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Efficiency of different attractant traps against cucurbit fruit fly on ridge gourd [*Luffa acutangula* (L.) Roxb.] Under mulched conditions

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Abstract

A field investigation entitled Effect of use of different attractant traps against cucurbit fruit fly on yield and quality of ridge gourd [*Luffa acutangula* (L.) Roxb.] Under mulched conditions was carried out during the *rabi* season of the year 2020-21 at College of Horticulture, Rajendranagar, Hyderabad. The experiment was laid out in Randomized Block Design with nine treatments and replicated thrice *viz.*, T₁ (Cue lure with destruction of damaged fruits) T₂ (Cue lure + Fipronil -6:4:2) T₃ (Cue lure + Thiamethoxam -6:4:2) T₄ (Cuelure + Spinosad -6:4:2) T₅ (Poison bait with destruction of damaged fruits) T₆ Poison bait (Vinegar rotted ridge gourd -100 gm)+ Fipronil @ 50 ml; T₇ Poison bait + Thiamethoxam @ 50 gm; T₈ Poison bait + Spinosad @ 50 ml; T₉ control (with mulching). The results revealed that among the different attractant traps T₄ treatment (Cue lure + Spinosad) recorded significantly maximum fruit yield (22.45 MT/ha) with the lowest percentage of cucurbit fruit fly damage (15.93) and also same treatment registered more number of cucurbit of fruit flies catches per trap per week (17.78) and has significantly highest percent of fruit damage reduction over control (63.51) as compared to treatment T₇ (14.73) lowest which might be due to more number of male flies catches in that treatment.

Keywords: Ridge gourd, fruit flies, poison bait and cue lure

Introduction

Ridge gourd [*Luffa acutangula* (L.) Roxb.] Popularly known as Kalitori and also called as angled gourd, angled Loofah, Chinese okra, silky gourd and ribbed gourd. Ridge gourd belongs to genus *Luffa* of Cucurbitaceous family and has chromosome number $2n=2x=26$, and is native to India. Most of the cucurbitaceous vegetables are usually cultivated in relatively small areas for local consumption. In India, gourds are cultivated in an area of 4.52 lakh ha with production of 36.16 lakh MT (NHB, 2019-20) and in Telangana the crop is grown in an area of 14,087 ha. with a production of 2.82 lakhs MT and productivity of 20 MT (NHB,2019-20). Fruit contain moisture 92.5g, protein 0.5g, fat 0.5g, carbohydrate 3.4g, energy 17 k cal, calcium 18mg, vitamin 'C' 5mg, riboflavin 0.01 mg, phosphorous 26 mg, iron 0.5 mg and carotene 33µg per 100g of edible portion (Sheshadri and Parthasarthy, 1980) [14]. Ridge gourd is large climber with long tap root system and leaves are green, simple and ovate with 5-7 lobes. Though cultivated species are monoecious in nature different sex forms *viz.*, androecious, gynoecious, gynomonocious, andromonoecious and hermaphrodite plants are also reported (Choudhary and Thakur, 1965). Anthesis starts between 5.00PM to 8.30PM in the evening and remain throughout the night and are ready for selfing and pollination in the early morning or afternoon. Anthesis and dehiscence are governed by temperature and humidity.

The fruit flies under Tephritidae are one of the largest and most diversified acalypterate, Diptera. Tephritids are refractory pests of fruits and vegetables throughout the world. They are medium sized, mostly with elaborate wing markings and highly ornate, hence also known as the peacock flies. The larvae of most species develop in the fruits of plants and above 35 per cent of species attack soft fruits including many commercial fruits. The fruitflies belong to tropical species of the genus *Dacus* and *Bactrocera* of the subfamily *Dacinae*. Vargas *et al.* (2015) [16] have mentioned that fruit flies (Diptera: Tephritidae) are among the most economically important pest species in the world, attacking a wide range of fruits and fleshy vegetables throughout tropical and sub-tropical areas. Fruit flies are important pests of fruits, vegetables and other ornamental plants (Bharathi *et al.*, 2004) [2].

Pheromone trap catches in relation to field infestation and environmental factors are crucially important for decision making process in the management of pests. Cue-lure trap has been used for monitoring and mass trapping of *B. cucurbitae* males. Though a number of works have been reported to be effective against fruit flies but the information on ridge gourd crop in relation to mulch and poison bait composition traps in Telangana region is very scanty. Keeping in view, the research program has been formulated to evaluate on efficiency of different attractant traps against cucurbit fruit fly on ridge gourd under mulched conditions.

Material and Methods

The present investigation entitled “Efficiency of different attractant traps against cucurbit fruit fly on ridge gourd [*Luffa acutangula* (L.) Roxb.] under mulched conditions” was carried out during 2020-21 at Student Research Farm, College of Horticulture, Rajendranagar, Sri Konda Laxman Telangana State Horticultural University. The experiment was laid out in a Randomized Block Design (RBD) with nine treatments including control which was replicated thrice with spacing 2 x 0.30 m, individual plot size of 4 x 2.7 m. Pandal was erected with help of cement poles to a height of 6 feet from ground level for easy creeping and preventing the plants from lodging. Raised beds will be laid by covering polyethelene mulch with 25 microns thickness. Observations were recorded for morphometric and quality parameters (Table 2 to 4).

Treatment details

Treatment	Composition
T ₁	Cue lure + destruction of damaged fruits
T ₂	Cuelure + Fipronil (6:4:2)
T ₃	Cuelure + Thiamethoxam (6:4:2)
T ₄	Cuelure + Spinosad (6:4:2)
T ₅	Poison bait + destruction of damaged fruits
T ₆	Poison bait (Vinegar rotted ridge gourd – 100 gm) + fipronil @ 50 ml
T ₇	Poison bait + Thiamethoxam @ 50 g
T ₈	Poison bait + spinosad @ 50 g
T ₉	Control (with mulching)

Preparation of traps

Cue Lure: Mix Ethyl Alcohol (70%) of 60ml, Cuelure (p-Acetoxyphenyl butanone-2) of 40ml and insecticide of 20ml which is in the ratio of 6:4:2. The cut cotton rope pieces was dipped in prepared mixture for 24 hours. Individually wrap the cotton ropes dipped in cue lure with aluminum foil until use. Removed the one third of aluminum foil at the time of use and tied the open end of the lure to the thin wire in the lid and hanged the boxes in shade at 4 feet above the ground level at different locations. These traps were replaced with new lure at 30 days interval.

Poison bait trap: Vinegar 50ml, rotted ridge gourd of 100g with insecticide at 50ml and placed in a box which were hanged at different locations of experimental field. These traps were replaced with bait at 15 days interval.

Results and discussion

Mean number of cucurbit fruit flies attracted per traps in ridge gourd under mulched conditions

44th standard meteorological week

The data on monitoring of cucurbit fruit flies population on different attractant traps indicated that mean trap catches

varied significantly among the various attractant traps and it was ranged from 2.00 to 11.33. On an average, the fruit flies population numbers were 5.62. Among the treatments, significantly maximum number of fruit flies population were noticed in T₄: Cue lure + Spinosad (11.33) as compared to others (Plate 5), while minimum values were recorded in T₇ Poison bait (Vinegar rotted ridge gourd – 100 gm) + Fipronil @ 50 ml (2.00) and T₆ Poison bait + Thiamethoxam @ 50 gm (2.33) and were statistically on par with each other. These results are in corroboration with the findings of Sowmya *et al.* (2020) who reported maximum population was observed and trapped at 35th Standard Meteorological Week (SMW) *i.e.*, 25.80 fruit flies trap⁻¹ in *kharif*. Vignesh *et al.* (2020) [17] also reported the peak incidence of fruit flies *i.e.*, 56.50 numbers trap⁻¹ during the month of August.

45th standard meteorological week

Data recorded at 45th SMW on cucurbit fruit flies population attracted by different traps showed that all the treatments were effective in various degrees for checking the population means of trap catches as these had significantly more trap catches than untreated check and it was ranged from 2.33 to 17.67. On an average, the fruit flies population numbers were 7.87. From the data it is clear that, T₄: Cue lure + Spinosad (17.67) registered significantly more number of fruit flies over others, while less number of mean trap catches were recorded in T₇ Poison bait (Vinegar rotted ridge gourd – 100 gm) + fipronil @ 50 ml (2.33) (Plate 6) and T₆ Poison bait + Thiamethoxam @ 50 gm (3.00) and were comparable with each other's. Similar results were also reported by Virakthamath and Babu, 2004 [18]; Patnaik *et al.* (2004) [11] in pointed gourd as peak incidence of cucurbit fruit fly was observed during April-May *i.e.*, around 18th-20th SMW.

46th standard meteorological week

There was significant difference observed among the treatments on mean number of fruit fly catches at 46th SMW. The treatment T₄: Cue lure + Spinosad recorded significantly higher number of fruit flies populations (23.33) as compared to others, whereas significantly lower values were recorded in T₇: Poison bait + Thiamethoxam @ 50 gm (4.67) over others. Our results are comparable with that of Chowdhary *et al.* (1993) [5] in bitter gourd who reported that captured 2.36 to 4.57 flies trap⁻¹ day⁻¹ in poison bait traps containing trichlorfon.

47th standard meteorological week

All treatments differed significantly on this parameter at 47th SMW. Among the treatments, T₄: Cue lure + Spinosad recorded significantly more number of fruit flies populations (21.67) as compared to rest of the treatments, while it was significantly less in T₇: Poison bait + Thiamethoxam @ 50 gm (3.33) over others. The findings of the present study are corroborated with Ganie *et al.* (2013) [7] on cucumber, bottle gourd and ridge gourd.

48th standard meteorological week

There was significant difference observed among the treatments with respect to number of fruit flies population at 48th SMW. Among the treatments, T₄: Cue lure + Spinosad registered the highest value (30.66), followed by T₂: Cue lure + Fipronil (22.33), T₃: Cue lure + Thiamethoxam (18.67), T₁ treatment: cue lure with destruction of damaged fruits (16.00), T₅ Poison bait with destruction of damaged fruits (12.67), T₈

treatment: poison bait+spinosad@50 ml (10.67) and T₆ Poison bait + Fipronil (8.33) and were statistically on par with each other, whereas significantly lowest value was recorded in T₇ Poison bait + Thiamethoxam @ 50 gm (7.00) over others. The present investigation was consistent with report of Pauer *et al.* (1991) [12] in bitter gourd who reported that among various locations selected Batmalo recorded the highest mean population of 6.80 flies trap week⁻¹.

49th standard meteorological week

From the data it was observed that, all treatments differed significantly on this parameter at 49th SMW. among the treatments with respect to cucurbit fruit flies catches in each trap, the highest number of fruit flies population was recorded in T₄ Cue lure + Spinosad (24.67) the minimum mean trap catches was recorded on T₇ Poison bait + Thiamethoxam @ 50 gm (5.33). These findings supported by similar that of Sarkar *et al.* 2017 reported that the highest number (83.67) of flies trapped at mid fruiting stage of bitter gourd in sex pheromone trap.

50th standard meteorological week

All the treatments had significant influence on number of cucurbit fruit flies catches in each trap at 50th SMW. Among all the treatments highest number of fruit flies population was recorded in T₄: Cue lure + Spinosad with 13.00 catches followed by T₂ Cue lure + Fipronil (10.66), T₃: Cue lure + Thiamethoxam (8.333). The lowest mean trap catches was recorded on T₇ Poison bait+ Thiamethoxam @ 50 gm (2.00) these findings supported by the Singh and Naik (2006) melon fruit fly population was low during January and increases gradually and attains peak in March.

51th standard meteorological week

The results related to mean number of fruit flies catches in each trap at 51st SMW, the significant difference were observed due to treatment with regard to cucurbit fruit flies catches. Among all the treatments maximum number of fruit flies' population were recorded in T₄: Cue lure + Spinosad (10.67) it might be due to the more longevity of lure as compared to other treatments while minimum mean trap catches were recorded on T₇ Poison bait + Thiamethoxam @ 50 gm (1.33). These findings supported by Krishna K. N. K. *et al.* (2006) [9] reported the *Bactrocera cucurbitae* maximum number of adults was trapped during August (14.14 trap week⁻¹).

52nd standard meteorological week

All the treatments had significant influence on mean number of fruit flies catches in 52nd Standard metrological week maximum number of fruit flies population was observed in T₄: Cue lure + Spinosad (7.00). The minimum mean trap catches were recorded on T₆ Poison bait (Vinegar rotted ridge gourd – 100 gm) + fipronil @ 50 ml (1.00). These results are supported by the findings of Gillani *et al.* (2002) [8] who reported the caught *Dacus zonatus* in the traps in greater numbers from May to August and their population was at the peak in July in both guava (80.66 males trap week⁻¹) and nectrin (168.66 males trap week⁻¹) orchards.

Over all mean of fruit flies from 44th SMW to 52th SMW

The data enunciated on number of fruit flies catches as affected by treatments in this investigation is presented in the Table 1. Significant differences were exerted among the

treatments with respect to the number of fruit flies catches, the highest overall mean number of fruit flies population was observed in T₄: Cue lure + Spinosad (17.78). While significantly minimum overall mean trap catches was recorded in T₇ Poison bait + Thiamethoxam @ 50 gm (3.11). These findings are supported by Draz *et al.* (2016) [6] McPhail trap highest mass trapping of adult was observed in autumn (20.35 adult trap week⁻¹).

Number of damaged fruits/ plot

The results related to number of damaged fruits per plot, percentage of damage and percentage of reduction over control as influenced by different treatments were compiled in the table 2. Results showed the minimum number of damaged fruits plot⁻¹ was recorded in T₄: Cue lure + Spinosad (29.00) which might be due to more number of fruit flies catches in T₄ treatment as compared to others. Maximum number of damaged fruits plot⁻¹ was observed in T₆: Cue lure + Thiamethoxam (73.00) which might be due to minimum number of fruit flies catches in T₆ treatment as the result more fruits were damaged by cucurbit fruit flies. These findings are similar to that of Chakraborty *et al.* 2019 [3] reported that significantly lowest mean number of ovipositional punctures (1.72 and 1.98 fruit⁻¹), lowest mean number of maggots (10.00 and 10.93 fruit⁻¹), lowest mean percent of fruit infestation (13.92 and 16.90%) and higher fruit yield (15.73 and 16.59 t ha⁻¹) in bitter gourd.

Percentage of damaged fruits/ plot

The data on percentage of damaged fruits per plot revealed that the treatment T₄: Cue lure + Spinosad was noticed minimum per cent of damaged fruits plot⁻¹ (15.93) which was due to more number of male fruit flies catches in T₄ treatment, the maximum percentage of damaged fruits per plot was recorded on T₉: Control with mulching (43.67) followed by T₇ Poison bait + Thiamethoxam @ 50 gm (37.50). These findings supported by of Krishna K. N. K. *et al.* (2006) [9] who stated that maximum fruit fly infestation was (77.03%) on bitter gourd and ridge gourd (75.65%). Similar results supported by Anant *et al.* (2019) [11].

Per cent fruit damage reduction over control

Highest per cent fruit damage reduction over control was noticed in treatment T₄: Cue lure + Spinosad was (63.51). The lowest per cent fruit damage reduction over control were recorded on T₇ Poison bait + Thiamethoxam @ 50 gm (14.13) which might be due to less number of fruit flies catches and less duration of longevity of lure.

Morphometric parameters of ridge gourd

The morphometric parameters of ridge gourd under mulched conditions were recorded during the investigation and prescribed in the table 3

Average Fruit Weight (gm)

The plots installed with different attractant traps did not shows the any significant difference with the average fruit weight. However the maximum fruit weight was recorded in T₂ (cue lure + Fipronil) and lowest fruit weight recorded in T₉ (control).

Average Fruit Length (cm)

The fruit length of ridge gourd has shown the significantly difference with different attractant traps. However the

maximum fruit length was recorded in T₈ (poison bait + Spinosad) and lowest fruit length recorded in T₆ (poison bait + Fipronil).

Number of fruits per plant

The number of fruits for plant of ridge gourd has shown the significantly difference with different attractant traps. The maximum number of fruits for plant was recorded in T₄ (cue lure + Spinosad) and lowest number of fruits for plant recorded in T₉ (control).

Average fruit yield per plant (kg)

The fruit yield per plant of ridge gourd showed significantly difference with different attractant traps. The maximum yield per plant was recorded in T₄ (cue lure+Spinosad) and lowest yield per plant recorded in T₉ (control).

Biochemical parameters of ridge gourd

The biochemical parameters of ridge gourd under mulched conditions were recorded during the investigation and presented in the table 4.

Total Soluble Solids (° Brix)

The Total Soluble Solids did not shown any significantly difference with different attractant traps. However the highest TSS was recorded in T₁ (cue lure with destruction of damaged

fruits), T₆ (poison bait + Fipronil) same and lowest TSS recorded in T₈ (poison bait + Spinosad).

Ascorbic acid (mg/100g)

The ascorbic acid did not shown any significantly difference with different attractant traps. However, the highest ascorbic acid was recorded in T₉ (control) and lowest ascorbic acid recorded in T₈ (poison bait + Spinosad).

Total sugars (%)

The total sugars did not shown any significantly difference with different attractant traps. However the highest sugars was recorded in T₂ (cue lure + Fipronil) and lowest was recorded in T₃ (cue lure + Thiomethaxam).

Reducing sugars (%)

The reducing sugars did not shown any significantly difference with different attractant traps. However the maximum reducing sugars was recorded in T₉ (control) and lowest was recorded in T₃ (cue lure + Thiomethaxam).

Non reducing sugars (%)

The non reducing sugars did not shown any significantly difference with different attractant traps. However the maximum non reducing sugars was recorded in T₇ (poison bait +Thiomethaxam) and lowest was recorded in T₈ (poison bait + Spinosad).

Table 1: Mean number of cucurbit fruit flies attracted per traps in ridge gourd under mulched conditions

Treatments	Mean of fruit flies trapped per trap										Grand total	Overall mean
	44 th SMW	45 th SMW	46 th SMW	47 th SMW	48 th SMW	49 th SMW	50 th SMW	51 st SMW	52 nd SMW			
T ₁	6.67	9.00	10.33	8.67	16.00	10.33	6.67	4.00	2.33	74.00	8.22 ^d	
T ₂	8.33	12.33	15.00	15.00	22.33	17.67	10.66	5.67	3.67	110.66	12.30 ^b	
T ₃	7.00	9.33	11.67	10.33	18.67	12.33	8.33	4.67	2.67	85.00	9.44 ^c	
T ₄	11.33	17.67	23.33	21.67	30.66	24.67	13.00	10.67	7.00	160.00	17.78 ^a	
T ₅	4.00	5.67	8.00	7.33	12.67	9.33	4.33	2.33	2.00	56.6	6.29 ^e	
T ₆	2.33	3.00	6.00	5.67	8.33	6.00	3.00	1.67	1.00	37.00	4.11 ^g	
T ₇	2.00	2.33	4.67	3.33	7.00	5.33	2.00	1.33	0.00	27.99	3.11 ^h	
T ₈	3.33	3.67	6.67	5.33	10.67	7.67	3.67	2.00	1.33	44.34	4.93 ^f	
T ₉	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Mean	5.62	7.88	10.71	9.67	15.79	11.67	6.46	4.04	2.50	74.45	8.27	
S.Em±	0.24	0.16	0.21	0.25	0.22	0.21	0.20	0.20	0.22	0.27	0.04	
CD@ 0.05	0.72	0.50	0.63	0.76	0.67	0.64	0.59	0.62	0.66	0.52	0.12	

Note: Cue lures and poison baits were replaced at every 30 & 15 days intervals, respectively. **SMW:** standard meteorological week.

Table 2: Different attractant traps against fruit fly on yield of ridge gourd under mulched conditions

Treatments	Total fruits/ plot	Number of damaged fruits/ plot	Percentage of damaged fruits	Per cent reduction over control
T ₁	192.00	47.00	24.74	43.36 ^d
T ₂	191.67	40.00	23.53	46.12 ^b
T ₃	182.13	44.00	23.91	45.24 ^c
T ₄	210.00	29.00	15.93	63.51 ^a
T ₅	170.66	56.00	31.82	27.14 ^e
T ₆	195.33	73.00	37.24	14.71 ^g
T ₇	168.66	63.00	37.50	14.13 ^h
T ₈	172.00	59.00	32.78	24.94 ^f
T ₉	162.00	69.00	43.67	0.00
S.Em±	2.73	0.02	0.15	0.17
CD@ 0.05	8.72	0.06	0.46	0.52

T₁ - Cue lure with destruction of damaged fruits

T₂ - Cue lure + Fipronil (6:4:2)

T₃ - Cue lure + Thiamethoxam (6:4:2)

T₄ - Cue lure + Spinosad (6:4:2)

T₅ - Poison bait with destruction of damaged fruits.

T₆ - Poison bait + Fipronil

T₇ - Poison bait + Thiamethoxam

T₈ - Poison bait + Spinosad

T₉ - Control (with mulching)

Table 3: Morphometrics of ridge gourd by use of different attractant traps against cucurbit fruit fly under mulched conditions

Treatments	Average fruit weight (g)	Average fruit length (cm)	Number of fruits per plant	Total fruits/ plot	Average Fruit yield /plant (kg)	Average Fruit yield /plot (kg)	Yield (t ha ⁻¹)
T ₁	244.73	38.22	9.600	192.000	2.349	46.986	20.556
T ₂	255.63	37.49	9.583	191.667	2.450	48.990	21.433
T ₃	251.26	39.72	9.107	182.133	2.289	45.771	20.025
T ₄	244.33	40.32	10.500	210.000	2.567	51.332	22.458
T ₅	252.83	40.39	8.533	170.667	2.157	43.143	18.875
T ₆	255.56	35.44	9.767	195.333	2.495	49.904	21.833
T ₇	264.50	38.10	8.433	168.667	2.231	44.627	19.524
T ₈	248.80	42.44	8.600	172.000	2.139	42.772	18.713
T ₉	233.90	40.82	8.100	162.000	1.894	37.883	16.574
S.Em±	5.62	0.01	0.14	2.73	0.07	1.30	0.57
CD@ 0.05	NS	0.03	0.41	8.72	0.19	3.94	1.73

T₁ - Cue lure with destruction of damaged fruitsT₂ - Cue lure + Fipronil (6:4:2)T₃ - Cue lure + Thiamethoxam (6:4:2)T₄ - Cue lure + Spinosad (6:4:2)T₅ - Poison bait with destruction of damaged fruitsT₆ - Poison bait +FipronilT₇ - Poison bait +ThiamethoxamT₈ - Poison bait +SpinosadT₉ - Control (with mulching)**Table 4:** Quality of ridge gourd by use of different attractant traps against cucurbit fruit fly under mulched conditions

Treatments	TSS (° Brix)	Ascorbic acid (mg/100g)	Total sugar (%)	Reducing sugars (%)	Non -Reducing sugars (%)
T ₁	4.30	11.33	7.67	5.33	2.34
T ₂	4.10	10.83	10.17	6.43	3.74
T ₃	3.80	10.90	7.44	4.32	3.12
T ₄	3.90	11.20	8.25	4.50	3.75
T ₅	4.20	12.17	8.15	5.83	2.32
T ₆	4.30	10.64	8.26	5.61	2.65
T ₇	3.60	11.63	9.71	4.90	4.81
T ₈	2.90	10.44	7.92	6.88	1.04
T ₉	3.40	12.23	9.42	7.28	2.14
S.Em±	0.50	0.61	0.92	1.05	0.96
CD@ 0.05	NS	NS	NS	NS	NS

T₁ - Cue lure with destruction of damaged fruitsT₂ - Cue lure + Fipronil (6:4:2)T₃ - Cue lure + Thiamethoxam (6:4:2)T₄ - Cue lure + Spinosad (6:4:2)T₅ - Poison bait with destruction of damaged fruitsT₆ - Poison bait +FipronilT₇ - Poison bait +ThiamethoxamT₈ - Poison bait +SpinosadT₉ - Control (with mulching)

Conclusion

The monitoring of cucurbit fruit fly in different attractant traps were clearly showed that by installation of trap consists of cue lure + Spinosad (T₄) has significantly highest number of average fruit flies trapped (17.78 average mean week⁻¹) and recorded significantly maximum fruit yield (22.45 MT/ha). Minimum percentage of damaged fruits per plot (15.93) was reported in the trap consists of cue lure + Spinosad (T₄) treatment which significantly difference with others. Treatment T₄ (cue lure + Spinosad) has significantly highest percent of fruit damage reduction over control (63.51) as compared to treatment T₇ (14.73) lowest which might be due to more number of male flies catches in that treatment. All the treatments did not shown the significant difference with quality parameters by installation of different attract traps in ridge gourd under mulched conditions.

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