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Fruit fly trap catches versus weather parameters in muskmelon (*Cucumis melo* L.): A study

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Abstract
Population dynamics of adult fruit flies was studied on muskmelon (*Cucumis melo* L.) during *rabi* 2017-18 and 2018-19 at College of Horticulture, Anantharajupeta, by using methyl eugenol and cue-lure traps. From the present study it can be concluded that total mean fly catch varied between 0 to 82 in 2018 and 5 to 101 during 2019. Two years pooled trap catch data indicated that, the peak fly catch was recorded from the last week of March to May (13-19 MSW) with maximum number of total flies (82,101) caught in 15th and 13th MSW during 2018 and 2019 respectively during which period the maximum temperature varied between 37-46°C and minimum temperature between 22-26°C which coincided with the peak fruit development and maturity periods of the crop. The trap catch showed significant positive correlation with maximum and minimum temperatures (r = 0.6435, 0.6555; $p< 0.01$) and negative significant correlation with morning relative humidity (r = -0.6243; $p< 0.01$). The abiotic factors *viz*., maximum and minimum temperatures, relative humidity, rainfall, wind velocity together influence to an extent of 65% variation ($R^2 = 0.650$) in the fly catch.

Keywords: Muskmelon, fruit flies, trap catch

Introduction
Among the different vegetables cantaloupe melons are a good source of potassium, vitamin A and folate. Muskmelon is a great source of beta-carotene, folic acid, potassium, vitamin A and vitamin C. The potassium content of the fruits helps to control blood pressure and prevents hypertension and also reduces the risk of heart diseases. Muskmelon (*Cucumis melo* L.) is an important horticultural crop in India and worldwide, and plays an important role in international trade. India is the first largest producer of melons among the SAARC countries and second among the BRICS countries [1]. In India, muskmelon is grown in 57 thousand hectares with a production of 1277 thousand tones [1] with a productivity of 23.6 tones/ha [1]. In Andhra Pradesh muskmelon is grown in an area of 9.9 thousand hectares with a production of 314.39 thousand metric tons and Andhra Pradesh ranks second in both muskmelon area and production in India [6].

Biotic factors like various insect pests are major limiting factors of muskmelon production and productivity in India. Among them the major one is cucurbit fruit fly (*Bactrocera cucurbitae* Coquillett). These fruit flies being serious pests of muskmelon, their outbreak causes substantial crop loss to the growers limiting higher yields and good quality fruits. The female flies prefer to oviposite on soft tender, physiologically ripen fruit tissues puncturing with it's ovipositor, watery fluid oozes out from the punctures, which later transform into dry resinous deposit. The affected fruits drop prematurely and get distorted, losing market value. Thus it is difficult to control this pest with insecticides. Krishna Kumar *et al*. (2006) [5] reported fruit fly infestation as 28.55% in watermelon, 77.03% in bitter gourd, 75.65% in ridge gourd, 73.83% in cucumber and 63.31% in pickling cucumber. Specifically in cucumber this fruit fly was reported to cause 100% damage [8] Based on the previous facts and reports it is clear that fruit flies damage >50% of the cucurbits either partially or completely there by making them unsuitable for human consumption. Hence, under present study an attempt was made to find out the seasonality of these fruit flies on muskmelon crop.

Materials and Methods
The study on seasonal activity of fruit fly adults in muskmelon was taken up during *rabi* 2017-18 and 2018-19 at College of Horticulture, Anantharajupeta, Kadapa district of Andhra Pradesh. In order to maintain continuous crop availability for installing the pheromone traps in the standing crop, staggered sowing of the muskmelon (variety Sweet) was done during

December, January and February (30/12/2017, 30/1/2018, 22/2/2018, 24/12/2018, 16/1/2019 and 19/2/2019) months separately in each season. The crop was sown in an area of 100 m^2 for each sowing, by following all the recommended package of practices except plant protection measures. Two fruit fly traps (cuelure and methyl eugenol traps) were installed in the experimental fields at time of flowering, at a height of 2 ft. above the ground level in each date of sowing. The traps consisted of a plywood (3cm x 3cm x 1cm) soaked in cue lure 6:1 v/v (cue lure: malathion) procured from Barrix Agro Sciences, Pvt. Ltd. The fruit flies captured in each trap were collected separately and the mean trap catches were counted for every week throughout the cropping season. Weather data *viz*., maximum and minimum temperature, rainfall, morning and evening relative humidity were collected from meteorological unit of COH, Anantharajupeta. Relation between number of fruit flies (by methyl eugenol and cue lure) caught and weather variables (minimum, maximum temperature, relative humidity, wind velocity and total rainfall) were found out by using correlation coefficient and regression analysis studies. The correlation coefficient between trap catch and mean fly population was calculated by the following formula [3].

$$r = \frac{N\sum xy - (\sum x)(\sum y)}{\sqrt{N\sum x^2 - (\sum x^2).N\sum y^2 - (\sum y^2)}}$$

Results and Discussion

Results from the table-1 and fig-1, revealed that, the fly population began to trap from 5th MSW during 2018 and 4th MSW during 2019 and total mean trap catch varied between 0 to 82 in 2018 and 5 to 101 during 2019. In cuelure traps only *Zeugodacus cucurbitae* species were caught whereas, in methyl eugenol (ME) traps the species *viz*., *B. dorsalis*, *B. zonata* and *B. correcta* were trapped. In ME trap the fly catch was found to increase continuously from 6-19 MSW (Feb-May) in 2018 with highest trap catch of 42 flies was recorded on 15 MSW (April) with 37 ^{0}C, 21.3 ^{0}C of maximum and minimum temperatures respectively. Similarly in 2019 also gradual increase in trap catch was observed from 5-18 MSW (January last week to May first week) with maximum of 65 flies caught on 13 MSW (Last week of March) with 42.3°C and 19.7°C of maximum and minimum temperatures respectively. In cuelure traps fly catch showed increasing trend from 10-19 MSW (Mar-May) in 2018 and from 6-18 MSW (Feb-May) in 2019. Maximum fly catch of 40 and 38 flies was recorded on 15th and 16th MSW in 2018, 2019 respectively. Overall observation of the two years total trap catches indicated that, the peak fly catch was recorded from the last week of March to May (13-19 MSW) with maximum number of total flies (82,101) caught in 15th and 13th MSW during 2018 and 2019 respectively. During this period the maximum temperature varied between 37- 46°C and minimum temperature between 22-26°C. This period also coincided with the peak fruit development and maturity periods of the crop sown at different dates.

The correlation analysis (Table-2) of the total fly catch with the various abiotic factors independently indicated that the trap catch was positively and significantly correlated with both maximum and minimum temperatures (r = 0.6435, 0.6555) and significant negatively correlated with morning relative humidity (r = - 0.6243). The present investigation results are in agreement with the Khalid Mahmood and Mishkatullah (2007), Barma *et al*., (2013); Tushar and Jha (2014); Vignesh and Viraktamath (2015) and Sita et al. (2019) who have reported significant positive correlation with Maximum and minimum temperatures and negative correlation with relative humidity and peak activity period of *B. cucurbitae* during March, April and May months coinciding with the fruiting period of the crop.

The regressions analysis (Table-3) results indicated that all the different abiotic factors *viz*., maximum and minimum temperatures, relative humidity, rainfall, wind velocity together contribute for 65% variation (R^2 = 0.650) in the fly catch whereas, individual factors separately influencing for < 40% variation (R^2 = < 0.40). Those factors possessing significant correlation *viz*., maximum temperature, minimum temperature and morning relative humidity together contribute for explaining 53.5% (R^2 = 0.535) variation in total fly catch. Barma *et al*. (2013) reported that *B. cucurbitae* population was influenced with all-weather parameters to an extent of 76.20 per cent.

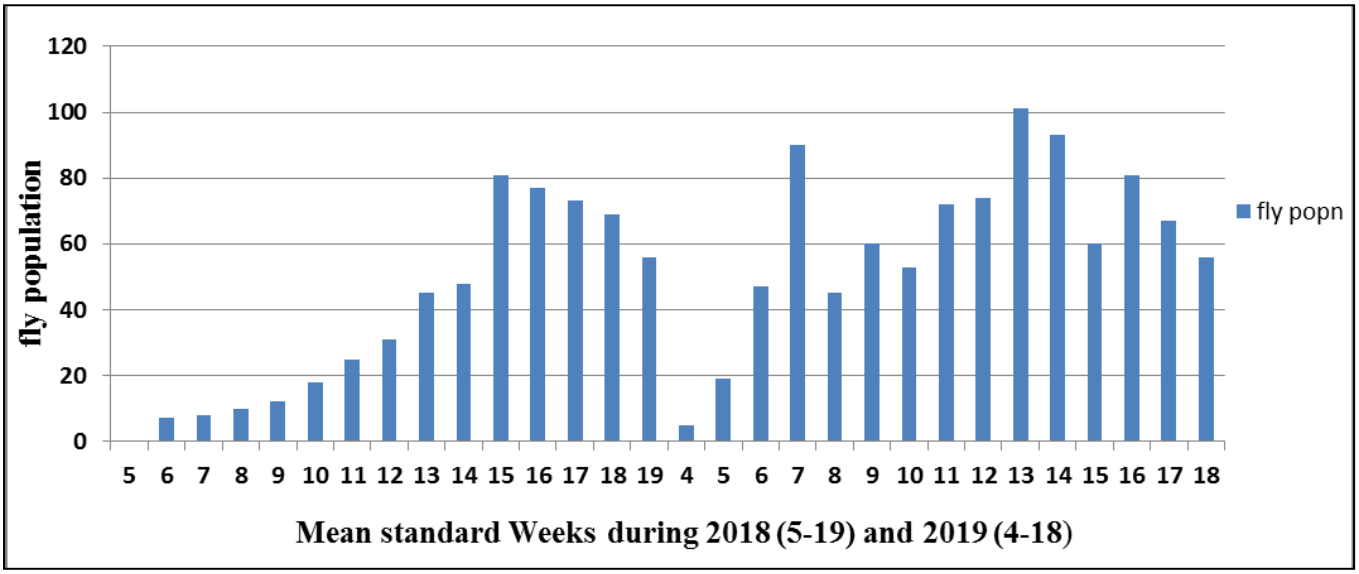

Fig 1: Seasonal fluctuation of fruit fly population in muskmelon during the years 2018, 2019

Table 1: Effect of weather parameters on population dynamics of fruit flies in muskmelon

Year	Month	MSW	Trap catches per week[y] (Mean)		Total Mean	Tmax	Tmin	RH1	RH2	RF	WV
			CL	ME							
2018	Jan	5	0	0	0	31.1	10.3	86	36.4	0	4.7
	Feb	6	2	5	7	32.1	15.7	77	54.4	3	4.6
		7	0	8	8	33.2	15	88.3	48.1	0	5.5
		8	0	10	10	32.7	13.3	86.7	43.6	0	4.8
		9	0	12	12	35.6	12.4	72	31	0	4.5
	Mar	10	3	15	18	35.6	15	77.1	27.4	0	3.7
		11	5	20	25	35.1	20.4	84.9	38.4	25.4	3.7
		12	12	19	31	36.6	21.4	83.1	39.1	0	3.9
		13	19	26	45	37.3	22.3	81.7	35.6	0	4.2
	Apr	14	28	20	48	37.6	22	75	36.9	0	3.9
		15	40	42	82	37	21.3	79.1	40.7	0	5.0
		16	37	40	77	34	24.1	75.3	37.4	0	4.6
		17	35	38	73	46	25.6	72.3	59.3	0	4.3
	May	18	29	40	69	39.4	23.9	75.6	36.1	92	5.5
		19	22	34	56	39.7	26.3	71.5	35.9	0	4.0
2019	Jan	4	5	0	5	32	15.9	86.3	39.7	19.3	5.8
		5	3	8	11	29.1	16.4	88.4	45	10.2	8.6
	Feb	6	28	19	47	32.4	16	81.7	41.6	0	6.5
		7	32	55	87	32.7	15.6	81.6	48.1	0	6.8
		8	25	20	45	36.4	18	23.3	36.8	0	4.8
		9	35	25	60	32	18	85.2	35.6	0	6.0
	Mar	10	18	35	53	38.7	16.9	78.6	35.7	0	5.4
		11	30	42	72	38.4	20	75.3	49.3	0	5.2
		12	25	49	74	38.9	20.3	70.3	37.7	0	6.1
		13	36	65	101	42.3	19.7	71.1	31.6	0	5.0
	Apr	14	35	58	93	40.9	23	65.7	41.8	0	5.1
		15	28	32	60	41.6	22.3	68.7	35.3	15	5.1
		16	38	42	80	40.9	21.3	64.9	31.6	0	5.8
		17	29	38	67	39.6	22.1	78.3	36.7	12	5.2
	May	18	20	34	54	39.1	22.1	75	34.1	0	7.1
	'r' values					0.644**	0.656**	-0.624**	-0.045	-0.017	0.140

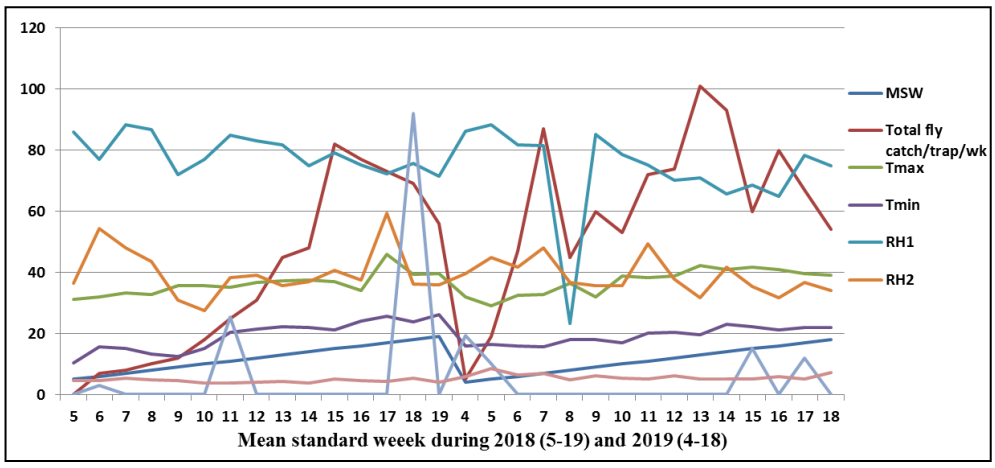

Fig 2: Effect of different weather parameters on seasonal fluctuation of fruit flies in muskmelon

Table 2: Correlation, regression studies of fruit fly trap catch with various abiotic factors studied during 2018-19

Variable	Maximum Temperature (Tmax)	Minimum Temperature (Tmin)	Morning RH (RH1)	Evening RH (RH2)	Rain Fall (RF)	Wind Velocity (WV)
Correlation coefficient	0.644 **	0.656 **	-0.624 **	0.045 NS	- 0.017 NS	0.140 NS

Table 3: Regression analysis studies of fruit fly trap catch with various abiotic factors studied during 2018-19

S. No.	Variable	Regression equation	R^2 Values
1.	Total fly catch Vs. Tmax	Y = -127.65 + 4.84 X	0.41
2.	Total fly catch Vs. Tmin	Y = -43.16 + 4.82X	0.43
3.	Total fly catch Vs. RH1	Y = 266.03 – 2.78 X	0.40
3.	Total fly catch Vs. Tmax. Tmin and RH1	Y = 75.29 + 0.79X1 +2.98X2 – 1.44X3	0.54
4.	Tmax,Tmin,RH1,RH2,RF and WV	Y = -41.9 + 1.96X1 – 3.15X2 – 1.08X3 -0.12X4 – 0.19X5 + 9.55X6	0.65

Conclusion

From the present study it can be concluded that total fly catch varied between 0 to 82 in 2018 and 5 to 101 during 2019. Observations of the two years total trap data indicated that, the peak fly catch was recorded from the last week of Marcto May (13-19 MSW) with maximum number of total flies (82,101) caught in 15th and 13th MSW during 2018 and 2019 respectively during which period the maximum temperature varied between 37-46°C and minimum temperature between 22-26°C. This period also coincided with the peak fruit development and maturity periods of the crops sown at different dates. The trap catch showed significant positive correlation with maximum and minimum temperatures (r = 0.6435, 0.6555) and negative correlation with morning relative humidity (r = -0.6243). The regressions analysis revealed that abiotic factors *viz*., maximum and minimum temperatures, relative humidity, rainfall, wind velocity together contribute for explaining 65% variation (R^2 = 0.650) in the fly catch.

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