

1963

The Rate of Disappearance of Some Induced Chromosome Aberrations in the Germinating Seeds of Jack Pine

Richard J. McMahan
University of Minnesota, St. Paul

Follow this and additional works at: <https://digitalcommons.morris.umn.edu/jmas>



Part of the [Botany Commons](#)

Recommended Citation

McMahan, R. J. (1963). The Rate of Disappearance of Some Induced Chromosome Aberrations in the Germinating Seeds of Jack Pine. *Journal of the Minnesota Academy of Science, Vol. 30 No.2*, 130-131. Retrieved from <https://digitalcommons.morris.umn.edu/jmas/vol30/iss2/9>

This Article is brought to you for free and open access by the Journals at University of Minnesota Morris Digital Well. It has been accepted for inclusion in Journal of the Minnesota Academy of Science by an authorized editor of University of Minnesota Morris Digital Well. For more information, please contact skulann@morris.umn.edu.

This study shows that seed should not be harvested above approximately 35% moisture content, as there is an increase in the percentage of abnormal seed, and that the temperature of drying is not too critical so long as the temperature is not high enough to injure the seed. No adverse effects were found when seed was dried at temperatures of up to 45° C.

LITERATURE CITED

1. AMERICAN ASSOCIATION OF CEREAL CHEMISTS. 1956. *Cereal Laboratory Methods*. American Assoc. of Cereal Chem. St. Paul, Minn. 6th ed.
2. CROSIER, WILLIAM. 1941. Split Seeds in Peas and Beans. *Proc. Assoc. Offic. Seed Analysts N. Amer.* 33:66-69.
3. FIELDS, R. W. 1961. Studies on the Deterioration of stored Pea Seed by *Aspergillus* Species. (Unpublished M.S. thesis. University of Minnesota, St. Paul, Minnesota).
4. HULBERT, H. W., and G. M. WHITNEY. 1934. Effect of seed injury upon the Germination of *Pisum sativum*. *Am. Agron. Jour.* 26:876-84.
5. HYNES, H. J. 1927. Defective Germination in Peas; the Desirability of Local Seed Production. *Ag. Gaz. of New South Wales* 38:251-254.
6. PADWICK, G. W. 1938. Complex Fungal Rotting of Pea Seed. *Ann. Appl. Biol.* 25:100-114.
7. VIRGIN, W. J. 1940. Low Germination of Peas Associated with the Presence of Bacteria in the Seed. *Phytopathology* 30:790-791.

BOTANY

The Rate of Disappearance of Some Induced Chromosome Aberrations in the Germinating Seeds of Jack Pine¹

RICHARD J. McMAHAN*

University of Minnesota, St. Paul

INTRODUCTION: The effect of ionizing radiation on plant material can be measured in several ways. One method makes use of the fact that irradiation causes chromosome aberrations which can be observed in the dividing cells of the resulting seedlings. Since the number of aberrations is thought to decrease as the germination of the seed progresses, cytological observations made at different stages of development are likely to render different results. The purpose of this study was to determine the rate at which induced aberrations disappear in germinating jack pine seed. This would aid in the determination of the best time to make cytological examinations when comparing the radiosensitivity of different pine seeds or the effect of different pre- and post-irradiation treatments given the seeds.

MATERIALS AND METHODS: Jack pine seed was collected for this study on Nov. 18, 1961 from several trees in a plantation about thirty years old in the Carlos Avery Game Refuge, about thirty-five miles north of St. Paul. On Nov. 21, 1961 the seed was given an X-ray dosage of 800r over a period of 45 minutes. The water content of the seed at the time of irradiation was 7.3%. Two hours after the irradiation treatment the seeds were spread on flats of fine, clean sand in a greenhouse and

watered. The seeds were not covered with sand; however, a polyethylene cover kept a constant high humidity in the flats. Natural light was supplemented by two 300 watt incandescent light bulbs providing about 85 foot-candles of light to the surface of the flats. This light supplement resulted in an 18 hour day. The temperature was controlled in the greenhouse and did not fall below 70 or rise above 85° F.

Each day following sowing, at the same hour, a sample of seeds (5 from the control and 10 from the irradiated group) was taken from the flats and the embryo tips or radicle tips, depending on the stage of development, were examined cytologically for chromosome aberrations. The following procedure was used in preparing the samples for examination. The tips were fixed in 3:1 aceto-alcohol for two hours and then hydrolyzed in 1N HCl at 60° C. for 15 minutes. The tips were then washed in water and stained in standard aceto-carmin for 2 to 5 minutes.

RESULTS AND DISCUSSION: Detectable embryo enlargement, cell division, and germination began five days after the seeds were sown, in both the irradiated seed and the control. The appearance of a radicle was considered evidence of germination of the jack pine seed. Non-irradiated seed showed 77% germination while irradiated seed showed only 58%. Cell division occurred in the embryo tips at or before the time of noticeable embryo enlargement. Chromosome aberrations were recorded as the percent of cells in division containing obvious chromosome

¹The author is indebted to Dr. Scott S. Pauley for his assistance in preparing the manuscript and to Mr. George Blake, Mr. Hugo John and Mr. Roland Schoenike for their helpful suggestions and aid.

* The editor reports with regret Mr. McMahan's death on August 11, 1962.

TABLE I

	Days in which cell division was observed													
	1st*		2nd†		3rd		4th		5th		6th		7th	
	Con.	Irr.	C	I	C	I	C	I	C	I	C	I	C	I
No. of cells observed	121	488	276	852	216	455	‡	246	..	308	—	375	—	284
No. of aberrant cells	0	20	0	29	1	16	—	7	—	6	—	2	—	1
Per cent aberrant cells	0	4.10	0	3.40	0.46	3.52	—	2.85	—	1.95	—	0.53	—	0.35

Lines connect days in which aberration values of irradiated seeds are not significantly different according to the *t* test.

* Cell division was first observed 5 days after the seed had been sown.

† The sample taken this day was 10 control seeds and 20 irradiated seeds.

‡ Detailed examination of the control group was discontinued after the 3rd day of cell division.

bridges or fragments. Only cells in anaphase or telophase stages of mitosis were considered in the total number of cells in division. Aberrations were observed in both the irradiated material and the non-irradiated material, see Table I.

The maximum percent of cells with chromosome aberrations (4.10) occurred the first day cell division was observed (five days after sowing). After the first day cell division was observed, the percentage of aberrations decreased daily. The aberration percent was 0.35 on the seventh day of cell division when the investigation was terminated. From the first day to the second, there was a significant (5% level) decrease in the number of dividing cells with aberrations. Although the aberration percent decreased daily after germination up to seven days, no significant difference was found between any two successive days after the second.

In order to make the above calculations an arcsin transformation was performed on the data as they were percentage values. Due to unequal observations within

classes a simple *t* test was used to evaluate all possible combinations of class means.

In relation to the length of the radicle, four size classes were analyzed: (1) radicles not extended from the seed coat; (2) radicles 0.40 mm-1.59 mm long; (3) radicles 1.98 mm-5.95 mm in length; and (4) radicles over 5.95 mm long. According to the analysis of variance test there was no significant difference between the four size classes with regard to the percent of cells having aberrations.

On the basis of this investigation the recommendation is made that cytological examinations that are made to determine sensitivity of pine seeds to irradiation should be made at the same time relative to the seed germination. This would give values that could be compared as measures of radiosensitivity. The most effective time in jack pine seeds would be at the first sign of germination, since this is the period of maximum aberration frequency. Chromosome aberrations can be used as a means to compare the radiosensitivity of different seeds, or differently treated seeds, only if consideration is given to the time of cytological examination.