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INTEGRATED MANAGEMENT OF RODENT PESTS IN SUGARCANE USING RODENTICIDES AND ANTIFERTILTY AGENT TRIPTOLIDE

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ABSTRACT

Five blocks of farmer's sugarcane fields were selected in district Jalandhar, Punjab during December 2016 to February 2017. These blocks were treated with 2% zinc phosphide (ZnP), 2% ZnP+ 0.005% bromadiolone (Br), 2% ZnP+ 0.25% triptolide (Tr) and 2% ZnP+ 0.005% Br+ 0.25% Tr at cane maturation stage; and 5th block was kept as untreated control. The post census and % re-buildup of rodents after 30 and 45 days of Tr treatment and cut canes (%) were significantly less in rodenticides+ Tr treated blocks (ZnP+ Tr and ZnP+ Br+ Tr) as compared to blocks treated only with rodenticides (ZnP alone and ZnP + Br). However, burrows and yield loss were found to be significantly less with ZnP+ Br+ Tr treatment. Thus, antifertilty agent, triptolide can be used along with rodenticides for better control of rodents in sugarcane.

Key words: Bromadiolone, zinc phosphide, triptolide, rodents, rebuildup, antifertility agent, burrow count, sugarcane, cane maturation, cut canes, damage, yield loss

Sugarcane (*Saccharum officinarum*) is an important cash and industrial crop, and occupied 91000 ha in Punjab during 2019-20 with yield of about 735 q/ ha (Anonymous, 2021). Sugarcane being a long duration crop provides an ideal habitat for a complex of rodents. There are about 103 species and 89 subspecies of rodents reported in India (Pradhan and Talmale, 2011), with serious economic loss (Singla and Babbar, 2010). Rodent damage to sugarcane has always been a matter of economic concern as 19.12% damage is caused in Punjab (Singla and Parshad, 2010). After use of rodenticides and other methods, rodents rapidly rebuild their population by enhancing their reproduction (Shilova and Tchabovsky, 2009), and repeated use of rodenticides, which cause several problems like bait shyness, resistance and other non-target toxicity hazards (Mineau et al., 2004). Fertility control has been identified as a more appropriate and environmentally safe strategy (Zhang et al., 2009). Witmer (2019) reported that it is essential to improve the effectiveness and safety of rodenticides. Triptolide is one of the registered sterilants for rodent management in China (Huang, 2014). IPM strategy through a combination of techniques such as biological control, habitat manipulation, modification of cultural practices, introduction of resistant varieties offers promise (Amir and Raza, 2020). The present study aims at a strategy for IPM of rodents in sugarcane deploying chemical and biological methods using rodenticides in combination with triptolide at cane maturation stage.

MATERIALS AND METHODS

Five blocks (I-V) of farmer's sugarcane fields each further consisting of three replicated fields of 0.40 ha were selected at village Apra (31.0861°N, 75.8781°E), Nangal (31.3832°N, 76.3766°E) and Thalla (31.0513°N, 75.8614°E) of district Jalandhar, Punjab during December, 2016 to February, 2017. The pre and post census bait consumption was recorded from all these keeping 1 kg/ ha of the plain WSO bait (cracked wheat, powdered sugar and groundnut oil in the ratio of 96:2:2) on pieces of paper at 20 bait points/ field arranged in a grid and by collecting and weighing remaining bait on third day to determine the bait consumption (g/ 100g bait). Precensus rodent population was thus assessed, and these fields at cane maturation stage were treated with 2% zinc phosphide (ZnP) followed by 0.005% bromadiolone- Br, and 0.25% triptolide (Tr) by keeping different baits @ 1 kg bait/ ha at 100 bait points arranged in a grid as: Block I: 2 % ZnP only; Block II: 2% ZnP+ 0.005% Br after 15 days; Block III: 2% ZnP + 0.25% triptolide (Tr) after 15 days; Block IV: 2% ZnP+ 0.005% Br after 15 days, and 0.25% Tr bait after another 15 days; and Block V: untreated control. The post- census (I) bait consumption was taken from all the fields after 30 days of treatment with 2%ZnP+ 2% ZnP+ 0.005% Br in all blocks. Similarly, post census II, III and IV bait consumption for second, third and fourth time respectively was taken in all blocks after 15, 30 and 45 days of treatment with Tr. From these pre and first post census bait consumptions,

Table 1. Effect of treatments on bait consumption, control success, rodent burrows, cut canes and yield loss in sugarcane crop (December 2016-February, 2017

Block (n=3 each)	Pre-census	Plain bait consumption (g/ 100g) Post-census				Control success (%)		No. of rodent burrows/ acre	Cut canes (%)	Yield loss (Q/acre)
		I	II	III	IV	wrt same field	wrt control field			
I (ZnP)	78.67± 0.88^{a}	50.67± 0.67^{a}	58.33± 4.05^{a} (6.67± 1.86^{a})^{I}	75.33± 2.91^{a} (24.67± 2.91^{a})^{II}	83.33± 1.86^{a} (32.67± 2.18^{a})^{III}	35.59± 0.56^{a}	37.15± 2.56^{a}	12.67± 0.67^{a}	2.51± 0.36^{a}	0.20± 0.02^{a}
II (ZnP+Br)	79.00± 2.30^{a}	42.67± 2.18^{a}	50.0± 0.58^{a} (6.67± 0.67^{a})^{I}	82.00± 2.52^{a} (24.00± 3.61^{a})^{II}	78.67± 3.33^{a} (36.00± 3.21^{a})^{III}	45.75± 4.34^{a}	45.02± 4.40^{a}	12.33± 1.33^{a}	2.69± 0.70^{a}	0.15± 0.04^{a}
III (ZnP+Tr)	81.67± 0.88^{a}	54.67± 2.03^{a}	61.33± 1.46^{a} (5.33± 1.20$^{a)}$ ^{I}	63.67± 6.84^{b} (21.00± 6.43^{a})^{II}	73.67± 5.84^{b} (19.00± 7.55^{b})^{III}	33.02± 2.82^{a}	32.00± 2.73^{a}	12.00± 2.00^{a}	1.35± 0.50^{b}	0.15± 0.05^{a}
IV (ZnP+Br+Tr)	83.33± 1.20^{a}	58.00± 2.89^{a}	63.33± 4.05^{a} (4.67± 0.88^{a})^{I}	65.67± 2.02^{b} (10.00± 2.31^{b})^{II}	72.33± 1.45^{b} (14.33± 3.93^{b})^{III}	30.35± 3.78^{a}	29.42± 3.83^{a}	6.33± 0.33^{b}	1.00± 0.19^{b}	0.10± 0.03^{b}
V (Untreated control)	76.00± 0.58^{a}	77.33± 1.45^{b}	83.33.± 1.86^{b} (7.67± 3.53^{a})^{I}	85.00± 1.53^{c} (7.67± 2.90^{b})^{II}	95.33± 1.33^{c} (18.00± 0.58^{b})^{III}	--	--	38.67± 1.76^{c}	4.01± 0.71^{c}	1.50± 0.07^{c}

Values mean ± SE; Values with superscripts a-c and I-III in a column and a row respectively differ significantly at $p \leq 0.05$; Figures in parentheses indicate values for population re-buildup

efficacy of rodenticides was evaluated by determining reduction in rodent activityin all the treated blocks with respect to the same field as well with respect to untreated control fields following Singla and Parshad (2010). The difference in post census II, III and IV bait consumption data taken after 15, 30 and 45 days of Tr treatment gave the % rebuildup, calculated as described by Dhar et al. (2014). Rodent pest live burrow count was determined at preharvest stage on the basis of characteristic burrow entrances (Dubey, 2001; Neelanarayan, 2004). The cut canes (%) and yield loss (q/ ha) depicting preharvest rodent damage were calculated following Singla and Parshad (2010) and Singla and Babbar (2012). The data was interpreted as Mean± SE and subjected to paired Student's t-test and one way ANOVA (p=0.05).

RESULTS AND DISCUSSION

The sugarcane fields in all blocks were surrounded by wheat and potato crops. The precensus bait consumption by rodents in fields of blocks I to V varied non-significantly (Table 1). The post census counts revealed a significantly low bait consumption in blocks I, II, III and IV as compared to untreated control block V, with a non-significant difference among treated blocks; in triptolide treated blocks III and IV was found to be significantly low. This indicated that combination of rodenticides and triptolide was effective. The rodent control success varied non-significantly among different blocks with respect to same (30.35- 45.75) as well as control (29.42- 45.02). The control success with rodenticides i.e. ZnP or ZnP+Br are in accordance with the earlier studies in sugarcane. Singla and Babbar (2012) found that three rodenticide treatments, first in July and second in October–November with two rodenticide baitings i.e. ZnP followed by Br each at 15 days interval and third treatment in December–January with single baiting of 0.005% Br was effective. Singla and Parshad (2010) observed double-baiting with ZnP and Br resulted in significant reduction in rodent activity. The present studies revealed significantly less re-buildup of rodents in block IV (ZnP+ Br+ Tr) and in blocks III (ZnP+ Tr) as well as IV (ZnP+ Br+ Tr) after 30 and 45 days of Tr treatment, respectively. Dhar et al. (2014) also suggested potential of Tr treatment in sugarcane in integration with chemical control. Laboratory studies also revealed the antifertility potential of Tr against both the male and female *Bandicota bengalensis* (Dhar and Singla, 2013 and 2014). The inhibitory action of Tr on testicular germ cells and ovarian follicular cells led to inhibition of reproduction (Deng et al., 2011; Dhar and Singla, 2013 and 2014).

The number of rodent burrows was found to be significantly less in block IV as compared to other treated blocks (block I,II and III); this indicated better control with ZnP+ Br+ Tr. *Bandicota bengalensis* was found to be the predominant rodent species followed by *Mus booduga* and *Millardia meltada* in all the blocks. Sugarcane crops were found to be infested with *B. bengalensis*, *M. booduga*, *M. meltada* and *Golunda ellioti* with *B. bengalensis* being the most prevalent (Singla and Parshad, 2010; Singla and Babbar, 2012). Qamar et al. (2019) reported that *B. bengalensis* eat the stem of sugarcane especially from internodes which contained higher sugar content. The cut canes (%) was observed to be significantly low in rodenticides + Tr treated blocks (III and IV, 1-1.35%) as compared to only rodenticide/s treated blocks; significantly minimum yield loss was observed in treated block IV (ZnP+ Br+ Tr). Singla and Parshad (2010) reported 19.12% damaged canes with an estimated 2.67% yield loss. The wheat crop (immature) and potato crop (tuber maturation stage) surrounding sugarcane crop fields perhaps provide a pathway for migration and survival of the rodents providing alternative habitat and food resources. Thus, 2% ZnP followed by 0.005% Br after 15 days interval and 0.25% Tr after further 15 days at cane maturation stage during (December-January) was the best treatment, and triptolide may be effectively used in an IPM of rodents in sugarcane.

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AUTHORS CONTRIBUTION

NK conducted experiments, analyzed data, interpreted results and wrote the manuscript. NS designed research and edited manuscript.

CONFLICT OF INTEREST

No conflict of interest.

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