International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
www.chemijournal.com
IJCS 2020; 8(6): 306-310

Received: 01-09-2020
Accepted: 03-10-2020

G Dhivya
Department of Agricultural Entomology, Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Serumavilangai, Nedungadu, Karaikal, Puducherry, India

K Kumar
Department of Agricultural Entomology, Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Serumavilangai, Nedungadu, Karaikal, Puducherry, India

Corresponding Author:
G Dhivya
Department of Agricultural Entomology, Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Serumavilangai, Nedungadu, Karaikal, Puducherry, India

Efficacy of essential oils against the rice leaf folder, *Cnaphalocrocis medinalis* (Guenee) in Karaikal district, U.T. of Puducherry

G Dhivya and K Kumar

DOI: https://doi.org/10.22271/chemi.2020.v8.i6e.10784

Abstract
Two field experiments was conducted in the eastern farm of Pandit Jawaharlal Nehru College of Agriculture and Research Institute (PAJANCOA & RI), Karaikal, during *kharif 2018*, and *rabi 2018-19* in a Randomized Block Design (RBD), with eight treatments and were replicated thrice in an experimental area of 4 x 5 m^2 each with rice variety of ADT 45.During *kharif*, the mean per cent leaf damage was low in the treatment with rynaxypyr 20 SC @ 150 ml/ha (6.68,4.81%) followed by camphor oil @ 1000 ml/ha (6.91,5.35%) with a per cent reduction of 38.20,58.49 and 36.07,53.83 per cent respectively over untreated check after two rounds of foliar application. In *rabi 2018-19*, the mean per cent leaf damage was low in the treatment with rynaxypyr 20 SC @ 150 ml/ha (5.57,4.34,3.02%) followed by camphor oil @ 1000 ml/ha (6.41,5.11,3.65%) with a per cent reduction of 40.42,31.44;58.90,51.60 and 69.01,63.27per cent respectively over untreated check after three rounds of foliar application. The effect of these applications also resulted on the yield attributes, with highest grain yield of 3.43 and 6.64 t/ha were observed in rynaxypyr 20 SC @ 150 ml/ha treated plot followed by dinotefuran 20 SG @ 200 g/ha (2.50 and 5.82 t/ha) and camphor oil @ 1000 ml/ha (2.28 and 5.68 t/ha) compared to the untreated check (1.33 and 4.06 t/ha) during kharif and rabi respectively. From the results of the field experiments, it was found that, the treatment with rynaxypyr 20 SC @ 150 ml/ha and among the botanicals, camphor oil @ 1000 ml/ha was found to be effective against the rice leaf folder, *C. medinalis*.

Keywords: Rice, leaf folder, essential oils, rynaxypyr

Introduction
Rice (*Oryza sativa*) is one of the world's most important crops providing a staple food for more than half of the global population (Kulgagod *et.al.* 2011) [4]. But rice production is hampered by infestation of a large number of insect pests. Nearly 300 species of insect pests attack the rice crop at different stages and among them only 23 species cause notable damage (Pasalu and Katti, 2006) [5]. The leaf folder, *C. medinalis* is one of the major pest of rice feed on leaves; hinder the photosynthesis of the leaves resulting in the reduction of rice yield. They feed inside the folded leaf creating longitudinal, white and transparent streaks on the blade. Indiscriminate use of nitrogenous fertilizers and mismanagement of insecticides have been attributed as the causes of this minor pest gaining major pest status (Dhaliwal *et al*., 2015) [2] and the yield loss caused by leaf folder, *C. medinalis* was reported to an extent of 5 to 25 per cent (Kulgagod *et al*., 2011) [4]. Essential oils are effective as contact and fumigant insecticides to a majority of insect pests giving quick knock down action (> 1% concentration). Mostly components of essential oils are lipophilic in nature, which acts like oviposition deterrent, feeding deterrent, repellent and toxins to a broad range of insect pests. Considering this, the present study was carried out to find the efficacy of certain essential oils and insecticides against the leaf folder, *C. medinalis* in rice.

Materials and Methods
The experiment was conducted in the eastern farm of Pandit Jawaharlal Nehru College of Agriculture and Research Institute (PAJANCOA & RI), Karaikal, during *kharif*, 2018 and *rabi* 2018-19 in Randomized Block Design (RBD), with 8 treatments and were replicated thrice in an experimental area of 4x5 m^2 each with the rice variety ADT 45.

The treatments were camphor oil, cedarwood oil, eucalyptus oil, lemon grass oil @ 1000 ml/ha each, neemazal 1.0 EC @ 1000 ml/ha, dinotefuran 20 SG @ 200 g/ha, rynaxypyr 20 SC @ 150 ml/ha were evaluated along with the untreated check.The economic threshold level basis of application of insecticides were followed and during *kharif*, the treatments were applied at 39 and 55 days after transplanting (DAT) while in rabi three applications were given at 22, 40 and 57 DAT. Leaf damage by *C. medinalis* was assessed based on the damaged leaves and total number of leaves from ten randomly selected hills/plot. The observations were taken a day before spraying and at 1, 3, 5, 7 and 14 days after sowing (DAS). The percentage leaf damage was calculated as given by Roy *et al*., (2017) [6]. The mean value of data obtained from the two field experiments were analyzed statistically by ANOVA using the package AGRISTAT after converting it to arc sine transformation value.

Results and Discussion

During *kharif*, before the first foliar application, the per cent leaf damage ranged from 9.45 to 11.10 per cent/hill. At 1 DAT, the per cent leaf damage ranged from 8.06 to 10.29 per cent/hill. In the treatment with rynaxypyr 20 SC @ 150 ml/ha, the per cent leaf damage was low (8.06%) and superior than the other treatments compared to the untreated check (10.29%).At 3 DAT, there was a reduction in the leaf damage and the per cent leaf damage ranged from 6.24 to 10.86 per cent/hill. Among the treatments, rynaxypyr 20 SC @ 150 ml/ha recorded a lower per cent leaf damage (6.24%) and was on par with the camphor oil @1000 ml/ha (6.75%) compared to the untreated check (10.86%). Similar trend was observed upto 7 DAT. At 14 DAT, the per cent leaf damage was in an increasing trend and ranged from 6.84 to 11.08 per cent/hill and similar trend was recorded as in earlier observations. It was found that, after the first foliar application, the per cent leaf damage was low in the treatment with rynaxypyr 20SC@ 150 ml/ha which ranged from 6.11 to 8.06 per cent/hill followed by camphor oil @ 1000 ml/ha (6.10 to 8.20 per cent/hill) with a per cent reduction of 38.20 and 36.07 per cent respectively compared to the untreated check (Table1)**.** Before the second foliar application, the per cent leaf damage ranged from 6.68 to 10.81 per cent/hill. At 1 DAT, the per cent leaf damage ranged from 4.78 to 11.24 per cent/hill. In the treatment with rynaxypyr 20 SC @ 150 ml/ha, the per cent leaf damage was low (4.78%) followed by camphor oil 1000 ml/ha (5.68%) and was superior than the other treatments compared to the untreated check (11.24%).At 3 DAT, there was a reduction in the leaf damage and the per cent leaf damage ranged from 4.57 to 11.49 per cent/hill. Similar trend was observed as at 1DAT and continued upto 14 DAT. After the second foliar application, the per cent leaf damage was low in the treatment with rynaxypyr 20SC@ 150 ml/ha which ranged from 4.57 to 5.01 per cent/hill followed by camphor oil @ 1000 ml/ha (5.04 to 5.68 per cent/hill) with a per cent reduction of 58.49 and 53.83 per cent respectively compared to the untreated check (Table 2).

In *rabi*, before the first foliar application, the per cent leaf damage ranged from 9.44 to 10.94 per cent/hill. After the application, the per cent leaf damage ranged from 5.14 to 9.70, 4.68 to 9.83, 4.80 to 8.16, 6.42 to 8.79 and 6.84 to 10.31 per cent/hill at 1, 3, 5, 7 and 14 DAT respectively. After the first foliar application the per cent leaf damage was low in the treatment with rynaxypyr 20SC@ 150 ml/ha which ranged from 4.68 to 6.84 per cent/hill followed by camphor oil @ 1000 ml/ha (5.50 to 7.25%) with a per cent reduction of 40.42 and 31.44 per cent respectively compared to the untreated check (Table 3). Before the second foliar application, the per cent leaf damage ranged from 6.84 to 10.31 per cent/hill. At 1,3,5,7,14 DAT, the per cent leaf damage ranged from 3.76 to 10.57, 3.81 to 10.34,4.12 to 10.79, 4.52 to 10.77 and 5.52 to 10.36 per cent/hill respectively. After the second foliar application, the per cent leaf damage was low in the treatment with rynaxypyr 20SC@ 150 ml/ha which ranged from 3.76 to 5.52 per cent/hill followed by camphor oil @ 1000 ml/ha (4.17 to 6.18 per cent/hill) with a per cent reduction of 58.90 and 51.60 per cent respectively compared to the untreated check (Table 4). Before the third foliar application, the per cent leaf damage ranged from 5.52 to 10.36 per cent/hill. At 1,3,5,7,14 DAT, the per cent leaf damage ranged from 2.97 to 10.57, 2.43 to 10.31, 3.11 to 10.27, 3.17 to 9.15 and 4.12 to 9.43 per cent/hill respectively After the third foliar application, similar trend was followed as in the previous applications. It was found that the per cent leaf damage was low in the treatment with rynaxypyr 20SC@ 150 ml/ha which ranged from 2.43 to 3.46 per cent/hill followed by camphor oil @ 1000 ml/ha (3.16 to 4.12 per cent/hill) with a per cent reduction of 69.61 and 63.27 per cent respectively compared to the untreated check (Table 5).

During *kharif* and *rabi*, the incidence of leaf folder was found to be low in the treatment with rynaxypyr 20 SC @ 150 ml/ha correspondingly the yield of rice was also higher in the same treatment (3.43 and 6.64 t/ha) followed by dinotefuran 20 SG @ 200 g/ha (2.50 and 5.82 t/ha) and camphor oil @1000 ml/ha (2.28 and 5.68 t/ha) compared to the untreated check (1.33 and 4.06 t/ha) respectively (Table 6). The results showed that the insecticidal treatments were significantly effective followed by the essential oils in reducing the infestation of rice leaf folder, *C. medinalis* damage compared to the untreated check. From the present study, it was concluded that the treatment with rynaxypyr 20 SC @ 150 ml/ha was found to be effective followed by ecofriendly application of essential oils viz., camphor oil @ 1000 ml/ha for suppression of leaf folder, *C. medinalis* damage with higher yield in both the seasons. Choudhary *et al*. (2017) [1] reported that rynaxypyr 20 SC @ 150 ml/ha was the best treatment in reducing the leaf folder, *C. medinalis* incidence in rice, *O. sativa* compared to the other newer insecticides. Karthikeyan (2018) [3] conducted the field trial and results revealed that the new insecticide chlorantraniliprole @ 150ml/ha was found to be more effective against the rice leaf folder, *C. medinalis*. Singh (2018) [7] found that the treatment with rynaxypyr (Coragen) 20 SC @ 150 ml/ha recorded the highest grain yield of 3250 and 3125 kg/ha during *kharif*' 2015 and 2016 respectively. The above findings are found to support the present findings.

Table 1: Effect of essential oils against the leaf folder, *Cnaphalocrocis medinalis* (Guenee) during *kharif*'2018 in rice

Sl. No	Treatments	Conc. a.i.ml/g /ha	Per cent leaf damage/hill# I Foliar application						Overall mean	Per cent reduction over control
			Pre treatment count	1 DAT	3 DAT	5 DAT	7 DAT	14 DAT		
1.	Camphor oil	1000 ml	9.90 (18.33)	8.20 (16.67)^{a}	6.75 (15.05)^{a}	6.28 (14.51)^{a}	6.10 (14.30)^{a}	7.24 (15.61)^{a}	6.91 (15.22)^{a}	36.07
2.	Cedarwood oil	1000 ml	9.45 (17.88)	8.18 (16.61)^{a}	7.83 (16.24)^{b}	7.37 (15.75)^{b}	7.49 (15.88)^{b}	7.56 (15.95)^{a}	7.68 (16.08)^{b}	28.95
3.	Eucalyptus oil	1000 ml	11.10 (19.46)	9.4 (17.85)^{b}	9.18 (17.63)^{c}	9.09 (17.55)^{c}	8.92 (17.37)^{c}	9.29 (17.74)^{b}	9.17 (17.62)^{c}	15.17
4.	Lemongrass oil	1000 ml	10.60 (19.06)	9.24 (17.69)^{b}	9.04 (17.50)^{c}	8.90 (17.34)^{c}	8.62 (17.06)^{c}	9.16 (17.61)^{b}	8.99 (17.44)^{c}	16.83
5.	Neemazal 1.0 EC	1000 ml	10.30 (18.72)	9.56 (18.00)^{b}	9.47 (17.92)^{c}	9.19 (17.64)^{c}	9.07 (17.53)^{c}	9.12 (17.57)^{b}	9.28 (17.73)^{c}	14.15
6.	Dinotefuran 20 SG	200 g	10.40 (18.87)	9.80 (18.24)^{bc}	9.20 (17.68)^{c}	9.12 (17.57)^{c}	9.09 (17.55)^{c}	9.13 (17.58)^{b}	9.26 (17.72)^{c}	14.33
7.	Rynaxypyr 20 SC	150 ml	10.30 (18.77)	8.06 (16.49)^{a}	6.24 (14.45)^{a}	6.11 (14.31)^{a}	6.19 (14.38)^{a}	6.84 (15.08)^{a}	6.68 (14.94)^{a}	38.20
8.	Untreated check	-	10.20 (18.68)	10.29 (18.71)^{c}	10.86 (19.23)^{d}	10.91 (19.28)^{d}	10.94 (19.30)^{d}	11.08 (19.44)^{c}	10.81 (19.19)^{d}	-
	CD (P=0.05)	-	NS	0.701**	0.847**	0.690**	0.891**	1.391**	0.658**	-

NS – Non Significant
** - Significant at P = 0.01
# Mean of 10 plants
Mean of 3 replications
In a column mean followed by a common letter are not significantly different by DMRT (P=0.05)
Values in Parentheses are Arc sine transformed values
DAT – Days after treatment

Table 2: Effect of essential oils against the leaf folder, *Cnaphalocrocis medinalis* (Guenee) during *kharif*'2018 in rice

Sl. No	Treatments	Conc. a.i. ml/g /ha	Per cent leaf damage/hill# II Foliar application						Overall mean	Per cent reduction over control
			Pre treatment count	1 DAT	3 DAT	5 DAT	7 DAT	14 DAT		
1.	Camphor oil	1000 ml	6.91 (15.22)^{a}	5.68 (13.78)^{b}	5.42 (13.45)^{b}	5.18 (13.16)^{a}	5.04 (12.95)^{a}	5.46 (13.51)^{a}	5.35 (13.37)^{a}	53.83
2.	Cedarwood oil	1000 ml	7.68 (16.08)^{b}	6.94 (15.27)^{cd}	6.43 (14.65)^{c}	6.27 (14.50)^{bc}	6.15 (14.36)^{b}	6.84 (15.16)^{b}	6.52 (14.78)^{bc}	43.74
3.	Eucalyptus oil	1000 ml	9.17 (17.62)^{c}	6.98 (15.31)^{cd}	6.47 (14.73)^{c}	6.31 (14.55)^{bc}	6.46 (14.72)^{bc}	6.57 (14.85)^{b}	6.55 (14.82)^{bc}	43.48
4.	Lemongrass oil	1000 ml	8.99 (17.44)^{c}	6.22 (14.43)^{bc}	6.08 (14.27)^{bc}	6.02 (14.19)^{b}	6.28 (14.50)^{bc}	6.44 (14.70)^{b}	6.20 (14.41)^{b}	46.50
5.	Neemazal 1.0 EC	1000 ml	9.28 (17.73)^{c}	7.46 (15.84)^{de}	7.02 (15.36)^{cd}	7.00 (15.32)^{cd}	7.20 (15.55)^{c}	7.10 (15.45)^{b}	7.15 (15.49)^{c}	38.30
6.	Dinotefuran 20 SG	200 g	9.26 (17.72)^{c}	8.00 (16.42)^{e}	7.76 (16.17)^{d}	7.46 (15.85)^{d}	7.18 (15.54)^{c}	6.94 (15.26)^{b}	7.46 (15.84)^{c}	35.63
7.	Rynaxypyr 20 SC	150 ml	6.68 (14.94)^{a}	4.78 (12.62)^{a}	4.57 (12.33)^{a}	4.82 (12.66)^{a}	4.88 (12.75)^{a}	5.01 (12.92)^{a}	4.81 (12.89)^{a}	58.49
8.	Untreated check	-	10.81 (19.19)^{d}	11.24 (19.59)^{f}	11.49 (19.81)^{e}	11.56 (19.87)^{e}	11.73 (20.03)^{d}	11.96 (20.23)^{c}	11.59 (19.90)^{d}	-
	CD (P=0.05)	-	0.658**	1.335**	1.473**	0.974**	1.067**	0.886**	1.177**	-

** - Significant at P = 0.01
# Mean of 10 plants
Mean of 3 replications
In a column mean followed by a common letter are not significantly different by DMRT (P=0.05)
Values in Parentheses are Arc sine transformed values
DAT – Days after treatment

Table 3: Effect of essential oils against the leaf folder, *Cnaphalocrocis medinalis* (Guenee) during *rabi'* 2018-19 in rice

Sl. No	Treatments	Conc. a.i.ml/g /ha	Per cent leaf damage/hill# I Foliar application						Overall mean	Per cent reduction over control
			Pre treatment count	1 DAT	3 DAT	5 DAT	7 DAT	14 DAT		
1.	Camphor oil	1000 ml	10.46 (18.83)	5.98 (14.14)^{ab}	5.50 (13.53)^{ab}	6.28 (14.04)^{ab}	7.08 (15.07)^{ab}	7.25 (15.61)^{ab}	6.41 (14.47)^{ab}	31.44
2.	Cedarwood oil	1000 ml	9.73 (18.16)	7.46 (15.82)^{b}	7.13 (15.44)^{bc}	7.73 (16.13)^{cd}	8.17 (16.59)^{bc}	9.82 (18.19)^{cd}	8.06 (16.43)^{cd}	13.79
3.	Eucalyptus oil	1000 ml	9.51 (17.93)	6.58 (14.85)^{ab}	6.52 (14.77)^{bc}	6.96 (15.30)^{bcd}	7.49 (15.82)^{bc}	8.13 (16.55)^{ab}	7.13 (15.45)^{bc}	23.74
4.	Lemongrass oil	1000 ml	9.76 (18.16)	6.21 (14.37)^{ab}	6.03 (14.20)^{abc}	6.48 (14.68)^{cd}	7.58 (15.97)^{bc}	7.90 (16.29)^{abc}	6.84 (15.10)^{abc}	26.84
5.	Neemazal 1.0 EC	1000 ml	10.39 (18.76)	7.29 (15.65)^{b}	7.43 (15.78)^{c}	7.51 (15.89)^{bc}	8.15 (16.45)^{bc}	9.19 (17.62)^{bcd}	7.91 (16.27)^{bcd}	15.40
6.	Dinotefuran 20 SG	200 g	10.94 (19.29)	6.49 (14.70)^{ab}	6.58 (14.85)^{bc}	6.73 (15.02)^{bcd}	7.54 (15.92)^{bc}	9.50 (17.94)^{cd}	7.36 (15.68)^{bc}	21.28

7.	Rynaxypyr 20 SC	150 ml	9.44 (17.82)	5.14 (13.05)^{a}	4.68 (12.46)^{a}	4.80 (12.64)^{a}	6.42 (14.06)^{a}	6.84 (15.13)^{a}	5.57 (13.46)^{a}	40.42
8.	Untreated check	-	9.63 (18.02)	9.70 (18.13)^{c}	9.83 (18.25)^{d}	8.16 (16.57)^{d}	8.79 (17.30)^{c}	10.31 (18.68)^{d}	9.35 (17.78)^{d}	-
	CD (P=0.05)	-	NS	2.060**	2.022**	1.843**	1.712**	2.246**	1.734**	-

NS – Non Significant
** - Significant at P = 0.01
# Mean of 10 plants
DAT – Days after treatment
In a column mean followed by a common letter are not significantly different by DMRT (P=0.05)
Values in Parentheses are Arc sine transformed values
Mean of 3 replications

Table 4: Effect of essential oils against the leaf folder, *Cnaphalocrocis medinalis* (Guenee) during *rabi'*2018-19 in rice

Sl. No	Treatments	Conc. a.i.ml/g /ha	Per cent leaf damage/plant# II Foliar application						Overall mean	Per cent reduction over control
			Pre treatment count	1 DAT	3 DAT	5 DAT	7 DAT	14 DAT		
1.	Camphor oil	1000 ml	7.25 (15.61)^{ab}	4.17 (11.77)^{ab}	4.21 (11.74)^{ab}	5.05 (112.99)^{ab}	5.97 (13.22)^{ab}	6.18 (14.39)^{ab}	5.11 (12.48)^{b}	51.60
2.	Cedarwood oil	1000 ml	9.82 (18.19)^{cd}	6.04 (14.21)^{d}	6.13 (14.26)^{c}	6.29 (14.52)^{bc}	7.12 (15.46)^{c}	8.10 (16.51)^{c}	6.73 (14.99)^{d}	36.26
3.	Eucalyptus oil	1000 ml	8.13 (16.55)^{ab}	5.48 (13.52)^{cd}	5.27 (13.23)^{abc}	5.93 (14.05)^{bc}	6.54 (14.82)^{c}	7.49 (15.88)^{bc}	6.14 (14.30)^{c}	41.85
4.	Lemongrass oil	1000 ml	7.90 (16.29)^{abc}	4.95 (12.85)^{bc}	5.73 (13.80)^{bc}	5.59 (13.67)^{bc}	6.16 (14.19)^{bc}	7.18 (15.43)^{bc}	5.92 (13.98)^{c}	43.99
5.	Neemazal 1.0 EC	1000 ml	9.19 (17.62)^{bcd}	5.97 (14.12)^{d}	6.11 (14.26)^{c}	6.72 (14.99)^{c}	7.06 (15.38)^{c}	7.92 (16.34)^{c}	6.75 (15.01)^{d}	36.07
6.	Dinotefuran 20 SG	200 g	9.50 (17.94)^{cd}	5.46 (13.51)^{cd}	5.39 (13.41)^{abc}	6.06 (14.14)^{bc}	6.98 (15.32)^{c}	7.39 (15.72)^{bc}	6.25 (14.42)^{c}	40.81
7.	Rynaxypyr 20 SC	150 ml	6.84 (15.13)^{a}	3.76 (11.18)^{a}	3.81 (11.26)^{a}	4.12 (11.71)^{a}	4.52 (11.91)^{a}	5.52 (13.59)^{a}	4.34 (11.92)^{a}	58.90
8.	Untreated check	-	10.31 (18.68)^{d}	10.57 (18.96)^{e}	10.34 (18.75)^{d}	10.79 (19.17)^{d}	10.77 (19.15)^{d}	10.36 (18.75)^{d}	10.56 (18.95)^{e}	-
	CD (P=0.05)	-	2.246**	1.206**	2.437**	1.891**	1.398**	1.716**	0.460**	-

** - Significant at P = 0.01
# Mean of 10 plants
Mean of 3 replications
In a column mean followed by a common letter are not significantly different by DMRT (P=0.05)
Values in Parentheses are Arc sine transformed values
DAT – Days after treatment

Table 5: Effect of essential oils against the leaf folder, *Cnaphalocrocis medinalis* (Guenee) during *rabi'* 2018-19 in rice

Sl. No	Treatments	Conc. a.i.ml/g /ha	Per cent leaf damage/hill# III Foliar application						Overall mean	Per cent reduction over control
			Pre treatment count	1 DAT	3 DAT	5 DAT	7 DAT	14 DAT		
1.	Camphor oil	1000 ml	6.18 (14.39)^{ab}	3.16 (10.23)^{ab}	3.44 (10.65)^{ab}	3.72 (11.03)^{ab}	3.83 (11.21)^{ab}	4.12 (11.64)^{ab}	3.65 (10.95)^{b}	63.27
2.	Cedarwood oil	1000 ml	8.10 (16.51)^{c}	5.06 (12.96)^{d}	5.13 (13.05)^{c}	5.73 (13.80)^{d}	5.88 (14.01)^{c}	6.15 (14.34)^{c}	5.59 (13.63)^{e}	43.76
3.	Eucalyptus oil	1000 ml	7.49 (15.88)^{bc}	3.43 (10.65)^{abc}	3.89 (11.375)^{bc}	4.17 (11.72)^{abc}	4.97 (12.81)^{bc}	5.09 (13.00)^{bc}	4.31 (11.91)^{c}	56.63
4.	Lemongrass oil	1000 ml	7.18 (15.43)^{bc}	4.26 (11.81)^{abc}	4.18 (11.75)^{bc}	4.54 (12.27)^{bcd}	5.11 (13.04)^{bc}	5.53 (13.55)^{bc}	4.72 (12.48)^{cd}	52.21
5.	Neemazal 1.0 EC	1000 ml	7.92 (16.34)^{c}	4.82 (12.63)^{cd}	4.97 (12.86)^{c}	5.49 (13.49)^{cd}	5.37 (13.33)^{bc}	5.97 (14.12)^{c}	5.32 (13.28)^{de}	46.47
6.	Dinotefuran 20 SG	200 g	7.39 (15.72)^{bc}	4.51 (12.19)^{bcd}	4.69 (12.48)^{bc}	5.17 (13.10)^{cd}	5.94 (14.10)^{c}	6.07 (14.24)^{c}	5.27 (13.22)^{de}	43.96
7.	Rynaxypyr 20 SC	150 ml	5.52 (13.59)^{a}	2.97 (9.87)^{a}	2.43 (8.93)^{a}	3.11 (10.14)^{a}	3.17 (10.17)^{a}	3.46 (10.64)^{a}	3.02 (9.95)^{a}	69.61
8.	Untreated check	-	10.36 (18.75)^{d}	10.57 (18.96)^{e}	10.31 (18.68)^{d}	10.27 (18.68)^{e}	9.15 (17.59)^{d}	9.43 (17.87)^{d}	9.94 (18.35)^{f}	-
	CD (P=0.05)	-	1.716**	2.304**	2.233**	1.846**	2.471**	2.204**	0.926**	-

** - Significant at P = 0.01
# Mean of 10 plants
Mean of 3 replications
In a column mean followed by a common letter are not significantly different by DMRT (P=0.05)
Values in Parentheses are Arc sine transformed values
DAT – Days after treatment

Table 6: Yield of rice, *O. sativa* in different treatments

S. No	Treatments	Conc. ml/g per ha	Grain yield (t/ha)	
			Kharif	***Rabi***
1.	Camphor oil	1000	2.28^{bc}	5.68^{bc}
2.	Cedarwood oil	1000	1.70^{de}	5.13^{d}
3.	Eucalyptus oil	1000	1.91^{d}	5.30^{cd}
4.	Lemongrass oil	1000	1.96^{cd}	5.18^{d}
5.	Neemazal 1.0 EC	1000	1.86^{d}	4.63^{e}
6.	Dinotefuran 20 SG	200	2.50^{b}	5.82^{b}
7.	Rynaxypyr 20 SC	150	3.43^{a}	6.64^{a}
8.	Untreated check	-	1.33^{e}	4.06^{f}
CD (P= 0.05)		-	0.370**	0.384**

** - Significant at P= 0.1

In a column mean followed by a common letters are not significantly different by DMRT (P=0.05)

Means of three replications

References

1. Choudhary R, Chandrakar G, Bhardwaj JR, Khan HH, Sahu R. Assessment of the efficacy of neem based insecticides for the management of yellow stem borer, *Scirpophaga incertulas* Walk. in paddy field. J Pharmacogn Phytochem 2017;6(5):1446-1449.
2. Dhaliwal GS, Jindal V, Mohindru B. Crop losses due to insect pests: global and Indian scenario. Indian J Ent 2015;77(2):165-168.
3. Karthikeyan K. Efficacy of new insecticide molecule against major pests of rice. Journal of Rice Research 2018;10(2):60-65.
4. Kulgagod SD, Hegade GV, Nayak AS, Vatrad PS, Huger, Basavanagoud K. Evaluation of insecticides and bio-rationales against yellow stem borer and leaf folder in rice crop. Karnataka J Agric Sci 2011;24(2):244-246.
5. Pasalu IC, Katti G. Advances in ecofriendly approaches in rice IPM. Journal of Rice Research. 2006; 1(1):83-90.
6. Roy P, Uddin MM, Islam KS, Das KR. Efficacy of different botanical and chemical insecticides against rice hispa (*Dicladispa armigera*). Progressive agriculture 2017;28(2):64-72.
7. Singh K. Comparative Efficacy of botanicals against yellow stem borers (*Scirpophaga incertulas*, Walker) and leaf folder (*Cnaphalocrocis medinalis*, Guenée) of rice in Eastern Uttar Pradesh. J Pharmacogn Phytochem 2018;1:474-478.