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Growth Response of Two Kenikir (Cosmos caudatus Kunth.) Plant Varieties on Gamma Ray Irradiation

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ABSTRACT

Kenikir (Cosmos caudatus Kunth.) is a plant that has many benefits for human health because it contains high antioxidants. The aim of this research was to identify the growth response of two kenikir (Cosmos caudatus Kunth.) plant varieties on gamma ray irradiation. The research was conducted in the greenhouse of the Faculty of Agriculture, University of Sumatera Utara, with an altitude of 32 meters above sea level starting from March to June 2018. Kenikir seeds of Aswana IPB and Dramaga Kuning varieties were irradiated with gamma rays doses (90, 100, 110, 120, 130, 140) using Co60 radiation sources. Observation variables observed were germination rate, plant height, number of leaves, age of flowering plants. 1 week after planting - 12 weeks after planting. Data were tested by t test using the Minitab 18 program. The results of this research showed that the Aswana IPB varieties in all observed variables; the average rate of irradiated plants varies and has differences when compared to the average rate of the control plants. The same results happened to Dramaga Kuning varieties.

Keywords: kenikir, Aswana IPB variety, Dramaga Kuning variety, gamma ray irradiation

INTRODUCTION

Kenikir (Cosmos caudatus Kunth) is a plant that is widely found in Indonesia. Kenikir is used as a vegetable and as a medicinal plant. The use of medicinal plants in Indonesia is increasing rapidly, this development is supported by the existence of community knowledge about medicinal plants for generations. Kenikir leaves can be consumed as vegetables, for appetite stimulant drugs, bone strengthening, preventing cancer and tumors and treating gastritis (Izza et al., 2016)

Problems that kenikir plants have are the plants are not widely known by the community and the benefits are not widely known by the community, especially in Sumatera Utara. Besides that, there have not been many diversity in kenikir plant, this is due to the length of time needed to obtain superior seeds through crossing. The existing kenikir plants also do not have many branches, with so many branches, the number of leaves that can be consumed will also increase. One way to get kenikir plants with different diversity in a shorter time is by using gamma ray irradiation mutation techniques.

Development of kenikir as indigenous vegetables requires quality seeds. One way to obtain good quality seeds is to determine the exact harvest time. Seed requirements in terms of quantity can be obtained with a fast harvest time. Increasing the yield of kenikir plants can be done by using seeds from the results of mutations

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that have high productivity (Hakim and Rahmad, 2015). Mutation breeding is one of the breeding methods that already have much success for genetic improvement of plants. The purpose of mutation induction is to increase natural genetic resources and is very helpful in developing old and new plant cultivars, both in plants propagated by seeds as well as in vegetative ways (Jain, 2008).

With the existence of mutation techniques using gamma ray irradiation, it is hoped that it can help to provide a better new character in the kenikir plant. Hence that it can increase the production of kenikir plants and it can be one of the types of vegetable plants that are in demand and are expanding widely in the community.

Based on the description above the author is interested in conducting a research entitled; "Growth Response of Two Kenikir (Cosmos caudatus Kunth.) Plant Varieties On Gamma Ray Irradiation".

MATERIALS AND METHODS

This research was carried out at the Greenhouse of the Faculty of Agriculture, University of Sumatera Utara at an altitude of ± 32 meters above sea level. The research began in March 2018 and ended in June 2018.

The materials used in this research were kenikir seeds of Aswana IPB and Dramaga Kuning varieties, topsoil and cow dung in a ratio of 2:1, baby polybags, 25 cm x 30 cm polybag (5 kg contents), Curacorn 500 EC insecticide.

The tools used were Irradiators Gamma Chamber 4000 A with Co60 radiation source, measuring instrument, stationery, camera, and other supporting tools.

Gamma ray irradiation was carried out in BATAN (National Nuclear Energy Agency of Indonesia). The radiated seeds were 50 seeds per dose. Irradiation using gamma rays was carried out at doses of 90, 100, 110, 120, 130, 140 Gy, which will be emitted through irradiator gamma chamber 4000A with Co60 ray sources. The planting medium used was topsoil and cow dung with a ratio of 2:1. The seeds that had been irradiated with gamma rays were sown together with the control seeds in the polybag measuring 17 cm x 20 cm (contents of 1 kg). Nursery was carried out for 2 weeks after that the plants were moved to a fixed polybag. Seed removal was done by tearing the polybag of seedlings and moving the seeds to a permanent polybag. Fertilizer application was carried out on 4 weeks after planting, implicated singly at a dose of 2 gr / polybag. Pest control was carried out by spraying curacron 500 EC insecticide with a dose of 2 ml / liter of water.

Data from each dose is averaged. Testing was done by comparing the average yield data from the treatment of irradiated plants with those that were not irradiated. Then the data was analyzed using the t-test at 5% and 1% using the Minitab 18 program.

The observed parameters were germination rate (days), plant height (cm), number of leaves (strands), age of flowering (days). Data from each dose were averaged. Testing was done by comparing the average yield data from the treatments.

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RESULTS AND DISCUSSION

The research results in Table 1 showed the kenikir plant of Aswana IPB variety; the highest germination rate was at 140 Gy treatments with germination rate of 4.70 / day. In kenikir plants of Dramaga Kuning variety; the highest germination rate was at 120 Gy treatment as much as 5.00 / day. This was in accordance with the statement of Soedomo (1986) which stated that gamma ray irradiation causes damage to morphological characters which include inhibition of growth in a plant.

Plant height

Table 2 showed that the average plant height for Aswana IPB variety aged 4 weeks after planting irradiated at a dose of 100 Gy - 140 Gy was differed very significant from the control plants. At the age of 8 weeks after planting gamma ray irradiation differed very significant at doses of 130 Gy and 140 Gy. At the age of 12 weeks after planting gamma ray irradiation differed very significant in the treatment of 110 Gy, 130 Gy and 140 Gy. The Dramaga Kuning variety showed that at 4 weeks after planting the average height rate of irradiated plants with doses ranging from 100 Gy - 140 Gy differed very significant from the control plants. At the age of 8 weeks after planting - 12 weeks after planting, the average height of irradiated plants with doses ranging from 100 Gy - 130 Gy differed very significant from the control plants.

Table 1. The germination rate of kenikir plant of Aswana IPB and Dramaga Kuning varieties at several doses of gamma ray irradiation.

Variety	Treatment	Germination Rate
		…… (Days) ……..
Aswana IPB	0 Gy	5.37
	90 Gy	6.40
	100 Gy	6.60
	110 Gy	5.83
	120 Gy	6.00
	130 Gy	5.71
	140 Gy	4.70
Dramaga Kuning	0 Gy	5.33
	90 Gy	5.60
	100 Gy	6.50
	110 Gy	6.75
	120 Gy	5.00
	130 Gy	6.00
	140 Gy	6.30

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Table 2. Kenikir plant height of Aswana IPB and Dramaga Kuning varieties aged 4, 8 and 12 weeks after planting at several doses of gamma ray irradiation.

Variety	Doses	Weeks After Planting		
		4	8	12
		…….. (cm) ……..……..		
Aswana IPB	0 Gy	15.21 ± 1.68	35.99 ± 4.94	73.58 ± 14.8
	90 Gy	13.48* ± 1.16	31.4** ± 25.62	66.82 ± 11.7
	100 Gy	12.36** ± 1.60	33.6 ± 6.39	92.20 ± 26.9
	110 Gy	12.18** ± 1.60	30.5* ± 14.25	61.39** ± 10.6
	120 Gy	12.15** ± 2.19	31.80 ± 5.25	65.23 ± 7.08
	130 Gy	10.77** ± 1.27	28.23** ± 5.47	51.21** ± 8.93
	140 Gy	7.62** ± 4.36	19.34** ± 12.1	32.18** ± 18.6
Dramaga Kuning	0 Gy	14.28± 5.6	38.88 ± 8.54	71.62 ± 10.3
	90 Gy	8.65* ± 2.24	20.89** ± 12.3	43.56** ± 23.8
	100 Gy	5.45** ± 4.15	11.67** ± 13.8	25.48** ± 27.2
	110 Gy	6.59** ± 2.12	19.37** ± 4.98	35.27** ± 6.63
	120 Gy	1.80** ± 2.33	7.12** ± 11.5	11.81** ± 9.2
	130 Gy	0.49** ± 1.55	5.28** ± 1.67	2.74** ± 8.66
	140 Gy	1.01** ± 2.14	-	-

Description: * and ** = significantly different and differed very significant with the control population (0 Gy) at the level of 5% and 1% based on the t test.

The higher the dose of irradiation was applied, it would suppress the growth of plant height and can even cause death in plants, this occurred at a dose of 140 Gy, the plant only can survive up to 4 weeks after planting. This was in accordance with the research of Sinambela et al. (2015) which stated that application of gamma ray irradiation can reduce the number of live plants, plant length, number of leaves, and number of tillers of shallots and in accordance with the research of Ginting et al. (2015) which stated that gamma ray irradiation starting at a dose of 5 Gy produces plants with plant length, number of leaves, and time of leaves sprouting which differed very significant from the control plants.

Number of Leaves

Based on table 3 showed that the number of leaves of kenikir plant Aswana IPB variety at the age of 4 weeks after planting with gamma ray irradiation was significantly different at a dose of 140 Gy. At the age of 8 weeks after planting gamma ray irradiation differed very significant at doses of 120 Gy and 140 Gy. At the age of 12 weeks after planting the average rate of irradiated plants population with doses ranging from 110 Gy - 140 Gy differed very significant from the control plants.

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Observation data of the number of leaves of kenikir plants Dramaga Kuning variety showed that the average rate of the leaves of kenikir plant aged 4 weeks after planting - 8 weeks after planting on 100 Gy - 140 Gy gamma ray irradiation differed very significant from the 0 Gy gamma ray applications. At the age of 12 weeks after planting, gamma ray irradiation differed very significant at a dose of 90 Gy - 130 Gy.

Table 3. The number of leaves of kenikir plants; Aswana IPB and Dramaga Kuning varieties aged 4, 8 and 12 weeks after planting at several doses of gamma ray irradiation.

Variety	Irradiation dose	Weeks After Planting		
		4	8	12
		……. (strand) ……..…….		
Aswana IPB	0 Gy	9.20 ± 1.40	29.90 ± 8.91	49.30 ± 11.6
	90 Gy	9.10 ± 1.53	23.90 ± 4.84	41.30 ± 4.92
	100 Gy	8.90 ± 0.99	30.20 ± 7.18	49.90 ± 10.4
	110 Gy	8.90 ± 0.99	23.40 ± 4.40	33.50** ± 4.86
	120 Gy	8.80 ± 1.40	20.30** ± 3.4	25.50** ± 3.44
	130 Gy	8.50 ± 1.08	20.60* ± 5.68	23.00** ± 2.26
	140 Gy	6.10* ± 3.73	16.30** ± 9.39	21.70** ± 13.6
Dramaga Kuning	0 Gy	8.60 ± 1.65	33.80 ± 6.80	52.10 ± 6.61
	90 Gy	7.30 ± 1.16	17.70** ± 10.9	27.50** ± 20.5
	100 Gy	4.50** ± 3.24	10.60** ± 11.7	17.20** ± 18.8
	110 Gy	6.20** ± 1.23	18.10** ± 3.87	26.70** ± 4.67
	120 Gy	2.30** ± 3.06	5.60** ± 9.03	8.30** ± 13.4
	130 Gy	0.60** ± 1.9	1.70** ± 5.38	2.40** ± 7.59
	140 Gy	1.20** ± 2.53	-	-

Description: * and ** = significantly different and differed very significant with the control population (0 Gy) at the level of 5% and 1% based on the t test

The higher the dose of irradiation applied, the more pressing the growth will be, this was supported by the research of Sinuraya et al. (2017) which stated that gamma ray irradiation on samosir onion plants causes a reduction in the number of leaves of plants irradiated with the number of leaves of plants that are not irradiated (control) in the first generation and in accordance with the research of Batubara et al. (2015) which stated that the effects caused by gamma ray irradiation application

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on different shallots plants significantly reduce the number of leaves at a dose of 5 Gy and 6 Gy, the greater the radiation dose, the more pressing the plant growth.

Flowering Period

Table 4. Flowering perido of kenikir plants; Aswana IPB and Dramaga Kuning varieties on the application of several doses of gamma ray irradiation

Variety	Irradiation dose (Gy)	Average Rate
		…….….. (days) …….
Aswana IPB	0 Gy	87.90 ± 4.46
	90 Gy	80.30 ± 28.4
	100 Gy	82.20* ± 5.49
	110 Gy	71.80 ± 37.9
	120 Gy	54.30** ± 46.7
	130 Gy	18.40** ± 38.8
	140 Gy	18.60** ± 39.2
Dramaga Kuning	0 Gy	26.00 ± 40.5
	90 Gy	9.60 ± 39.0
	100 Gy	0.00 ± 0.00
	110 Gy	0.00 ± 0.00
	120 Gy	0.00 ± 0.00
	130 Gy	0.00 ± 0.00
	140 Gy	0.00 ± 0.00

Description: * and ** = significantly different and differed very significant with the control population (0 Gy) at the level of 5% and 1% based on the t test

Table 4 showed that flowering period of kenikir plant; Aswana IPB variety with 0 Gy gamma ray irradiations; the application of gamma ray irradiation at dose of 100 Gy can accelerate the flowering period 5 days faster than the flowering period of the plant by a dose of 0 Gy irradiation applications. In the kenikir plants; Dramaga Kuning variety, the flowering period of kenikir plants with 90 Gy gamma ray irradiation applications had no significant effect compared to 0 Gy gamma ray irradiation, on the other hand for the application of gamma ray irradiation at a dose of 120 to 140 Gy, none of the plants were flowering, this was in accordance with Rakasiwi's research (2018) which stated that the population of 450 Gy has different

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morphological diversity with control plants. Morphological diversity of rosella plants such as branching and flower color, this is supported by Putri's literature (2016) which stated that gamma ray irradiation with a dose of 150 Gy is more than control plants.

CONCLUSION

There was a significant difference in morphological characters (flowering period) between irradiated kenikir plants with control plants. In Aswana IPB varieties with 100 Gy treatments, the flowering period was 5 days faster and the flower color was darker than other treatments, and in Dramaga Kuning variety the flowering period of the control treatment was faster than other treatments. There were different agronomic characters that vary in Aswana IPB and Dramaga Kuning varieties.

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