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COMPARATIVE EVALUATION OF DIFFERENT APPLICATION RATES AND TIMES OF FURADAN (CARBOFURAN) 3% G IN SUGARCANE CROP FOR MANAGING BORERS ATTACK AND YIELD ENHANCEMENT

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ABSTRACT

The experimental study was conducted to assess Furadan 3% G (Carbofuran) borers control level, impact on yield and the level of residue in Sugarcane tops and juice . The experiments were conducted in 2 consecutive years 2011-12 & 2012-13 at Research Farm of Sugarcane Research Institute, Faisalabad. Five dosages in split applications (32, 40, 48, 48 and 32 kg/acre) were evaluated with different application timings. Sugarcane setts of T5 were sprayed with Bifenthrin 10% EC before sowing. In 1st year minimum damage by top borer (2.04%), Stem borer (1.17%) and root borer (1.82%) was recorded by T3 (48kg/Acre) along with minimum cumulative inter-node damage (5.04%) was found statically significant to all other treatments and the yield was also highest in T3 i.e. 103.88 t ha^{-1}. In 2nd year experiment showing the same trend and the minimum damage by top borer (2.05%), stem borer (2.52%) and root borer (1.08%) found in T3 (48kg) which is statistically significant than the other treatments and the highest yield (108.39 t ha^{-1}) was also recorded in T3. The residues in cane tops and juice were below the detectable limits.

Keywords: Carbofuran, Borers, Residue, Sugarcane, Bifenthrin

INTRODUCTION

Sugarcane is the cash crop of Pakistan and in 2012-13, the sugarcane crop was cultivated on 1124 thousands hectare and the production was 62.5 million tones. It shares, value added as 3.4% and GDP as 0.7% (Anonymous, 2013-14). Its major contribution is in sugar industry and provides raw material for clip board, paper and ethanol industries. According to Gul *et al.* (2008) insect pest attack is major contributing factor in lower yield of Sugarcane. A wide range of insect pests i.e. termites, borers, pyrilla, whitefly, bugs and mites attack sugarcane crop. About 103 insects are associated with sugarcane crop (Kumarasinghe, 1999). In Pakistan 12 species of insects have been reported as pest of sugarcane crop (Chaudhry & Ansari, 1988). Among all insect pests, borers are more damaging to crop by making tunnels in stubbles and internodes. As per *Gupta and Singh (1997)* due to 3rd and 4th broods of Sugarcane borers reduction in weight may be upto 25%. Due to these tunnels, the food supply to aerial parts (stem & leaves) stop and these tunnels also pave way for the diseases. *Rana et al (2011)* narrated from May to December about 12.06 to 36.51% crop damage occurs due to insect pest attack. The loss may exceed upto 85% which results in low yield. In Pakistan Furadan 3% G (Carbofuran) was first registered in 1979 as insecticides against Sugarcane borers. Furadan 3%G is granular insecticide still used by a very large community of farmers on Sugarcane and Maize crop. In that study, different dose rates of Furadan 3% G were evaluated with different application timings to find out the best application rate and time to control the borers (Top Borer, Shoot Borer & Root Borer) and its ultimate impact on yield. Moreover, the residual analysis tests of sugarcane juice and tops were also done in Residual Laboratory of NIAB (National Institute of Agriculture & Biology) Faisalabad.

MATERIAL AND METHODS

The experiment was laid out at Research Farm of Sugarcane Research Institute, Ayub Agricultural Research Institute, Faisalabad. In 2011-12 experiment, S2003-US-114 clone and in 2012-13 CPF-247 varieties were planted. The treatments were applied

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(Table 1).

Table 1

Treatments applied for managing borers' attack and yield enhancement.

T_1	Furadan 3%G @ 8kg at sowing + 8kg at 30 DAS + 8kg at 60 DAS + 8kg at 90 DAS (32 kg/Acre)
T_2	Furadan 3%G @ 8kg at sowing + 8kg at 30 DAS + 8kg at 60 DAS + 16kg at 90 DAS (40 kg/Acre)
T_3	Furadan 3%G @ 8kg at sowing + 8kg at 30 DAS + 16kg at 60 DAS + 16kg at 90 DAS (48 kg/Acre)
T_4	Furadan 3%G @ 16kg at sowing + 16kg at 60 DAS + 16kg at 90 DAS (48 kg/Acre)
T_5	Spray of Bifenthrin 10 %EC @ 250ml/Acre on setts at sowing + Furadan 3%G @ 8kg at 30 DAS + 8kg at 60 DAS + 16kg at 90 DAS (Spray + 32kg/Acre)
T_6	Control (UTC)

The trial was replicated thrice following randomized complete block design (RCBD). The plot size was 5m X 9.5m. The data on tiller infestation was recorded twice during May & June due to the highest insect pest activity period and after June the data was recorded with one month interval. At harvest, sampling was made by 10 randomly selected canes from each plot and the canes were split longitudinally and each cane was closely observed for borer attack and cumulative inter-node damage caused by borers was calculated. At the end of crop season, yield data in tones per hectare was recorded for each treatment.

RESULTS

Five different application schedules of Furadan 3% G with different application timing were evaluated to control Insect Pest (Borers) in sugarcane. Treatment wise data of tillers and cane damage and impact on yield is as under,

Pest Control

Crop infestation data was recorded in two ways, i.e. Tiller damage and Inter-node damage percentage. In 1st year (2011-12) least tiller damage was recorded in T3 (2.52%) followed by T2, T1, T4, & T5, i.e. 2.62%, 2.86%, 2.9% & 3.18% respectively. Highest average damage percentage was found in untreated plot, i.e. 8.68%. The scenario was same in 2nd year (2012-13), T3 was found better among all with 2.62% tiller damage. Minimum to maximum tiller damage trend was T4, T5, T2, & T1 (4.05%, 4.59%, 5.03% & 5.61%) respectively. Cumulative Inter node damage (caused by 3-types of Borers) in 1st year was recorded as T3 (5.04%) followed by T4 (7.05%), T2 (8.03%), T5 (8.76%), and T1 (9.38%). In 2nd year it was again minimum in T3, i.e. 5.65% followed by T4, T2, T5 and T1. The damage in untreated fields was 16.42% & 16.49% in 1st and 2nd year respectively (Table 2).

The dose rate in T3 & T4 was the same (48kg/Acre) but in T3, 6 bags were applied in 4 applications and in case of T4, 6 bags were applied in three applications. Same in case of T1 & T5 the complete insecticide was applied at different dose rates per application. Split dose of Furadan 3% G gives better control of borers at Cumulative Inter node damage (caused by 3-types of Borers) in 1st year was recorded .

Yield Comparison

The yield comparison was recorded at harvesting of crop. Clear difference in yield was found in treated and untreated plots. The maximum yield in both years was recorded in T3 i.e. 103.88 ton/Ha & 108.39 ton/Ha in 1st and 2nd year respectively. The overall yield comparison of all treatments along with cost benefit ratio is as under, (Table 3).

Table 2

Percentage tiller and inter-node damage due to borers (Treated vs Un-treated).

Trt.#	Furadan 3%G Application (Kgs/Ac).	Tiller Damage		Inter-Node Damage percentage						Cumulative Inter-Node damage.	
				TB	SB	RB	TB	SB	RB		
		2011-12	2012-13	2011-12			2012-13			2011-12	2012-13
1	32	2.86 b	5.61 b	3.85 b	2.72 b	3.08 b	2.84 b	4.57 ab	2.2 b	9.38 b	9.61 b
2	40	2.62 b	5.03 b	3.17 b	2.17 b	2.69 b	2.16 c	3.66 b	1.11 b	8.03 b	7.27 bc
3	48	2.52 b	2.62 c	2.04 b	1.17 b	1.82 b	2.05 c	2.52 b	1.68 b	5.04 c	5.65 c
4	48	2.9 b	4.05 bc	3.24 b	2.08 b	2.71 b	2.27 c	2.72 b	1.12 b	7.05 b	5.91 c
5	Spray + 32	3.18 b	4.59 bc	3.82 b	2.41 b	2.52 b	2.85 b	4.31 b	1.89 b	8.76 b	9.16 b
6	UTC	8.68 a	12.17 a	6.48 a	5.43 a	6.16 a	5.6 a	6.87 a	4.12 a	16.42 a	16.49 a

Table 3

Yield comparison and cost benefit ratio (Treated *vs* un-treated).

Trt #	Yield 2011-12 ton/ha	Yield increase over control 2011-12 ton/ha	Yield 2012-13 ton/ha	Yield increase over control 2012-13 ton/ha	Avg Yield Increase over control ton/ha	Avg. Increase in Value/Ha (Rs)	Avg. appl cost of Furadan 3%G (Rs.)	Cost Benefit Ratio
T1	79.57	15.12	89.33	12.11	13.615	47652.5	8000	1 : 5.95
T2	83.32	18.87	93.05	15.83	17.35	60725	10000	1 : 6.07
T3	103.88	39.43	108.39	31.17	31.17	109095	12000	1 : 9.09
T4	85.6	21.15	101.94	24.72	24.72	86520	12000	1 : 7.21
T5	84.71	20.26	96.94	19.99	19.72	69020	8700	1 : 7.93
T6	64.45	0.00	77.22	0.00	0.00	0.00	-	-

*Price of Sugarcane per 40kg = Rs. 150/-. Furadan 3% G MRP = Rs. 800/bag

Cost Benefit Analysis

In addition to insect pest control, Furadan 3% G enhanced yield of sugarcane crop by controlling insect pests and producing phyto-tonic effect on crop. Reduction in insect pest damage significantly increases the yield of crop. Minimum Ratio of cost and benefit is 1: 5.95 in T1 and maximum is in T3 (1: 9.09) which is interesting for farmers.

Residual Studies

The residual studies were carried out of Sugarcane tops and Juice in Toxicology Lab of NIAB, Faisalabad. The samples were analyzed by chromatographic technique. The residues of Carbofuran were found below the detectible limits (Detection Limit = 0.01 mg kg^{-1}). The instrument showed good sensitivity and linear response. As per analysis report, there will be no MRL issue in sugarcane by applying Carbofuran as an insecticide.

DISCUSSION

The infestation of borers on sugarcane starts when crop is of 1 foot height and it continues till September, in particular, the infestation of stem borers. In order to manage the infestation of stem borers during this long period of crop development, the data show that better would be to split the dose rate with 25-30 days interval to effectively control the stem borer in particular. The cost benefit ratio of Furadan vs yield increase comes out as 1:9 which is exciting and for the highest yield of Cane crop, farmers can use Furadan 3%G in 4 applications with 25-30 days interval. The first 2 applications can be @ 8 kg/acre and the last 2 applications @ 16 kg/acre.

At harvesting, the residue study of sugarcane tops which is used as animal feed and the juice show that the level of residues of Carbofuran have been below the detectable level and residues have not been detected in any treatment. The use of Carbofuran does not impose any threat of residues in Sugarcane crop when used as per label recommendations.

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