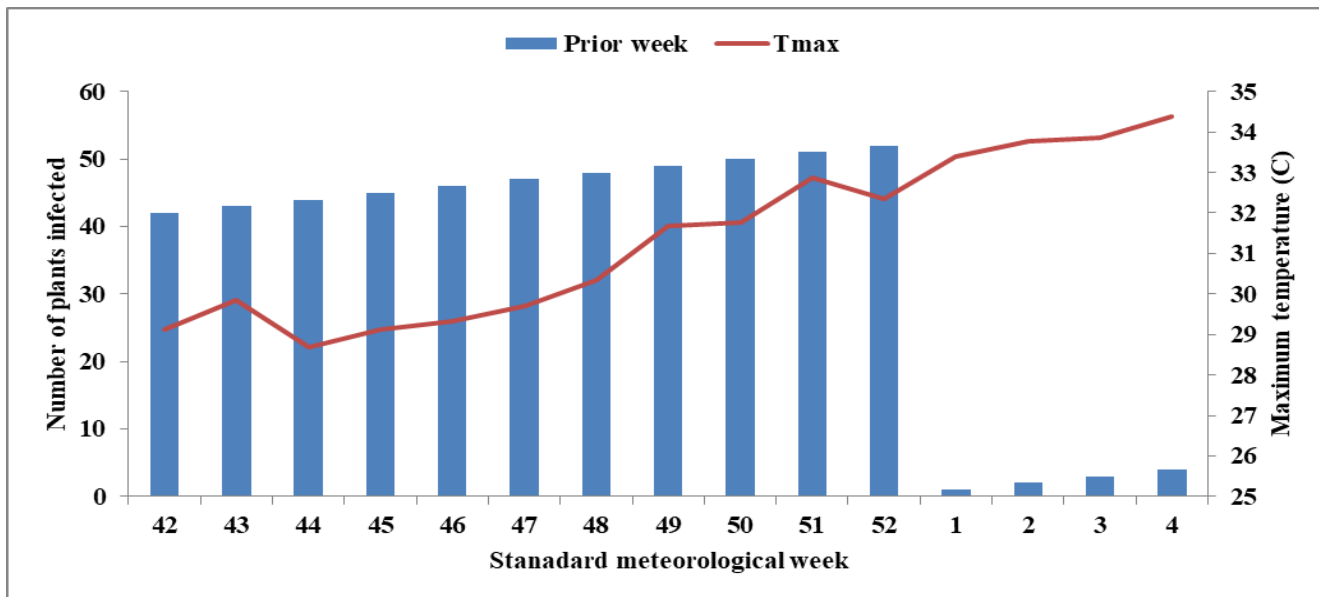


Fig 6: Cowpea pod borer incidence in Pudukkad plotted against maximum temperature experienced during two prior weeks in the year 2012

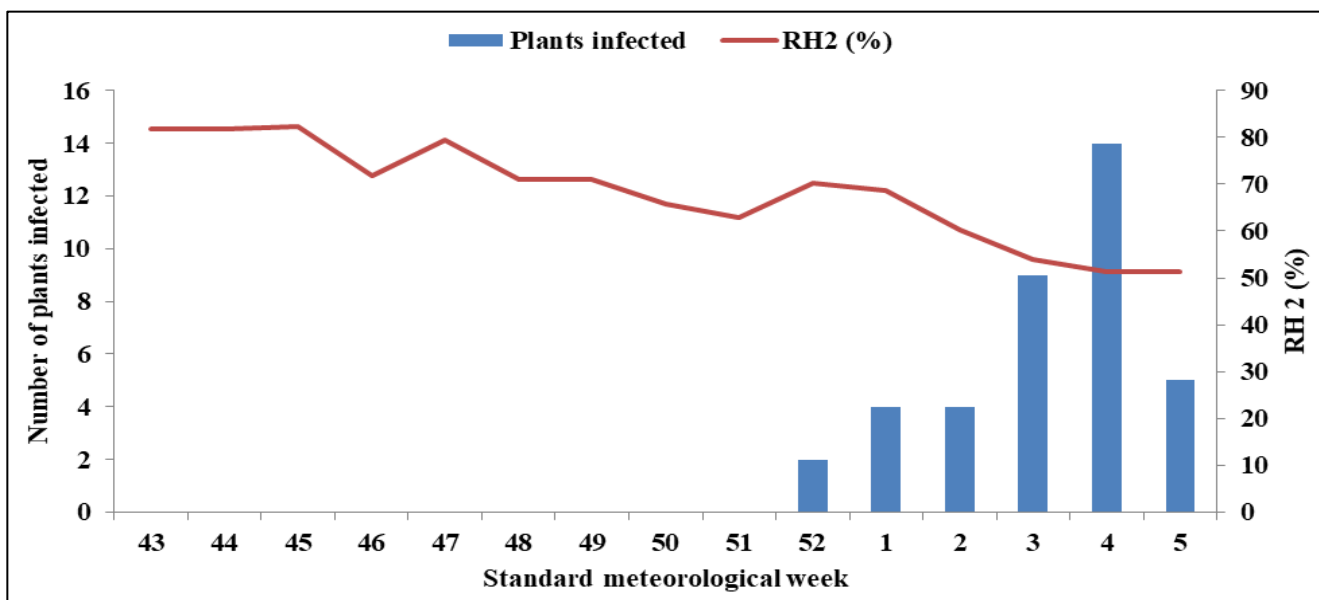


Fig 7: Cowpea pod borer incidence in Pudukkad plotted against afternoon relative humidity experienced during prior week in the year 2012

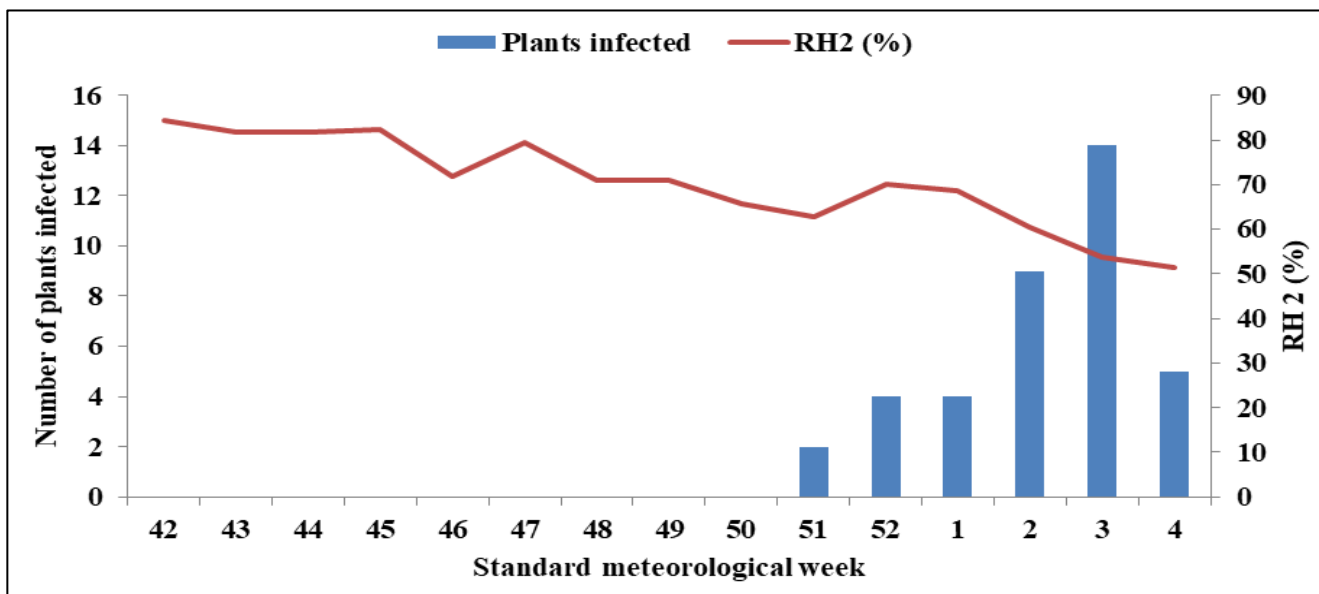


Fig 8: Cowpea pod borer incidence in Pudukkad plotted against afternoon relative humidity experienced during two prior weeks in the year 2012

## Conclusion

Weather parameters like minimum temperature, rainfall, number of rainy days and afternoon relative humidity is having negative correlation, whereas, maximum temperature and diurnal temperature range had positive correlation with pod borer attack. This study will help to find out the optimal weather condition for multiplication of cowpea pod borer.

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