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EFFECTS OF HERBICIDES ON THE RATE OF GERMINATION AND RESPIRATION OF COTTON SEEDS

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Delinted seeds of *Gossypium hirsutum* L. cv. M-100 were treated with prometryne, cotoron and their mixture (1:1). Percentage germination and rate of respiration were recorded after regular intervals.

A highly significant increase in the rate of respiration was found to be associated with a markedly reduced percentage of germination as a result of cotoron application. Results obtained from the mixture were significant at $P < .05$, whereas the effect of prometryne was insignificant on either parameters.

INTRODUCTION

Varied responses of plants to different herbicides under various conditions provokes an extensive toxicological study to evaluate the suitability of various herbicide species to Pakistani crops.

In general, triazines have been reported to cause irreversible mitotic disturbances [1] and inhibition of respiration associated with oxidative phosphorylation [2]. Substituted urea compounds are, however, considered to be responsible for acceleration of respiration [3], swelling and distortion of mitochondrial [4] and retardation of mitosis in various tissues [5].

For weed control in cotton, prometryne (6-methylmercapto-2-4-bis(isopropylamino)-s-triazine) and cotoron (3-trifluoromethyl-phenyl)-1, 1-diethyl urea) are generally recommended at a rate of 3–4 kg/ha as pre- or postemergence measures.

The present investigation is on the germination and respiratory responses of the seeds of a widely cultivated variety of cotton M-100 to promotryne, cotoron and their equal mixture.

EXPERIMENTAL

Germination trials were expedited on Whatman filter paper No.1 in 10-cm dia petri dishes each containing ten acid delinted seeds of *Gossypium hirsutum* L.cv. M-100. Prometryne, cotoron and a mixture (1:1) of both were applied at a rate of 440 ppm (approx. 3 kg/ha) using 5 ml aqueous solution per petri dish. Four replicates were maintained for each treatment and control in dark at 32° and 27° for 12-hr alternate duration. Distilled water was used for successive watering and the rate of germination was recorded daily.

Warburg's constant volume respirometer was employed to entail the respiratory behaviour of the seeds [6]. The main chamber of the Warburg's flask contained 2 ml phosphate buffer (pH 6.8) and the seeds. Whereas the central well was loaded with 0.5 ml of 10% KOH. The herbicide doses were mixed with the buffer to attain 440 ppm concentration. Six replicates of five seeds each were maintained for every treatment.

About 7 hr after administering the herbicides, the flasks were shaken at 30 strokes/min in dark at 27°. From the hour 8 onwards the manometric levels were monitored after every 10 min.

RESULTS AND DISCUSSION

It is apparent from Table 1A that both the herbicides and their equal mixture reduce the germination percentage.

As compared to the control, the rate of germination on the second day of the experiment was 52.37% for prometryne, 28.57% for cotoron and 47.62% for the mixture-treated seeds. On the third day the same ratios were 40.63, 34.38 and 31.25% for the treatments of prometryne, cotoron and the mixture, respectively.

The controls attained their maximum on the 4th day by exhibiting 85% germination, whereas the seeds treated with prometryne were able to cover 52.94% and those with cotoron and the mixture up to 38.24% of the control.

Germination was abated in the cotoron-treated seeds from the 4th day onward. Nevertheless, germination rate on the 5th day crept up to 73.53% near the control in the prometryne-treated seeds. Those treated with the mixture could follow up to 44.12%. The final ratio of treatments to control was 76.74% for prometryne and 55.88% for the mixture. No further seed germination was observed in any of the replicates on the 7th day. Final observations tabulated for germination study, project a highly significant

Table 1A. Relative percentage germination of cotton seeds.

Treatments	Day 2	3	4	5	6	7
Prometryne	52.38	40.63	52.94	73.53	76.47	76.47
Cotoron	28.57	34.38	38.24	38.24	38.24	38.24
Prom. + Cot. (1:1, w/w)	47.62	31.25	38.24	44.12	55.88	55.88

Table 1B. Respiratory oxygen uptake of cotton seeds during the 8th hour of their germination.

Treatments	Rate of respiration μl. O_2 uptake/seed/hr
Control	0.5190±0.044
Prometryne	0.7765±0.087
Cotoron	2.6850±0.059
Prom. + Cot. (1:1 w/w)	1.6275±0.095

(The herbicides were applied at a rate of 440 ppm–approx. 3kg/ha).

reduction in the per cent germination of cotoron-treated seeds. A reduction significant at $P < .05$ level was apparent in the seeds treated with the mixture. However, prometryne was not found to cause a significant reduction in germination (Table 2A).

The study of the respiratory behaviour (Table 1B) revealed that during the 8th hr the untreated seeds consumed 0.519±0.044 μl . O_2/seed/hr. Application of prometryne accelerated the uptake of oxygen to 0.7765± 0.087 μl . The highest rate of respiration recorded for cotoron-treated seeds was 2.685±0.059 μl . O_2 uptake/ seed/hr. A mixture of both the herbicides could raise the oxygen uptake to 1.6275±0.095 μl seed/hr. These results find their significance on a level mirror image to that of germination study (Table 2B).

Contrary to Gysin and Knusli [7], Sasaki and Kozlowski [8] and Sasaki *et al* .[9], the present investigation encountered 23.53% inhibition in germination in the case of prometryne-treated cotton seeds. The increase in respiration due to the action of these herbicides is consistent with the earlier observations of Thompson *et al*.[2], and suggests that increase in respiration and concomitant decrease in the rate of germination may well be due to the uncoupling of oxidative phosphorylation by herbicide action. Similar phenomenon has been observed by a number of other

Table 2A. Analysis of variance of germination study.

Source of variation	SS	d.f	MS	F
Treatments	17.2038	3	05.7346	17.377*
Prometryne	00.9627	1	00.9627	02.917†
Cotoron	13.6486	1	13.6486	41.359*
Prom. + Cot. (1:1)	02.5925	1	02.5925	07.856**
Error	00.6590	20	00.3300	–
Total	23.7938	23	–	–

Table 2B. Analysis of variance of respiration study.

Source of variation	SS	d.f	MS	F
Treatments	881.58	3	293.86	09.0566*
Prometryne	127.81	1	127.81	03.939†
Cotoron	510.59	1	510.59	15.736*
Prom. + Cot. (1:1)	243.18	1	243.18	07.495**
Error	389.364	12	32.447	–
Total	1270.944	15	–	–

Level of significance: *$P < .001$;
† insignificant; and **$P < .05$.

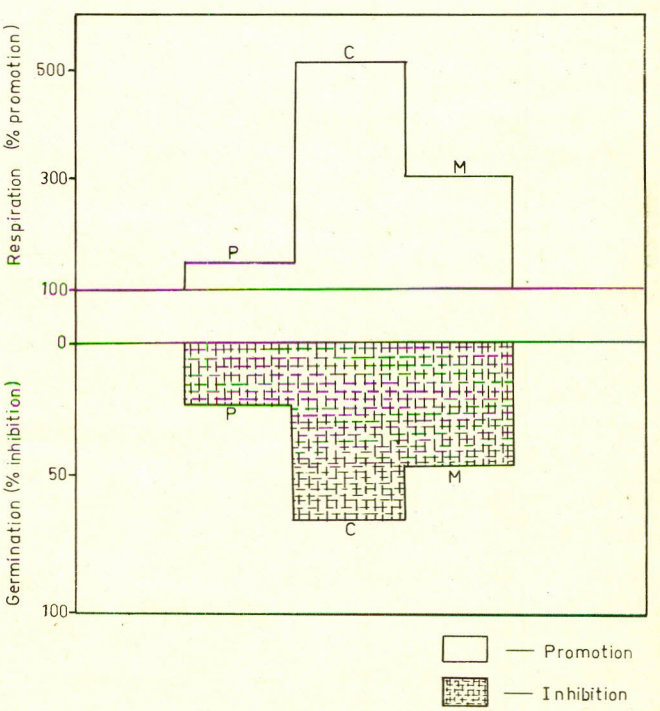

Fig. 1. Relative rate of germination and respiration under the influence of prometryne, cotoron and their equal mixture [P prometryne, C cotoron, M mixture of P and C (1:1)].

workers [3,5].

Combined together, both the herbicide species do not appear to exhibit a behaviour synergistic or otherwise.

A negative correlation is discernible in the two parameters studied (Fig. 1) where a decrease in the percentage germination seems inversely associated with an increase in the uptake of oxygen.

In the present investigation, oxygen uptake by delinted seeds during the 8th hour of their germination, qualifies as a good measure for a rapid evaluation of likely effects of a herbicide on the rate of germination.

It is evident that cotoron severely effected the physiology of the cotton seeds, which renders this herbicide a rather less attractive preemergence weed control measure for M-100 cotton fields. It is suggested that its application should be confined to a very limited scale as far as *Gossypium hirsutum* L.cv. M-100 is concerned. Further, a thorough probe is urged into the responses of our crops, including their varieties, to generally recommended herbicides to select and apply the appropriate herbicide or herbicide system.

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