Madras Agric. J., 97 (1-3): 88-91, March 2010
https://doi.org/10.29321/MAJ.10.100353

Short Note

Bioefficacy of Kinadongold® against Sucking Pests of Cotton

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Supervised field trials were conducted to evaluate Kinadongold (Phosphamidon 40% + imidacloprid 2% SP) as foliar application for its bioefficacy against sucking insects, phytotoxicity and effect on natural enemies on cotton in Tamil Nadu Agricultural University, Coimbatore. Two season field experiments on cotton revealed that the higher dose of Kinadongold (700 g ha^{-1}) recorded 76.43, 73.28, 76.06 and 69.66 per cent reduction over untreated check for leafhoppers, thrips, aphids and whiteflies, respectively and it was followed by with on par Kinadongold (600 g ha^{-1}), that recorded 74.02, 72.33, 74.34 and 66.77 per cent reduction over untreated check for leafhoppers, thrips, aphids and whiteflies, respectively. There was an initial setback in the population of natural enemies in the Kinadongold treated plots, but it started increasing gradually. Kinadongold did not cause any phytotoxic symptoms even up to a dose of 2400 g ha^{-1} on cotton.

Key words: Kinadongold, Sucking pests, Cotton, Phytotoxicity, Safety.

The pesticides are synonymous with modern agriculture. The discovery of insecticidal properties of DDT in 1939 by Paul Muller opened a new era in chemical control of pests due to immediate and spectacular effects. In India, pesticide usage started in 1940s and was characterized by the use of persistent insecticides like HCH, DDT, endrin, aldrin, dieldrin, heptachlor, chlordane, methyl parathion and phorate (ICAR, 1967). The chlorinated hydrocarbons ruled Indian pesticide industry till 1990s, later with the imposing of "ban and restricted use" strategy on this class, a steady decline in total consumption was observed. Pesticide consumption in India has shown an increasing trend from 2353 metric tonnes (MT) in 1954 - 56 to 75,033 MT in 1990-91. Later it declined to 47,020 MT in 2001-02 may be because of awareness created on IPM aspects. A similar trend was observed in Tamil Nadu which shares about 3 per cent of nation's consumption. The estimated usage of 3904 MT in 1974-75 in the state declined to 1668 MT during 2000-01 (DPPQ, 2002).

The damage caused by the insect pests is one of the major causes for poor yield of cotton. Nearly 1326 insects and mites all over the world (Hargreaves, 1948) and about 200 in India have been recorded as pests of cotton. Cotton growers in India depend heavily on synthetic pesticides to combat these pests; atleast 6-9 sprays are directed against sucking pests at early stage (Lingappa *et al.,* 2001). The cotton crop consumed about 54 per cent of the total insecticides used in the country. Due to the continuous and indiscriminate use of these systemic insecticides, their efficacy is lost due to buildup of resistance to these insecticides due to selection pressure. Hence combination of two chemicals with different mode of action is the new strategy to reduce the development of resistance among insects. With this background we have focused our research to evaluate the efficacy of new combination product Kinadongold against sucking pests of cotton.

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Materials and Methods

Two field trials were conducted one at Sathyamangalam, and another at A.Mettupalayam, Erode district of Tamil Nadu in Randomized Block Design (RBD). All the treatments were replicated three times with the plot size of 20 m^2.The first trial was conducted using cotton variety MCU 5 and the second with, LRA 5166. The crop was maintained well by adopting standard agronomic practices as per the recommendations of Tamil Nadu Agricultural University. The treatments were imposed at particular concentrations using pneumatic knapsack sprayer with the spray volume of 500 lit. ha^{-1} when the pests crossed economic threshold level (ETL) during 60 DAS (days after sowing) and untreated check plots were maintained with water spray. Two sprays were given at 15 days interval. The treatments tried were, Phosphamidon 40 SL @ 625 ml ha^{-1}, Imidacloprid 17.8 SL @ 112 ml ha^{-1}, Kinadongold @ 400 g ha^{-1}, Kinadongold @ 500 g ha^{-1}, Kinadongold @ 600 g ha^{-1}, Kinadongold @ 700 g ha^{-1} and untreated check. The population of leafhoppers, thrips, aphids and whiteflies were recorded on three leaves one each at top, middle and bottom portions from 10 randomly tagged plants per plot on prior to spraying and on 3, 7, 10 and 14 days after spraying.

Cotton yield per plot was recorded from each picking and pooled to arrive at the total yield. Finally, it was computed to Kg ha^{-1}. The population of spiders, chrysopids and coccinellids were recorded on ten randomly tagged plants per plot prior to application of insecticides and 3, 7, 10 and 14 in order to assess the effect of insecticides.

To assess the phytotoxicity, Kinadongold® at three doses *viz.,* 600, 1200 and 2400 g ha^{-1} were used. The plants were observed on 1, 3, 5, 7, 10, 14, 21 and 28 DAT for the phytotoxic symptoms such as injury to the leaf tip, wilting, necrosis, vein clearing, epinasty and hyponasty on the plants. The extent of phytotoxicity was recorded based on the scale prescribed by Central Insecticide Board and Registration Committee (CIB and RC). The per cent leaf injury was calculated using the formula,

$$\text{Per cent leaf injury} = \frac{\text{Total grade points}}{\text{Maximum grade} \times \text{Number of leaves observed}} \times 100$$

Leaf injury was assessed by visual rating in a 0-10 scale i.e., 0 - No phytotoxicity, 1 - 1 to 10 %, 2 - 11 to 20 %, 3 - 21 to 30 %, 4 - 31 to 40 %, 5 - 41 to 50 %, 6 - 51 to 60 %, 7 - 61 to 70 %, 8 - 71 to 80 %, 9 - 81 to 90 %, 10 - 91 to 100 % phytotoxicity. The corrected per cent reduction of pests over untreated check in the field population was worked out by using the formula given by Henderson and Tilton (1955). The data on percentage were transformed into arc sine values and the population number into square root values before statistical analysis. The data obtained from the field experiments were subjected to ANOVA (Gomez and Gomez, 1984). The mean values were compared using Duncan's Multiple Range Test (DMRT) (Duncan, 1951).

Results and Discussion

The results revealed that all the treatments were significantly superior over untreated check in reducing the population of leafhoppers. Kinadongold @ 600 g ha^{-1} and 700 g ha^{-1} were found to be significantly superior over all other treatments and on par with each other by recording 74.02 and 76.43 per cent reduction of leafhopper population over untreated check. Imidacloprid 17.8 SL @ 112 ml ha^{-1} (63.72 %) was found to be less effective than Kinadongold @ 600 g ha^{-1} and 700 g ha^{-1} for leafhoppers. Pooled mean of population of thrips revealed that Kinadongold @ 600 g ha-1 and 700 g ha^{-1} was the most effective treatment in reducing the thrips population and it recorded 73.28 and 72.33 per cent reduction over untreated check, respectively, which was followed by Imidacloprid 17.8 SL @ 112 ml ha^{-1} (56.98 %), Kinadongold @ 500 g ha^{-1} (41.90 %), Phosphamidon 40 SL @ 625 ml ha^{-1} (37.06 %) and Kinadongold @ 400 g ha^{-1} (36.36 %).

Kinadongold @ 600 g ha^{-1} and 700 g ha^{-1} performed well in reducing the population of aphids on cotton, which were on par with each other and superior over all other treatments.Imidacloprid 17.8 SL @ 112 ml ha^{-1} was effective next to the Kinadongold @ 600 g ha^{-1} and 700 g ha^{-1}. The order of effectiveness of insecticides against aphids were, Kinadongold @ 700 g ha^{-1} (76.06%) and 600 g ha^{-1} (74.34%) > imidacloprid 17.8 SL @ 112 ml ha^{-1} (67.80 %) > Kinadongold @ 500 g ha^{-1} (49.65%) > Kinadongold @ 400 g ha^{-1} (40.13 %) > Phosphamidon 40 SL @ 625 ml ha^{-1} (35.92%). The results on the efficacy of Kinadongold against the population of whiteflies revealed that all the treatments were significantly superior over untreated check in reducing the population of whiteflies.

Table 1. Bioefficacy of Kinadongold® against sucking pests of cotton

Treatment	Population of sucking pests (Number / 10 plants)											
	Leafhoppers			Thrips			Aphids			Whiteflies		
	PTC	PSC	PRU	PTC	PSC	PRU	PTC	PSC	PRU	PTC	PSC	PRU
Untreated check	155.33 (12.46)	182.5 (13.5)f	-	155.66 (12.48)	184.7 (13.6)e	-	765.00 (27.66)	852.3 (29.2)f	-	367.66 (19.17)	368.8 (19.2)f	-
Phosphamidon 40 SL @ 625 ml ha-1	148.00 (12.17)	105.8 (10.3)d	42.00	160.66 (12.68)	116.2 (10.8)d	37.06	768.00 (27.71)	546.1 (23.4)e	35.92	370.00 (19.24)	194.7 (14.0)e	47.22
Imidacloprid 17.8 SL @ 112 ml ha-1	148.33 (12.18)	66.2 (8.1)b	63.72	155.33 (12.46)	79.5 (8.9)b	56.98	770.00 (27.75)	274.4 (16.6)b	67.80	374.00 (19.34)	156.2 (12.5)c	57.65
Kinadon gold @ 400 g ha-1	151.33 (12.30)	117.6 (10.8)e	35.57	155.00 (12.45)	117.5 (10.8)d	36.36	775.00 (27.84)	510.3 (22.6)d	40.13	379.00 (19.45)	196.1 (14.0)e	46.84
Kinadon gold @ 500 g ha-1	152.00 (12.33)	81.1 (9.0)c	55.54	158.00 (12.57)	107.3 (10.4)c	41.90	765.00 (27.66)	429.1 (20.7)c	49.65	368.66 (19.20)	178.2 (13.3)d	51.68
Kinadon gold @ 600 g ha-1	143.66 (11.99)	47.4 (6.9)a	74.02	160.33 (12.66)	51.1 (7.1)a	72.33	770.00 (27.75)	218.7 (14.8)a	74.34	370.33 (19.24)	122.6 (11.1)b	66.77
Kinadon gold @ 700 g ha-1	152.33 (12.34)	43.0 (6.6)a	76.43	161.00 (12.69)	49.3 (7.0)a	73.28	775.00 (27.84)	204.0 (14.3)a	76.06	375.00 (19.36)	111.9 (10.6)a	69.66
CD (P=0.05)	NS	0.40		NS	0.10		NS	0.61		NS	0.22	

Means in a column followed by same letter(s) are not significantly different (P=0.05) by DMRT
PTC – Pretreatment count, PSC – Post spray count, PRU – Percent reduction over untreated check;
Figures in parentheses are square root transformed values

Kinadongold @ 700 g ha^{-1} was significantly superior by recording 69.66 per cent reduction of whiteflies over untreated check, followed by Kinadongold @ 600 g ha^{-1} (66.77%), imidacloprid 17.8 SL @ 112 ml ha^{-1} (57.65%). Kinadongold @ 500 g ha^{-1} (51.68 %), Phosphamidon 40 SL @ 625 ml ha^{-1} (47.22 %) and Kinadongold @ 400 g ha^{-1} (46.84 %) performed next to imidacloprid 17.8 SL @ 112 ml ha^{-1}. Ameta and Sharma (2005) indicated that Confidor® 200 SL at 100 and 125 ml ha^{-1} and 70 WG at 30 and 35 g ha^{-1} were effective against the sucking pests of cotton. Raghuraman and Gupta (2005) stated that imidacloprid 200 SL at 100 g a.i. ha^{-1} was the most effective treatment against *Bemisia tabaci* (Gennadius). Phosphamidon 40 SL @ 500g a.i. ha^{-1} effectively reduced the population of leaf hoppers aphids and whiteflies in cotton (Srinivasan, 2000; Santhini and Uthamasamy, 1997).

The studies on the effect of Kinadongold to the natural enemies of cotton ecosystem revealed that the untreated plots recorded the highest population of chrysopids, coccinellids and spiders(Table 2). The highest number of chrysopids, coccinellids and spiders was observed in Kinadongold 400 g ha^{-1} treated plots (11.8, 18.2 and 10.2 per ten plants, respectively) and was followed by Kinadongold @ 500 g ha^{-1} (10.7, 16.6 and 9.7 per ten plants, respectively). The lowest population of natural enemies was observed in imidacloprid 17.8 SL @ 112 ml ha^{-1} (6.4, 12.0 and 7.5 number of chrysopids, coccinellids and spiders per ten plants, respectively) treated plots. Reduction in the population of coccinellids and spiders was observed immediately after the application of insecticides. Though there was an initial setback in the population, it started

Table 2. Effect of Kinadongold® on natural enemies and yield

Treatment	Population of natural enemies (Number / 10 plants)									Kapas yield	
	Chrysopids			Coccinellids			Spiders				
	PTC	PSC	PRU	PTC	PSC	PRU	PTC	PSC	PRU	Kg ha^{-1}	PIU
Untreated check	24.33 (4.93)	29.4 (5.4)a	-	44.17 (6.65)	48.7 (7.0)a	-	13.67 (3.70)	15.7 (4.0)a	-	785.5 (28.0)f	--
Phosphamidon 40 SL @ 625 ml ha-1	22.67 (4.76)	8.5 (2.9)c	71.16	46.00 (6.78)	15.6 (4.0)d	67.93	14.00 (3.74)	10.8 (3.3)b	31.42	981.0 (31.3)d	24.89
Imidacloprid 17.8 SL @ 112 ml ha-1	23.50 (4.85)	6.4 (2.5)d	78.30	45.50 (6.71)	12.0 (3.5)e	75.35	13.00 (3.61)	7.5 (2.7)e	52.35	1163.0 (34.1)b	48.06
Kinadon gold @ 400 g ha-1	23.00 (4.80)	11.8 (3.4)b	59.89	46.17 (6.79)	18.2 (4.3)b	62.74	13.50 (3.67)	10.2 (3.2)bc	35.04	909.0 (30.1)e	15.72
Kinadon gold @ 500 g ha-1	22.67 (4.76)	10.7 (3.3)b	63.74	45.83 (6.77)	16.6 (4.1)c	65.95	13.50 (3.67)	9.7 (3.1)cd	37.90	1033.0 (32.1)c	31.51
Kinadon gold @ 600 g ha-1	22.83 (4.78)	9.0 (3.0)c	69.35	44.83 (6.70)	15.5 (3.9)d	68.21	13.17 (3.63)	9.3 (3.0)d	40.88	1260.0 (35.5)a	60.41
Kinadon gold @ 700 g ha-1	23.17 (4.81)	8.2 (2.9)c	79.27	45.17 (6.72)	12.3 (3.5)e	74.77	14.17 (3.76)	7.5 (2.7)e	51.91	1290.5 (35.9)a	64.29
CD (P=0.05)	NS	0.19		NS	0.07		NS	0.12		0.69	

Means in a column followed by same letter(s) are not significantly different (P=0.05) by DMRT; PTC - Pretreatment count, PSC - Post spray count, PRU - Percent reduction over untreated check; PIU - Percent increase over untreated check; Figures in parentheses are square root transformed values

increasing gradually. However the population was found to be less than untreated check in all the insecticide treated plots.

Among the treatments, Kinadongold 700 g ha^{-1} and Kinadongold 600 g ha^{-1} recorded high kapas yields (1290.5 and 1260.0 kg ha^{-1}, respectively) and were on par with each other and Kinadongold 400 g ha^{-1} recorded lowest yield (909.0 kg ha^{-1}) against the untreated check (785.5 kg ha^{-1}) (Table 2). The effectiveness of imidacloprid on the increase in yield was already reported by Gupta *et al.* (2005) and Ameta and Sharma (2005) on cotton. The results of phytotoxicity study revealed that cotton plants sprayed with Kinadon gold each at 600, 1200 and 2400 ml ha^{-1} doses did not show any phytotoxic symptoms like epinasty, hyponasty, leaf injury, wilting, vein clearing and necrosis. The present findings are in consonance with the earlier reports of Suganthy (2003) and Preetha (2008) on cotton who had observed no phytotoxicity on the respective crops when sprayed with imidacloprid. Phosphamidon 40 SL @ 500, 1000 and 2000 g a.i. ha^{-1} to rice and 600 and 1200 g a.i. ha^{-1} to cotton and brinjal did not show any phytotoxic effects (Srinivasan, 2000).

Acknowledgement

The authors are grateful to M/s. United Phosphorus Limited, Mumbai for providing the test chemicals and financial support for this study.

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Received: December 8, 2009; Accepted: March 10, 2010