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Relative Efficacy of Simazine and Select Dithiolcarbamates in the Control of Weeds in Hybrid Sorghum

by

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Sorghum is grown on comparatively heavier soils on which control of weeds is one of the most difficult tasks as these soils and climatic conditions give rise to a host of weed problem. Past experiments at Udaipur showed that application of 2, 4-D sodium salt best controls weeds when applied at the rate of 1.0 to 1.5 kg/ha (Singh and Faroda, 1964). Yet, some weeds like *Trianthema portulacustrum* and *Physalis minima* remained unhurt and hand weeding was the best to control many of the weeds including *Trianthema portulacustrum* (Singh and Porwal, 1967). Use of simazine which has given remarkable control of weeds in maize and also other herbicides as EPTC and PEBC which hold great promise are worth trying. Since time and rates of application of these herbicides are different for different crop weed situation it will be of practical importance to try these new herbicides and work out proper time and rate of application and to see how the new practices compare with the traditional methods of controlling weeds by the use of 2, 4-D.

Materials and Methods : The experiment consisted of three herbicides *viz.*, simazine, EPTC and PEBC with seven concentrations *viz.*, 1.0, 1.5, 2 0, 2.5 3.0, 3.5 and 4.0 kg (*a.i.*) per hectare, applied as pre-planting and pre-emergence treatments making thereby 21 treatments in pre-planting and 21 in pre-emergence series. To these treatment combinations one control in pre-planting

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and one standard (2, 4-D application) in pre-emergence treatments were added. These 44 treatments, replicated two times, were tried in split plot desi

Simazine, EPTC, PEBC and 2, 4-D sodium salt were applied through Tafazine (50% *a.i.*), Eptam (60% *a.i.*), Tillam (60% *a.i.*) and Bladex-A (80% *a.i.*) respectively as aqueous sprays.

Hybrid sorghum CSH-1 was sown on June 27, 1965 as a test crop. Pre-planting application was done 10 days before sowing. EPTC and PEBC were incorporated into the soil immediately after spraying. Since incorporation is not possible after sowing without disturbing the seeds, application of EPTC and PEBC was made before sowing in case of pre-emergence application. Pre-emergence application of simazine was made one day after sowing.

Dry matter production and uptake of N by weeds and grain yield and uptake of N by the sorghum crop were used as criteria for treatment evaluation.

Results and Discussion: *Dry matter production and uptake of N by weeds:* Application of herbicides as pre-planting treatment reduced weed dry matter production over control by 5 6 and 14.5 q/ha at 30 days after sowing and at harvest respectively. Corresponding per cent wise decreases were 66.7 and 47.7. Uptake of N by weeds due to the application of herbicides was reduced by 14.0 and 27.1 kg/ha at these stages respectively with per cent decrease of 36.5 and 32.5. Although there was no significant difference between 2, 4-D treatment and herbicidal treatment, reduced dry matter production and N uptake were to a very great extent associated with herbicidal treatment.

On the effect of different herbicides it may be noted that application of simazine very drastically reduced production of dry matter and uptake of N by weeds. Simazine as pre-planting and pre-emergence treatment did not differ in its effect on dry matter production or uptake of N by weeds.

TABLE 1. *Effect of different treatments on dry matter production and uptake of N by weeds*

Treatments	Dry matter (q/ha)		Uptake of N (kg/ha)	
	30 days	at harvest	30 days	at harvest
Control	14 1	44.9	38.3	83.4
Standard	10.8	29.9	23.1	60.3
Treatments	8.5	28.6	24.2	54.4
Simazine	3.4	16.6	11.4	36.2
EPTC	11.2	34.6	31.6	63.5
PEBC	10.7	34.5	29.5	63.4
S. Em. ±	0.3	1.1	3.1	2.1
L.S.D. at 5%	0.9	3.6	8.9	6.1

Weeds produced more dry matter and removed N to the extent of 83.4 kg/ha in check plots. Dry matter production and removal of N therein was significantly greater than that in plots where either 2, 4-D was applied or new treatment were tried. While there was no difference between the effect of 2, 4-D and new treatments, effects of both of these practices were significantly better than applying no treatment. Thus use of 2, 4-D saved N to the extent of 23 kg/ha and that of new herbicides saved about 29 kg N/ha.

TABLE 2. *Combined effect of different herbicides and their rate of application on dry matter production (q/ha) and uptake of N (kg/ha) by weeds at harvest*

Rate of application (kg/ha)	Herbicides									
	Simazine		EPTC		PEBC		S.Em.*		L.S.D. at 5%	
	Dry matter	N	Dry matter	N	Dry matter	N	Dry matter	N	Dry matter	N
1.0	25.0	46.3	34.5	57.8	35.5	63.8	2.9	5.9	8.1	16.7
1.5	21.5	47.0	35.1	59.3	32.2	58.1				
2.0	18.6	39.5	34.1	57.6	40.5	73.2				
2.5	17.4	38.2	27 6	61.8	27.9	52.7				
3.0	15.2	30.0	40.2	77.9	31.3	56.3				
3.5	11.5	33.0	33.1	57.7	36.6	64.4				
4.0	8.2	19.7	37.9	72.8	37.2	77.8				

It may be noted from Table 2 that application of simazine tended to reduce weed dry matter production and N removed by them with increasing rates of application. It may also be pointed out that decreases or increases in uptake of N by weeds due to different weed control treatments were proportionate to dry matter production by weeds. Although increasing levels of simazine had very depressing effect on uptake of N it was not upto the application rate of 2.5 kg/ha that effects were drastic. At higher rates of application than 2.5 kg/ha weed dry matter production and uptake of N were cut off absolutely. Similarly within the given levels of EPTC and PEBC differences on weed dry matter production and removal of N were not significant but compared to the effect of simazine at any level weed dry matter production and uptake of N over EPTC and PEBC were significantly less. Weed dry matter production and N uptake were significantly more i. e. at the rate of 1.0 kg/ha the removal of N under simazine was 46.3 kg/ha and under EPTC and PEBC at the same rate were 57.8 and 63.8 kg/ha respectively.

In most of the cases pre-emergence application was the best and pre-planting application had poor effect. Better control of weeds due to pre-emergence use of simazine appears to be due to upsetting of physiological functions of the weeds particularly at pre-emergence stage which is clearly evidenced

by reduced dry matter production and N uptake by weeds which are important characteristics of growth. Weeds growing in plots treated with simazine produced only 1/3 dry matter as compared to those growing in dithiolcarbamates treated plots. Damaging effect of simazine in reducing the dry matter production by weeds and uptake of N by them were further aggravated when simazine was applied at the rate of 1.5 to 2.0 kg/ha as pre-emergence treatment.

Grain Yield: An examination of data on the effect of different herbicides on grain yield indicates that all herbicides were equally effective in so far as effect on grain yield was concerned. Similar was the case with respect to the effect on removal of N by the crop. There, however, occurred significant variation due to the effect of herbicides at different levels. Highest yield was obtained when application rate did not exceed 1.0 kg/ha. Increasing rates of herbicides tended to significantly scale down grain yield of sorghum. Uptake of N under the influence of different herbicides almost followed the same pattern as on grain yield.

While relative efficiency of herbicides in terms of grain yield and uptake of N was very large when they were applied as pre-planting treatment, there was, however, no large difference as regards their effect on grain yield and uptake of N by sorghum.

The effect of the new set of herbicides was better than control but inferior to 2, 4-D standard treatment. A further reference to the combined effect of different herbicides and their time and rate of application on grain yield shows that application of simazine, EPTC and PEBC at the rate of 1.0 kg/ha was the best and any increase beyond this leaves adverse effect on the crop. While simazine did not seem to be so serious in increasing concentration from 1.0 to 2.0 kg/ha, application of EPTC and PEBC even at the rate of 1.5 kg/ha seriously jeopardised expression of grain yield. Similarly all the herbicides were found to be superior to control weeds and increase grain yield when applied as pre-planting treatment. Pre-planting application of simazine, EPTC and PEBC increased the grain yield over pre-emergence application by 156.3, 30.0 and 63.3 % respectively.

Application of herbicides particularly simazine brought about very good results when made in suitable combinations with time and rate of application. Application rate of 1-2.0 kg/ha as pre-planting treatment gave similar results and when compared with higher doses or pre-emergence treatment, increases were statistically significant. Pre-emergence application on the whole, was unsatisfactory for all the herbicides but it was particularly true for simazine. In no case there was any scope to increase the dose beyond 1.0 kg/ha. Pre-planting application of simazine, EPTC and PEBC increased

TABLE 3. *Combined effect of different herbicides and their rate and time of application on grain yield of sorghum (q/ha)*

Rate of application (kg/ha)	Herbicides				
	Simazine	EPTC	PEBC	S. Em.	L.S.D. at 5%
1.0	25.2	26.3	26.8		
1.5	25.1	21.5	24.0		
2.0	27.3	18.1	15.3		
2.5	19.1	12.1	22.1	2.5	7.0
3.0	14.5	13.5	15.3		
3.5	10.1	22.5	16 6		
4.0	6.9	15.9	18.6		
Time of application :-					
Pre-planting	26.4	20.9	24.5	1.3	3.6
Pre-emergence	10.3	16.1	15.0		

grain yield of sorghum by 16.1, 4.8, and 9.5 q/ha over pre-emergence application respectively. Increasing rate of application were associated with reduced grain yield which can also be verified from the existence of inverse relationship. The correlation coefficient was 0.94 and regression equation was $Y = -4.06X + 29.05$. This shows that a unit increase of 1.0 kg/ha in the dose of herbicide decreased grain yield by 4.06 q/ha.

Maximum and significantly higher grain yield per ha was obtained when simazine was applied at the rate of 1–2.0 kg/ha as pre-planting treatment. Inreased grain yield of sorghum due to this treatment might be because of reduced weed infestation which, in turn, might have made more nutrients and water available to crop plants. Since N is the most important limiting factor in crop production, increased uptake of this element might, in all possibilities, have increased grain yield. Increased yield of sorghum with the application of simazine at the similar rate of application were also reported by Brasesco (1962), Matveenko (1964) and also by Shell (1960).

Higher doses of simazine not only did not offer any advantage but they were associated with decreased grain production. Decreased grain yield with increasing rates of application appears to be due to toxic effect of simazine on sorghum plants at both the stages, but particularly at pre-emergence stage. Injurious effects of simazine on sorghum at higher rates, particularly at pre-emergence stage were also reported by Elder (1961), Albert (1961) and Faivre Dupaigre (1963). Reduced yield of sorghum due to doses of simazine below 2.0 kg/ha, however, might be due to reduced control of weeds.

Existence of significant negative correlation of 0.87 between the rates of simazine at pre-planting stage and grain yield show that higher rates of application were not associated with higher yields. The regression equation $Y = -8.21X + 46\ 52$ shows that increase in the application rate of simazine by 1.0 kg/ha decreased grain yield by 8.21 q/ha while at pre-emergence state the correlation coefficient was 0.89 and the regression equation $Y = -5.48X + 24.00$ showing that yield of grain was decreased by 5.48 q/ha with an increase in the application rate by 1.0 kg/ha. It thus comes out that reduced dry matter production by weeds was not associated with increased yield most probably because of damaging effect of simazine on the crop also. The rates of application which reduced dry matter production by weeds also had a similar effect on grain yield.

In case of EPTC and PEBC good results were obtained at the rate of 1.0 kg/ha when applied as pre-planting treatment. Yield of grain decreased but in an nonuniform way with the increasing rates of application of EPTC and PEBC and particularly at pre-emergence state, probably due to soil conditions not exactly understood or due to lack of inadvertent precision in their application. Toxic effect was more at higher rates of application, particularly at pre-emergence stage. Toxic effect of these herbicides on sorghum were also reported by Freeman and Waldrep (1963) and Orsenigo (1963).

Poorer grain yield due to the use of EPTC etc., might also be due to poorer weed control with these herbicides which was also reported by Orsenigo (1963).

Existence of a negative significant correlation of 0.94 between the levels of herbicides and grain yield and the regression equation $Y = -4.96X + 29.05$ show that increase in the rate of application of herbicides as a whole increased grain yield by 4.06 q/ha. This relationship shows increased toxic effect of increasing rates of application on grain yield.

The rate and time of application of these herbicides had a very profound effect on uptake of N. Out of the new herbicides tried, highest uptake *i.e.* 64.5 kg/ha occurred when simazine was applied at 2.0 kg/ha but application rate of simazine from 1–2 kg/ha did not significantly affect the N uptake but higher rates tended to appreciably lower down the uptake of N. Rate of application of EPTC and PEBC had no effect on uptake but in most cases 1.0 kg/ha increased uptake of N. Pre-planting application of simazine resulted in the uptake of 53.0 kg/ha which was 24.3 kg/ha more than that under pre-emergence treatment. Corresponding pre-planting application of EPTC and PEBC were inferior to pre-planting treatment of simazine.

TABLE 4. *Combined effect of different herbicides with different rates and time of application on uptake of nitrogen by the sorghum crop (q/ha)*

Rate of application (kg/ha)	Herbicides				
	Simazine	EPTC	PEBC	S.Em. ±	L.S.D. at 5%
1.0	51.0	42.9	62.0		
1.5	55.8	39.0	53.0		
2.0	64.5	34.1	27.6		
2.5	40.9	22.4	44.6	6.9	19.7
3.0	34.2	26.9	32.1		
3.5	26.0	32.5	29.3		
4.0	14.1	31.8	28.0		
Time of application:					
Pre-planting	53.0	38.6	43.7	3.6	10.3
Pre-emergence	28.7	32.7	35.4		

Uptake of N:

Significantly increased uptake of N was noted under the pre-planting application of simazine, applied at the rate of 1–2.0 kg/ha followed by that under EPTC and PEBC applied at the rate of 1.0 kg/ha. Greater uptake of N under pre-planting treatment as a whole as compared to pre-emergence treatment appears to be due to the effective weed control and safety to crop under these treatments. In case of pre-emergence treatment or under higher rates of application crop was so much damaged that sufficient population and/or growth was not available to make use of N set free due to control of weeds.

Summary and Conclusion: Application of simazine, EPTC and PEBC all when applied at the rate of 1.0 kg/ha as pre-planting treatment compared well with standard 2, 4-D treatment and were superior to no treatment. Effective control of weeds and associated increase of yield of the crop shows that all these herbicides hold a very great promise in this direction but further experiments are necessary by employing lower doses to work out the suitable dose and innocuous method of application of these herbicides. Pending further investigation, application of simazine as pre-planting treatment *i. e.* 10 days before sowing, would increase yield by 66.2 and 21.0% over control and standard 2, 4-D treatment respectively. The reduction in weed dry matter production were found to be 48.5 and 21.7% over control and standard 2, 4-D treatment. Pre-emergence treatment of none of the two herbicides tried was found to be useful.

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