COMPARATIVE EFFICACY OF SULFOXAFLOR AGAINST COTTON LEAFHOPPER, *AMRASCA DEVASTANS* (DISTANT) (CICADELLIDAE: HOMOPTERA) UNDER FIELD CONDITIONS OF PUNJAB AND SINDH

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ABSTRACT

Efficacy of sulfoxaflor was evaluated in six field experiments against the cotton jassid, *Amrasca devastans* (Distant) during 2008 and 2009 in Hyderabad and Multan areas of Pakistan. The data revealed that sulfoxaflor 240SC significantly reduced *A. devastans* populations upto one week in three trials conducted during 2008. Sulfoxaflor @ 36 g a.i. per hectare provided very good control even at 10 days. Movento 150 OD (spirotetramat) and Confidor 200SL (imidacloprid) at 50 g a.i. per hectare were also highly active on Indian jassid in Hyderabad, but in Multan where the initial pest pressure was high, only neonicotinoid provided some initial activity. In 2009, where the population of *A. devastans* was very high, initial efficacy after 3 days application and residuality of two neonicotinoids was low, whereas sulfoxaflor 500WDG demonstrated very robust short-term and residual activity when applied @ 25-50 g a.i. per hectare. In all field experiments conducted in Multan and Hyderabad sulfoxaflor at 24-50 g a.i. per hectare clearly exhibited consistent performance against *A. devastans* and proved as an excellent new tool for managing the most destructive pest of cotton in Pakistan.

KEYWORDS: ***Gossypium hirsutum; Amrasca devastans;*** **sulfoxaflor; performance; Pakistan.**

INTRODUCTION

Cotton (*Gssypium hirsutum* L.) plays a pivotal role in the economy of Pakistan. It contributes about 8.6 percent to value added products in agriculture and about 1.9 percent to GDP (5). This crop is cultivated on 3.075 million hectares (6) in Pakistan. The cotton jassid, *Amrasca devastans* (Distant) (Cicadelleidae: Homoptera) is one of the most important sap feeding pests of malvaceous and solanaceous crops in Pakistan and is widely distributed throughout the cotton growing provinces of Sindh and Punjab (16). Other host plants include okra, holly hock, brinjal, potato, maize, sorghum,

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groundnut, pigeonpea, sunflower, beetroot, mulberry, amaranthus, marigold and cucurbits (14, 18). The pest has been recorded as damaging the cotton and okra crops in other countries such as India, Thailand and other South East Asian countries (18). Twenty five species of *Amrasca* attacking cotton plant have been recorded throughout the world (1).

In Indo-Pakistan, *A. devastans* became a problem after the introduction of upland cotton, during the early 20th century (2). It is widely believed that *A. devastans* moved to cotton from spring vegetables such as okra, potato, tomato, red pepper and brinjal. *Bt* cotton varieties were introduced in Pakistan during 2005 to control lepidopteran insect pests attacking cotton. However, widespread adoption of *Bt* cotton has resulted in an increase in sap feeding insect pests (12). Weather conditions, host plants ad biological equilibrium with beneficial insects affect the population dynamics of these pests. *A. devastans* is usually considered as an early phase cotton pest, but occurs throughout the cropping period (16, 18). The Department of Agriculture in Punjab regularly monitors pest levels in cotton to register hot spots; areas where the population pressure of *A. devastans* is above the economic threshold level (ETL) of 1-1.5 per leaf.

A. devastans nymphs and adults suck plant sap resulting in downward leaf curling, burning, drying, growth retardation and shedding of buds and bolls of cotton plants (18). By one estimate, *A. devastans* plant injury may account for 18.78 percent loss of cotton yield in Pakistan (10, 13).

Pesticides are believed to be the effective way of controlling *A. devastans* populations. The mainstay of jassid control shifted to neonicotinoids after development of resistance against most of pyrethroids and organophosphates (4). Foliar application of imidacloprid 200 SL at 20 g a.i. per hectare reduced the *A. devastans* population significantly for three weeks on sunflower (17). In another study (15) imidacloprid and thiamethoxam effectively reduced jassid population below ETL (1-1.5/leaf) upto seven days after application. However, in the last couple of years, there have been many complaints of unsatisfactory control following commercial applications with these neonicotinoids. So there is a need for new chemistry to be introduced.

The present study was undertaken to determine the efficacy of sulfoxaflor against *A. devastans* compared with neonicotinoids such as Confidor (imidacloprid) and Actara (thiamethoxam) and Movento (spirotetramat), a novel insecticide belonging to the new chemical class of ketoenols effective against a wide range of sucking insect including *A. devastans* (8).

Sulfoxaflor is the first member of a novel chemical class, the sulfoximines. Low use rates of foliarly applied sulfoxaflor control a broad spectrum of sap feeding insects such as aphids, whiteflies, jassids and plant bugs (*Lygus* spp.) through both contact and plant systemic action. It also possesses excellent crop tolerance (19) and may offer an excellent alternative tool for managing *A. devastans* for profitable cotton production in Pakistan.

MATERIALS AND METHODS

Six field experiments were conducted to evaluate the efficacy of sulfoxaflor at different locations in Multan (one trial in 2008 and three in 2009) and Hyderabad (2 trials in 2008), against *A. devastans* on different cotton varieties (CIM-496, NIAB-78 and *Bt*-121). All treatments were replicated four times using a randomized complete block design with plot sizes ranging from 36 to 64 square meter. Plant to plant and row to row distance were maintained at 25 and 75 cm, respectively. All products were applied as a foliar application. Two formulations of sulfoxaflor were used as 240 SC (240 g a.i./l) and 500 WDG (500 g a.i./kg) in 2008 and 2009, respectively. Sulfoxaflor 240 SC was applied @ 6, 12, 24 and 36 g a.i. per hectare while sulfoxaflor 500 WDG was applied @ 12.5, 25, 37.5 and 50 g a.i. per hectare. The reference products, Movento 150 OD @ 50 and 75 g a.i., Confidor 200 SL at 50 g a.i. and Actara 25 WG @ 15 g a.i. per hectare were also sprayed once. The spray was applied with hand operated knapsack sprayer at a volume of 200 litre per hectare at 40-50 days after sowing. The growth stage of cotton at this time was BBCH 60-72 (11). The control plots were not sprayed.

Data regarding population of adults and nymphs of *A. devastans* were recorded by using the procedure of counting adults and nymphs on 15 randomly selected leaves from each plot before spray and then again at 1 DAA (days after application), 3 DAA, 7 DAA, 10 DAA and 14 DAA according to trial conditions. The initial population was calculated on number of jassids per leaf. Statistical analyses of collected data were performed using MSTAT-C-software (9). Treatment means were separated using LSD value at 5 percent level.

RESULTS AND DISCUSSION

On the basis of two years average, population pressure in Hyderabad at start of the trials, was at threshold (23.5 jassids/15 leaves) and it gradually increased and reached 46.8 jassids per 15 leaves at 10 DAA. All products showed a quick knockdown of jassid population at 1 DAA (Table 1, Fig. 1) with sulfoxaflor 240 SC @ 36 g a.i. at all assessments demonstrating above

90 percent control. Movento at both dose rates (50 and 75 g a.i./ha) was statistically at par with sulfoxaflor at 36 g a.i.. Confidor recorded a reduction similar to sulfoxaflor but lacked residuality and was numerically inferior to 36 g a.i. of sulfoxaflor at final assessment.

Table 1. Population reduction of *A. devastans* in cotton with different insecticides in Hyderabad, during 2008.

Insecticides		Active concentration (g a.i./l or kg)	Active concentration (g a.i./ha)	Dose (g or ml form/ha)	Jassid population/15 leaves				
Trade name	Common name				0 DDA	1 DAA	3 DAA	7 DAA	10 DAA
XDE-208 240 SC	Sulfoxaflor	240	6	25	18.7	3b	8.17b	17.50b	16.33b
XDE-208 240 SC	Sulfoxaflor	240	12	50	21.2	1.83b	5.67bc	11.33c	15.33b
XDE-208 240 SC	Sulfoxaflor	240	24	100	21.3	1.67b	4.50bc	6.33d	9.67bc
XDE-208 240SC	Sulfoxaflor	240	36	150	22.3	1.17b	1.33c	1.50e	3.5c
Movento 150 OD	Spirotetramat	150	50	333.3	20.0	2.0b	1.67c	1.50e	5.17c
Movento 150 OD	Spirotetramat	150	75	500	22.0	2.33b	2.0c	2.83de	4.83c
Confidor 200 SL	Imidacloprid	200	50	250	20.5	2.5b	2.0c	2.33de	8.33bc
Contol (untreated)	-	-	-	-	23.5	29.83a	33.33a	49.83a	46.83a
LSD						2.409	4.990	4.62	8.98

Means sharing similar letters in columns do not differ by DMR test at 0.05%.
DAA = Days after application.

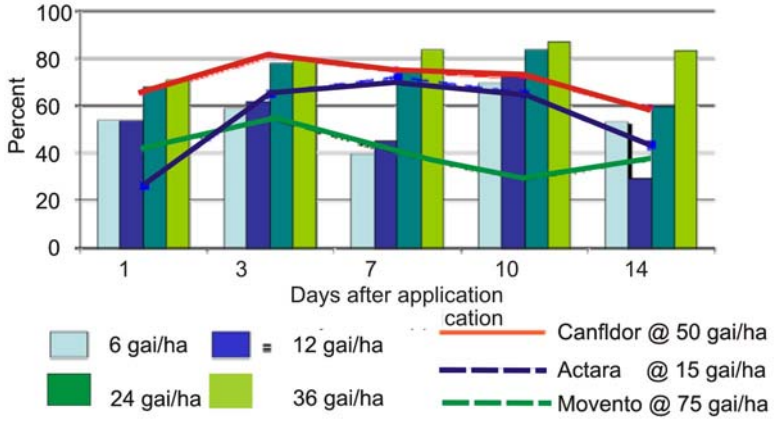

Fig.1 Efficacy of sulfoxaflor 240 SC versus nicotinoids and spirotetramat on *A.devastans* in Multan during *2008.*

The pest pressure was high at trial onset in Multan during 2008 (Table 2, Fig. 2) and increased untill 3 DAA and thereafter fluctuated, but it was still well above ETL at 5 jassids per leaf at final assessment. Sulfoxaflor 240 SC at 24-

36 g a.i. per hectare was the most effective treatment; the 24 g a.i. rate recorded good activity upto 7 days but lacked residuality, while 36 g a.i. rate was consistent at or above 80 percent level from 3-14 DAA. Movento and Actara did not provide commercially acceptable control throughout the trial duration and only Confidor recorded some good control at 3-10 DAA.

Table 2. Population reduction of *A. devastans* in cotton with different insecticides in Multan during 2008.

Insecticides (trade names)	Active concen-tration (g a.i./l or kg)	Active concen-tration (g a.i./ ha)	Dose (g or ml form/ ha)	Population of jassids/15 leaves					
				0 DDA	1 DAA	3 DAA	7 DAA	10 DAA	14 DAA
XDE-208 240 SC	240	6	25	38.0	29.3de	27 bc	32.5bc	11.75cd	34cde
XDE-208 240 SC	240	12	50	64.0	29.8de	24.3cd	28.8bcd	9.75cd	30.6cde
XDE-208 240 SC	240	24	100	91.0	24.8de	16de	16de	7.25cd	18de
XDE-208 240SC	240	36	150	39.0	20e	14de	9.3e	5.25d	12.6e
Movento 150 OD	150	50	333.3	48.0	46.8bc	36.3b	36b	34.25b	42.4abc
Movento 150 OD	150	75	500	52.0	41cd	31.5bc	34.3bc	29.5b	28.4ab
Confidor 200 SL	200	50	250	47.0	20.5e	11.3e	12.3e	9.5cd	13.6bcde
Actara 250 WG (Thiamethoxam)	250	15	60	89.0	58.5b	27.8bc	18.3cde	16.25c	25.4bcd
Control (untreated)	-	-	-	73.0	81a	82.3a	63a	44.5a	77.8a
LSD -	-	-	-	-	16.81	10.82	16.43	9.79	17.53

Means sharing similar letters in columns do not differ by DMR test at 0.05%.
DAA = Days after application.

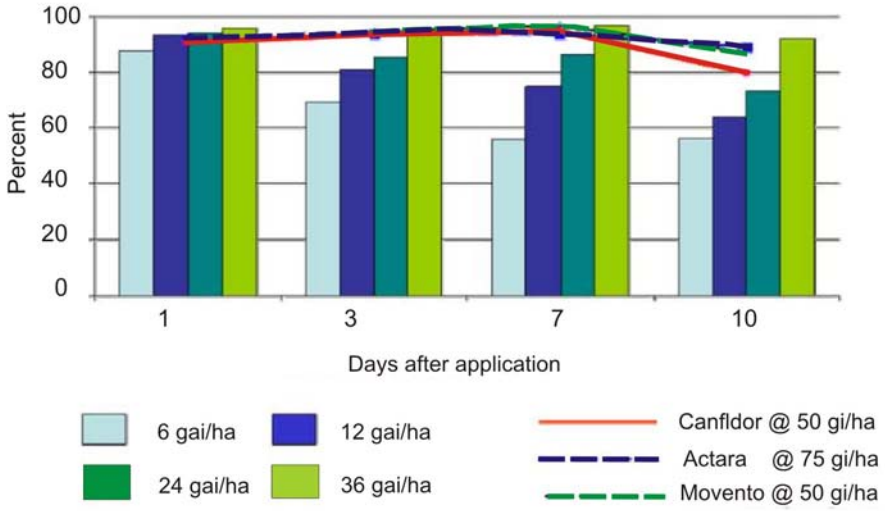

Fig.2 Efficacy of sulfoxaflor 240 SC versus nicotinoids and spirotetramat on *A.devastans* in Hyderabad during *2008.*

In Multan during 2009, average pest pressure of three field experiments was very high (98.6 jassids/ 15 leaves) at beginning of the trials which increased upto 138.2 jassids at 7 DAA with a slight decrease at final assessment (Table 3). Under this elevated pest pressure, sulfoxaflor 500 WDG @ 12.5-50 g a.i.

per hectare demonstrated a moderate-good knockdown effect on *A. devastans*. At 3-10 DAA, sulfoxaflor at 25 g a.i. per hectare rate showed

Table 3. Population reduction of *A. devastans* in cotton with different insecticides in Multan, during 2009.

Insecticides (trade names)	Active concen-tration (g a.i./l or kg)	Active concen-tration (g a.i./ ha)	Dose (g or ml form/ ha)	Population of jassids/15 leaves				
				0 DDA	1 DAA	3 DAA	7 DAA	10 DAA
XDE-208 500 WG	500	12.5	25	98.4	27.9b	11.82bcd	20.8c	26.8c
XDE-208 500 WG	500	25	50	95.0	17.6b	9.1bcd	16.3c	22.1c
XDE-208 500 WG	500	37.5	75	98.0	20.1b	5.65d	13.4c	15.6c
XDE-208 500 WG	500	50	100	96.4	21.5b	7.25cd	17c	14.2c
Actara 250 WG	250	15	60	93.3	25.8b	20.15bc	52.9b	51.3b
Confidor 200 SL	200	50	250	105.4	23.4b	20.83b	50.3b	62.3b
Control (untreated)	-	-	-	98.6	95a	96.68a	138.2a	123.4a
LSD				-	15.67	13.03	15.73	12.85

Means sharing similar letters in columns do not differ by DMR test at 0.05%.
DAA = Days after application.

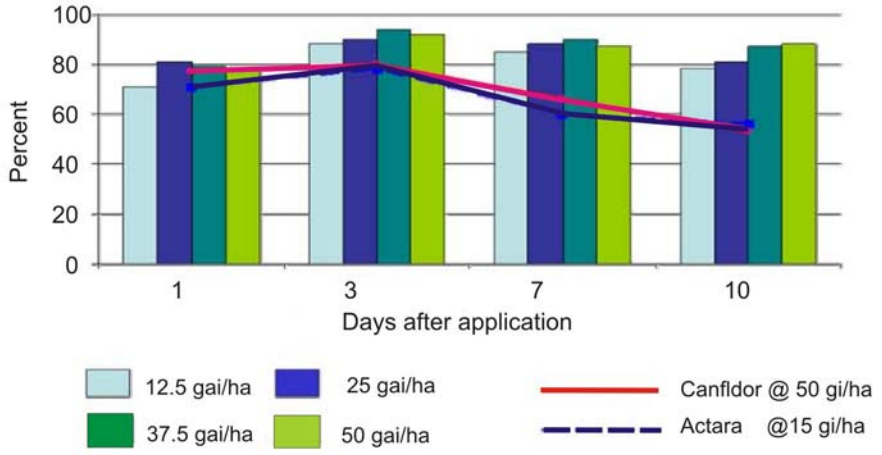

Fig.3 Efficacy of sulfoxaflor 500WDG versus nicotinoids and spirotetramat on *A. devastans* in Multan during *2008.*

a high level of activity (81-90%), but rates of 37.5-50 g a.i. provided consistent control near or above 90 percent from 3-10 days (Fig. 3). The neonicotinoids were similar to sulfoxaflor in speed of action. Similar results have been reported by Razaq *et al.* (15) and Santhram *et al.* (17). However,

sulfoxaflor was found as more residual and significantly more potent. These positive effects on plant growth might result from control of target pest, however, these may also result from a physiological effect. Sulfoxaflor effects on plant growth in the absence of insects have been documented elsewhere (7).

CONCLUSION

It may be concluded that sulfoxaflor @ 25-50 g a.i. per hectare is a very potent insecticide for control of *A. devastans,* irrespective of the pest pressure. The reference products lacked consistent control and showed particularly weak performance when jassid populations were high. All treatments were considered to be safe to cotton varieties tested based on the absence of any negative foliar effects. While not quantified, visual observation of crop condition showed that sulfoxaflor treatments, especially @ 36 g a.i. per hectare and higher had a pronounced greening effect compared to the reference products.

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