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SEASONAL EFFICIENCY AND ECONOMICS OF TRAPS BAITED WITH PARAPHEROMONS AGAINST FRUIT FLIES, *BACTROCERA* SPP.

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Abstract:-Rakshak Fruit Fly Trap was found most effective to Bottle Fruit Fly Trap, trapped 35.18, 17.30 and 15.22 per cent more fruit flies during *Kharif, Zaid* and *Rabi* season, respectively. Methyl eugenol was most effective during *Kharif* and *Zaid* season but cue-lure was most effective during Rabi season. Maximum fruit flies were trapped during *Zaid* season. Bottle Fruit Fly Traps baited with methyl eugenol dispensed cotton wick and replenished at two month interval provide most economical and trapped 394.12 FFs on per rupee investment during Zaid season.

Keywords: Fruit Fly Traps, Lures, Dispensers, Efficiency and Economics.

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INTRODUCTION:

Fruit flies are quarantine pest and are difficult to control. They have great impact on agriculture and cause enormous damage to fruits, vegetables and flower heads. Out of nearly 4,400 species of fruit flies distributed throughout the world (Norrbom, 2004), 250 species are of economic importance and are distributed widely in temperate and sub-tropical regions of the world (Christenson and Foote, 1960), but the greatest diversity of species occur in the tropical regions (Norrbom *et al.*, 1998). Habitats they occupy range from rainforest through to open grassland and suburbia (Michaux and White, 1999). More than 200 species of fruit flies have been reported from India, however, majority of them have no economic importance (Madhura and Verghese, 2003). The major economically important species of fruit flies are *Bactrocera cucurbitae*, *B. dorsalis*, *B. zonata* and *B. correcta*. Among these, *B. dorsalis*, *B. zonata* and *B. correcta* infest mango and guava and *B. cucurbitae* infests cucurbitaceous vegetables (Nath and Bhushan, 2006). Knowledge of seasonal abundance of the pest under the existing ecological conditions may be quite useful in mitigating the losses caused by these flies. Biotic factors viz., parasites, predators, host plant resistance and abiotic factors viz., temperature, rainfall, humidity and sunshine hours play an important role in regulation of the pest population. Parapheromones *viz.*, methyl eugenol and cue-lure are good male attractants and play an important role both in monitoring and management of fruit flies. Keeping above point in view, present study has been conducted.

MATERIALS AND METHODS

The trial were conducted in RBD with 24 treatments (Table 1) and 3 replications at Main Experiment Station (MES) Vegetable Science, Horticulture and Students' Instructional Farm and in the Laboratory of Department of Entomology, N.D. University of Agriculture and Technology, Narendra Nagar (Kumarganj), Faizabad, U.P from 41st SW (Standard Week) 2008 to 22nd SW of 2010 during *Kharif, Rabi* and *Zaid* season. Mixtures of both para-pheromones (ME & CL) were prepared in the ratio of 6, 4, 1 of ethyl alcohol, methyl eugenol/cue-lure and malathion 50 EC. The fruit flies trapped in each trap were collected into plastic vials separately and brought to the laboratory, identified, counted and recorded at weekly interval. Further to fruit fly species and crop association, infested fruits of commonly grown having/ vegetables will be collected from Main Experiment Station (MES) Vegetable Science, Horticulture and other related place and brought to the laboratory, kept into insect rearing cages having a layer of fresh sand without any insect/pupae. The flies emerged will be preserved and identified. Unidentified specimens were preserved and sent for identification to Dr. C. A. Viraktamath, Principle Investigator, CAR Network Project on Insect Bio-systematic, Department of Entomology, G.K.V.K. Bangaluru.

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RESULTAND DISCUSSION

Efficiency of traps baited with parapheromons for trapping of fruit flies

Data present in Table 2 revealed that the Bottle Fruit Fly Trap was most effective during Kharif season 2008-09 and maximum trapped 1592 Fruit Flies (FFs) when replenished at one month interval baited with methyl eugenol (ME) dispensed through ply wood (PW). The minimum fruit flies was trapped 126 FFs from same trap, chemical and replenished interval dispensed through cotton wick (CW). In case of cue-lure, maximum trapped 433 FFs dispensed through ply wood replenished at one month interval and minimum 150 FFs dispensed through CW replenished at three month interval. A total of maximum fruit flies trapped 1718 in ME baited traps replenished at one month interval.

Rakshak Fruit Fly Traps were recorded that most performed and maximum trapped 2446 FFs when replenished at three month interval baited with methyl eugenol (ME) dispensed through ply wood (PW) and minimum trapped 458 FFs in same lure replenished at two month interval. When trap baited with CL was maximum and minimum trapped 645 and 310 FFs replenished at one and three month interval, respectively. A total of maximum fruit flies were trapped (3383) in traps baited with ME replenished at one month interval and minimum 720 FFs were catch in trap baited with CL replenished at three month interval

An overall observation during Kharif season, Bottle fruit fly trap was trapped of maximum fruit flies (2327) replenished at one month interval and Rakshak Fruit Fly Trap was trapped maximum fruit flies (4465) replenished at one month interval followed by two and three month intervals. Rakshak Fruit Fly Trap was most effective and trapped 10425 FFs i.e.67.59-32.41=35.18% more, followed by Bottle fruit fly trap.

Bottle fruit fly trap was trapped 1004, 623 and 459 FFs baited with CL through PW (Table 2), while 229, 107 and 204 FFs trapped in ME baited traps through PW from one, two and three month replenished interval, respectively. In case of Rakshak Fruit Fly Trap, maximum fruit flies viz., 1235, 1345 and 1153 trapped baited with CL through PW, where 225, 224 and 226 FFs trapped baited with ME through CW from one, two and three month replenished interval, respectively. In case of total trapped flies, Bottle Fruit Fly Traps were trapped maximum flies (4429) in baited with CL followed by ME (879). Rakshak Fruit Fly Traps were trapped maximum flies (6202) in baited with CL followed by ME (1326).

An overall observation during Rabi season 2008-2009 and 2009-2010, Bottle Fruit Fly Traps were trapped 2048, 1577 and 1683 FFs, while in Rakshak Fruit Fly Traps were trapped 2405, 2663 and 2460 FFs from one, two and three month replenished intervals. Rakshak Fruit Fly Trap was most effective and trapped 7528 FFs i.e.58.65-41.35= 17.30% more, followed by Bottle fruit fly trap.

Data present in Table 2 revealed that the Bottle Fruit Fly Trap baited with CL through CW was most effective and trapped 109, 218 and 124 FFs, when parapheromon replenished at one, two and three month intervals followed by PW. In case of ME, maximum flies trapped in PW viz., 22531, 25490 and 21180 FFs, when parapheromon replenished at one, two and three month intervals followed by CW. In case of Rakshak Fruit Fly Trap baited with CL through PW was most effective and trapped 178, 192 and 96 FFs, when lure replenished at one, two and three month intervals followed by CW. In case of ME, maximum flies trapped in CW viz., 32247, 27449 and 28746 FFs, when chemical replenished at one, two and three month intervals followed by CW. In case of total trapped flies in Bottle Fruit Fly Trap were maximum in ME followed by CL and it was 99.12, 98.46 and 98.70 per cent more from one, two and three month replenished intervals, respectively. In Rakshak Fruit Fly Trap were trapped maximum fruit flies in ME followed by CL and it was 98.72, 98.80 and 99.5 per cent more from one, two and three month replenished intervals, respectively.

On overall observation during Zaid season 2009 and 2010, Rakshak Fruit Fly Trap were trapped maximum flies followed by Bottle Fruit Fly Trap and it's were 8.18, 11.18 and 27.92 per cent more at one, two and three month intervals, respectively.

Rakshak Fruit Fly Trap was most effective and trapped 163420 (57.61%) FFs followed by Bottle Fruit Fly Trap 120228 (42.39%) FFs. Rakshak Fruit Fly Traps were trapped 15.22 per cent more fruit flies. Data in Table 4 revealed that the maximum fruit flies were trapped during Zaid season followed by Kharif and Zaid season. When parapheromon were replenished at one month interval, trapped 82.26 and 84.56 per cent more fruit flies flowed by Kharif and Rabi season. Where it was replenished at two month interval, trapped 90.29 and 89.37 per cent and at three month interval, trapped 84.95 and 86.22 per cent more fruit flies flowed by *Kharif* and Rabi season.

Performances of traps have been evaluated earlier also Sundar et al. (2012) reported that the Rakshak fruit fly trap was superior to bottle fruit fly trap. Maximum fruit flies were trapped when parapheromones were replenished at one month interval Patel and Patel, 1998; Jhala et al., 2008, Shukla et al., 2008 and Chua, 2009 but none of these workers have evaluated the performance of Bottle Fruit Fly Traps and Rakshak Fruit Fly Traps, hence present results could not be compared.

Economics of traps baited with parapheromons for trapping of fruit flies

Data given in Table 3 on economics of traps lures and dispensers revealed that, in case of CL during Kharif season maximum of 1.78 fruit flies on per rupee investment were trapped in bottle fruit fly traps with lure dispensed through cotton wick and replenished at three months interval. It was followed by Rakshak fruit fly traps replenished at one, two and three months interval dispensed through cotton wick in which, respectively, 1.47, 1.59 and 1.59 FFs trapped on per rupee investment

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were found, where in ply wood, respectively trapped 0.83, 0.86 and 1.01 FFs on per rupee investment, Bottle fruit fly traps replenished at one, two and three months interval dispensed through ply wood in which, respectively, 0.65, 0.52 and 1.11 FFs trapped on per rupee investment and in cotton wick replenished at one and two months intervals were trapped 0.94 and 1.36 FFs. In case of ME, maximum of 10.23 fruit flies on one rupee investment were trapped in Rakshak fruit fly trap with lure dispensed through Ply wood and replenished at three months interval. It was followed by Bottle fruit fly trap (7.71 FFs/rupee) replenished at two months interval and (6.45 FFs/rupee) three months. Minimum (1.62 FFs/rupee) trapped in Bottle fruit fly trap replenished at one month intervals.

Data present in Table 3 revealed that CL dispensed through CW in Bottle fruit fly trap and replenished at three months interval and maximum of 7.90 FFs on one rupee investment were trapped during Rabi season 2008-2009 and 2009-2010. It was followed by CL dispensed through CW in Bottle fruit fly trap and replenished at two month interval, Rakshak fruit fly trap dispensed through CW and replenished at three and two months interval trapped, respectively 4.42, 3.98 and 3.22 fruit flies on per rupee investment. In case of ME, maximum of 2.71 fruit flies were trapped on one rupee investment in Rakshak fruit fly trap with lure dispensed through CW and replenished at two month interval. It was followed by bottle fruit fly trap dispensed through CW and replenished at three months interval, Rakshak fruit fly trap dispensed through CW and replenished at three and two months interval. Minimum of 0.36 fruit flies were trapped on per rupee investment in Rakshak fruit fly trap dispensed through PW and replenished at one month interval.

Data given in Table 3 during Zaid season 2009 and 2010, in CL, maximum 1.84 fruit flies were trapped per rupee investment in Bottle fruit fly trap dispensed through CW and replenished at two month interval. Minimum 0.11 fruit flies were trapped per rupee investment in Bottle fruit fly trap dispensed through PW and replenished at one month interval.

In case of ME, maximum of 394.12 fruit flies on per rupee investment were trapped in Bottle fruit fly traps with lure dispensed through Cotton wick and replenished at two month interval. It was followed by Bottle fruit fly trap replenished at three and one month interval, Rakshak fruit fly trap replenished at three, one and two month interval, in which, respectively, 300.36, 242.49, 195.27, 171.22 and 170.58 FFs on one rupee investment were found. In case of PW, in Bottle fruit fly trap were trapped maximum of 165.09 FFs/rupee investments and replenished at three month interval. It was followed by Bottle fruit fly trap replenished at two months interval, Rakshak fruit fly trap replenished at three and two month interval, in which, respectively, 140.48, 119.24 and 100.3 FFs on per rupee investment were found.

Sundar et al. (2012) earlier reported that the Bottle Fruit Fly Traps dispensed through cotton wick and replenished at 3 months interval proved most economical (205.38FFs/rupee). Rakshak Fruit Fly Trap baited with ME, maximum 38.25 & 31.09 FFs per rupee investment were trapped during June, 2011 & 2012, respectively.

Ply wood block (PW) dispenser was found more effective than cotton wick (CW). Similarly in case ME, ply wood block (PW) dispenser trapped 11.92% more fruit flies than cotton wick (CW). Ply wood block bocks have been found as better dispenser earlier also (Patel et al., 2008; Singh et al., 2008; Stonehouse et al., 2008) hence confirm our findings. Rai et al, (2008) found non wood substrates superior however their replenished intervals were, respectively, after a week and after 45 days.

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Table 1: Details of treatments

Treatments	Details
T_1	Bottle Fruit Fly Trap baited with ME soaked in cotton wick replenished at one month.
T_2	Bottle Fruit Fly Trap baited with ME soaked in cotton wick replenished at two months.
T_3	Bottle Fruit Fly Trap baited with ME soaked in cotton wick replenished at three months.
T_4	Bottle Fruit Fly Trap baited with ME soaked in ply wood block replenished at one month.
T_5	Bottle Fruit Fly Trap baited with ME soaked in ply wood block replenished at two months.
T_6	Bottle Fruit Fly Trap baited with ME soaked in ply wood block replenished at three months.
T_7	Bottle Fruit Fly Trap baited with CL soaked in cotton wick replenished at one month.
T_8	Bottle Fruit Fly Trap baited with CL soaked in cotton wick replenished at two months.
T 9	Bottle Fruit Fly Trap baited with CL soaked in cotton wick replenished at three months.
T_{10}	Bottle Fruit Fly Trap baited with CL soaked in ply wood block replenished at one month.
T ₁₁	Bottle Fruit Fly Trap baited with CL soaked in ply wood block replenished at two months.
T ₁₂	Bottle Fruit Fly Trap baited with CL soaked in ply wood block replenished at three months.
T ₁₃	Rakshak Fruit Fly Trap baited with ME soaked in cotton wick replenished at one month.
T_{14}	Rakshak Fruit Fly Trap baited with ME soaked in cotton wick replenished at two months.
T ₁₅	Rakshak Fruit Fly Trap baited with ME soaked in cotton wick replenished at three months.
T ₁₆	Rakshak Fruit Fly Trap baited with ME soaked in ply wood block replenished at one month.
T ₁₇	Rakshak Fruit Fly Trap baited with ME soaked in ply wood block replenished at two months.
T ₁₈	Rakshak Fruit Fly Trap baited with ME soaked in ply wood block replenished at three months.
T ₁₉	Rakshak Fruit Fly Trap baited with CL soaked in cotton wick replenished at one month.
T_{20}	Rakshak Fruit Fly Trap baited with CL soaked in cotton wick replenished at two months.
T ₂₁	Rakshak Fruit Fly Trap baited with CL soaked in cotton wick replenished at three months.
T ₂₂	Rakshak Fruit Fly Trap baited with CL soaked in ply wood block replenished at one month.
T ₂₃	Rakshak Fruit Fly Trap baited with CL soaked in ply wood block replenished at two months.
T ₂₄	Rakshak Fruit Fly Trap baited with CL soaked in ply wood block replenished at three months.

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							No. of fruit f	lies trapped						
Replenishment	Bottle Fruit Fly Trapped							Rakshak Fruit Fly Trap						
interval	0	CL		ME		Total		CL		ME		Total		
	CW	PW	CW	PW	CL	ME	Over All	CW	PW	CW	PW	CL	ME	Over All
Kharif season 2008 & 2009														
One month	176	433	126	1592	609	1718	2327	437	645	973	2410	1082	3383	4465
	(28.71)	(40.17)	(11.46)	(39.78)	(26.17)	(73.83)	(34.26)	(71.29)	(59.83)	(88.54)	(60.22)	(24.23)	(75.77)	(65.74)
Two month	161	218	387	409	379	796	1175	364	457	458	778	821	1236	2057
	(30.67)	(32.30)	(45.80)	(34.46)	(32.26)	(67.74)	(36.36)	(69.33)	(67.70)	(54.20)	(65.54)	(39.91)	(60.09)	(63.64)
Three month	150	329	235	782	479	1017	1496	310	410	737	2446	720	3183	3903
	(32.61)	(44.52)	(24.18)	(24.23)	(32.02)	(67.98)	(27.71)	(67.39)	(55.48)	(75.82)	(75.77)	(18.45)	(81.55)	(72.29)
Total	487	980	748	2783	1467	3531	4998	1111	1512	2168	5634	2623	7802	10425
	(30.48)	(39.33)	(25.65)	(33.06)	(29.35)	(70.65)	(32.41)	(69.52)	(60.67)	(74.35)	(66.94)	(25.16)	(74.84)	(67.59)
	Rabi season 2008-2009 and 2009-2010													
One month	734	1004	81	229	1738	310	2048	708	1235	225	237	1943	462	2405
	(50.90)	(44.84)	(26.47)	(49.14)	(84.86)	(15.14)	(45.99)	(49.10)	(55.16)	(73.53)	(50.86)	(80.79)	(19.21)	(54.01)
Two month	674	623	173	107	1297	280	1577	848	1345	224	246	2193	470	2663
	(44.28)	(31.66)	(43.58)	(30.31)	(82.24)	(17.76)	(37.19)	(55.72)	(68.34)	(56.42)	(69.69)	(82.35)	(17.65)	(62.81)
Three month	935	459	85	204	1394	289	1683	913	1153	226	168	2066	394	2460
	(50.60)	(28.47)	(27.33)	(54.84)	(82.83)	(17.17)	(40.62)	(49.40)	(71.53)	(72.67)	(45.16)	(83.98)	(16.02)	(59.38)
Total	2343	2086	339	540	4429	879	5 308	2469	3733	675	651	6202	1326	7528
	(48.69)	(35.85)	(33.43)	(45.34)	(83.44)	(16.56)	(41.35)	(51.31)	(64.15)	(66.57)	(54.66)	(82.39)	(17.61)	(58.65)
						Zaid season	2009 and 201	0						
One month	109	73	18815	22531	182	41346	41528	134	178	32247	16368	312	48615	48927
	(44.86)	(29.08)	(38.85)	(57.92)	(0.44)	(99.56)	(45.91)	(55.14)	(70.92)	(63.15)	(42.08)	(0.64)	(99.36)	(54.09)
Two month	218	133	19773	25490	351	45263	45614	151	192	27449	29310	343	56759	57102
	(59.08)	(40.92)	(41.87)	(46.51)	(0.77)	(99.23)	(44.41)	(40.92)	(59.08)	(58.13)	(53.49)	(0.60)	(99.40)	(55.59)
Three month	124	87	10951	21180	211	32131	32342	47	96	28746	28502	143	57248	57391
	(72.51)	(47.54)	(27.59)	(42.63)	(0.65)	(99.35)	(36.04)	(27.49)	(52.46)	(72.41)	(57.37)	(0.25)	(99.75)	(63.96)
Total	451	293	49539	69201	744	118740	120228	332	466	88442	74180	798	162622	163420
	(57.60)	(38.60)	(35.90)	(48.26)	(0.62)	(99.38)	(42.39)	(42.40)	(61.40)	(64.10)	(51.74)	(0.49)	(99.51)	(57.61)

Table 2: Efficiency of par pheromones baited traps against fruit fly, Bactrocera spp. during 2008-10

Table 3: Economics of traps baited with parapheromones against fruit flies, *Bactrocera* spp. during 2008-10

Replenishment	Number of fruit flies trapped/rupee investment										
interval		С	Ľ		ME						
	C	W	P	W	C	W	PW				
	Bottle trap	Rakshak trap	Bottle trap	Rakshak trap	Bottle trap	Rakshak trap	Bottle trap	Rakshak trap			
<i>Kharif</i> season 2008 & 2009											
One month	0.94	1.47	0.65	0.83	1.62	5.17	5.53	6.05			
Two month	1.36	1.59	0.52	0.86	7.71	2.85	2.25	2.66			
Three month	1.78	1.59	1.11	1.01	6.45	5.01	6.10	10.23			
Rabi season 2008-2009 and 2009-2010											
One month	One month 2.05 1.51 0.78 0.88 0.55 0.88 0.41 0.36										
Two month	4.42	3.22	1.14	2.05	2.71	1.28	0.46	0.71			
Three month	7.90	3.98	1.09	2.17	1.69	1.40	1.12	0.57			
Zaid season 2009 and 2010											
One month	0.58	0.45	0.11	0.23	242.49	171.22	78.30	41.074			
Two month	1.84	0.66	0.32	0.36	394.12	170.58	140.48	100.31			
Three month	1.47	0.24	0.29	0.24	300.36	195.27	165.09	119.24			

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Replenishment interval		Total		
	Khrif season	Rabi season	Zaid season	
One month	6792 (6.68)	4453 (4.38)	90455 (88.94)	101700
Two month	3232 (2.93)	4240 (3.85)	102716 (93.22)	110188
Three month	5399 (5.44)	4143 (4.17)	89733 (90.39)	99275
Total	15423	12836	282904	3,11,063

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 Table 4: Seasonal performance of replenished interval during 2008 to 2010

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