



# Influence of Weather Parameters on Seasonal Incidence of Pod Boring Weevil, *Apion clavipes* Gerst (Apionidae: Coleoptera) on Pigeonpea [*Cajanus cajan* (L.) Millsp.] under West Bengal Conditions

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## Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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## ABSTRACT

Pigeon pea is a high protein legume cultivated by marginal farmers in the Indian sub-continent. It exposes a wide variety of biotic stresses especially insect pests. Pod boring weevil, *Apion clavipes* Gerst is a major concern in eastern India which causes direct damages to economic parts such as flowers and pods. Pod boring weevil, *Apion clavipes* Gerst infests pigeonpea during vegetative, flowering, pod formation and pod maturity stages. However, there is not much information on seasonal incidence of pod boring weevil, *A. clavipes* Gerst on this particular host, which is very much essential for forecasting and forewarning of pest incidence and development of Integrated Pest Management module. The seasonal incidence of pod boring weevil was studied in two consecutive years during 2016-17 and 2017-18. The grub and weevil populations in shoots, flower raceme and pods were recorded and obtained weather data from automatic weather station of BCKV, West Bengal and subjected to correlation and regression analysis. The experimental results revealed that pest population started during 43<sup>rd</sup> SMW (4<sup>th</sup> week of October) and pest population attained the maximum population of 45.00 grub/plant during 4<sup>th</sup> SMW (4<sup>th</sup> week of January). Pest population was observed till 11<sup>th</sup> SMW (3<sup>rd</sup> week of March). Seasonal incidence of pod boring weevil negatively correlated with maximum relative humidity, minimum relative humidity and rainfall, whereas, positively correlated with maximum temperature, minimum temperature and sunshine hours.

**Keywords:** Pigeonpea; pod weevil; grub; population; seasonal incidence; analysis.

## 1. INTRODUCTION

Pulses are important sources of protein in human dietary requirements. Pigeon pea (*Cajanus cajan* (L.) Millsp.) is the mostly grown pulse crop in India, next to Chickpea (Pandey et al. 2016). India shares 90 per cent of total world Pigeonpea production (AICRP 2010). In India, Pigeonpea is cultivated in the states of Maharashtra, MP, UP, AP, Haryana, Punjab, Orissa, Bihar, TN, Karnataka, Gujarat, West Bengal, Kerala and a few NE states. In India, West Bengal grew 4,500 ha of Pigeonpea and produced 5,850 tons of Pigeonpea grains (Indiastat 2018-19). However, low yield in Pigeonpea is due to several major insect pest (Akhilesh & Parasnath 2003; Pawar et al., 2012; Srilakshmi & Paul, 2010; Yadav et al., 2016). In India, avoidable yield losses due to insect pests in Pigeonpea was recorded to the tune of 78%. Together borer pest tend to damages 57.07% pods and 34.79% seeds, experiencing a yield loss of 28.07% in early maturing Pigeonpea cultivars (Chandrayudu et al., 2008). Recent years, pod boring weevil is emerging as a serious pest of Pigeonpea in east (Bihar and West Bengal) and north east region of India (Subharani & Singh, 2004; Bandopadyay et al., 2009; Patra et al., 2016). The grub of pod weevil enters into the seeds and starts feeding developing grain and causes 77.8% damage to pod and 43.1% damage to seed. Moreover, Adults of pod weevil cause damage by feeding on vegetative leaves, shoots and flower leading to poor pod development. The present

experiment done to study the seasonal incidence of pod boring weevil, *Apion clavipes* under West Bengal condition and to generate data for development of Integrated pest management module for this serious borer pest.

## 2. MATERIALS AND METHODS

Seasonal incidence of *A. clavipes* on pigeonpea (UPAS-120) was recorded on two consecutive cropping seasons during 2016-17 and 2017-18 at teaching farm, Mondouri, BCKV, Mohanpur, West Bengal (22°40' N latitude & 88°18' E longitude). All observations were recorded during early morning hours at weekly interval basis starting from 120 (17 WAS) to 150 (20 WAS) days after sowing. The pod weevil, *A. clavipes* grub, adult population, number of damaged flower buds and pods were recorded to assess seasonal incidence. The grub and adult population were recorded from ten randomly selected samples representing flowers, pods respectively on five different locations in the experimental plots. The number of damaged flowers and pods were recorded from five active racemes in a plant on ten randomly selected plants. The observational data on the grub and adult population and the number of damaged pods were recorded entire cropping season. Influence of weather parameters on the seasonal incidence of pigeonpea pod weevil were correlated with weather parameters viz., maximum temperature ( $T_{max}$ ), minimum temperature ( $T_{min}$ ), relative

humidity (RH), Sunshine hours and rainfall data received from the Directorate of Research, Bidhan Chandra Viswa Vidyalyaya (BCKV) weather station, Kalyani, Nadia, West Bengal.

**Statistical Analysis:** The correlation and multi linear regression analysis was done using SPSS ver.20.0 software to assess influence of weather parameters on the pod weevil seasonal incidence and derived correlation matrix and regression co-efficient using formula given below (1).

$$Y = b_0 \pm b_1 (T_{\max}) \pm b_2 (T_{\min}) \pm b_3 (RH) \pm b_4 (SSH) \pm b_5 (RF) \quad (1)$$

### 3. RESULTS AND DISCUSSION

The experimental results revealed that during 2016-17, pod boring weevil, *A. clavipes* incidence started during 43<sup>rd</sup> SMW (4<sup>th</sup> week of October) at very low density. Pest population

rose gradually and attained the peak population of 43.00 grubs /plant during 4<sup>th</sup> SMW (4<sup>th</sup> week of January). January onwards pest population started declining gradually and the pest population recorded till 11<sup>th</sup> SMW (3<sup>rd</sup> week of March) (Table 1 & Fig. 1). During 2017-18, pod weevil population began in 43<sup>rd</sup> standard meteorological week (4<sup>th</sup> week of October) and reached peak population of 47.00 grub/ plant during 4<sup>th</sup> SMW (4<sup>th</sup> week of January) and pest population persisted up to 11<sup>th</sup> SMW (3<sup>rd</sup> week of March) (Table 2 & Fig. 2). The present experimental results contradicts with Umesha et al., 2006 who reported the pest population started during 26<sup>th</sup> SMW, raised gradually and reached first peak during 30<sup>th</sup> SMW and second peak during 40<sup>th</sup> SMW. Pest populations exist till 47<sup>th</sup> SMW. Moreover, Worku et al., 2018 reported that weevil population started from early vegetative stage to pod initiation stage and reaches its peak in the fourth week of September (early grain filling stage). There is not much information available in relation to this study.

**Table 1. Incidence of Pod weevil, *Apion clavipes* during 2016-17**

Standard weeks	Duration	Mean weather parameters 2016-2017						
		Max T(°C)	Min T(°C)	Max RH (%)	Min RH (%)	SSH	RF (mm)	Pod weevil (Grub)
23	4 – 10	35.0	26.8	94.0	70	8.0	34.0	0.00
24	11 – 17	33.2	25.7	95.0	78	3.1	40.9	0.00
25	18 – 24	34.0	27.0	94	81	5.7	36.2	0.00
26	25 – 01	34.2	27.3	93.6	76.0	8.2	20.2	0.00
27	2 – 8	31.7	26.1	98	88.9	1.7	128.3	0.00
28	9 – 15	29.4	27.3	90.9	42.4	4.4	83.6	0.00
29	16 – 22	31.4	26.2	97	87.4	0.6	77.0	0.00
30	23 – 29	32.0	25.9	96.4	85.6	4.0	61.8	0.00
31	30 - 5	31.6	26.3	96.9	88.6	3.9	54.5	0.00
32	6 – 12	30.0	25.6	98.4	91.1	1.7	169.7	0.00
33	13 – 19	32.7	26.5	96.1	83.3	4.2	55.0	0.00
34	20 – 26	31.8	25.6	97.6	85.9	5.2	182.0	0.00
35	27 – 2	30.5	27.6	85.1	38	4.2	16.2	0.00
36	3 – 9	32.5	26.4	97.1	77.9	4.4	123	0.00
37	10 – 16	33.8	26.8	93.9	71.0	6.6	12.0	0.00
38	17 – 23	33.7	25.9	96.7	80.4	5.5	23.2	0.00
39	24 – 30	32.6	25.9	97.4	83.9	4.8	31.3	0.00
40	1 – 7	34.0	25.9	95.6	73.7	7.2	26.0	0.00
41	8 – 14	32.6	24.4	98.9	78.9	6.0	61.2	0.00
42	15 – 21	33.8	22.6	94.3	56.1	9.8	0.0	0.00
43	22 – 28	33.9	22.7	95.3	64.9	5.9	0.0	0.03
44	29 – 4	31.6	23.9	95.7	72.3	6.0	7.4	0.41
45	5 – 11	28.9	18.4	95.7	73.7	6.2	12.2	0.76
46	12 – 18	30.1	16.8	92.1	48.6	8.9	0.0	1.14
47	19 – 25	29.3	15.1	91.4	52.4	6.7	0.0	2.35
48	26 – 02	29.4	16.6	93.0	58.3	4.7	0.0	0.25
49	3 – 9	27.8	16.6	93.7	57.0	7.7	0.0	1.63
50	10 – 16	25.3	10.8	94.1	54.6	7.3	0.0	2.01
51	17 – 23	25.9	12.4	92.0	57.9	3.9	0.0	3.00

Standard weeks	Duration	Mean weather parameters 2016-2017						
		Max T(°C)	Min T(°C)	Max RH (%)	Min RH (%)	SSH	RF (mm)	Pod weevil (Grub)
52	24 – 31	25.5	13.4	95.8	66.1	2.7	0.0	4.66
1	1 – 7	25.7	12.4	94.9	57.1	5.5	0.0	6.33
2	8 – 14	24.1	10.6	91.0	47.3	5.9	0.0	20.66
3	15 – 21	26.3	8.8	90.0	43.3	7.7	0.0	32.33
4	22 – 28	27.7	11.8	91.71	50.4	6.6	0.0	43.0
5	29 – 4	26.9	11.8	91.71	53.0	7.4	0.0	21.66
6	5 – 11	29.64	13.42	89.57	41.42	8.3	0.0	14.66
7	12 – 18	30.48	15.74	89.85	44.42	4.7	0.0	8.0
8	19 – 25	31.85	18.58	88.57	44.28	5.8	0.0	3.0
9	26-1	33.42	16.5	91.28	47	8.8	0.0	0.66
10	2-8	31.42	19.28	95.14	60.85	4.6	0.45	0.00
11	9-15	32.21	16.72	86.71	34.14	9.4	0.0	0.00
							CD	0.558
							SE(m)	0.193
							SE(d)	0.273
							C.V (%)	13.10

**Table 2. Incidence of Pod weevil, *Apion clavipes* during 2017-18**

Standard weeks	Duration	Mean weather parameters 2017-2018						Pod weevil (Grub)
		Max T(°C)	Min T(°C)	Max RH (%)	Min RH (%)	SSH	RF (mm)	
23	4 – 10	36.7	27.77	88.28	58.85	7.5	9.50	0.00
24	11 – 17	34.77	26.91	92.57	68.14	4.2	7.9	0.00
25	18 – 24	34.07	26.38	93.42	74.0	4.17	97.40	0.00
26	25 – 01	33.5	26.9	95.1	79.1	5.39	26.2	0.00
27	2 – 8	32.4	26.4	98.4	88.3	1.9	142.5	0.00
28	9 – 15	31.8	26.4	96.6	82	3.5	49.5	0.00
29	16 – 22	31.5	26.4	95	83.3	3.29	104.6	0.00
30	23 – 29	30.5	25.6	97.4	88.9	1.67	133.0	0.00
31	30 - 5	33.7	26.4	96.4	82.3	3.43	128.5	0.00
32	6 – 12	32.7	26.7	94.1	78.7	3.53	41.4	0.00
33	13 – 19	32.35	25.77	97.42	85.57	3.45	75.0	0.00
34	20 – 26	32.97	28.32	94.85	81.42	5.75	45.8	0.00
35	27 – 2	32.48	25.85	95.28	90.28	3.45	44.6	0.00
36	3 – 9	32.12	26.64	95.71	68.85	6.25	4.57	0.00
37	10 – 16	34.95	27.07	93.07	63.57	17.5	43.15	0.00
38	17 – 23	33.57	26.62	96.62	76.42	4.62	26.7	0.00
39	24 – 30	33.94	26.67	96.42	75.42	3.31	59.6	0.00
40	1 – 7	33.0	25.30	97.71	81.00	5.15	36.3	0.00
41	8 – 14	32.37	25.47	97.86	78.86	5.08	84.9	0.00
42	15 – 21	31.86	25.5	95.86	74.14	5.47	99.6	0.00
43	22 – 28	32.01	22.74	99.43	69.14	7.043	16.9	0.17
44	29 – 4	32.2	20.24	95.43	62.12	7.39	0.00	0.31
45	5 – 11	31.83	19.89	94.00	53.86	9.74	0.00	0.56
46	12 – 18	27.91	20.37	94.71	75.57	3.52	37.00	0.72
47	19 – 25	28.50	16.09	92.29	51.86	8.69	0.0	0.91
48	26 – 02	27.69	12.83	89.71	46.57	7.8	0.0	2.23
49	3 – 9	25.97	14.85	90.42	62.00	4.72	2.6	3.37
50	10 – 16	27.50	17.41	95.57	68.71	5.99	1.83	4.11
51	17 – 23	23.81	13.8	93.57	66.14	4.91	0.0	4.33
52	24 – 31	25.86	11.49	95.57	53.29	7.81	0.0	6.00
1	1 – 7	25.18	11.49	95.57	53.29	7.81	0.0	8.00
2	8 – 14	25.18	9.34	93.28	51.85	6.91	0.0	22.00
3	15 – 21	21.47	7.34	90.57	53.85	4.22	0.0	34.333

Standard weeks	Duration	Mean weather parameters 2017-2018						Pod weevil (Grub)
		Max T(°C)	Min T(°C)	Max RH (%)	Min RH (%)	SSH	RF (mm)	
4	22 – 28	26.40	9.76	89.14	42.14	7.84	0.0	47.00
5	29 – 4	28.28	11.28	90.71	45.42	7.84	0.0	24.00
6	5 – 11	29.38	16.44	89.00	43.42	8.44	0.0	18.33
7	12 – 18	29.41	13.95	88.14	43.42	5.72	0.0	7.33
8	19 – 25	33.38	17.64	91.28	44.42	5.72	0.0	2.00
9	26-1	34.07	19.90	91.42	34.57	6.31	0.0	1.33
10	2-8	34.35	18.17	84.42	29.85	8.95	0.0	0.66
11	9-15	35.44	19.77	87.71	38.14	7.04	0.028	0.33
							CD	0.55
							SE(m)	0.19
							SE(d)	0.27
							C.V (%)	12.45

Correlations matrix of pod weevil, *A. clavipes* population and weather parameters were given in Table 3. It revealed that significant and positive correlation between *A. clavipes* population and maximum temperature, minimum temperature and sunshine hours. The correlation coefficient (r) values for 2016-17 were 0.466, 0.720 and 0.093, respectively suggesting maximum and minimum temperature showed strong positive correlation and sunshine hours showed minimum positive correlation. In comparison correlation values for 2017-18 were 0.710, 0.480 and 0.080, respectively. Data on population of pod weevil, *A. clavipes* negatively correlated with RH<sub>max</sub>, RH<sub>min</sub> and rainfall. Correlation coefficient (r) values for 2016-17 were -0.132, -0.160 and -0.198 (2016-17),

respectively and -0.483, -0.472 and -0.306 for 2017-18 (Table 4). The present results in contradictory to Umeha et al., 2006 who reported pest populations showed positive correlation with temperature minimum, relative humidity and rainfall while negative correlation with temperature maximum. The multi linear regression analysis revealed that weather factors influenced 64.60 per cent and 74.10 pod weevil population during 2016-17 and 2017-18, respectively. Based on the present results, we can interpret that weather factors significantly influences the pod weevil population in pigeon pea. Hence, all management decision must be taken based on seasonal incidence and identifying weaker point of pod boring weevil (Ramar et al., 2012).

**Table 3. Correlation analysis of seasonal incidence of Pod weevil with weather parameters during 2016-17 & 2017-18**

Name of the pest	Year	Weather parameters					
		Maximum Temperature (°C)	Minimum Temperature (°C)	Maximum Relative Humidity (%)	Minimum Relative Humidity (%)	Sun Shine Hours (SSH)	Rainfall (mm)
Pod weevil, <i>Apion clavipes</i>	2016-17	0.466	0.720**	-0.132	-0.160	0.093	-0.198
	2017-18	0.710**	0.480*	-0.483*	-0.472*	0.08	-0.306

Note: \*\*- Correlation significant at 99 % confidence interval ( $P < 0.01$ ), \*- Correlation significant at 95 % confidence interval ( $P < 0.05$ ).

**Table 4. Regression analysis of seasonal incidence of Pod weevil with weather parameters 2016-17 & 2017-18**

Name of the pest	Year	Regression equation	R <sup>2</sup> value
Pod weevil, <i>Apion clavipes</i>	2016-17	$Y = 142.43 - 0.750T_{Max} - 2.621T_{Min} - 0.455RH_{Max} - 0.581RH_{Min} - 0.587SSH - 0.567RF$	0.646
	2017-18	$Y = -335.29 + 10.77T_{Max} - 3.714T_{Min} + 3.654RH_{Max} - 3.164RH_{Min} - 9.868SSH + 63.36RF$	0.741

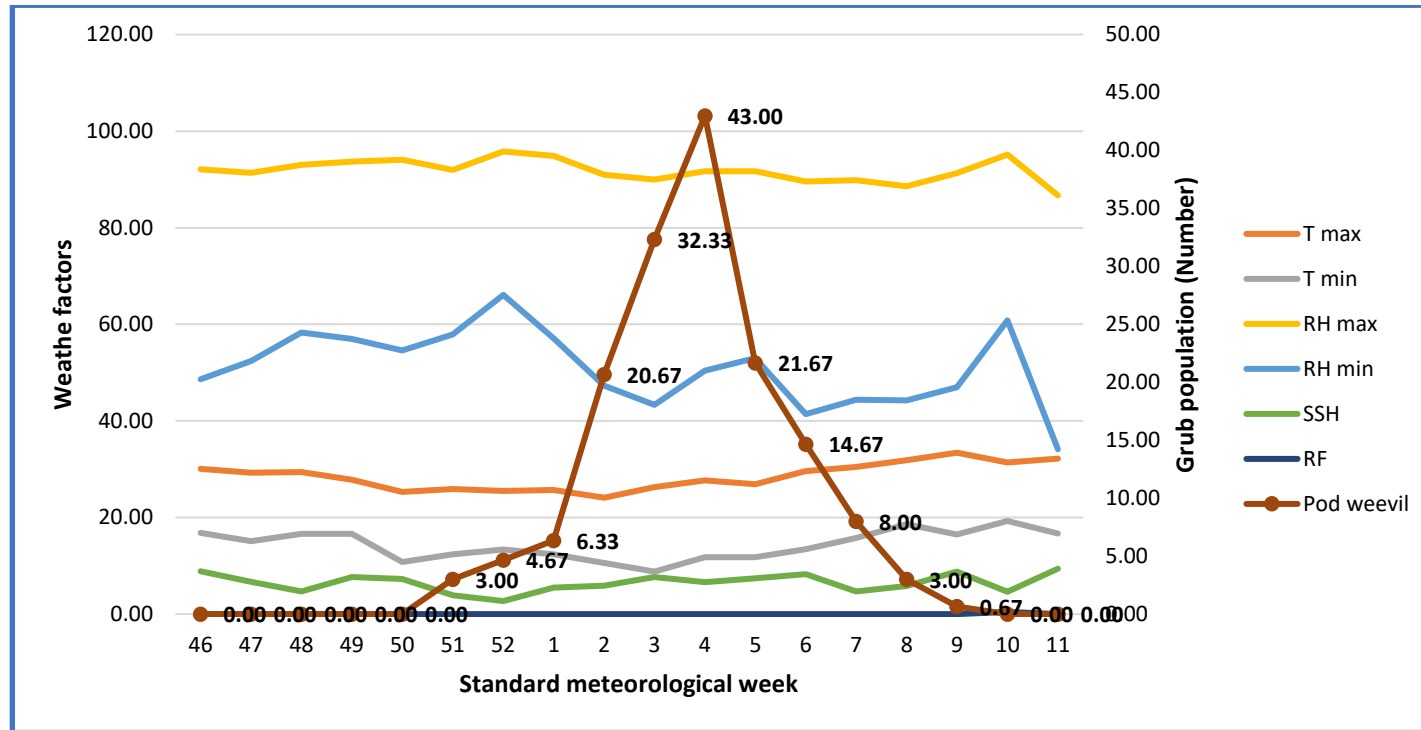


Fig. 1. Seasonal incidence of Pod boring weevil, *Apion clavipes* Gerst. under West Bengal condition during 2016-17

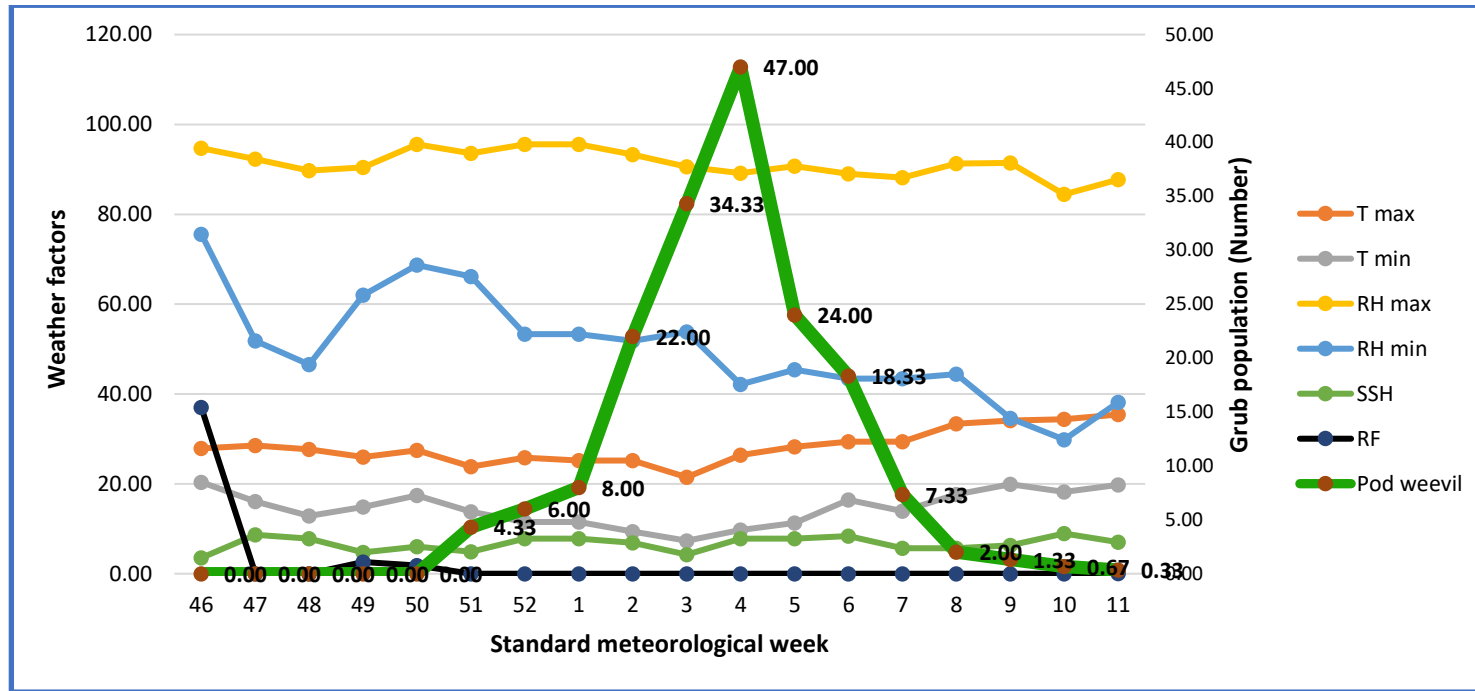


Fig. 2. Seasonal incidence of Pod boring weevil, *Apion clavipes* Gerst. under West Bengal condition during 2017-18

#### 4. CONCLUSION

The present findings indicate a strong positive correlation between temperature, sunshine hours and pest incidence, with peak infestations occurring during 4<sup>th</sup> week of January during the both the years. Strategic application of insecticides during flowering and pod setting stages (43<sup>rd</sup> SMW-4<sup>th</sup> week of October) is recommended.

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#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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