EFFECT OF IONIZING RADIATION ON AMYLASE ACTIVITY IN MAIZE SEEDLINGS

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SUMMARY

Effect of ionizing radiation on amylase activity in the seeds of high yielding maize hybrid var. Ganga-5 was investigated. Gamma radiation doses varying from 500 to 30000 R were used to treat the seeds prior to germination. The seeds were germinated for 96 hr and amylase activity was determined periodically. The results showed significantly high activity at 24 hr in seeds exposed to 1000 R. The amylase activity was stimulated even at high doses of 10000 R.

INTRODUCTION

Radio-biological effects have occasionally been shown beneficial and in certain instances are directly applicable in agriculture (Haber, 1968). Sax (1963) and Pal (1967) observed earlier flowering (anthesis) and McCornick and Platt (1962) an increase in drought resistance following ionizing radiation. Decrease in transpiration co-efficient in tomato following cobalt-60 irradiation was observed by Szoke (1971). Comprehensive investigation on the pre-sowing effect of gamma irradiation was initiated by Pal and coworkers in 1963. The majority of experiments were performed in the phytotron and an increase in the mobilisation of nitrogen, phosphorus and carbohydrates was observed during germination (Pal *et al.*, 1964). Gurumurti (1971) observed significant increase in the mobilization of several compounds, especially of starch from endosperm to embryo at low doses of 50-150 R. Favourable effect of low irradiation doses on yield has been reported by other investigators (Sax, 1963; Pal, 1967; Balint, 1971).

Since different effects of ionizing radiation have been obtained by various workers and enough data is not available on the effect of these radiations on enzymatic activities, specially α-amylase, it was considered interesting to investigate the effect of different doses of ionizing radiation on the activity in a high yielding hybrid maize variety.

MATERIALS AND METHODS

Dormant seeds of maize var. Ganga-5 were irradiated with 500-30000 R in a 200 curie, cobalt-60 gamma source, at the rate of 1500 R per minute. Moisture content of

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each group of seeds, immediately prior to irradiation, ranged from 8 to 8.5%. Following gamma exposure, the seeds were stored for 24 hr and then transferred to Petri-dishes (15 cm dia.) lined with Whatman No. 1 filter paper. The Petri-dishes were maintained in a germinator at 30°C and watered uniformly for 96 hr. At 24-hr intervals, 14-15 seeds were weighed. The samples were then maintained at temperature of −1°C and subsequently ground in a chilled mortar in 30 ml citrate buffer (pH 5). The homogenised samples were then centrifuged at 2000 rpm for 15 min at 1°C and 0.05 and 1.00 ml of the supernatant was incubated in 5 ml of 0.02% starch sol at room temperature (25°C). The reaction was arrested after 10 min by adding 0.2 ml of 0.2% iodine solution and it was then diluted by 10 ml distilled water. For the blank series, reaction was arrested by adding 0.2 ml iodine reagent directly to the supernatant containing 5 ml of starch sol. Ten ml distilled water was added to this solution. Absorption was recorded at 600 mμ on a Spectronic-20 spectrophotometer and starch content was determined by a standard curve. Amylase activity was expressed in terms of mg starch hydrolysed by 1 gm fresh wt of the seeds at room temperature after 10 min of incubation. Duration of the experiment was 4 days and it was repeated 5 times.

Results and Discussion

In the present experiments, the activity of α-amylase was considerably low after 24 hr and no significant variation was observed between treatments during this period. In 48 hr old seedlings, there was no difference in amylase activity of the control and irradiated seedlings. After 72 hr, however, irradiated seeds showed higher activity than unirradiated ones. The higher irradiation doses of 5000, 10000 and 30000 R increased the activity which was less in the seeds irradiated with 1000 R. A similar trend was noted after 96 hr (Table I and Fig. 1).

Table I. Amylase activity in maize seeds irradiated with varying doses of gamma radiation. Activity expressed in mg of starch hydrolyzed per mg fresh wt of the tissue

Dose (R)	Set of experiments I	II	III	IV	V	Mean
Control	19.98	26.72	26.16	8.98	18.14	19.99
500	20.43	26.31	27.83	9.02	18.40	20.49
750	20.50	29.43	25.49	9.06	16.96	20.28
1000	28.29	40.39	30.20	15.02	20.91	26.96
5000	19.55	34.26	22.31	9.66	18.32	50.82
10000	22.05	36.03	26.34	11.43	16.57	22.48
30000	20.43	33.92	21.21	11.01	16.32	20.57

Each figure is a mean of 4 replicates.
C. D. at 5%=3.01 C. D. at 1%=4.08

Gurumurti (1971) observed a similar effect of low dose (20-200 R) of cobalt-60 irradiation on the amylase activity of wheat prior to sowing. He observed a progressive increase of the enzyme activity in wheat endosperm upto 150 R irradiation level and a decline at 200 R at which level the activity was still higher than that of the controls.

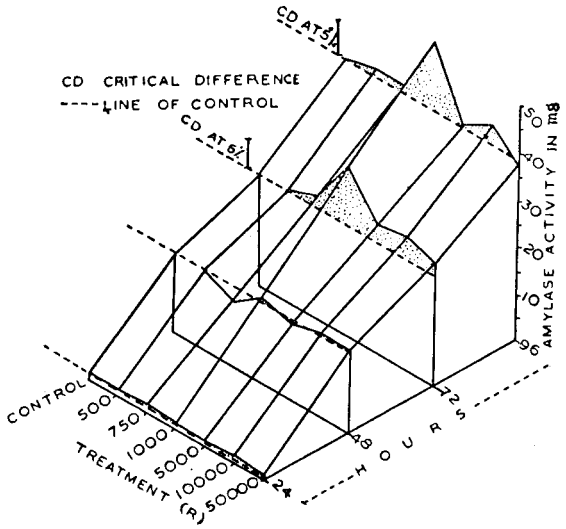

FIG. Amylase activity in maize seedlings at different intervals of time as influenced by irradiation of seeds with varying doses of gamma radiation.

However, the data shows that the pattern of amylase activity in response to radiation resembles that of wheat as far as the duration of germination was concerned. But the sensitivity was markedly different from that in wheat as the stimulatory effect of radiation in this case was noted at significantly higher doses than reported in wheat by Gurumurti (1971). Work is now in progress to see why maize differs from wheat in this respect.

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