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Efficacy of new generation insecticides against whitefly, *Trialeurodes ricini* (Genn) and thrips, *Retithrips syriacus* (Mayet) on castor

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Abstract
Field experiment was conducted at Agricultural College and Research Institute, Vazhavachanur, Tamil Nadu to to study the efficacy of new generation insecticides *viz*., Clothianidin 50 WDG @ 0.1 g/l, Flonicamide 50 WG @ 0.2 g/l, Acetamiprid 20 SP @ 0.2 g/l, Thiomethaxam 25WG @ 0.4 g/l, Imidacloprid 17.8 SL @ 0.5 ml/l, Buprofezin 25 SC @ 0.8 ml/l, Diafenthiuron 50 WP @ 0.8 g/l and conventional insecticides Profenophos 50 EC @ 2ml/l and Dimethoate 30 EC @ 1.7 ml/l along with untreated control against thrips and whitefly in castor. The pooled mean of Buprofezin 25 SC i.e, 4.46 whitefly per plant was noticed after the treatment, which was followed by Profenophos 50 EC, where 8.75 whiteflies were noticed against 57.43 in untreated control in whitefly. The percent reduction over control of thrips population was observed in Buprofezin 25 SC @ 0.8 ml/litre of water (73) followed by Clothianidin 50 WDG @ 0.1 g/litre of water (70) and Dimethoate 30 EC @ 1.7 ml/litre of water (60) in thrips. The highest yield was recorded in Buprofezin 25 SC @ 0.8 ml/litre of water (1821 kg/ha) followed by Imidacloprid 17.8 SL @ 0.5 ml/ litre of water (1626 kg/ha) against 893 kg/ha in untreated control.

Keywords: Newer insecticides, conventional insecticides, whitefly, thrips, yield, untreated control

Introduction
Castor, *Ricinuscommunis* Linnaeus (Euphorbiaceae) is one of the important oilseed crops mostly raised under rainfed condition in India. India ranks first in total castor production (FAO, 2020) [4] with 70 percent and 87 percent of world area and production, respectively (Agyenim-Boateng *et al*., 2018) [1]. India has more area under cultivation in Gujarat, Rajasthan, Andhra Pradesh and Tamil Nadu with an average productivity of 1,856 Kg/ha. Insect pests and diseases together cause more economic losses and resulted with low yield. Among them 50 insect and mite species account for yield loss of upto 40 -89 percent (Karan, 2014, Duraimurugan *et al*., 2015 and Patel *et al*., 2015) [5, 2, 7]. Farmer adopt insecticidal application as prime management strategy and apply insecticides having broad spectrum activity pose a threat to naturalenemies which may result in pest resurgence and also affect environment (Singh *et al*., 2020) [11]. Recent times the incidence of whitefly, *Trialeurodes ricini* (Genn) and thrips, *Retithrips syriacus* (Mayet) has become major threat to castor production (Ranganatha *et al*., 2021 and Ranga *et al*., 2022) [9, 8]. Thus, the current study was proposed to study the efficacy of new generation insecticides against whitefly and thrips on castor and commonly occurring natural enemies in castor ecosystem in assuring environmental safety.

Materials and Methods
Field experiment was conducted in completely randomized block design with three replications at Agricultural College and Research Institute, Vazhavachanur, Tamil Nadu, India farm during Rabi 2019 to study the efficacy of new generation insecticides against thrips and whitefly on castor.
Castor F1 hybrid YRCH 1 seeds were sown at 120 cm x 90 cm and raised as per the package of practices recommended by Tamil Nadu Agricultural University. The insecticides were applied with high volume knapsack sprayer using solid cone nozzle when the insect pest

attained the economic threshold. Observations on the incidence of sucking pests *viz*., thrips and whitefly were recorded on target pests were done on five randomly selected plants per replication before the application of insecticide and 3,7,10 and 14 days after the insecticidal treatment. The incidence of insect pests is expressed as number of insects per plant.

The seed yield was recorded at each harvest and pooled. Gross income, net income and benefit cost ratio (BCR) were worked out for each treatment. The data obtained from the field experiments were analyzed using AGRES ver. (7.01) after subjected to square root transformation.

Results

The results of the field experiment conducted at Agricultural College and Research Institute, Vazhavachanur, Tamil Nadu, India farm during Rabi 2019 to study the efficacy of new generation insecticides against whitefly on castor are presented in Table 1. Among the ten treatments evaluated, the lowest population of whitefly was observed in the treatment Buprofezin 25 SC @ 0.8 ml/litre of water during first and second spraying which was followed by Profenophos 50 EC @ 2 ml/litre of water. The pooled mean of Buprofezin 25 SC i.e, 4.46 whitefly per plant was noticed after the treatment, which was followed by Profenophos 50 EC, where 8.75 whiteflies were noticed against 57.43 in untreated control. The third lowest population was observed in Imidacloprid 17.8 SL @ 0.5 ml/litre of water (10.35) and the remaining three treatments *viz*., Clothianidin 50 WDG @ 0.1 g/ litre of water, Acetamiprid 20 SP@ 0.2 g/ litre of water, Thiomethaxam 25WG @ 0.4 g/ litre of water were on-par with each other (22.34, 23.30 and 24.04, respectively). Buprofezin 25 SC was recorded highest percent reduction over control (89), followed by Profenophos 50 EC (84).

Bioefficacy of newer insecticides against thrips on castor was tabulated in Table 2. The thrips populations were recorded on 3,7,14 days after treatment in both the spraying. The lowest populations were recorded in Dimethoate 30 EC @ 1.7 ml/ litre of water (0.51, 0.19 and 4.88 thrips per spike during 3,7,14 DAT, respectively) followed by Imidacloprid 17.8 SL @ 0.5 ml/ litre of water (0.92, 0.60 and 4.15 thrips per spike) during 3,7,14 DAT, respectively during the first spraying against 18.06, 20.74 and 27.21 in untreated control during 3,7,14 DAT, respectively. The low pooled mean of thrips population was observed in Dimethoate 30 EC @ 1.7 ml/ litre of water after the treatment followed by Profenophos 50 EC @ 2 ml/litre of water against the untreated control (34.38). The percent reduction over control of thrips population was observed in Buprofezin 25 SC @ 0.8 ml/litre of water (73) followed by Clothianidin 50 WDG @ 0.1 g/litre of water (70) and Dimethoate 30 EC @ 1.7 ml/litre of water (60).

The yield parameters were recorded and presented in table 3. The highest yield was recorded in Buprofezin 25 SC @ 0.8 ml/litre of water (1821 kg/ha) followed by Imidacloprid 17.8 SL @ 0.5 ml/ litre of water (1626 kg/ha) against 893 kg/ha in untreated control. The Benefit cost ratio was recorded in Buprofezin 25 SC @ 0.8 ml/litre of water followed by 3.86 followed by Profenophos 50 EC @ 2 ml/litre of water (3.28) and Imidacloprid 17.8 SL @ 0.5 ml/ litre of water (3.15) against 2.11 in untreated control.

Discussion

Present study revealed that, Buprofezin 25 SC @ 0.8 ml/litre of water recorded highest pest reduction both thrips and whitefly population along with highest yield as well as cost benefit ratio. In contrast, Singh *et al*. (2016) [10] and Kavita *et al*. (2014) [6] reported that clothianidin followed by acetamiprid and profenofos in terms of higher seed yield in mungbean. The same trend of results were obtained in the seed yield reported by (Duraimurugan and Alivelu, 2017) [3] i.e, clothianidin (1116 kg/ha) followed by profenofos (1017 kg/ha) and acetamiprid (1012 kg/ha). Thus the newer insecticides *viz*., Buprofezin, clothianidin and Imidacloprid showed greater efficacy in the present study, than standard insecticides currently recommended for the management of sucking pests in castor ecosystem. Thereby, the above insecticides can be coupled with the IPM practices of castor ecosystem.

Table 1: Bioefficacy of newer insecticides against whitefly on castor

Treatments	Population of whitefly (Number/plant)								Mean population of whitefly after treatment (Number/plant)			Per cent reduction in whitefly population over control
	I spray				II spray							
	PTC	3 DAT	7 DAT	14 DAT	PTC	3 DAT	7 DAT	14 DAT	I spray	II spray	Pooled mean	
T_1 -Clothianidin 50 WDG @ 0.1 g/l	41.20 (6.40)	24.50 (4.95)	14.00 (3.74)	22.30 (4.72)	30.00 (5.46)	19.90 (4.46)	13.30 (3.64)	19.10 (4.37)	23.78 (4.81)	20.90 (4.51)	22.34 (4.66)	66
T_2 -Flonicamide 50 WG @0.2 g/l	27.10 (5.19)	21.80 (4.67)	9.90 (3.14)	13.90 (3.73)	26.00 (5.08)	17.20 (4.14)	9.30 (3.05)	10.70 (3.27)	17.88 (4.15)	15.03 (3.81)	16.45 (3.98)	67
T_3 -Acetamiprid 20 SP@ 0.2 g/l	33.50 (5.77)	28.90 (5.37)	16.80 (4.10)	19.90 (4.46)	32.00 (5.64)	24.30 (4.93)	16.20 (4.02)	16.70 (4.08)	24.73 (4.92)	21.88 (4.63)	23.30 (4.77)	62
T_4- Thiomethaxam 25WG @ 0.4 g/l	32.60 (5.69)	26.30 (5.12)	20.90 (4.57)	20.40 (4.51)	36.00 (5.98)	21.70 (4.65)	20.20 (4.49)	17.20 (4.14)	25.48 (5.01)	22.60 (4.72)	24.04 (4.86)	62
T_5- Imidacloprid 17.8 SL @ 0.5 ml/l	27.00 (5.18)	11.30 (3.36)	3.90 (1.97)	16.50 (4.06)	32.90 (5.72)	6.70 (2.59)	3.30 (1.82)	13.30 (3.64)	11.78 (3.33)	8.93 (2.89)	10.35 (3.11)	82
T_6- Buprofezin 25 SC @ 0.8 ml/l	14.30 (3.77)	4.90 (2.21)	1.90 (1.38)	7.80 (2.79)	29.10 (5.38)	0.30 (0.55)	1.30 (1.14)	8.70 (2.95)	5.38 (2.25)	3.55 (1.65)	4.46 (1.95)	89
T_7 -Diafenthiuron 50 WP @ 0.8 g/l	26.50 (5.13)	35.60 (5.96)	29.70 (5.45)	24.20 (4.92)	32.70 (5.70)	31.00 (5.56)	29.00 (5.38)	20.80 (4.56)	31.78 (5.61)	28.85 (5.34)	30.31 (5.48)	44
T_8 - Profenophos 50 EC @ 2ml/l	25.50 (5.04)	13.50 (3.67)	5.60 (2.36)	9.80 (3.13)	34.00 (5.81)	8.90 (2.98)	5.20 (2.28)	6.60 (2.57)	10.15 (3.14)	7.35 (2.69)	8.75 (2.92)	84
T_9 - Dimethoate 30 EC @ 1.7 ml/l	26.70 (5.15)	4.30 (2.07)	22.80 (4.77)	15.20 (3.90)	29.50 (5.42)	11.70 (3.42)	22.20 (4.71)	12.10 (3.48)	15.05 (3.74)	15.23 (3.86)	15.14 (3.80)	71
T_{10} -Untreated control	31.00 (5.55)	61.90 (7.86)	62.60 (7.91)	71.10 (8.43)	31.90 (5.63)	57.30 (7.56)	62.10 (7.87)	68.20 (8.25)	58.80 (7.62)	56.05 (7.43)	57.43 (7.52)	-
CD (0.05)	1.13	0.89	0.72	0.70	0.92	0.40	0.38	0.39	0.84	0.49	0.66	
SEd	0.54	0.42	0.34	0.33	0.44	0.19	0.18	0.18	0.40	0.23	0.31	

Values in parentheses are square root transformed values

Table 2: Bioefficacy of newer insecticides against thrips on castor

Treatments	Population of thrips (Number/spike)								Mean population of thrips after treatment (Number/spike)			Per cent reduction in thrips population over control
	I spray				II spray							
	PTC	3 DAT	7 DAT	14 DAT	PTC	3 DAT	7 DAT	14 DAT	I spray	II spray	Pooled mean	
T_1 -Clothianidin 50 WDG @ 0.1 g/l	15.48 (3.93)	1.92 (1.39)	1.60 (1.26)	5.21 (2.28)	34.37 (5.86)	15.54 (3.94)	18.81 (4.34)	18.63 (4.32)	4.47 (2.11)	19.82 (4.45)	12.15 (3.49)	70
T_2 -Flonicamide 50 WG @0.2 g/l	19.62 (4.43)	6.06 (2.46)	5.74 (2.40)	0.85 (0.92)	24.14 (4.91)	18.74 (4.33)	16.61 (4.08)	17.83 (4.22)	6.49 (2.55)	18.44 (4.29)	12.46 (3.53)	65
T_3 -Acetamiprid 20 SP@ 0.2 g/l	15.42 (3.93)	1.86 (1.36)	1.54 (1.24)	6.01 (2.45)	28.40 (5.33)	22.61 (4.75)	22.47 (4.74)	23.30 (4.83)	4.63 (2.15)	22.87 (4.78)	13.75 (3.71)	61
T_4- Thiomethaxam 25WG @ 0.4 g/l	19.38 (4.40)	5.82 (2.41)	5.50 (2.35)	4.65 (2.16)	26.97 (5.19)	23.01 (4.80)	14.54 (3.81)	22.10 (4.70)	7.26 (2.69)	21.14 (4.60)	14.20 (3.77)	62
T_5- Imidacloprid 17.8 SL @ 0.5 ml/l	14.48 (3.81)	0.92 (0.96)	0.60 (0.77)	4.15 (2.04)	24.37 (4.94)	18.61 (4.31)	25.34 (5.03)	22.63 (4.76)	3.46 (1.86)	21.37 (4.62)	12.41 (3.52)	61
T_6- Buprofezin 25 SC @ 0.8 ml/l	18.42 (4.29)	4.86 (2.20)	4.54 (2.13)	5.18 (2.28)	34.97 (5.91)	22.01 (4.69)	12.61 (3.55)	10.97 (3.31)	6.67 (2.58)	16.97 (4.12)	11.82 (3.44)	73
T_7 -Diafenthiuron 50 WP @ 0.8 g/l	15.58 (3.95)	2.02 (1.42)	1.70 (1.30)	4.31 (2.08)	24.37 (4.94)	14.48 (3.81)	27.34 (5.23)	22.17 (4.71)	4.32 (2.08)	20.12 (4.49)	12.22 (3.50)	62
T_8 - Profenophos 50 EC @ 2ml/l	17.18 (4.14)	3.62 (1.90)	3.30 (1.82)	6.01 (2.45)	18.07 (4.25)	15.41 (3.93)	10.94 (3.31)	15.83 (3.98)	5.95 (2.44)	14.42 (3.80)	10.18 (3.19)	64
T_9 - Dimethoate 30 EC @ 1.7 ml/l	10.85 (3.29)	0.51 (0.71)	0.19 (0.44)	4.88 (2.21)	22.07 (4.70)	17.14 (4.14)	12.74 (3.57)	7.77 (2.79)	2.53 (1.59)	13.89 (3.73)	8.21 (2.87)	69
T_{10} -Untreated control	16.62 (4.08)	18.06 (4.25)	20.74 (4.55)	27.21 (5.22)	26.27 (5.13)	38.31 (6.19)	49.54 (7.04)	80.60 (8.98)	20.83 (4.56)	47.94 (6.92)	34.38 (5.86)	-
CD (0.05)	5.18	1.12	1.22	1.66	8.75	3.89	4.20	5.43	1.87	5.11	3.49	
SEd	2.46	0.53	0.58	0.79	4.16	1.85	2.00	2.58	0.89	2.43	1.66	

Values in parentheses are square root transformed values

Table 3: Efficacy of newer insecticides on yield and economics of castor

Treatments	Yield (kg/ha)	Per cent increase in yield	Gross income (Rs.)	BCR
T_1 -Clothianidin 50 WDG @ 0.1 g/l	1416	58.57	76464	1:2.98
T_2 -Flonicamide 50 WG @ 0.2 g/l	1431	60.25	77274	1:2.96
T_3 -Acetamiprid 20 SP @ 0.2 g/l	1409	57.78	76086	1:2.95
T_4- Thiomethaxam 25 WG @ 0.4 g/l	1401	56.89	75654	1:3.06
T_5- Imidacloprid 17.8 SL @ 0.5 ml/l	1626	82.08	87804	1:3.15
T_6- Buprofezin 25 SC @ 0.8 ml/l	1821	103.92	98334	1:3.86
T_7 -Diafenthiuron 50 WP @ 0.8 g/l	1068	19.60	57672	1:2.23
T_8 - Profenophos 50 EC @ 2 ml/l	1524	70.66	82296	1:3.28
T_9 - Dimethoate 30 EC @ 1.7 ml/l	1469	64.50	79326	1:3.19
T_{10} -Untreated control	893	0.00	48222	1:2.11
CD (0.05)	24.13			
SE.d	11.25			

Conclusion

Efficacies of newer insecticides *viz.*, Buprofezin, clothianidin and Imidacloprid have showed greater mortality against whitefly and thrips population in castor ecosystem. The yield and cost benefit ratio also gave the same trends against the above pests.

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