Pakistan J. Sci. Ind. Res., Vol. 16, Nos. 3-4, June-August 1973

COMPARATIVE STUDIE OF THE EFFECTS OF ULTRASONICS, RED LIGHT AND GIBBERELLIC ACID, ON THE GERMINATION OF CASSIA HOLOSERICEA FRES SEEDS

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(Received April 4, 1972; revised April 2, 1973)

Abstract. A comparative study of the increase in germination of *Cassia holosericea* Fres seeds by ultrasonics treatment against those of red light and gibberellic acid treatment have been made. An increase of approximately six times germination over the control are obtained with the seeds treated with ultrasonics of 1 MHz, 30 watts /cm² for 20 min at the incubation temperature of 40°C; whilst three- and four-folds increase are recorded with the seeds exposed to red light for 24 hr and treated with 20 p.p.m. gibberellic acid respectively at about 35°C incubation temperature.

In the life circle of plants, seed dormancy is a natural phenomenon which control the population dynamics of the plants Curtis[1] and Cantlon[2] showed that germination of seeds is not possible without the activation of embryo even in optimal conditions of growth. Time taken for activation of embryo before actual germination is dependent on physicochemical state of the embryo within the seed and that can be altered by chemical or physicochemical means. Newcombs,[3] Davis *et al.*[4] used temperature gradient for boosting up the germination[5] whilst Burstom[6] and Brown[7] employed the growth promoting compounds of gibberellic and indole series. Halsted and Vicario[7] studied the percentage increase in germination by treating the seeds with ultrasonics.

Materials, Methods and Results

Light green, heart shape, uniform size seeds of *Cassia holosericea* Fres are collected from the vicinity of P.C.S.I.R. Laboratories, Karachi. The seeds were air-dried at room temperature and subjected to the treatments described below:

Ultrasonics. Batches of hundred seeds in three replicates are treated with ultrasonics of 0.2, 0.5, 1.0 and 1.5 MHz frequencies and average energy output of 30 W/cm² for a period 5–30 min at temperature between 40–60°C. The treated seeds are surface sterilized with 0.1% aquous murcuric chloride solution and transferred to false bottom plastic mesh fitted saucers. These are then placed on 2.5 in dia and 4.5 in high plastic pots which contain nutrient medium having the composition: 0.003M $Ca(NO_3)_2$, 0.002M KNO_3, 0.002M $MgSO_4$, 0.002M KH_2PO_4, 7 p.p.m. of EDTA and 1 ml micrometabolic elements/ litre, pH being kept at 6.0±0.5. The plants are grown at temperature between 10–70°C, having a 15-hr long day period for 12 weeks. The data are presented in Table 1.

Red Light. Batches of surface sterilized moist seeds are exposed to red light for 6–42 hr at room temperature and grown in total darkness for twelve weeks in the temp. earlure range 20–50°C. The information obtained are recorded in Table 2.

Gibberellic Acid. Surface sterilized seeds are soaked in 5–35 p.p.m. solution of gibberellic acid at room temperature for 30 min then blotted dry and placed on pot-saucer assembly, and grown in the temperature between 20–50°C for a period of twelve weeks. The experimental data are recorded in Table 3.

Discussion

It is seen from the experimental data presented in Table 1, and the plots of $G(t)$, (T) where G, t and T are the number of seed germinated in a batch of hundred seeds, time of ultrasonic exposure, and the temperature of incubation respectively (Fig. 1), that at all the ultrasonic frequencies understudy the number of seeds treated for 20 min germination is maximum (of different magnitude) at 40°C incubation temperature. As also seen from the plot of $G(F)$, where F is the ultrasonic frequency (curve I) the highest germination is obtained with 1.0 MHz ultrasonic treated seeds which is approximately six times that of untreated or control seeds. The variation of germination of different batches of untreated seeds are shown by the height of the double-arrows in the figure.

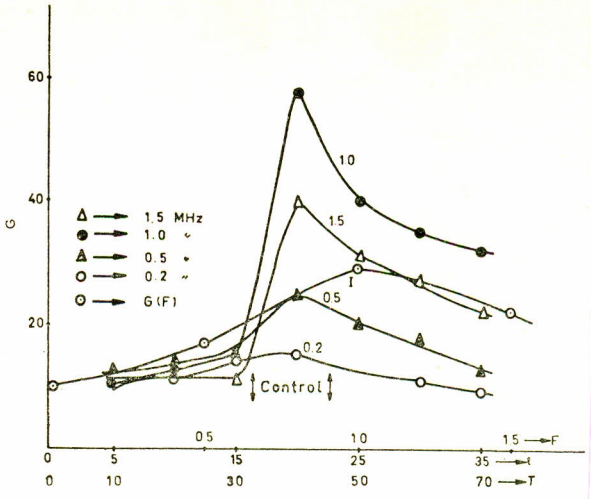

Fig. 1. The plots of $G(T)$, (t) at different ultrasonic frequencies together with the plot of average G against F of treated and untreated seeds.

TABLE 1. THE GERMINATION OF SEEDS *TREATED WITH ULTRASONICS OF DIFFERENT FREQUENCIES AT VARYING INCUBATION TEMPERATURES.

Ultrasonic exposure time (min)	Temperature of incubation (°C)	Ultrasonics frequencies with 30 W/cm² energy output (MHz)				
		0	0.2	0.5	1.0	1.5
5	10	8	11	13	10	10
10	20	10	11	14	13	12
15	30	10	14	16	15	11
20	40	11	15	25	58	40
25	50	10	12	20	40	31
30	60	12	11	18	35	27
35	70	11	9	13	32	22

TABLE 2. THE GERMINATION OF SEEDS *EXPOSED TO RED LIGHT FOR DIFFERENT TIME PERIODS AT VARYING INCUBATION TEMPERATURES.

Temperature of incubation (°C)	Red light exposure time (hr)							
	0	6	12	18	24	30	36	42
20	10	13	17	19	25	14	12	11
25	12	16	25	26	26	16	13	10
30	14	17	23	28	27	17	12	15
35	14	15	19	25	30	19	28	16
40	13	14	16	21	27	26	20	13
45	12	13	14	20	25	24	17	15
50	10	11	17	18	20	20	14	10

TABLE 3. THE GERMINATION OF SEEDS *TREATED WITH GIBBERELLIC ACID OF DIFFERENT CONCENTRATIONS AT VARYING INCUBATION TEMPERATURES.

Temperature of incubation (°C)	Concentration of gibberellic acid (p.p.m.)							
	0	5	10	15	20	25	30	35
20	9	13	29	17	16	12	12	10
25	10	14	27	29	28	18	16	14
30	11	16	39	37	38	29	16	13
35	12	18	40	39	52	35	25	20
40	12	14	28	29	48	31	18	14
45	11	13	14	22	41	28	25	20
50	9	12	14	20	38	28	23	17

*Number of seeds germinated in a batch of one hundred seeds (mean of three sets).

The plots of $G(T)$ of the seeds exposed to red light for different time period in Fig. 2 show that the maximum germinations roughly three-folds that of the control (or untreated batches of seeds, the variation of which is shown by curve I). The heighest germination is obtained with the seeds exposed to red light for 24 hr at 35°C incubation temperature and shown by the average plot of $G(T)$ (curve II).

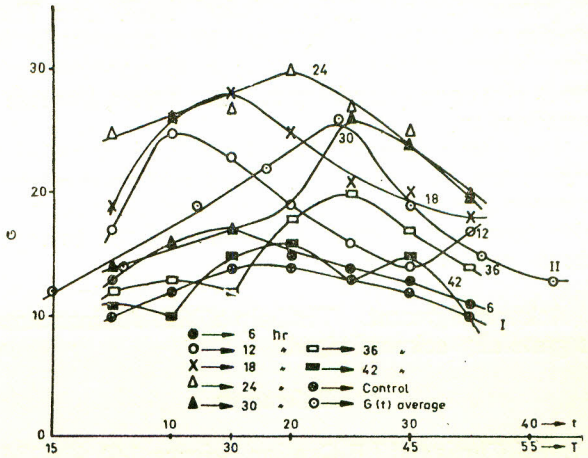

Fig. 2. The plots of $G(T)$ of seed exposed to red light for different time periods together with the plot of average $G(t)$ of treated and untreated seeds.

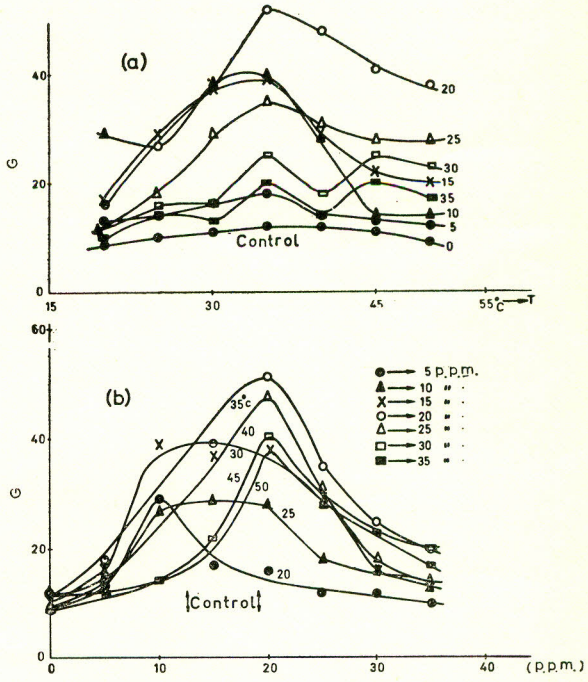

Fig. 3. The plot of $G(T)$ and $G(C)$ of the seeds treated with gibberellic acid of different concentrations.

Next, the plots of $G(T)$ and $G(C)$ where C is the concentration of gibberellic acid in p.p.m. in Fig. 3a and 3b show that the seeds treated with gibberellic acid of 20 p.p.m. concentration germinated approximately five times that of the control at about 35°C incubation temperature. An examination of the results obtained from the above described treatment, namely, ultrasonic, red light and gibberellic acid show that the germination of seeds is maximum when they are treated with ultrasonic of 1.0 MHz frequency for 20 min at 40°C incubation temperature. It must, nevertheless, be stressed that the figures may not be statistically as significant as they appear. More fine measurements at closer intervals of the variable parameters are already underway to work out the optimum conditions

of germination and their statistical significance. These studies are, however, significant by themselves in that they bring out the fact that the ultrasonics-treated seeds give equally significant, if not higher, increase in germination.

The above investigations have been extended to cash crops such as wheat, cotton and pulse where a comparative study of the growth of the plants has also been carried out. The authors hope to report these results later.

Acknowledgement. The help of Md. Aminuzzaman is gratefully acknowledged.

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