GENETICAL STUDIES OF THE EFFECT OF CO TREATMENT ON SOME MORPHOLOGICAL AND ECONOMICAL CHARACTERS OF EGYPTIAN ONION

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TABLE OF CONTENTS

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I. INTRODUCTION

Onion (Allium cepa L.) is one of the most important field crops exported to foreign markets in the A.R.Egypt. About 70 percent of the total production of the winter crop is annually exported to European markets and some other countries in Asia, Africa and America since it matures earlier than onion grown in both Italy and Spain and other exporting countries. Its acreage reached about forty thousand faddans (4200 m^2) mostly grown in the governorates of Middle and Upper Egypt in the season 1972 yielding about 487,430 tons of onion bulbs as reported in the Annual Book of Agriculture Economy A.R. Egypt (1972). For that reason great attention had been directed by onion breeders to improve the bulb yield per unit area, as well as bulb qualities such as storability, low percentage of double bulbs and to attain homogeneity in both shape and colour. Furthermore, improvements in seed production were also taken into consideration.

For reaching a rapid improvement in bulb and seed production, however, conventional methods need more time and are more expensive. Therefore, increasing interest in the application of ionizing radiation has been carried out in order to produce genetic variants. Hence, after irradiation, the number

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of variations can be dramatically increased, making it possible for breeders to observe more variability. This dynamic pool of genetic variability is a necessary prerequisite for a successful breeding programme.

The biological effects of radiation have been tested in plants rather than in animals as test systems for radiosensitivity are more available in plants. Hence, cell nucleus is generally considered to be the major site of radiation injury; i.e., chromasomal breakage, somatic mutation, growth inhibition and lethality. It is assumed that growth inhibition and lethal effects are both the result of some form of nuclear or cytogenetic damage. One of the most readily observed and accurately scorable nuclear effects is chromosomal aberration. Available evidence seems to support the idea that mutation may or may not result following breakage of the chromosome, but also the breakage is not the prerequisite for mutation (Mackey, 1956). It is now known that a large proportion of mutations induced in higher plants by radiation are due to cytogenetic deficiencies (Stadler, 1940). This effect therefore has received special consideration and the degree of chromosomal damage has been correlated with gross effects on growth or survival.

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The present work aimed to study some morphological and physiological aspects of Gamma radiation with appropriate doses on the two onion cultivars Giza 6 M. and yellow Creole. The study was also extended to include the effectiveness of Gamma radiation on mitotic and meiotic duration and also the types of chromosomal aberrations that occur in these two cultivars.

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II. REVIEW OF LITERATURE

1. Effect of Gamma radiation on different stages of growth:

a. Effect on germination:

Koernike (1915) stated that rape (Brassica napus) seeds were especially resistant to the effect of x-rays. Brassica and other Cruciferae tolerated x-ray doses of 64,000 r. with no decrease in seed germination or other deleterious effects during early growth.

Froier (1946) noted a marked reduction in the germination of oat seeds (Avena sativa) exposed to x-rays at 5,000 r., while only few seeds germinated at the 10,000 r., and non in the 15,000 and 20,000 r. treatments.

On the other hand, marked reduction in the speed of germination was observed by the following investigators. Messeri (1957), in spinach at 1800 r., Ocrovic and Canakle (1958) in castor bean at 4,000 r., Grebinskaja (1959) in bean at 40,000 r., and Petijevic and Jouanovic (1964) in sweet and hot peppers at 8,000 r., all of them found significant reduction in seed germination.

Bashow and Hoff (1962) exposed the seed of common Dallis grass variety Louisiana 430 (Paspalum dilatatum) to five Gamma ray treatments ranging from 4 to 64 Kr. and five different periods of neutrons. They found such doses to have no effect

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on germination rate, but did cause considerable seedling mortality, particularly at higher doses. All the seedlings from 10 and 20 hours neutron treatments died few hours after germination.

Bianchi et al. (1963) exposed the seeds of some tomato (Lycopersicon esculentum) varieties to 7, 14 and 21 Kr. of x-radiation. They indicated that the percentage of germination of the treated seeds appeared to be unaffected by the various irradiation doses used.

Dyck (1964) irradiated the dry seeds of oats with three doses of 5, 10 and 15 Kr. x-rays and observed that all irradiation treatments, with the exception of 5 Kr., had reduced M_1 plant emergence than that in the untreated controls. He recorded 24 and 21 percent reduction in germination at the 10 and 15 r. treatments, respectively.

Selim et al. (1964) treated the seeds of Ashmoni, and Giza 45 varieties of Egyptian cotton (Gossypium barbadense) with γ-rays at doses ranging from 1 to 44 Kr. and reported that no effect was observed on the germination rate as compared with the control.

Molle (1965) treated seeds of radish (Raphanus sativus L.) with 500 to 5,000 r. and stated that no effect on the germination rate was observed.

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Srb and Hora (1966) noted that irradiated onion (Allium cepa) with 100 r. x-rays had stimulated germination in two of the five varieties tested. However, they reported that a dose of 5,000 r. did not have a significant effect on germination.

b. Effect on vegetative growth:

Back (1946) observed that irradiating seeds of Allium cepa with x-ray (2,000 r.) had no measurable effect on the height of onion seedlings.

Many investigators reported that irradiation of seeds had no appreciable effect on the growth of many crop plants; Sax (1955) in lettuce and cabbage at 3000 r., Breslovec (1956) in radish at 500 r. and in carrot at 1000-2000 r., Kuzin (1955-1956) in radish and pea at 500 r. and cucumber at 300 r., Birecka et al. (1959) in beans at 350, 500 and 750 r., Campos et al. (1960) in onion at 50 to 100 r., Orborne et al. (1960) in wheat at 500 r., 1000 r. and 2500 r., Abu El-Fath (1964) in Sorghum at doses up to 40 Kr. On the other side remarkable depression of plant growth as result of exposing dry seeds to radiation was reported by a number of investigators, Pushkareva (1958) in cucumbers, peas, hemp, and sunflower at 1000 to 10,000 r., Seric (1958) in wheat, Glushchenko et al. (1959) in wheat and oat at doses up to 16,000 r., Yu (1960) in tomato, Hazawa

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(1961) in wheat, Sfikas (1962) and Bianchi et al. (1963) in tomato, Pozsar (1963) in wheat and Yeh and Henderson (1963) in rice.

In cotton, Constantin (1964) exposed dormant seeds of three American Upland cotton varieties (Gossypium hirsutum) to 0, 5, 10, 20 and 40 Kr. Gamma radiation and reported that the M_1 seedling survival was not affected, while a highly significant reduction in M_2 seedling survival at three weeks after planting was observed at the 40 Kr. radiation dose, being 36 percent against 56 percent for the control. There were no differences in this respect among controls, 5, 10 or 20 Kr. seed treatments.

In soybean, Shevchenko (1968) exposed (Glycine max) to X-rays and noted that plants grown from such seeds differed slightly in growth period and morphology from controls but were a little shorter, had fewer pods and on the whole were less productive than the control.

Bose and Banerjee (1969) subjected seeds of the variety Ponderosa in tomato with single and combined treatments of x-rays (doses of 10 Kr. and 20 Kr.) and colchicine. They observed some abnormal growth habits such as fasciation and bifurcation of stems in some of the M_1 plants originating from most of the treatments.

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In wheat, Popovic et al. (1969) reported the occurrence of induced mutations with respect to plant height, ear length and number of tillers per plant as a result of irradiating the seeds with different x-rays doses ranging from 2,500 to 20,000 r The M_1's and M_2's included awned plants, white eared plants and speltoids.

Velich (1969) irradiated dry seeds of melon with doses between 5 and 100 Kr. γ-ray and observed morphological injury in the G_1 above 40 or 50 Kr. and complete sterility with 3-4% survival occurring at about 100 Kr. The sterility was associated with meiotic disturbances. A dose of 40 Kr. was regarded as suitable for the production of mutations that could be detected in the G_2 generation.

In corn, Pfahler (1970) exposed Zea mays to various doses of γ-irradiation and reported that between 1.0 and 24.0 Kr., fertilisation ability was equal to or above that of the non-irradiated controls. Above 24.0 Kr., fertilisation ability of pollen was reduced so that at 40 Kr., it was about 75% of that of the controls. Increasing doses decreased progressively female fertility until at 40 Kr. where it was less than 10% of that of the controls. In general, the effects of seed irradiation on the exposed generation were more pronounced in the female gametophyte than in the male gametophyte.

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Shahani and Zafar (1970) indicated that plant height in wheat decreased while ear length and stem thickness increased by using five different doses of ϑ-radiation.

Illieva (1971) treated seeds of peas with 5, 10 and 20 Kr. ϑ-irradiation. A study of the M_1, M_2 and M_3 showed that radiosensitivity was related to the physiological state of the seeds. The lethal dose for dry seeds was 20 K-rad, for soaked seeds 10 K-rad and for germinating seeds 5 K-rad.

In barley, Yankulov (1971) irradiated seeds of barley with ϑ-rays doses of 5, 10, 15 and 20 Kr. at rates of 78 and 240 rad/min. and observed that the proportion of chlorophyll to morphological mutants rose after repeated irradiation as compared with a single treatment. Valuable mutants, including erectoid, early maturing, large grained and short stemmed forms with many tillers were obtained.

Marki et al. (1972) treated grains of twelve cultivars of wheat belonging to four botanical varieties with x-rays. The cultivars Autonomia, San Paslore and Triumph from different botanical groups, had the highest survival rates at 30 Kr., with up to five leaves per seedling having developed.

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