International Journal of Entomology Research
ISSN: 2455-4758; Impact Factor: RJIF 5.24
www.entomologyjournals.com
Volume 2; Issue 3; May 2017; Page No. 04-09

Field Evaluation of Virtako 2.4 DT an insecticidal tablet against certain key pests on rice

G Balamurugan, V Suhasini, S Arivudainambi

Department of Entomology, Faculty of Agriculture, Annamalai University, Annamalainagar- 608 002, Tamil Nadu, India

Abstract
Application of Virtako 2.4 DT @ 2.5 kg/ha at 20 days after transplantation of rice was found effective in reducing green leafhopper (*Nephotettix virescens*), stem borer (*Scirpophaga incertulas*), leaf folder (*Cnaphalocrocis medinalis*) and brown plant hopper (*Nilaparvata lugens*) and recorded 1.80 hill^{-1}, 1.83% white ear, 3.47% leaf damage and 0.99 hill^{-1} respectively as compared with untreated check where 9.33 hill^{-1}, 16.66% white ear, 15.42% leaf damage and 7.66 hill^{-1} were seen. There was no reduction in the natural enemies population in the field and no phytotoxicity recorded. The treatment with Virtako 2.4 DT @ 2.5 kg/ha recorded the highest rice grain yield of 4.53 t ha^{-1} as compared to untreated check 2.23 t ha^{-1}.

Keywords: virtako 2.4 DT, insecticidal management of rice pests, insecticidal tablet

1. Introduction
Rice is a staple food for India which cultivated over an area of 44 million hectares with the annual production of around 95 million tones and its production was reduced due to insect damage and was found 25 per cent (Dhaliwal and Arora, 2001) [2]. In Asia, green leafhopper (*Nephotettix virescens* Distant), brown planthopper (*Nilaparvata lugens* Stal.), leaf folder (*Cnaphalocrocis medinalis* Guenee) and stem borer (*Scirpophaga incertulas* Walker) are considered as most serious pest (Krishnaiah *et al*., 1999) [4]. In the management, insecticides are mostly preferred by the farmers and it is not possible to propose the effective management strategy without insecticide. However, formulation type of insecticides can be improved to minimize the deleterious effects on non-target organisms. Virtako 2.4DT (Chlorantraniliprole 1.2% + Thiamethoxam 1.2%) is an emerging type of formulation, especially useful with compounds that are effective at grams per hectare application rate and safer to non-targets. They are applied by following broadcasting; so no special skills and equipments needed for application. Virtako 2.4 DT tablets possessing two different modes of action. Thiamethoxam is the first commercial neonicotinoid insecticide from the thianicotinyl subclass and acts by binding to nicotinic acetylcholine receptor (nAChR), interfere with the nicotinic acetylcholine receptor and blocking the necotinergic neutral pathway causing accumulation of the neurotransmitter acetylcholine. Thiamethoxam is an effective chemical for controlling the sucking pests, whiteflies, aphids, thrips and some other microlepidoptera (Sharma and Lal, 2002) [5]. Chlorantraniliprole is an anthranilicdiamide insecticide with a noval mode of action (Suri, 2001) [6]. It was considered as highly toxic to lepidopteran, coleopteran and dipteran pest (Xu *et al.*, 2008) [7]. Chlorantraniliprole induces the activation of insect ryanodine receptors. This activation stimulates uncontrolled release of calcium from the internal stores of smooth and striated muscle, causing impaired muscle regulation, paralysis and ultimately death of insect (Cordova *et al.*, 2006) [1].
To generate data on Virtako 2.4DT, a field trail was conducted with three different doses of Virtako 2.4DT (1.5, 2 and 2.5 kg ha^{-1}) and compared with chlorantraniliprole 0.4% G @ 10 kg ha^{-1}, thiamethoxam 75 SG @ 0.15 kg ha^{-1} and fiproil 0.3% GR @ 25 kg ha$^{-1.}$

2. Materials and methods
A field trial was conducted at Therkumangudi village (Cuddalore district, Tamil Nadu) in a Randomized Block Design during 2016-17 to assess the bioefficacy of Virtako 2.4 DT against major insect pests of rice such as Yellow Stem borer (*Scirpophaga incertulas* Walker), Leaf folder (*Cnaphalocrocis medinalis* Guenee), Green leafhopper (*Nephotettix virescens* Distant and *Nephotettix nigropictus* Stal.) and Brown planthopper (*Nilaparvata lugens* Stal). Broadcasting of various doses of Virtako 2.4 DT was made on rice at 20 days after transplanting (Var. BPT) and compared with chlorantraniliprole 0.4% G, thiamethoxam 75 SG and fiproil 0.3% GR. The plot size was 50sq.m and each treatment was replicated three times. Counts were undertaken on the number of insects per 10 randomly selected hills and per cent damage by leaf folder and stem borer on 7, 14, 21, 28, 35, 42 and 49 days after application. Then cumulative population was calculated in addition to percent reduction over control. Population of spiders, Ichneumonids and mirids were also recorded in the plots. Phytotoxicity studies were conducted with higher doses such as 2.5 and 5.0 Kg/ha. Finally, grain yield was measured in t ha^{-1}during harvest. The data were statistically analysed by following the procedures of Randomized Block Design (Gomez and Gomez, 1984)[3]. The mean values were ranked using Duncan's Multiple Range Test (DMRT).

3. Results and discussion
Efficacy of Virtako 2.4 DT against *Nephotettix spp*.
Population of green leafhopper (GLH) during pre-count, ranged from 4.33 to 5.0/hill in experimental plots. Seventh day after application, T_6-Thiamethoxam 75% SG @ 0.15 kg/ha recorded 3.0 GLH/hill. This was the lowest on 7th day after application and followed by T_4-Virtako 2.4DT @ 2.5kg/ha. Even at 14th day after application, the same trend as seen above was found. However, the 21st day count revealed that T_4-

Virtako 2.4DT @ 2.5 kg/ha and T_6-Thiamethoxam 75% SG @ 0.15 kg/ha recorded 2.0 and 2.66 GLH/hill respectively. The 28th day after application, T_4-Virtako 2.4DT @ 2.5 kg/ha and T_6-Thiamethoxam 75% SG @ 0.15 kg/ha recorded 1.33 and 2.0 GLH/hill respectively. It was followed by T_3-Virtako 2.4DT @ 2 kg/ha. The population of GLH/hill was lower in T_4-Virtako 2.4DT @ 2.5 kg/ha and T_6-Thiamethoxam 75% SG @ 0.15 kg/ha at 35, 42 and 49 days after application.

Overall mean of seven different counts at regular intervals showed the lowest population of 1.71 GLH/hill in T_6-Thiamethoxam 75% SG @ 0.15 kg/ha and was followed by T_4-Virtako 2.4DT @ 2.5 kg/ha where 1.80 GLH/hill was found. The highest overall mean population was recorded in T_1-Untreated check (7.28 GLH/hill).

The highest per cent reduction of population over control, was found in T_6-Thiamethoxam 75% SG @ 0.15 kg/ha (76.51%) and was followed by T_4-Virtako 2.4DT @ 2.5 kg/ha (75.27%) and T_3-Virtako 2.4DT @ 2 kg/ha (55.63%). The lowest per cent reduction over control was in T_5-Chlorantraniliprole 0.4% G (Ferterra) @ 10 kg/ha.

Table 1: Efficacy of Virtako 2.4 DT in transplanted rice against *Nephotettix spp.*

Treatment (dose/ha)		*Population of GLH (No./hill)								Overall mean population	Per cent reduction over control
		Pre-Treatment count	7 DAA	14 DAA	21 DAA	28 DAA	35 DAA	42 DAA	49 DAA		
T_1	Untreated check	4.66 (2.38)	4.66 $(2.38)^{bc}$	5.33 $(2.52)^{d}$	6.66 $(2.77)^{d}$	7.33 $(2.89)^{e}$	8.66 $(3.11)^{e}$	9.0 $(3.16)^{e}$	9.33 $(3.21)^{d}$	7.28	-
T_2	Virtako 2.4 DT @ 1.5 kg/ha	5.0 (2.45)	5.0 $(2.45)^{bc}$	4.66 $(2.38)^{d}$	4.33 $(2.31)^{b}$	4.0 $(2.24)^{c}$	4.0 $(2.24)^{c}$	3.66 $(2.16)^{c}$	3.66 $(2.16)^{b}$	4.18	42.58
T_3	Virtako 2.4 DT @ 2kg/ha	5.0 (2.45)	5.33 $(2.52)^{c}$	5.0 $(2.45)^{d}$	3.66 $(2.16)^{b}$	2.33 $(1.82)^{b}$	2.33 $(1.82)^{b}$	2.33 $(1.82)^{b}$	1.66 $(1.63)^{a}$	3.23	55.63
T_4	Virtako 2.4 DT @ 2.5kg/ha	4.66 (2.38)	4.33 $(2.30)^{b}$	3.0 $(2.00)^{b}$	2.0 $(1.73)^{a}$	1.33 $(1.52)^{a}$	0.66 $(1.28)^{a}$	0.66 $(1.28)^{a}$	0.66 $(1.28)^{a}$	1.80	75.27
T_5	Chlorantraniliprole 0.4% G (Ferterra) @ 10kg/ha	4.66 (2.38)	5.0 $(2.45)^{bc}$	5.33 $(2.52)^{d}$	5.66 $(2.58)^{cd}$	6.0 $(2.65)^{d}$	6.66 $(2.77)^{d}$	7.0 $(2.83)^{d}$	6.33 $(2.71)^{c}$	5.99	17.71
T_6	Thiamethoxam 75% SG @ 0.15kg/ha	4.33 (2.31)	3.0 $(2.00)^{a}$	2.0 $(1.73)^{a}$	2.66 $(1.91)^{a}$	2.0 $(1.73)^{b}$	1.0 $(1.41)^{a}$	0.66 $(1.28)^{a}$	0.66 $(1.24)^{a}$	1.71	76.51
T_7	Fiproil 0.3% GR @ 25kg/ha	4.33 (2.31)	4.0 $(2.24)^{b}$	3.66 $(2.16)^{c}$	4.66 $(2.38)^{bc}$	4.66 $(2.38)^{c}$	4.0 $(2.24)^{c}$	4.0 $(2.24)^{c}$	3.66 $(2.16)^{b}$	4.09	43.81
SEd		-	0.10	0.07	0.11	0.09	0.11	0.14	0.18	-	-
CD(0.05)		N/S	0.21	0.15	0.23	0.19	0.23	0.31	0.39	-	-

*Mean of Three Replications; DAA – Days after Application; Figures in parentheses are square root transformed values; Figures with various alphabets differ significantly; N/S- Not Significant.

Though T_6- Thiamethoxam 75% SG @ 0.15 kg/ha shown slightly higher efficacy than T_4-Virtako 2.4DT @ 2.5 kg/ha statistically T_4 and T_6 were on par (Table 1).

Virtako 2.4DT @ 2.5 kg/ha and Thiamethoxam 75% SG @ 0.15 kg/ha shown similar efficacy in reducing the population of GLH in transplanted rice.

Efficacy of Virtako 2.4 DT against *C.medinalis*

The per cent leaf damage by leaf folder during pre-count ranged from 3.33 to 4.0 in various treatments. Seventh day count after application did not show any variation among the treatments. Statistically these treatments were not significant. At 14th day after application both, T_5-Chlorantraniliprole 0.4% G (Ferterra) @ 10 kg/ha and T_7-Fiproil 0.3% GR @ 25 kg/ha recorded 3.33%, the lowest leaf damage and these two treatments were statistically on par. At 21st day after application T_5-Chlorantraniliprole 0.4% G (Ferterra) @ 10 kg/ha recorded 2.0% leaf damage and this was the lowest. On 28th day after application T_4-Virtako 2.4DT @ 2.5 kg/ha shown lowest mean per cent leaf damage (3.0%) which was on a par with T_5-Chlorantraniliprole 0.4% G (Ferterra) @ 10 kg/ha (3.66%). The data recorded on 35th day after application T_4-Virtako 2.4DT @ 5 kg/ha exerted the lowest leaf damage of 3.33% and was followed by T_5-Chlorantraniliprole 0.4% G (Ferterra) @ 10 kg/ha (4.66%). The per cent leaf damage was lowest in T_4-Virtako 2.4DT @ 2.5 kg/ha at 42nd (3.33%) and 49th day (3.33%) after application. Efficacy of Chlorantraniliprole 0.4% G (Ferterra) @ 10 kg/ha was high up to 21 days after application and then declined and at 49th day the population recorded was 8.0%. But T_4 initially shown lesser efficacy and after 3 weeks of application increased efficacy was exerted.

The overall mean with regard to percent leaf damage showed that T_4-Virtako 2.4DT @ 2.5 kg/ha was superior and recorded the lowest leaf damage of 3.47% and followed by T_5-Chlorantraniliprole 0.4% G (Ferterra) @ 10 kg/ha and T_3-Virtako 2.4DT @ 2 kg/ha (4.56%). The highest overall mean damage (15.42%) was reported in T_1-Untreated check. Reduction in per cent damage reduction over control was also high in T_4-Virtako 2.4DT @ 2.5 kg/ha (77.49%) and followed by T_5-Chlorantraniliprole 0.4% G (Ferterra) @ 10 kg/ha (70.42%) (Table 2). There was a seven percent significant difference between these treatments. Virtako 2.4DT @ 2.5 kg/ha achieved significant reduction in the population of *C.medinalis*in transplanted rice and stood first among the other treatments.

Efficacy of Virtako 2.4 DT against *S.incertulas*

The first observation was undertaken on 28th day after application where T_4-Virtako 2.4DT @ 2.5 kg/ha recorded the lowest stem borer damage (1.66%) and was followed by T_3-Virtako 2.4DT @ 2 kg/ha and T_5-Chlorantraniliprole 0.4% G (Ferterra) @ 10 kg/ha. On 35th day after application, T_4-Virtako 2.4DT @ 2.5 kg/ha recorded 1.66% damage and was again the lowest. The 42nd day after application, both T_4-Virtako 2.4DT @ 2.5 kg/ha and T_5- Chlorantraniliprole 0.4% G (Ferterra) @ 10 kg/ha recorded 2.0% damage. However at 49th day after application, T_5-Chlorantraniliprole 0.4% G (Ferterra) @ 10

kg/ha showed 3.0% damage. The calculated overall mean damage showed that T_4-Virtako 2.4DT @ 2.5 kg/ha was superior and recorded the lowest per cent damage of 1.83% and was followed by T_5-Chlorantraniliprole 0.4%G (Ferterra) @ 10 kg/ha

Table 2: Efficacy of Virtako 2.4 DT in transplanted rice against *C.medinalis*

Treatment (dose/ha)		*Per cent leaf damage								Overall mean damage	Per cent reduction over control
		Pre- Treatment count	7 DAA	14 DAA	21 DAA	28 DAA	35 DAA	42 DAA	49 DAA		
T_1	Untreated check	3.33 (10.49)	3.33 (10.49)	7.33 (15.70)^{c}	11.33 (19.65)^{e}	17.0 (24.33)^{d}	21.33 (27.50)^{e}	22.33 (28.19)^{e}	25.33 (30.21)^{e}	15.42	-
T_2	Virtako 2.4 DT @ 1.5kg/ha	3.33 (10.49)	3.66 (11.01)	4.33 (11.89)^{ab}	8.66 (17.11)^{de}	7.66 (16.06)^{b}	15.0 (22.77)^{d}	17.0 (24.32)^{d}	15.0 (22.77)^{c}	10.18	33.98
T_3	Virtako 2.4 DT @ 2kg/ha	3.66 (11.01)	4.0 (11.53)	5.0 (12.87)^{b}	7.33 (15.70)^{cd}	10.0 (18.41)^{c}	10.0 (18.37)^{c}	12.0 (20.22)^{c}	12.0 (20.19)^{c}	8.61	44.16
T_4	Virtako 2.4 DT @ 2.5kg/ha	3.33 (10.49)	3.33 (10.49)	4.0 (11.53)^{ab}	4.0 (11.37)^{b}	3.0 (9.88)^{a}	3.33 (10.40)^{a}	3.33 (10.34)^{a}	3.33 (10.34)^{a}	3.47	77.49
T_5	Chlorantraniliprole 0.4% G (Ferterra) @ 10kg/ha	4.0 (11.53)	3.0 (9.88)	3.33 (10.49)^{a}	2.0 (8.13)^{a}	3.66 (11.01)^{a}	4.66 (12.46)^{b}	7.33 (15.67)^{b}	8.0 (16.40)^{b}	4.56	70.42
T_6	Thiamethoxam 75% SG @ 0.15kg/ha	3.33 (10.49)	3.33 (10.49)	8.0 (16.36)^{c}	10.66 (19.05)^{e}	15.33 (23.04)^{d}	21.0 (27.26)^{e}	20.0 (26.54)^{e}	21.0 (27.24)^{e}	14.18	8.04
T_7	Fiproil 0.3% GR @ 25kg/ha	4.0 (11.53)	3.0 (9.97)	3.33 (10.49)^{a}	6.0 (14.17)^{bc}	9.33 (17.78)^{c}	12.33 (20.55)^{c}	14.0 (21.96)^{c}	14.33 (22.24)^{c}	8.90	42.28
SEd		-	-	0.96	1.34	0.76	0.99	1.01	1.29	-	-
CD(0.05)		N/S	N/S	2.09	2.91	1.64	2.15	2.19	2.79	-	-

*Mean of Three Replications; DAA – Days after Application; Figures in parentheses are arc sine transformed values.
Figures with various alphabets differ significantly; N/S- Not Significant.

Table 3: Efficacy of Virtako 2.4 DT in transplanted rice against *S. incertulus*

Treatment (dose/ha)		*Per cent dead heart/white ear				Overall mean damage	Per cent reduction over control
		28 DAA	35 DAA	42 DAA	49 DAA		
T_1	Untreated check	10.66 (19.04)^{d}	15.0 (22.77)^{f}	20.33 (26.78)^{d}	20.66 (27.02)^{f}	16.66	-
T_2	Virtako 2.4 DT @ 1.5 kg/ha	6.0 (14.14)^{c}	8.33 (16.77)^{d}	11.33 (19.65)^{c}	13.33 (21.40)^{d}	9.74	41.53
T_3	Virtako 2.4 DT @ 2kg/ha	3.66 (11.01)^{b}	4.66 (12.46)^{c}	5.66 (13.75)^{b}	7.66 (16.06)^{c}	5.41	67.52
T_4	Virtako 2.4 DT @ 2.5kg/ha	1.66 (7.33)^{a}	1.66 (7.33)^{a}	2.0 (8.13)^{a}	2.0 (8.13)^{a}	1.83	89.01
T_5	Chlorantraniliprole 0.4% G (Ferterra) @ 10kg/ha	3.66 (11.01)^{b}	3.0 (9.97)^{b}	2.0 (8.13)^{a}	3.0 (9.97)^{b}	2.91	82.53
T_6	Thiamethoxam 75% SG @ 0.15kg/ha	7.33 (15.67)^{c}	15.0 (22.78)^{f}	18.33 (25.10)^{d}	18.0 (25.09)^{e}	14.66	12.00
T_7	Fiproil 0.3% GR @ 25kg/ha	9.33 (17.76)^{d}	10.66 (19.05)^{e}	17.66 (24.84)^{d}	18.0 (25.09)^{e}	13.91	16.50
SEd		0.81	0.51	1.53	0.54	-	-
CD(0.05)		1.73	1.11	3.31	1.18	-	-

*Mean of Three Replications; DAA – Days after Application; Figures in parentheses are arc sine transformed values; Figures with various alphabets differ significantly

The percent reduction over control reported that T_4-Virtako 2.4DT @ 2.5 kg/ha was superior and recorded 89.01% reduction in damage and was followed by T_5-Chlorantraniliprole 0.4% G (Ferterra) @ 10 kg/ha (82.53%) and T_3-Virtako 2.4DT @ 2 kg/ha (67.52%) (Table 3).Virtako 2.4DT @ 2.5 kg/ha was found superior when compared with control

Efficacy of Virtako 2.4 DT against *N.lugens*

The 28th day after application T_4-Virtako 2.4DT @ 2.5 kg/ha shown 0.33 Number of BPH/hill. This was the lowest and followed by T_6-Thiamethoxam 75% SG @ 0.15 kg/ha, T_3-Virtako 2.4DT @ 2 kg/ha. The counts taken on 35th, 42nd and 49th day after application clearly showed that T_6-Thiamethoxam 75% SG @ 0.15 kg/ha and T_4-Virtako 2.4DT @ 2.5 kg/ha were almost equal in exerting the efficacy and statistically on a par (Table 4). Regarding the overall mean population, the lowest number of BPH was found in T_4-Virtako 2.4DT @ 2.5 kg/ha (0.99/hill) and was followed by T_6-Thiamethoxam 75% SG @ 0.15 kg/ha (1.08/hill). The lowest number of BPH was found in Virtako 2.4DT @ 2.5 kg/ha (0.99/hill) and was followed by Thiamethoxam 75% SG @ 0.15 kg/ha (1.08/hill) in transplanted rice. The highest overall mean population of BPH was reported in T_1-Untreated check (7.66/hill). The per cent reduction over control was maximum in T_4-Virtako 2.4DT @ 2.5 kg/ha (87.07%) and was followed by T_6-Thiamethoxam 75% SG @ 0.15 kg/ha (85.90%).

Safety of Virtako 2.4 DT to natural enemies

Spider population ranged from 5.0 to 6.0/10 hills in various treatments during pre-count. The overall mean population of spider ranged between 5.04 and 5.47 (Table 9). All the treatments were statistically not significant. Mirids population ranged from 0.00 to 0.66/10 hill in various treatments. The overall mean population of mirids ranged from 1.23 to 1.42/10

hills. No treatments were significant statistically (Table 5). Over all mean of Ichneumonids population (Table 6) was ranged from 4.37 to 5.33/10 hills. Natural enemies such as spiders, mirid bugs (Table 7) and Ichneumonids parasitoids were seen in the experimental plots considerably. The treatments were statistically not significant in transplanted rice. It indicates their safety to natural enemies.

Safety of Virtako 2.4 DT to rice

No phytotoxic symptoms such as leaf injury, wilting, vein clearing, necrosis epinasty and hyponasty were observed in the treatments with Virtako 2.4 D @ 2.5 kg/ha and 5.0 kg/ha in transplanted rice (Table 8).

Yield

Yield data related to variety BPT in the first season showed that the grain yield ranged from 2.23 to 4.53 t ha^{-1}. Highest yield was recorded in T_4-Virtako 2.4DT @ 2.5 kg/ha (4.53 t ha^{-1}) and T_3-Virtako 2.4DT @ 2 kg/ha^{-1} showed 3.96 t ha^{-1}. T_5-Chlorantraniliprole 0.4% G (Ferterra) @ 10 kg/ha^{-1}, T_2-Virtako 2.4DT @ 1.5 kg/ha^{-1}, T_7-Fiproil 0.3% GR @ 25kg/ha and T_6-Thiamethoxam 75% SG @ 0.15kg/ha, registered the yield of 3.84, 3.76, 3.65 and 3.25 t ha^{-1} respectively when compared to untreated check which recorded 2.23 t ha^{-1} (Table 9)

Table 4: Efficacy of Virtako 2.4 DT in transplanted rice against *N. lugens*

Treatment (dose/ha)		*Population of BPH (No./hill)				Overall mean population	Per cent reduction over control
		28 DAA	35 DAA	42 DAA	49 DAA		
T_1	Untreated check	5.0 (2.44)^d	6.0 (2.65)^d	8.33 (3.05)^c	11.33 (3.51)^e	7.66	-
T_2	Virtako 2.4 DT @ 1.5 kg/ha	2.66 (1.90)^c	3.0 (2.00)^c	3.33 (2.08)^b	3.33 (2.08)^b	3.08	59.79
T_3	Virtako 2.4 DT @ 2kg/ha	1.66 (1.63)^b	2.33 (1.82)^{bc}	2.66 (1.90)^b	2.33 (1.82)^b	2.24	70.75
T_4	Virtako 2.4 DT @ 2.5kg/ha	0.33 (1.14)^a	1.33 (1.52)^{ab}	1.33 (1.52)^a	1.0 (1.41)^a	0.99	87.07
T_5	Chlorantraniliprole 0.4% G (Ferterra) @ 10kg/ha	5.66 (2.58)^d	6.0 (2.64)^d	7.66 (2.94)^c	8.0 (2.99)^d	6.83	10.83
T_6	Thiamethoxam 75% SG @ 0.15kg/ha	1.33 (1.52)^b	1.0 (1.38)^a	1.0 (1.38)^a	1.0 (1.41)^a	1.08	85.90
T_7	Fiproil 0.3% GR @ 25kg/ha	2.33 (1.82)^c	3.33 (2.08)^c	3.66 (2.16)^b	5.66 (2.58)^c	3.74	59.00
SEd		0.16	0.16	0.16	0.13	-	-
CD(0.05)		0.34	0.34	0.35	0.29	-	-

*Mean of Three Replications; DAA – Days after Application; Figures in parentheses are square root transformed values; Figures with various alphabets differ significantly

Table 5: Efficacy of Virtako 2.4 DT in transplanted rice against on Natural enemy's population

Treatment (dose/ha)		*Population of spider (No./10 hills)								Overall mean population
		Pre-Treatment count	7 DAA	14 DAA	21 DAA	28 DAA	35 DAA	42 DAA	49 DAA	
T_1	Untreated check	5.33 (2.52)	6.0 (2.65)	5.33 (2.52)	5.0 (2.45)	5.33 (2.52)	5.66 (2.58)	4.66 (2.38)	5.33 (2.52)	5.33
T_2	Virtako 2.4 DT @ 1.5 kg/ha	5.33 (2.52)	5.33 (2.52)	5.0 (2.45)	5.0 (2.45)	5.0 (2.45)	4.66 (2.38)	5.33 (2.52)	5.0 (2.44)	5.04
T_3	Virtako 2.4 DT @ 2kg/ha	5.0 (2.45)	6.0 (2.65)	5.0 (2.44)	5.0 (2.45)	5.0 (2.45)	5.0 (2.44)	5.33 (2.52)	5.33 (2.52)	5.23
T_4	Virtako 2.4 DT @ 2.5kg/ha	5.66 (2.58)	5.0 (2.45)	6.0 (2.64)	5.0 (2.45)	5.66 (2.58)	5.33 (2.52)	5.33 (2.52)	5.33 (2.52)	5.37
T_5	Chlorantraniliprole 0.4% G (Ferterra) @ 10kg/ha	5.66 (2.58)	6.0 (2.65)	6.33 (2.71)	5.66 (2.58)	5.33 (2.52)	5.0 (2.45)	5.0 (2.45)	5.0 (2.44)	5.47
T_6	Thiamethoxam 75% SG @ 0.15kg/ha	5.0 (2.45)	5.0 (2.45)	4.33 (2.31)	5.0 (2.45)	5.0 (2.45)	5.33 (2.52)	5.33 (2.52)	5.33 (2.52)	5.04
T_7	Fiproil 0.3% GR @ 25kg/ha	6.0 (2.65)	5.33 (2.52)	5.33 (2.52)	5.0 (2.45)	4.66 (2.38)	5.33 (2.52)	5.33 (2.52)	5.33 (2.52)	5.18
SEd		-	0.06	-	0.03	-	-	-	-	-
CD(0.05)		N/S	0.12	N/S	0.07	N/S	N/S	N/S	N/S	-

*Mean of Three Replications; DAA – Days after Application; Figures in parentheses are square root transformed values; Figures with various alphabets differ significantly; N/S- Not Significant.

Table 6: Efficacy of Virtako 2.4 DT in transplanted rice against on Natural enemies population

Treatment (dose/ha)		*Population of Mirids (No./10hill)								Overall mean population
		Pre-Treatment count	7 DAA	14 DAA	21 DAA	28 DAA	35 DAA	42 DAA	49 DAA	
T_1	Untreated check	0.33 (1.14)	0.33 (1.14)	0.66 (1.28)	1.0 (1.41)	1.0 (1.41)	1.33 (1.52)	2.0 (1.73)	2.33 (1.82)	1.23
T_2	Virtako 2.4 DT @ 1.5 kg/ha	0.33 (1.14)	0.66 (1.28)	0.66 (1.28)	1.0 (1.41)	1.0 (1.41)	2.0 (1.72)	2.33 (1.82)	2.33 (1.82)	1.42
T_3	Virtako 2.4 DT @ 2kg/ha	0.00 (1.00)	0.33 (1.14)	0.66 (1.28)	1.0 (1.41)	1.0 (1.41)	1.66 (1.63)	2.33 (1.82)	2.66 (1.91)	1.37
T_4	Virtako 2.4 DT @ 2.5kg/ha	0.33 (1.14)	0.33 (1.14)	0.66 (1.28)	1.0 (1.41)	1.0 (1.41)	1.66 (1.63)	2.33 (1.82)	2.66 (1.91)	1.37
T_5	Chlorantraniliprole 0.4% G (Ferterra) @ 10kg/ha	0.66 (1.28)	0.33 (1.14)	0.33 (1.14)	1.0 (1.41)	1.0 (1.41)	1.66 (1.61)	2.66 (1.91)	3.0 (2.00)	1.42
T_6	Thiamethoxam 75% SG @ 0.15kg/ha	0.33 (1.14)	0.33 (1.14)	0.66 (1.28)	1.0 (1.41)	1.0 (1.41)	1.66 (1.63)	2.33 (1.82)	3.0 (2.00)	1.42
T_7	Fiproil 0.3% GR @ 25kg/ha	0.33 (1.14)	0.33 (1.14)	0.33 (1.14)	1.0 (1.41)	1.0 (1.41)	2.0 (1.72)	2.66 (1.91)	2.66 (1.91)	1.42
SEd		-	-	-	-	-	-	-	-	-
CD(0.05)		N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	-

*Mean of Three Replications; DAA – Days after Application; Figures in parentheses are square root transformed values; Figures with various alphabets differ significantly; N/S- Not Significant.

Table 7: Efficacy of Virtako 2.4 DT in transplanted rice against on Natural enemies population

Treatment (dose/ha)		*Population of Ichneumonids (No./10 hills)								Overall mean population
		Pre Treatment count	7 DAA	14 DAA	21 DAA	28 DAA	35 DAA	42 DAA	49 DAA	
T_1	Untreated check	3.66 (2.16)	5.0 (2.45)	5.33 (2.52)	5.33 (2.52)	6.0 (2.65)	5.0 (2.45)	5.33 (2.52)	5.33 (2.52)	5.33
T_2	Virtako 2.4 DT @ 1.5 kg/ha	3.66 (2.16)	4.33 (2.31)	4.0 (2.24)	4.33 (2.31)	5.0 (2.45)	4.33 (2.31)	5.0 (2.45)	4.33 (2.31)	4.47
T_3	Virtako 2.4 DT @ 2kg/ha	4.66 (2.38)	5.0 (2.45)	4.66 (2.38)	4.66 (2.38)	4.66 (2.38)	4.66 (2.38)	4.33 (2.31)	5.0 (2.45)	4.71
T_4	Virtako 2.4 DT @ 2.5kg/ha	4.0 (2.24)	4.66 (2.38)	4.66 (2.38)	4.66 (2.38)	5.0 (2.45)	4.66 (2.38)	4.33 (2.31)	5.0 (2.45)	4.71
T_5	Chlorantraniliprole 0.4% G (Ferterra) @ 10kg/ha	3.66 (2.16)	5.0 (2.44)	5.0 (2.45)	4.66 (2.38)	4.66 (2.38)	5.0 (2.45)	5.0 (2.44)	5.66 (2.58)	4.99
T_6	Thiamethoxam 75% SG @ 0.15kg/ha	4.0 (2.24)	5.0 (2.45)	4.66 (2.38)	5.33 (2.52)	5.0 (2.45)	5.66 (2.58)	6.0 (2.65)	5.33 (2.52)	5.28
T_7	Fiproil 0.3% GR @ 25kg/ha	4.0 (2.23)	4.0 (2.24)	4.33 (2.31)	4.66 (2.38)	4.33 (2.31)	4.33 (2.31)	4.33 (2.31)	4.66 (2.38)	4.37
SEd		-	0.08	-	-	0.06	-	-	-	-
CD(0.05)		N/S	0.17	N/S	N/S	0.13	N/S	N/S	N/S	-

*Mean of Three Replications, DAA – Days after Application; Figures in parentheses are square root transformed values; Figures with various alphabets differ significantly; N/S- Not Significant.

Table 8: Phytotoxicity studies with Virtako 2.4 DT in transplanted rice

Treatment (dose/ha)	Symptoms of phytotoxicity	Pre-count	Post-treatment observation				
			1	3	5	7	10
Virtako 2.4 DT @ 2.5kg/ha	Hyponasty	Nill	Nill	Nill	Nill	Nill	Nill
	Epinasty	Nill	Nill	Nill	Nill	Nill	Nill
	Vein clearing	Nill	Nill	Nill	Nill	Nill	Nill
	Stunting	Nill	Nill	Nill	Nill	Nill	Nill
	Scorching	Nill	Nill	Nill	Nill	Nill	Nill
	Necrosis	Nill	Nill	Nill	Nill	Nill	Nill
	Chlorosis	Nill	Nill	Nill	Nill	Nill	Nill
	Leaf injury	Nill	Nill	Nill	Nill	Nill	Nill
	Wilting	Nill	Nill	Nill	Nill	Nill	Nill
Virtako 2.4 DT @ 5kg/ha	Hyponasty	Nill	Nill	Nill	Nill	Nill	Nill
	Epinasty	Nill	Nill	Nill	Nill	Nill	Nill
	Vein clearing	Nill	Nill	Nill	Nill	Nill	Nill
	Stunting	Nill	Nill	Nill	Nill	Nill	Nill

	Scorching	Nill	Nill	Nill	Nill	Nill	Nill
	Necrosis	Nill	Nill	Nill	Nill	Nill	Nill
	Chlorosis	Nill	Nill	Nill	Nill	Nill	Nill
	Leaf injury	Nill	Nill	Nill	Nill	Nill	Nill
	Wilting	Nill	Nill	Nill	Nill	Nill	Nill

Table 9: Influence of Virtako 2.4 DT on the yield (Var.BPT) in transplanted rice

Treatment (dose/ha)		*Yield (t/ha)
T_1	Untreated check	2.23 (1.80)^{f}
T_2	Virtako 2.4 DT @ 1.5 kg/ha	3.76 (2.18)^{bc}
T_3	Virtako 2.4 DT @ 2kg/ha	3.96 (2.23)^{b}
T_4	Virtako 2.4 DT @ 2.5kg/ha	4.53 (2.35)^{a}
T_5	Chlorantraniliprole 0.4% G (Ferterra) @ 10kg/ha	3.84 (2.12)^{d}
T_6	Thiamethoxam 75% SG @ 0.15kg/ha	3.25 (2.06)^{f}
T_7	Fiproil 0.3% GR @ 25kg/ha	3.65 (2.16)^{cd}
CD(0.05)		0.05

*Mean of Three Replications
Figures in parentheses are square root transformed values.
Figures with various alphabets differ significantly.

Virtako 2.4 DT effectively managed all the four key pests and this reflects in the yield data where Virtako 2.4 DT @ 2 kg/ha shown 2nd highest yield. Thus a concluding remarks Virtako 2.4 DT @ 2.5kg/ha can be recommended for the effective management of major pests such as GLH, BPH, *S.incertulas* and *C.medinalis* at 20 days after transplanting as a single broadcasting.

4. Acknowledgment
The authors are thankful to our chairman, Department of Entomology, Faculty of Agriculture, Annamalai University for providing necessary facilities for the period of my research work.

5. Reference

1. Cordova D, Benner EA, Sacher MD, Rauh JJ, Sopa JS, Lahm GP *et al*. Anthranilicdiamides: A new class of insecticides with a novel mode of action, ryanodine receptor activation. Pesticide Biochemistry and Physiology. 2006; 84(3):196-214.
2. Dhaliwal GS, Arora Ramesh. Integrated Pest Management: Concepts *and* Approaches. Kalyani Publishers New Delhi. 2001, 109.
3. Gomez KA, Gomez AA. Statistical procedures for agricultural Research, John Wiley and Sons, New York. 1984, 680.
4. Krishnaiah K, Reddy K, Krishnaiah APK, Krishnaiah NV, Pasalu IC. Current problems and future needs in plant protection in rice. Indian Journal of Plant Protection. 1999; 27:47-64.
5. Sharma DR, Lal OP. Bio-efficacy of thiamethoxam in comparison to recommended insecticides against leafhopper and white fly of brinjal (Solanum melongena L.). Journal of Entomological Research. 2002; 26(3):257-262.
6. Suri KS. Bio-efficacy of some insecticides against rice stemborers and leaffolder infesting rice in Punjab. Pesticide of Research Journal. 2011; 23:190-193.
7. Xu C, Sh, Yu YF, Wang XJ, Wan Q. Rynaxypyr, a new insecticide and its research and development in application. Modern Agro chemistry. 2008; **7**(5):8-11.