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INFLUENCE OF INSECTICIDE FORMULATIONS AND DISCHARGE RATE ON SPRAY CHARACTERISTICS AND INCIDENCE OF MAJOR INSECT PESTS ON FCV TOBACCO

G. RAGHUPATHI RAO, U. SREEDHAR AND S.K. DAM

ICAR-Central Tobacco Research Institute, Rajahmundry- 533 105, Andhra Pradesh, India

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Investigations were conducted to determine the influence of insecticide formulations on spray characteristics and insect pest incidence in a replicated field trial on flue-cured Virginia (FCV) tobacco during 2013-15. Spray characteristics indicated that at 25 days after planting (DAP), imidacloprid 200 SL emitted through Hi-tech sprayer at a discharge rate of 450 ml/min at 40 PSI pressure with a walking speed of 3.6 - 4 kmph were superior with higher droplet density (67/sq cm), lower uniform coefficient (1.51) and higher coverage (0.66) on plant canopy. At 45 DAP, spraying with novaluron 8.8 SC, 450 ml/min through Hi-tech sprayer exhibited superior spray characteristics of higher droplet density (62), lower uniform coefficient (1.52) and higher coverage (0.65). The treatment comprising initial two sprays with imidacloprid 200 SL and subsequent two sprays with novaluron 8.8 SC applied through Hi-tech sprayer at a discharge rate of 450 ml/min at 40 PSI showed lower uniform coefficient and higher spray coverage on plant canopy which resulted in significant reduction in infestation of aphid, leaf eating caterpillar and budworm with higher cured leaf yield.

Key words: FCV tobacco, Insecticide formulations, Insect pests, Spray characteristics

INTRODUCTION

Success in pest management depends not only on the choice of the insecticide and time of application but also on the type of formulation aids *viz.* solvents, emulsifiers, dispersants, wetting agents, stickers and softeners, and method of application, which can have a profound influence on the performance of active material. Increased coverage and uniform deposition will results in significant reduction in pest infestation. The physical properties of the spray liquid have a substantial effect on spray formation such that changes in formulation type can give changes in spray characteristics that would be equivalent to doubling the flow rate through conventional hydraulic flat fan nozzles (Miller and Ellis, 2000). In the present investigation, attempts were made to study the impact of dicharge rate on spray characteristics and incidence of aphid, *Myjus nicotianae*, leaf eating caterpillar, *Spodoptera litura* and budworm, *Helicoverpa armigera* on FCV tobacco.

MATERIALS AND METHODS

Field experiment was conducted to determine the influence of insecticide formulations on spray characteristics and insect pest incidence on FCV tobacco with imidacloprid (70 WG and 200 SL @ 0.005%) and novaluron (8.8 SC and 10 EC @ 0.01%) during 2013-15. They were evaluated by applying through Hi-tech and compression sprayers at a nozzle discharge rate of 250 and 450 ml/min at 40 PSI with an operator speed of 3.6 to 4 kmph. The experiment comprised of three replications and nine treatments (Table 1). Spray spectrum emitted through the sprayers was collected on photographic paper strips of 5 x 2 cm size on leaf surface at top, middle and bottom canopies of tobacco plant and were analysed using an image analyser with Prog. Res CT3 soft- ware. Spray characteristics *viz.*, droplet density/ cm^2, number median diameter (NMD), volume median diameter (VMD), uniform coefficient (UC) and spray coverage were computed. Spray characteristics were determined at 25 and 45 DAP. Need based sprays were applied for the management of insect pest infestation. Observations on aphid infestation was recorded at 35 DAP, whereas leaf eating caterpillar, *S. litura* and budworm, *H. armigera* infestation was recorded at 45 and 60 DAP.

RESULTS AND DISCUSSION

Influence of insecticide formulations and discharge rate on spray characteristics

Spray characteristics indicated that at 25 DAP, imidacloprid 200 SL emitted through Hi-tech sprayer, at a discharge rate of 450 ml/min (T8) was characterized by superior spray characteristics of higher droplet density (67 per cm^2), lower uniform coefficient (1.51) and higher coverage on plant canopy (0.66) as against of lower droplet density (49/cm^2), higher uniform coefficient (2.39) and lower coverage (0.42) in control (T9). The ratio between NMD and VMD is an indicator of the range of size, thus more uniform the size of droplets, nearer is the ratio to unity. In contrast, imidacloprid 70 WG emitted through compression sprayer at a discharge rate of 250 ml/min through compression sprayer (T1)

Table 1: Treatments

Treatments	
T1	Initial 2 sprays with imidacloprid 70 WG and subsequent 2 sprays with novaluron 8.8 SC @ 250 ml/min through compression sprayer,
T2	Initial 2 sprays with imidacloprid 70 WG and subsequent 2 sprays with novaluron 8.8 SC @ 450 ml/min through compression sprayer
T3	Initial 2 sprays with imidacloprid 200 SL and subsequent 2 sprays with novaluron 10 EC @ 250 ml/min through compression sprayer
T4	Initial 2 sprays with imidacloprid 200 SL and subsequent 2 sprays with novaluron 10 EC @ 450 ml/min through compression sprayer
T5	Initial 2 sprays with imidacloprid 70 WG and subsequent 2 sprays with novaluron 10 EC @ 250 ml/min through Hi-tech sprayer
T6	Initial two sprays with imidacloprid 70 WG and subsequent 2 sprays with novaluron 10 EC @ 450 ml/min through Hi-tech sprayer
T7	Initial 2 sprays with imidacloprid 200 SL and subsequent 2 sprays with novaluron 8.8 SC @ 250 ml/min through Hi-tech sprayer
T8	Initial 2 sprays with imidacloprid 200 SL and subsequent 2 sprays with novaluron 8.8 SC @ 450 ml/min through Hi-tech sprayer
T9	Control

Table 2: Mean spray characteristics on plant canopy as influenced by insecticide formulations, discharge rate and sprayers

Treat-ments	Droplet density /cm^2		NMD		VMD		UC		Coverage	
	25 DAP	45 DAP	25 DAP	45 DAP	25 DAP	45 DAP	25 DAP	45 DAP	25 DAP	45 DAP
T1	32	44	137.4	175.5	383.1	394.8	2.79	2.25	0.35	0.44
T2	43	60	221.0	150.2	415.5	310.1	1.88	2.05	0.52	0.44
T3	29	42	192.5	161.2	421.4	393.6	2.19	2.44	0.45	0.48
T4	45	57	209.6	194.9	379.7	358.2	1.81	1.85	0.55	0.54
T5	38	45	145.7	168.2	303.2	385.1	2.08	2.29	0.48	0.44
T6	61	58	130.2	197.2	255.2	357.2	1.96	1.81	0.51	0.55
T7	30	39	131.9	322.4	249.8	382.5	1.88	1.92	0.53	0.45
T8	67	62	178.9	206.8	270.8	317.5	1.51	1.52	0.66	0.65
T9	49	42	201.6		480.3		2.39		0.42	

UC: Uniuform coefficient

showed inferior spray characteristics *viz.*, lower droplet density (32/cm^2), higher uniformity coefficient (2.79) and lower coverage (0.35) on plant canopy (Table 1). At 45 DAP spraying with novaluron 8.8 SC, 450 ml/min through, Hi-tech sprayer (T8) exhibited superior spray characteristics of higher droplet density (62), lower uniform coefficient (1.52) and higher coverage (0.65) and was superior over the rest of the treatments (Table 2). It may be mainly attributed to the increased droplet size with emulsions over other formulations evaluated. Butler Ellis and Tuck (1999) reported that sprays from hydraulic pressure nozzles operating with emulsions generally give sprays that are coarser than those produced when spraying surfactant solutions. Further, Butler Ellis *et al.* (1997) demonstrated that emulsions cause rapid fluid sheet disintegration with the formation of large droplets. Similarly, formulation effects were studied by Pasupathy and Venugopal (1986a) on cotton and reported that cypermethrin EC formulations applied through knapsack, mist blower and ULV sprayers showed higher mite population when compared to cypermethrin ED formulation. Further they reported that cypermethrin 3 ED @ 15 ng a.i. recorded very low resurgence followed by other ED formulations.

Influence of insecticide formulations and discharge rate on insect pest infestation

Infestation of aphid *M. nicotianae*: At 35 DAP, imidacloprid 200 SL at a discharge rate of 450 ml/min through Hi-tech sprayer (T8) showed significantly lower infestation (6.8%) and it was at a par with other treatments except imidacloprid 70 WG (T1) and 200 SL (T3) at a discharge rate of 250 ml/min through compression sprayer. It was evident from the results that application of imidacloprid 200 SL at a discharge rate of 450 ml/min through Hi-tech sprayer (T8) was effective in minimizing the aphid infestation (Table 3)

Infestation of *S. litura*: At 45 DAP, the infestation of *S. litura* was low (16.8%) in the plots treated with novaluron 8.8 SC at a discharge rate of 450 ml/min applied through Hi-tech sprayer (T8) as against 22.7% in control (T9). It was significantly lower than all the other treatments. The infestation was significantly higher in the plots treated at a discharge rate of 250 ml/min (Table 3).

Infestation of *H. armigera*: The infestation of *H. armigera* in different treatments varied significantly at 45 and 60 DAP. At 60 DAP, the infestation was significantly lower in the plots treated with novaluron 8.8 SC at a discharge rate of 450 ml/min applied through Hi-tech sprayer (T8) and differed from other treatments indicating the superior performance in minimizing the infestation (Table 3). Similar studies on influence of insecticide formulations and spray systems were conducted by Pasupathy and Venugopal (1986b) and reported that cymbush ED formulations were more effective than EC formulations applied through knapsack, mist blower and ULV sprayers for the control of bollworms *Earias vitella, H. armigera* and *Pectinophora gossypiella.* In the present findings, the treatment comprising initial two sprays with imidacloprid 200 SL and subsequent two sprays with novaluron 8.8 SC applied through Hi-tech sprayer at a discharge rate of 450 ml/min at 40 PSI showed lower uniformity coefficient and higher spray coverage on plant canopy which resulted in significantly lower infestation of aphid, leaf eating caterpillar and budworm.

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Table 2: Insect pest incidence as influenced by nozzle discharge rate

Treatment	Aphid infestation DAP (%)		*S. litura* infestation DAP (%)	*H. armigera* infestation DAP (%)	
	25	**35**	**45**	**45**	**60**
T1: 2 spr Imida 70 WG + 2 spr novaluron 8.8 SC - 250 cc/min-CS	4.2 (11.7)	3.6 (10.6)	11.9 (20.2)	6.5 (14.7)	8.9 (12.8)
T2 :2 spr Imida 70 WG + 2 spr novaluron 8.8 SC- 450 cc/min-CS	2.9 (9.8)	2.4 (8.7)	10.7 (19.1)	5.3 (13.2)	7.7 (12.7)
T3: 2 spr Imida 200 SL + 2 spr novaluron10 EC - 250cc/min-CS	2.4 (8.7)	4.2 (11.7)	11.9 (20.2)	7.7 (16.1)	9.5 (13.0)
T4: 2 spr Imida 200 SL + 2 spr nova10 EC - 450cc/min-CS	2.4 (8.7)	2.4 (8.7)	10.1 (18.5)	5.9 (14.1)	7.1 (12.5)
T5: 2 spr Imida 70 WG, + 2 spr novaluron -10 EC250 cc/min Hi- tech	4.2 (11.7)	2.9 (9.8)	8.3 (16.7	7.1 (15.5)	8.3 (10.1)
T6: 2 spr Imida 70WG + 2 spr noval. 10 EC –450 cc/min Hi-tech	4.1 (11.7)	2.4 (8.7)	8.3 (16.7)	4.2 (11.7)	5.9 (10.2)
T7: 2 spr Imida 200 SL + 2 spr noval8.8 SC -250cc/min-Hi-tech	2.9 (9.8)	3.0 (9.8)	10.7 (19.1)	6.5 (14.8)	3.1 (8.9)
T8: 2 spr Imida. 200 SL + 2 spr Noval. 8.8 SC - 450 cc/min Hi-tech	3.6 (10.6)	2.9 (6.8)	6.5 (14.8)	3.5 (10.9)	3.5 (5.3)
T9: Control	4.7 (12.5)	7.7 (16.1)	14.8 (22.7)	11.3 (19.6.)	13.5 (14.8)
SEm±	**1.05**	**1.12**	**0.66**	**0.66**	**0.68**
CD (P=0.05)	**NS**	**3.37**	**2.00**	**1.99**	**2.04**
CV (%)	**17.3**	**18.6**	**6.20**	**7.0**	**7.04**

Figures in parenthesis are arc.sin transformations

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