

<Original article>

PHYSIOLOGICAL EFFECTS OF GAMMA-RADIATION ON MEIOSIS IN RYE

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李雄植 : 「감마」-線 照射에 依하여 호밀의 減數分裂에 誘發된 生理的影響

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SUMMARY

1. A vernalized Korean rye was exposed to Co^{60} in dose of 150r (dose rate was 7r per minute) and pollen mother cells were examined for cytological study.
2. According to the observation, it is quite clear that scraping of chromosomes soon after irradiation and surface stickiness at the period of 6 hours after irradiation were followed by structural changes at the period of 12 hours after irradiation.

INTRODUCTION

As physiological effects of ionizing radiation on chromosomes Marpuardt (1938) pointed out clumped and fused chromosomes as well as temporary inhibition of nuclear development. Sax (1941) found clumped and fused chromosomes for several hours after irradiation. Furthermore, Koller (1952) pointed out that clumped chromosomes at metaphase, stickiness at anaphase, etc., are manifested in the pollen grain of *Tradescantia* almost immediately after irradiation. During a series of work concerning the effect of gamma-radiation on meiosis in rye marked physiological effects were found.

MATERIAL AND METHOD

Population Korean rye(*sca*le cereale) was vernalized at 3°C for a duration of 6 weeks. Before irradiation, chromosome numbers were identified in root-tips to select plants containing 14 ordinary chromosomes. When plants were exposed to Co^{60} in doses of 500 and 1000r, it was apparent that intensities were too high to analyse meiotic configuration. Then, a plant was exposed to Co^{60} in dose of 150r (7r p.m. Irradiation was so arranged that the plant was exposed at the stage of first metaphase in pollen mother cells. The temperature during irradiation was maintained between 21° to 22°C.

For cytological study, spikes were fixed as follows:

Shortly before irradiation, soon after irradiation, 6 hours, 12 hours and 24 hours after irradiation. Whole spikes were fixed in Carnoy's fluid and stained with aceto-orcein.

RESULT

In the control or shortly before irradiation, meiosis was quite normal except unpaired chromosomes and sticky bridges in a few cells. Chromosomes uniform showed stain ability

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Soon after irradiation:

Chromosomes exhibited several types of physiological effects. Clumped chromosomes were found in some pollen mother cells. Also, there were number of pollen mother cell containing chromosomes which were more swollen than normal chromosomes and showed more or less spongy like appearance. In another pollen mother cells, chromosomes frequently formed rings and indicated upset in stain ability. Chromosomes were so scraped out that number of hollows and holes were found on surface and inside of chromosomes (Plate fig. 1). In extreme case depolymerization of nucleic acid was so marked that matrix of chromosome was entirely dissolved and coiled spiral was visible. As exceptional cases, chromosome breakages were found while the other chromosomes exhibited physiological effects.

At the period of 6 hours after irradiation :

Gradual recovery was noticed. Scraping of chromosomes was not so pronounced as the previous period. On the other hand, fusion of chromosomes due to surface stickiness was most marked at this period (Plate fig. 2).

At the period of 12 hours after irradiation:

Structural changes of chromosome were observed in first anaphase and telophase. Sticky bridges, dicentric bridges accompanied by acentric fragments and lagging fragments were found at first anaphase and telophase (Plate fig. 3). Delayed first metaphase did not exhibit any physiological effect. Presumably these delayed pollen mother cells were irradiated at early prophase or resting stage.

At the period of 24 hours after irradiation:

Suitable stage for analysis was not obtained. This fact may be attributed to upset in timing of the meiotic cycle.

DISCUSSION AND CONCLUSION

It has been understood that physiological effects of chromosomes induced by ionizing radiation are found in those cells which were entering division at the time of irradiation. In the present work physiological effects of chromosomes are manifested at first metaphase soon after irradiation and gradually disappeared. Cells not already in division at the time of irradiation but nearing the end of interphase do not exhibit physiological effects. They may, however, show structural changes. At the period of 12 hours after irradiation, genetical effects of irradiation or structural changes of chromosomes were more marked than physiological effect. It is assumed that these pollen mother cells showing structural changes were at the stage of early prophase or end of resting stage when they were exposed to radiation source.

As exceptional cases, chromosome breakages were found at first metaphase soon after irradiation. Marshak (1937, 1939) carried out experiments in which root tips of various plants are fixed soon after irradiation, and the proportion of anaphases which show fragments or bridges recorded. These deal with a mixture of changes of physiological and structural types and consequently more experimental work needed before proper explanation can be obtained.

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摘 要

1. 春化處理를 받은 韓國産「호밀」을 放射性同位元素 Co^{60} 에 依하여 150r (每分 7r)의 照射量을 가지고 處理하여 花粉細胞의 減數分裂에서 細胞學的研究을 하였다.
2. 放射直後에는 染色體의 凝集, 染色體의 變形等の 生理的影響을 볼수있으며 6時間이 經過함에 따라 染色體의 切斷, 染色體橋等の 染色體의 構造的變化가 나타났다.

Plate



Fig. 1 Marked physiological effects soon after irradiation. Scraping of chromosome is seen on bivalents which form rigs. $\times 2000$



Fig. 2 Fusion of chromosomes at early first anaphase in the period of 6 hours after irradiation. $\times 2000$

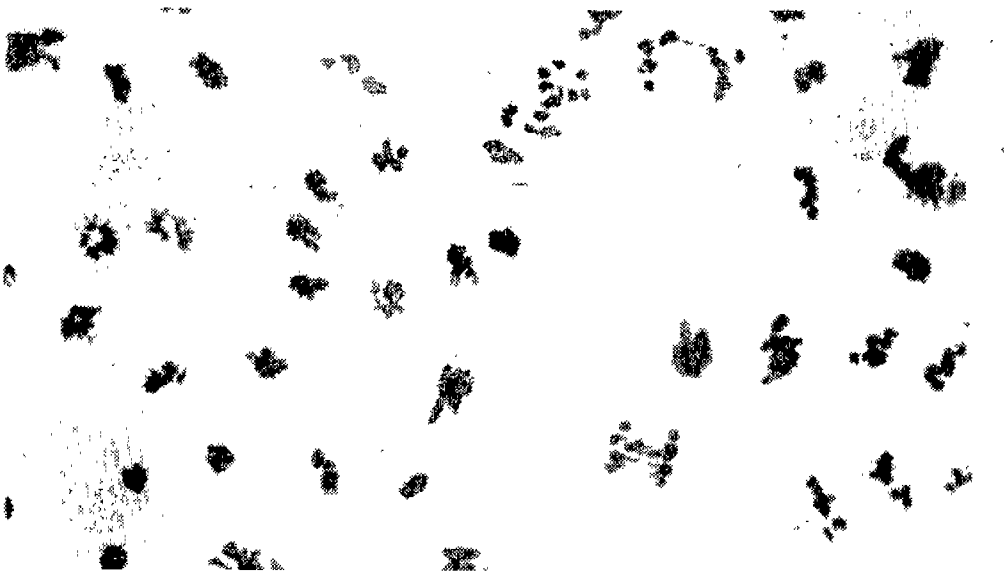


Fig. 3 Structural changes of chromosomes at anaphase I and telophase I in the period of 12 hours after irradiation. Sticky bridges, dicentric bridges accompanied by acentric fragments and lagging fragments are seen many pollen mother cells. $\times 400$