Krismat 75 WG, A Novel Herbicide for Early and Late Post-Emergence Weed Control in Sugarcane

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ABSTRACT

A series of field experiments was conducted at the Sugarcane Research Institute (SRI), Uda Walawe, Sri Lanka from 2013 to 2014 to evaluate the effects of herbicide Krismat 75 WG on weeds control in sugarcane. Initially, the Krismat, at the rates 0.5, 1.0 and 1.5 kg/ha was tested after early-post emergent (15 days after planting – DAP) and the late-post emergent (28 DAP) applications. Subsequent studies were conducted to test Krismat at higher rates (2.0, 4.0 and 6.0 kg/ha) at late post-emergent stages. The effects of the herbicide on weed knock down, residual activity and crop phytotoxicity was evaluated by rating visually and counting live weeds. The data were analysed by ANOVA procedure.

The knock down of grasses and broad-leaved weeds was over 90% after early-post emergent application of Krismat at rates 0.5, 1.0 and 1.5 kg/ha. Satisfactory residual weed control was observed only at the rate 1.5 kg./ha., until six weeks after spraying (WAS). In the late-post emergent application, knock down of broad-leaved weeds was over 82% at the rates 0.5 and 1.0 kg/ha and was 100 % at the rate 1.5 kg/ha. The knock down of grass was less, 38% and 45% at 0.5 and 1.0 kg/ha respectively. The residual effect of the rates 0.5, 1.0 and 1.5 kg/ha did not exceed satisfactory level beyond 4 WAS. In contrast, application of Krismat at higher rates (2, 4 to 6 kg/ha) at late post-emergence stage gave weed knock down over 85 - 90% and residual control until 4 – 6 WAS. The phytotoxicity of Krismat on sugarcane was minor and negligible.

Thus, the herbicide Krismat can be safely and effectively applied to control annual grasses and broad-leaved weeds in sugarcane. The rates of application should be 2-4 kg/ha of the commercial formulation and the period of application could be within two to four weeks after planting.

Keywords: Krismat 75 WG, post-emergence, residual effect, sugarcane, weed knock down

INTRODUCTION

Yield losses due to weed growth in sugarcane plantations vary from 6% to 75% and sometimes up to 100% depending on types of weeds, degree and duration of competition (Witharama, 2000). As the early growth of sugarcane occurs at a fairly slow pace, it takes about 3-4 months to develop a good canopy cover under irrigation, and this period could further extend up to 4-5 months under rain-fed. Thus, to raise a successful crop, weeds in sugarcane plantations have to be kept controlled until the crop develops a full canopy cover. Usually, this critical period of weed/crop competition extends from 21 to 90 days after planting (DAP) and control measures have to be adopted before weed competition begins at 21 DAP (Witharama, 2001). Several control options such as manual, mechanical, cultural and chemical methods are available to control weeds in sugarcane. However, adoption of integrated weed management is the best solution in which the use of herbicide has been inevitable.

A number of herbicides have been recommended as pre- and post-emergent application for effective control of weeds (Witharama, 2000). Application of post-planting residual herbicides along with mechanical control options has been an effective strategy of obtaining lasting weed

control during the critical period of crop weed competition. Among the effective post-planting herbicides with residual action, mixture of Diuron and Paraquat was proved to be superior to other herbicides in terms of the knock-down effect and residual activity and had been widely used to control weeds in sugarcane. However, since the importation of Paraquat is no longer allowed, finding alternative herbicides for more economical control of weeds in sugarcane has become necessary. The Sugarcane Research Institute (SRI) started field studies to screen several new herbicides and Krismat 75 WG was found to be promising. This paper presents the results of the experiments conducted with Krismat 75 WG to find out its effect on weed knock-down, residual activity and phytotoxicity on sugarcane to recommend the optimum time and rates of application for effective control of weeds in sugarcane.

MATERIALS AND METHODS

Experimental procedure

Krismat 75 WG, a mixture of Ametryn (731.5 g/kg) and Ttrifloxysulfuron (18.5 g/kg), a selective post-emergence herbicide developed by Syngenta for control of grasses, broad-leaved weeds and Cyperus species was selected to test its effect on controlling weeds in sugarcane. Initially, two field experiments; one for early-post emergence application (Experiment I) and the other for late-post emergence application (Experiment II) were conducted at the research farm of the Sugarcane Research Institute (SRI), Uda Walawe. The two experiments were laid as randomised complete block design with four replicates adopting a plot size of 9m long 6 cane rows and three different dosage rates of Kristmat as 0.5kg, 1 kg and 1.5 kg/ha were tested. In the Experiment I, herbicide treatments were applied few days after sporadic emergence of sugarcane, and the weeds were at 2-4 leaf stage (15 days after planting – DAP). The same treatments were evaluated in the Experiment II, but sprayed at 28 DAP when weeds were grown up and matured. In the both experiments I and II, a tank mixture of Diuron and Paraquat was applied as the standard treatment and an untreated control was also included for comparison. Since, phytotoxicity appeared on crop due to the Kristmat at the rates tested above was negligible, subsequent experiments were conducted to test higher dosage rates of Kristmat (2, 4 and 6 kg /ha) after spraying each treatment in an extent of about 0.1 hectare at late-post emergence stage (Experiment III). The treatment details of the three experiments are given in the Table 1.

Description of the experimental sites

The soil in the experimental area is predominantly well–drained Reddish Brown

Table 1. Details of herbicide treatments evaluated after early and late post emergence application and in the pilot project (Field studies I, II & III)

Treatments	Rate of application- kg or l/ha	
	Experiments I & II	Experiment III
Krismat 75 WG	0.5 kg	2 kg
Krismat 75 WG	1.0 kg	4 kg
Krismat 75 WG	1.5 kg	6 kg
Praquat 65 SL + Diuron 80% WP	6l + 3.5 kg	6l + 3.5 kg
Control	No weeding	No weeding

Experiment I: Early post emergence application at 15 DAP

Experiment II: Late post emergence application at 28 DAP

Experiment III: Pilot project spraying at late post emergence stage with higher rates

Earths (RBE) (Alfisol to Ustalf). The area is characterised by a bimodal pattern of rainfall distribution, with about 1,300 mm average annual precipitation. About, two-thirds of the annual rainfall is received during September to February (Maha season). There is a small peak of rainfall during March to May (Yala season) but it is erratic. The ambient air and soil temperatures are high and range from 28^0 C to 32^0C.

Weed spectrum

A considerably heavy weed growth was observed in the experimental locations and weed pressure was very high from several weeds that were common to the sugarcane plantations. The commonly-observed weeds are shown in Table 2.

Establishment and maintenance of the experiments

The all field trials were established at the research farm of the Sugarcane Research Institute (SRI) at Uda Walawe. Land preparation, planting and crop management were carried out as per SRI recommendations (SRI, 1991). Seed beds were prepared by making ridges and furrows with a tractor-mounted ridger with the centre spaced at 1.4m to create furrows of 17 to 22 cm deep. The sugarcane variety (Co 775) stem cuttings with three internodes (setts) were planted in the furrows. The planting was coincided with the commercial planting periods for sugarcane in the area; the experiments I & II on April 10, 2013 and the experiment III during October / November 2013. The crops were raised under supplementary irrigation. Tank mixtures of herbicides were applied by a hand-operated knapsack sprayer fitted with single, poly-jet nozzle. The herbicides were directed sprayed in between the cane rows by walking the operator on the ridges. The swath-width (45cm above the ground) was 1.5m; the spraying pressure was approximately 2 – 3

Assessments

Assessment criterion

The effects of the herbicides treatments on weed knockdown, residual activity and crop phytotoxicity were evaluated. The weed control and crop damages were assessed visually and graded on a 0 to 100 scale. The ratings were summarised according to the Table 3.

Table 2. Common weeds grown in association with sugarcane in the experimental area

Grasses	Broadleaves	Sedges
Panicum maximum	*Ageratum conizoides*	*Cyperus rotundus*
Elusine indica	*Amaranthus viridis*	*Cyperus iria*
Isachne globosa	*Ipomea triloba*	*Fimbrystylis miliaceae*
Dactyloctenium aegptium	*Acanthospermum hispidum*	
Echinocloa colona	*Euphobia heterophyla*	
	Euphobia hirta	
	Cleome rutidosperma	
	Waltheria indica	
	Boraria laevis	

Table 3.The scale used for evaluating weed control and crop damage visually

Scale	Degree of weed control	Degree of crop damage
0 – 10	No weed control	Non / Minor crop damage
10 – 30	Poor weed control	Less crop damage
30 – 60	Moderate weed control	Significant crop damage
60 – 90	Satisfactory weed control	Severe crop damage
90 – 100	Complete weed control	Complete crop damage

The weed knock down and residual activity of the herbicide treatments were also assessed by counting the number of live weeds before and after regular intervals of introducing herbicide treatments.

Assessment of weed control

Visual observations were made and species composition of weed flora was recorded before herbicide application in all locations where investigations were carried out (Table 2). The weeds knock down was rated according to the scale given in Table 3, one, two and three weeks after herbicide application in each of the experiment I and II. The residual activity was assessed as the effect of herbicide treatments on weeds in comparison with untreated control at 4, 6, 8 and 12 weeks after spraying (WAS). The density and species composition of weeds which appeared before herbicide application and after regular intervals were also recorded. In the replicated experiments, weed appeared in five randomly-selected places on the ridges in each treatment plot were counted by placing 50 x 50 cm quadrat to estimate density. In the case of the experiment III, weeds were counted in ten random places on the ridges in each treatment plot.

Assessment of crop damage

Crop damage or phytotoxicity as burning/discoloration or stunting including the death of plants were assessed in each plot visually using a 0 to 100 scale (Table 3). Phytotoxicity assessments are reported only when there were observable toxicities.

Data analysis

The visual ratings given for weed control and crop damage by three assessors were averaged and presented with their standard error values and those values were compared with the levels given in Table 3. Also the rated values were subjected to ANOVA procedure for comparison.

Weed counts of different species in each sampling point were categorised under three major weeds types; i.e. grasses, broad-leaved weeds and sedges. The total numbers of each weed specie belonged to one category i.e. grasses, broad-leaved weeds and sedges in one sampling point were added and converted to number per square metre to estimate density. Then, the estimated densities of grasses, broad-leaved weeds and sedges in five sampling points were added separately and divided by five to estimate average density of each weed type in each treatment plot. The total weeds densities in each treatment plot were estimated by adding average densities of grasses, broad-leaved weeds and sedges in each treatment plot. Total weed densities and densities of individual weed types; grasses, broad- leaved weeds and sedges were subjected to ANOVA procedure for mean comparison.

RESULTS AND DISCUSSION

Early post-emergence application

At the time of herbicide application, weeds were tiny and tender with 2 – 4 leaves; densities ranged between 175 – 280 plants/m^2. The recently-emerged sugarcane settlings were sporadically scattered in the fields as spikes.

Effect on weed knock down and crop phytotoxicity

Weed knock down as appeared from the ratings given for weed control were above the satisfactory level (60%) in all herbicide treatments except Kristmat 0.5 kg/ha at 3 weeks after spraying (WAS). Degree of weed knock down increased with increasing the rate of application (Table 4). However, the effect of weed knock down was not satisfactory and was not comparable with that of the standard treatment, Diuron and Paraquat mixture.

The phytotoxicity of Krismat on sugarcane, as appeared from the rated crop damage was minor and negligible (the ratings 2 - 4) and lower than rating (16) recorded in standard herbicide Diuron + Paraquat treatment (Table. 4). The only phytotoxicity found at 1WAS was slight yellowing of sugarcane leaves. But the symptoms have entirely disappeared in a week time, showing a rapid recovery.

According to the counted live weeds left behind 3 WAS, there was an over 90% reduction of densities of grasses, broad-leaved weeds and total and the effect is not significantly different between different rates of Krismat applied from 0.5 to 1.5 kg/ha and Diuron + Paraquat treatment (Table 5). However, in the case of sedges dominated by *Cyperus rotundus*, there was no significant reduction ($P \geq 0.05$) of densities either due to Krismat treatments or standard treatment compared with the control. This indicates an appreciably higher effect of tested rates of Krismat on the knock down of grasses and broad-leaved weeds when applied at early post-emergence stage of weeds and poor control of *Cyperus rotundus*.

Residual effect

The residual effect of Krismat at the rates tested in comparison with the control treatment appeared to be fairly poor. The over satisfactory weed control was appeared only until six weeks when Krismat was applied at the rate of 1.5 kg/ha. On the other hand, standard treatment provided an appreciably high level of lasting residual effect for almost 12 weeks after application of the treatment. The level of weed control provided by Diuron/ Paraquat mixture is fairly adequate to keep the weed competition at a minimum during the critical period of crop growth.

Table 4. Visual ratings (%) given for weed control at 1 and 3 WAS and crop damage at 1 WAS herbicide treatments at early post-emergence stage

Treatment	Weed Control				Crop damage	
	1 WAS		3 WAS		1 WAS	
	Rating	SE	Rating	SE	Rating	SE
Krismat 0.5kg /ha	75 [a]	0.63	47[a]	2.5	2.5	2.5
Krismat 1.0kg / ha	77[a]	5.0	64[b]	4.7	2.5	2.5
Krismat 1.5kg /ha	80[a]	3.13	77[b]	6.3	3.8	3.8
Paraquat 6l + Diuron 3.5kg/ha	94[b]	1.88	100[c]	0.0	15.6	3.1
Control	0.0	0.0	0.0	0.0	2.5	2.5

Means followed by the same letter in each column are not significantly different ($P \geq 0.05$).

Table 5. Mean live weed densities (Plants / m^2) of grasses, broad-leaved weeds, sedges and their totals before and 3 WAS at early post-emergence stage

Treatment	Grasses		Broad leaves		Sedges		Total	
	Before	3WAS	Before	3WAS	Before	3WAS	Before	3WAS
Krismat 0.5kg /ha	104	3b	146	11b	14	7	263	22b
Krismat 1.0kg /ha	96	9b	174	15b	19	11	289	35b
Krismat 1.5kg / ha	75	0b	188	5b	22	5	285	9b
Paraquat 6l + Diuron 3.5kg/ha	106	0b	204	3b	12	7	321	10b
Control	82	35a	143	80a	12	13	237	128a
CV%	29	163	24	144	61	54	14	119

Means followed by the same letter in each column are not significantly different ($P \geq 0.05$).

It was noted that Krismat exhibited a differential degree of residual control of different weed species. The rates adopted in the present study effectively controlled all broad-leaved weeds for about 6 weeks after application, but failed to give a lasting control of grasses and Cyperus rotundus.

Late post-emergence application

At the time of herbicide application, weeds were grown-up and mature. Sugarcane germination has been completed and the emerged settlings, the majority at 3 – 5 leaves stage, were appeared along the planted furrows with 3 – 5 inches inter settling spacing.

Effect on weed knock down and crop phytotoxicity

Weed knock down 1 WAS, rated visually was above the satisfactory level (60%) only when Kristmat was applied at the rates of 1.0 and 1.5 kg / ha (Table 7). Effect of Krismat at low dosage rates (0.5 kg/ha) failed to knock down mature weeds satisfactorily. However, the effect on weed knock down was not satisfactory and was not comparable with that of the standard treatment, Diuron + Paraquat mixture.

Similar to the early post-emergence application, the phytotoxicity of Krismat on sugarcane was minor and negligible (the ratings 2–5) even on young sugarcane settlings. In contrast, the phytotoxicity on young sugarcane settlings as appeared burning of leaves due to Diuron + Paraquat treatment was significantly ($P \leq 0.05$) higher (rating 20) and also took several weeks to recover inducing mild stress condition over crop and perhaps retardation of growth. This high tolerance of sugarcane settlings to the rates tested in this experiment allows increasing the rate of application of Kristmat to get higher level of weed control (Table. 7).

Table 6. Visual ratings (%) given for weed control at 4, 6, 8 and 12 WAS herbicide treatments at early post-emergence stage

Treatments	Weed control ratings			
	4 WAS	6 WAS	8 WAS	12 WAS
Krismat 0.5kg / ha	50[a]	33[a]	25[a]	2[a]
Krismat 1.0kg / ha	60[b]	50[b]	40[b]	10[b]
Krismat 1.5kg/ha	65[b]	60[b]	53[b]	19[b]
Paraquat 6l + Diuron 3.5kg/ha	97[c]	95[c]	86[c]	86[c]
Control	0	0	0	0

Means followed by the same letter in each column are not significantly different ($P \geq 0.05$).

Table 7. Visual ratings (%) given for weed control and crop damage 1 WAS at late post- emergence stage

Treatment	Weed control		Crop damage	
	Rating	SE	Rating	SE
Krismat 0.5kg / ha	59[b]	6.4	2.5[b]	1.5
Krismat 1.0kg /ha	64[b]	5.2	2.5[b]	1.5
Krismat 1.5kg / ha	68[b]	4.5	5.0[b]	2.3
Paraquat 6l + Diuron 6 l + 3.5kg/ha	95[a]	3.8	20[a]	4.2
Control	0	0.0	na	Na

Means followed by the same letter in each column are not significantly different ($P \geq 0.05$).

The effect on weed knock down of herbicide treatments to reduce density of different weed species were non-significant ($P \geq 0.05$) perhaps due to heterogeneity of occurrence and distribution of weeds species, as evidenced by the corresponding higher CV% values. However, the knock down of total weed densities were 62%, 71% and 92% when Kristmat was applied at the rates of 0.5, 1.0 and 1.5 kg./ha respectively and comparatively higher than the observed 42% in Diuron + Paraquat treatment. Moreover, Kristmat showed differential knock-down effect on different weed species. The knock down of grasses was over 83% when Krismat was applied at the rate of 1.5 kg/ha, according to the mean weed density values before and 3 WAS (Table 8). However, knock down of grasses was less than 50 % if Krismat was applied at lower dosage rates of 1.0 kg/ha and negligible if applied at 0.5 kg/ha. The knock down of broad-leaved weeds by Krismat was more as there is an over 82% reduction both at the rates of 0.5 and 1.0 kg / ha and 100 % if applied at 1.5 kg / ha. The knock down of grasses and broad-leaved weeds were 38% and 45% respectively in Diuron + Paraquat treatment and less than the effect of Kristmat when applied at the rates of 1.5 kg/ha. This indicates that, Krismat 75 WG even at lower dosage rates (0.5 & 1.0 kg/ha) are sufficient to knock down broad-leaved weeds but relatively higher dosage rates are required to knock down grasses. However, there is no an appreciable knock down of *Cyperus rotundus*, due to Krismat treatment in the rates tested here.

Residual effect

The residual effect of Krismat at the rates tested was below the satisfactory level beyond 4 WAS. On the other hand, the standard Diuron + Paraquat treatment provided an appreciably high level of lasting residual effect even beyond 12 WAP and adequate to keep the weed competition at a minimum during the critical period of crop growth.

The above analysis indicates that Kristmat 75 WG could effectively be used to control annual grasses and broad-leaved weeds in sugarcane plantations by application at both early post- emergent and post-emergent stages. Moreover, increasing trend in the degree of weed control, both knock-down effect and residual effect on weeds, with increasing the rate of application from 0.5 to 1.5 kg/ha together with extremely high crop tolerance suggests that further increase of the rate of application may provide more effective level of weed control. This is quite evident from the results of the experiment III in which higher dosage rates of Krismat were tested after late post- emergence application.

Effect on cane yield

After early post-emergence application, cane yield was significantly ($P \leq 0.05$) less in

Table 8. Mean live weed densities (Plants / m^2) of grasses, broad-leaved weeds, sedges and the total weeds before and 3 WAS at late post emergence stage

Treatment	Grasses		Broad-leaved		Sedges		Total	
	Before	3WAS	Before	3WAS	Before	3WAS	Before	3WAS
Krismat 0.5kg / ha	56	46	116	17	1	3	173	65
Krismat 1.0kg / ha	50	28	158	28	6	4	213	61
Krismat 1.5kg / ha	66	11	145	0.63	7	4	218	16
Paraquat 6l + Diuron 2.5kg / ha	67	41	129	71	12	9	208	121
Control	48	36	123	49	8	3	179	88
CV%	46		50		104		48	

Means followed by the same letter in each column are not significantly different at 5% probability.

Table 9. Visual ratings (%) given for weed control 4 and 8 WAS when herbicide treatments were applied at late post-emergence stage

Treatments	Weed control	
	4 WAS	8 WAS
Krismat 0.5kg / ha	37[a]	10[a]
Krismat 1.0kg / ha	35[a]	09[a]
Krismat 1.5kg / ha	54[b]	14[a]
Paraquat 6l + Diuron 3.5kg / ha	93[c]	93[c]
Control	0	0

Means followed by the same letter in each column are not significantly different $P \geq 0.05$.

Krismat 0.5 and 1.0 kg/ha treatments than the Krismat 1.5 kg/ha and Diuron + Paraquat treatments. This may be due to differences of degree of weed-crop competition until clean weeding 16 weeks after planting (WAP). The least yield recorded in control plots is due to higher weed pressure over the crop in terms of degree and duration of competition. Likewise, there is an increasing trend of cane yield from 44 t/ha to 62 t/ha with increasing the rate of Krismat applied from 0.5 kg/ka to 1.5 kg/ha and Diuron + Paraquat treatment, again due to varying degree and duration of weed competition in the respective treatment plots (Table 10).

After late post-emergence application, cane yields in all treatment plots were comparatively low; perhaps due to the effect of weed/crop competitions until adoption of herbicide treatments, 28 DAP. Differences of yields in the plots applied with different herbicide treatments could be attributed to their different levels of weed control. The effect of Kristmat in controlling weeds is superior over the Diuron + Paraquat treatment when it was applied at late post-emergence stage. There is an increase in cane yield by 21% when Krismat was applied at the rates of 0.5 and 1.0 kg/ha rates and by 48 % when Krismat was applied at the rate of 1.5 kg/ha compared with control and Diuron + Paraquat treatment. This could be attributed to the level of weed control in terms of knock-down and residual effects and negligible crop damages reported in Krismat treatments applied at late post-emergence stage compared with that of the control and Diuron + Paraquat treatment (Table 10).

Effect of higher rates of Krismat 75 WG applied at late post-emergence stage

The visual ratings reported 1 WAS indicate appreciable knock-down of weeds over 85% to 90% when Krismat was applied at the rates from 2 to 6 kg /ha (Table 11). It was also noted that poorly controlled weed species after application of low rates of Krismat (0.5 to 1.5 kg/ha) were able to control successfully when higher rates were adopted. Further, comparatively higher rating values recorded at 4 and 8 WAS confirm high level of residual control of annual grasses and annual broad-leaved weeds after application of Krismat at higher rates of 2 – 6 kg / ha.

Table 10. Cane yield in different herbicide treatments and control in early post emergence and late post emergence sprayed experiments

Treatment	Early post-emergence		Late post-emergence	
	Yield (t/ha)	SE	Yield (t/ha)	SE
Krismat 0.5kg / ha	44b	1.39	40b	5.05
Krismat 1.0kg /ha	48b	6.14	43ab	4.03
Krismat 1.5kg / ha	60a	3.64	49a	1.92
Paraquat 6l + Diuron 3.5kg/ha	62a	4.02	35c	2.28
Control	30c	3.77	33c	11.54

Means followed by same letter in each column are not significantly different P=0.05.

Table 11. Visual ratings (%) given for weed control and crop damage after different time periods when Krismat was applied at higher dosage rates at early post emergence stage

Treatment	Weed control rating			Phytotoxicity rating	
	1 WAS	4 WAS	8 WAS	1 WAS	2 WAS
Krismat 2.0 kg / ha	85[a]	80[a]	65[a]	2.5	0
Krismat 4.0kg / ha	90[a]	88[a]	75[a]	4.4	0
Krismat 6.0kg / ha	90[a]	93[a]	80[a]	6.0	0
Control	0	0	0	0	0

Means followed by the same letter in each column are not significantly different $P \geq 0.05$.

The very high level of weed control accompanied with broad spectrum activity and presence of effective knock-down and residual effect on weeds showed by Krismat during the present investigations could be attributed to the different modes of action (inhibition of amino acid biosynthesis and photosynthesis light reaction) of the two chemical constituents, Ametryn and Trifloxysulfuron, in Krismat formulation (Thomson, 1986). Combination of two herbicides with different modes of action would also offer more opportunities for the management of resistance development in weeds that are sensitive to both herbicides independently (Preston, 2000).

The phytotoxicity showed by Krismat on sugarcane was almost negligible. The only phytotoxicity symptom found at 7 days after herbicide application was slight yellowing of the leaves of sugarcane (Table 11). But the symptoms have entirely disappeared in a week time showing a rapid recovery. Change in application time or increasing the rate of application have made no serious observable changes in phytotoxiciy except for slight yellowing of leaves in sugarcane. Thus, there is hardly any chances in reducing sugarcane yields due to toxicities when Krismat is applied at the rates from 0.5 kg/ha to 6kg/ha.

CONCLUSIONS

The herbicide Krismat can be safely and effectively applied to control annual grasses and annual broad-leaved weeds by knock-down and residual action in sugarcane for over two months after planting the crop. The appropriate rate of application would be 2 - 4 kg/ha of the commercial formulation (Krismat 75 WG) and the period of application could be varied between two to four weeks after planting (from early to late post-emergence stages). Broad-leaved species are more vulnerable and could easily be controlled by a low dosage rate whereas a high dosage rate has to be applied to control grasses species. Event though, there is a little suppression, the control of *Cyperus rotundus* is not satisfactory after application of this herbicide.

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