

The diversity of agromorphological characters of *Portulaca grandiflora* in the MV8 population deriving from recurrent irradiation

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Abstract. Aisyah SI, Saraswati RAM, Yudha YS, Nurcholis W. 2022. The diversity of agromorphological characters of *Portulaca grandiflora* in the MV8 population deriving from recurrent irradiation. *Biodiversitas* 23: 4432-4439. A multipurpose ornamental plant, *Portulaca grandiflora* has the value of attractiveness and uniqueness, which lies in various agromorphological characters, primarily in flowers. The potential of *P. grandiflora* in qualitative characters such as new and unique shapes and colors of the morphology must be enhanced further to increase its economic and aesthetic significance as a floriculture commodity. The induced mutation technique has been proven to improve plants' morphological diversity, and even numerous novel cultivars are produced from artificial mutations. The recurrent irradiation technique was applied in the *P. grandiflora* mutation breeding program and produced new morphological variations of *P. grandiflora* until the MV7 generation (seventh generation of the mutation breeding program). The current study aimed to evaluate the diversity of morphological characters of *P. grandiflora* mutants in the MV8 population resulted from recurrent irradiation technique. Fifty-three selected mutants of *P. grandiflora* generation MV7 were multiplied by stem cuttings to create an MV8 population. The total MV8 population of *P. grandiflora*, the result of vegetative propagation, was 1104 plants. The diversity of morphological characters of *P. grandiflora* in the MV8 population was identified quantitatively (measurement) and qualitatively (visual observation). The results of this study reveal that several *P. grandiflora* mutants in the MV8 population have a new phenotypic appearance, chiefly in the qualitative characters of flowers. Besides, most of the *P. grandiflora* MV8 mutant population has inherited identical morphological characters from the previous generation (MV7 population). Further morphological analysis in the next generation needs to be conducted to evaluate the morphological stability of *P. grandiflora* mutants to develop new cultivars and to investigate the possibility of new phenotypic variations caused by recurrent irradiation treatments.

Keywords: Recurrent irradiation, variability, ornamental plant

INTRODUCTION

Portulaca grandiflora, originating from the *Portulacaceae* family, is an ornamental plant with a creeping habit and is classified as a succulent ornamental plant. *P. grandiflora* is native to South America, and as time goes by, this plant has come across the board in various countries. *P. grandiflora* has fast growth and multiplication; hence this plant is often cultivated as a landscape plant (Jia et al. 2017). There are more than 100 species in the family *Portulacaceae*, and *P. grandiflora* is a member of the family *Portulacaceae* (Christenhusz and Byng 2016). In Indonesia, *P. grandiflora* has several local names such as krokot, sutra bombai, and bunga pukul sembilan (Amirul Alam et al. 2014). The morphological characteristics of *P. grandiflora* include reddish-green leaf color, short round leaf shape with a leaf length ranging from 2-4 cm, flower diameter ranging from 3-5 cm, and plant length varying from 7-15 cm (Setiawan et al. 2016). Propagation of *P. grandiflora* can be performed using seeds (generatively) and shoot cuttings (vegetatively). However, vegetative propagation is preferable for its feasibility and efficiency (Cruz et al. 2019). Although *P.*

grandiflora is widely known as an ornamental plant, in-depth research and exploration of the biochemical compounds of *P. grandiflora* have led to a piece of knowledge on the use of *P. grandiflora* as a medicinal plant (Lim et al. 2014; Devi et al. 2019).

The existence of new and enchanting floriculture commodities cannot be separated from the availability of abundant genetic resources. Plant genetic diversity arises because of variations in genetic structure among plants. The artificial mutation technique is one of the age-old methods to modify the genetic structure of living creatures initiated by exposing electromagnetic energy or certain substances that affect genetic material (Syukur and Sastrosumarjo 2015). Thus far, gamma-ray irradiation, one of the physical mutation agents, has a significant role in producing new genetic diversity in plants (Espina et al. 2018; Naoura et al. 2019; Kouighat et al. 2020). The application of gamma-ray irradiation in crop improvement contributes to fulfilling the need for potential superior plants with high yields, resistance to pests and diseases, and increased nutritional content (Chen et al. 2018; Melsen et al. 2021). In particular, the induced mutation in ornamental plants emphasizes

phenotypic changes and the addition of new color variations. Various studies on increasing the morphological diversity of commercial ornamental plants due to gamma-ray irradiation induction have been reported in *Chrysanthemum* (Din et al. 2021), *Hibiscus rosa-sinensis* (Naveena et al. 2020), Tulip (Li et al. 2022), *Lilium* (Hajizadeh et al. 2022), *Celosia cristata* (Muhallilin et al. 2019), and Orchid (Hartati et al. 2021). Increasing morphological variety through gamma-ray irradiation will increase the attractiveness and economic value of *P. grandiflora*.

Recurrent irradiation is a mutation technique utilizing two or more irradiation applications. The irradiation dose in the second application or following application is supposed to be lower than the first irradiation dose (Syukur and Sastrosumarjo 2015). The recurrent irradiation technique has been proven to be successful in increasing the morphological and biochemical diversity of *Celosia cristata* (Aisyah et al. 2019). Nunoo reported changes in plant morphology and increased fruit characters in wild-type tomato (*Solanum pimpinellifolium* L.) after recurrent irradiation treatment (Nunoo et al. 2014). The recurrent irradiation technique can potentially increase the diversity of plant morphology and biochemical properties. The morphological diversity that arises in a population needs to be studied intensively. Evaluation of phenotypic variation is essential to validate whether the morphological diversity appearing in particular generations is due to gamma irradiation treatment. Moreover, evaluation of morphological diversity needs to be conducted continuously during each planting season to obtain new morphological variations. To date, selected mutants of *P. grandiflora* have been regenerated vegetatively for seven seasons which called as MV7 generation. The present study aims to evaluate the morphological diversity of *P. grandiflora* in the MV8 generation and obtain information on the stability and alteration of the observed morphological characters of *P. grandiflora* to develop promising cultivars.

MATERIALS AND METHODS

Study area

We conducted this research in the experimental field of Sabisa Farm, IPB, Sindang Barang, Bogor, West Java, Indonesia (latitude: "-6.5891806", longitude: "106.76766", altitude (m): 202).

Plant material and observation

The MV8 population was derived from the propagation of selected mutants from the MV7 generation. Table 1 presents the selected MV7 mutants that formed the MV8 population and their morphological description. We selected *P. grandiflora* mutants which exhibit distinct phenotypes from control plants determined from floral qualitative characters. This study's total population of the MV8 generation *P. grandiflora* was 1104 plants. Morphological observations of *P. grandiflora* included quantitative and qualitative characters. The observed quantitative traits were the plant length, number of branches, flower diameter, and flower stamen diameter. Concurrently, observations on

qualitative characters contained flower color, flower shape, leaf color, leaf shape, and stem color. To notice the color change of *P. grandiflora* in the MV8 population, we used the Royal Horticulture Society Color Chart (RHSCC), an international color reference in agriculture, to observe the color differences of the observed phenotypes in the entire *P. grandiflora* population.

Planting and maintenance

The MV8 population of *P. grandiflora* was derived from stem cuttings from selected mutants in the MV7 generation. The branches are cut to 5-7 cm. Before planting, the selected branches are immersed in a root stimulant solution. Soon after, the branches are grown into the media with the composition of soil, husk charcoal, and manure (5: 5: 2). Maintenance in this study includes watering, fertilizing, and pest and disease control.

Data analysis

Quantitative data are presented in a boxplot processed using Minitab software version 19. Qualitative characters are introduced through photo documentation, and the stability of qualitative characters is shown descriptively.

RESULTS AND DISCUSSION

Qualitative characters

Several *P. grandiflora* plants in the MV8 population showed morphological changes. Morphological changes are found in the color and shape of the stem, leaves and flowers. Stem color changes were observed in two plants, GVT 50+35 13.8 and GMT 50+35 8.8 (Figure 1). GVT 50+35 13.8 experienced a change in stem color which initially (in the MV7 generation) showed orange-brown (RHS 173C), in the MV8 population it was transformed into yellow-brown (RHS 163A). Most probably, a forward mutation causes the phenomenon of stem color change. Li et al. (2022) define forward mutation as a phenotypic change that always occurs continuously. Thus, it produces a new shape and color dissimilar from its original form. Interestingly, GMT 50+35 8.8 is the only plant in the MV8 population that has stems with a different color from brown (RHS N199A) and orange (RHS 32A) (Figure 1 C, D).

We also found two *P. grandiflora* plants in the MV8 population that exhibit distinct flower shapes that differ from their original shape (Figure 2). GMT 50+45 10.8 and GMT 50+45 12.8 have a narrow petal shape with slightly wavy edges, and the space between the petals is a distance apart. In addition, based on the UPOV (2022) description for *P. grandiflora*, there are two types of *P. grandiflora* petals, i.e. present (stacked petals) and absent (layered petals). The wild-type plant of *P. grandiflora* had a present petal (Figure 2A), while a recurrent irradiation mutant, GMT 50+45 12.8, showed an absent petal (Figure 2C). New variations arising from induced mutation occur randomly, meaning that each mutated plant can exhibit diverse morphologies. In this study, several *P. grandiflora* mutants from recurrent irradiation in the MV8 population showed a new flower shape and color, different from the *P. grandiflora* wild-type.

Table 1. Morphological description of *P. grandiflora* in the MV7 population and its propagation in MV8 population

Genotypes	Initial genotype (before irradiated)	Phenotypes alteration in MV7 generation	Color code according RHSCC	Propagated branches in MV8
GMT 50+45 7.1.3.8.3.4	Red present	Pink petal present	RHS N70C	45
GMT 50+45 7.1.18.7.4.4	Red present	Pink petal present	RHS N70C	13
GMT 50+45 7.1.18.7.4.8	Red present	Pink petal present	RHS N70C	10
GMT 50+55 7.1.3.5.3.4	Red present	Pink petal present	RHS N70C	10
GMT 50+35 25.1.8.5.3.2	Red present	Pink petal present	RHS N70C	49
GMT 50+35 25.1.8.5.3.4	Red present	Pink petal present	RHS N70C	31
GMT 50+35 25.1.8.5.3.12	Red present	Pink petal present	RHS N70C	29
GMT 50+35 25.1.8.5.3.8	Red present	Pink petal present	RHS N70C	13
GMT 50+35 25.1.17.1.5.11	Red present	Pink petal present	RHS N70C	17
GMT 50+35 25.1.17.1.5.13	Red present	Pink petal present	RHS N70C	19
GMT 50+55 25.1.8.3.2.13	Red present	Pink petal present	RHS N70C	29
GMT 50+45 25.1.10.9.1.3	Red present	Pink petal present	RHS N70C	11
GMT 50+45 25.1.10.9.1.9	Red present	Pink petal present	RHS N70C	16
GMT 50+35 25.2.3.10.2.3	Red present	Pink petal present	RHS N70C	4
GMT 50+35 25.2.2.22.5.8	Red present	Pink petal present	RHS N70C	3
GMT 50+55 25.2.2.11.4.10	Red present	Pink petal present	RHS N70C	3
GMT 50+45 30.1.6.10.3.2	Red present	Pink petal present	RHS N70C	2
GMT 50+45 30.1.10.13.4.1	Red present	Pink petal present	RHS N70C	42
GMT 50+45 30.1.10.13.4.18	Red present	Pink petal present	RHS N70C	13
GMT 50+45 30.1.10.13.4.24	Red present	Pink petal present	RHS N70C	16
GMT 50+45 30.1.13.17.5.5	Red present	Pink petal present	RHS N70C	10
GMT 50+55 30.1.7.12.3.6	Red present	Pink petal present	RHS N70C	8
GMT 50+55 30.1.7.12.3.12	Red present	Pink petal present	RHS N70C	22
GMT 100+55 2.2.4.6.1.4	Red present	Pink petal present	RHS N70C	22
GMT 100+55 2.2.28.10.3.27	Red present	Pink petal present	RHS N70C	18
GMT 100+55 2.2.28.5.3.1	Red present	Pink petal present	RHS N70C	21
GMT 100+55 2.2.4.6.1.5	Red present	Pink petal present	RHS N70C	24
GMT 100+55 2.2.4.6.1.14	Red present	Pink petal present	RHS N70C	25
GVT 50+35 3.1.23.7.5.11	Variiegata present	Pink petal present	RHS N74A	31
GVT 50+35 3.1.23.7.5.27	Variiegata present	Pink purple petal present	RHS N74A	57
GVT 50+35 10.1.23.6.5.3	Variiegata present	Pink purple petal present	RHS N74A	7
GVT 50+45 10.1.1.4.4.14	Variiegata present	Pink purple petal present	RHS N74A	8
GVT 50+45 10.1.13.3.1.24	Variiegata present	Pink purple petal absent	RHS N74A	24
GVT 50+45 10.1.13.3.1.26	Variiegata present	Pink purple petal absent	RHS N74A	14
GVT 50+55 10.1.9.4.5.15	Variiegata present	Pink purple petal present	RHS N74A	38
GVT 50+45 11.1.8.5.5.17	Variiegata present	Pink purple petal present	RHS N74A	25
GVT 50+45 11.1.8.5.5.21	Variiegata present	Pink purple petal present	RHS N74A	21
GVT 50+45 11.1.8.5.5.25	Variiegata present	Pink purple petal present	RHS N74A	15
GVT 50+45 11.1.8.5.5.29	Variiegata present	Pink purple petal present	RHS N74A	30
GVT 50+45 11.1.3.8.4.15	Variiegata present	Pink purple petal present	RHS N74A	27
GVT 75+35 8.1.14.1.3.15	Variiegata present	Pink purple petal present	RHS N74A	34
GVT 75+35 8.1.14.1.3.8	Variiegata present	Pink purple petal absent	RHS N74A	17
GVT 75+55 8.1.22.13.1.14	Variiegata present	Pink purple petal absent	RHS N74A	24
GVT 75+55 8.1.22.13.1.15	Variiegata present	Pink petal present	RHS N70C	12
GVT 75+55 8.1.22.13.1.18	Variiegata present	Pink petal present	RHS N70C	13
GVT 75+55 8.1.22.13.1.21	Variiegata present	Pink petal present	RHS N70C	21
GVT 75+55 8.1.22.13.1.22	Variiegata present	Pink petal present	RHS N70C	31
GVT 125+45 6.1.13.6.4.1	Variiegata present	Pink purple petal present	RHS N74A	17
GVT 125+55 6.1.4.9.4.2	Variiegata present	Pink purple petal present	RHS N74A	16
GVT 125+55 10.1.15.3.5.12	Variiegata present	Pink purple petal present	RHS N74A	27
GVT 125+45 11.1.16.5.3.9	Variiegata present	Pink purple petal present	RHS N74A	24
GVT 125+35 14.1.11.5.3.14	Variiegata present	Pink purple petal present	RHS N74A	15
GVT 125+55 14.1.10.8.2.3	Variiegata present	Pink purple petal present	RHS N74A	31

Note: MV7: Consecutive vegetative regeneration for seven generations in a mutation breeding program; MV8: Consecutive vegetative regeneration for eight generations in a mutation breeding program; RHSCC: Royal Horticulture Society Colour Chart



Figure 1. Variation of stem color of *P. grandiflora* in the MV8 population. A. Stem color GVT 50+35 13.8 in the MV7 generation, B. Its changes in the MV8 generation, C & D. Two stem color variations of GMT 50+35 8.8 in the MV8 population

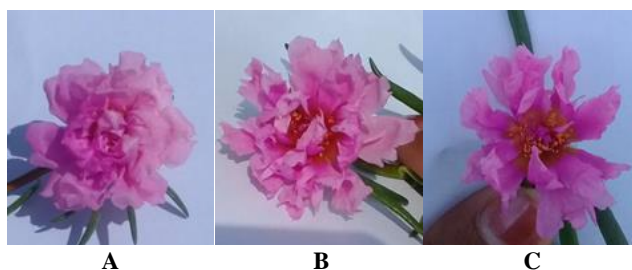


Figure 2. Comparison of flower shape. A. Wild-type, B & C. Two *P. grandiflora* mutants in the MV8 population

Regarding plant coloring, pigment is one of the endogenous factors that contribute to plant coloring. Numerous studies have reported the role of pigments in the appearance of the original color of plants and changes in color. He et al. 2013 studied the red color change in *Chrysanthemum* petals caused by the accumulation of cyanidin, a metabolite of the anthocyanidin group. Han et al. 2014 found that the dominance of orange-red color in petal *Osmanthus fragran* depended on the high amount of α -carotene and β -carotene, and fewer levels of carotenoids can cause color degradation to be yellowish. In another study by Stavenga et al. (2021) the diversity of flower color in some *Papaver* species stems from a complex combination of plant pigments and cell pH values. Although plant pigments are responsible for the coloration of plants, there are several other endogenous factors such as the epidermal cell structure, pH degree of the vacuole, and genetic background. These factors also play a remarkable role in the coloring of plant organs; modification of one of the factors allows changes in plant color (Trajković et al. 2021; Liu et al. 2022).

The flower color diversity of *P. grandiflora* in the MV8 population is shown in Figure 3. We recorded the occurrence of forwarding mutations in several *P. grandiflora* mutants are characterized by flower color alteration from MV7 generation to MV8 generation. GMT 50 30.1, with pink petals in MV7 generation, showed a pink-purple petal (RHS N74A) discoloration observed in eleven plants in MV8 population. The same phenomenon also occurs in the GMT 100+55 1.8 genotype (pink petals RHS N70C in MV7 generation) with identical color change. In addition, the GVT 75 8.1 (pink petal RHS N70C in the MV7 generation),

which comes from irradiated doses of 75 and 55 Gy, shows a new color of magenta and is complemented by a tinge of orange (N57A and N28A) and pink-purple petal in the MV8 population. Three mutants originate from GVT 75 8.1, which shows a magenta color with an orange tinge and six mutants with pink-purple petals. A magenta color change was observed in one of the mutants in the MV8 population, GVT 75+55 11.8. We found a fascinating fact that *P. grandiflora* mutants that underwent flower discoloration in the MV8 generation were derived from mutants with pink petals in the MV7 generation.

One of the phenotypic parameters that mutations occur at the gene or chromosomal level is color alteration. Plant color variations have attracted research interest from the molecular, biochemical, and agronomic fields. Jiao et al. (2020) stated that pigments are responsible for coloring plant parts. Changes in the color of the stems and flowers of *P. grandiflora* are most supposedly caused by pigment modifications. However, further molecular and biochemical analysis is required to confirm. A morphological study of *Vicia sativa* conducted by Shi et al. (2021) revealed the role of anthocyanin accumulation on red and green leaf color when there was no anthocyanin accumulation. Whereas, from the molecular field, (Sundaramoorthy et al. (2016) studied the mechanism of soybean flower discoloration, which is controlled by six gene loci that also play an active role in flavonoid biosynthesis. Chromatographic analysis of the floral parts of *Hemerocallis* demonstrated that rutin and cyanidin played a crucial role in the staining of the *Hemerocallis* tepals (Li et al. 2021).

Floriculture commodities and other horticultural commodities treated with artificial mutations will likely modify the morphology, shape, and color. Susrama and Yuliadhi (2020) reported variations in leaf color of *Tagetes erecta* due to the application of a chemical mutagen, i.e., colchicine. Arisha et al. (2015) reported changes in plant architecture, morphology, and leaf color due to ethyl methane sulfonate (EMS) mutagenesis. Gamma irradiation induction treatment on cowpea, one of the functional food commodities, changes the color of flowers, leaves and affects the quantitative characters of production (Ezzat et al. 2019). Morphological changes occur when mutations reach functional genes, and large-scale chromosomal damage occurs. The higher the concentration or dose of the mutagen treatment, the greater the damage to plant genetic material.

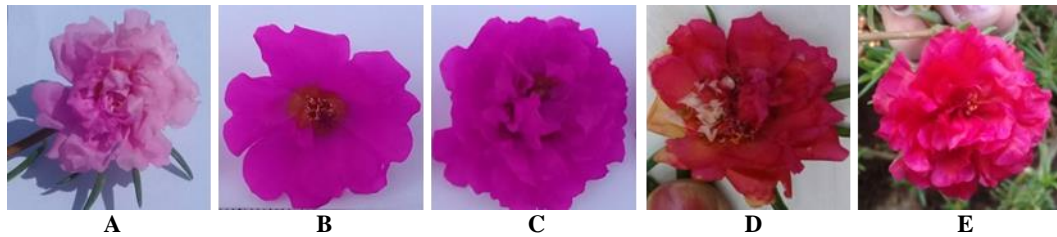


Figure 3. The diversity of flower color of *P. grandiflora* in the MV8 population. A. Pink petal present (N70C), B. Pink purple petal absent (N74A), C. Pink purple petal present (N74A), D. Magenta with an orange tinge (N57A dan N28A), E. Magenta present (N57A)

Quantitative characters

We visualized the quantitative characters of *P. grandiflora* in the MV8 population in boxplots (Figure 4). Besides qualitative characters, the increase in morphological diversity can be assessed by observing the quantitative characters (Syukur et al. 2018). In this study, plant length, the number of branches, flower diameter, and flower stamen diameter reflected the morphological diversity of *P. grandiflora* in the MV8 population. For plant length observations, GV50+45.11.1.8 has one outlier value (16 cm), indicating one plant's presence in the subpopulation GV50+45.11.1.8 with distinct characteristics from other observations. GVT75+55.8.1.22 generally has the lowest observed values compared to GVT50+45 11.1.8 and GVT50+35 3.1.23. GVT75+55.8.1.22 was recorded with one plant with the smallest observed value (9.6 cm). Outliers and extreme values are unique data that depict specific characteristics different from all existing observations (Hu 2020). Observations categorized as outliers indicate the presence of plants with uncommon and unique quantitative morphological traits in a population. An outlier in GVT75+55 8.1.22 was the only mutant with a significantly prominent phenotype compared to other observations in the number of branches (30 branches).

GVT50+35 3.1.23 has the most outliers for flower diameter characters. However, the outliers in GVT50+35 3.1.23 did not have distinctive characteristics compared to the distribution of other subpopulation data (GVT50+45

11.1.8 and GVT75+55 8.1.22). In contrast, GVT 50+45 11.1.8 and GVT 75+55 8.1.22 have outliers with new characteristics. *P. grandiflora* mutants identified as outliers, in subpopulations GVT 50+45 11.1.8 and GVT 75+55 8.1.22, had small flower sizes (1.8 cm and 2.0 cm). In other words, the morphological variation of the *P. grandiflora* flower not only lies in the color and shape of the flower but also in the size of the flower. In contrast to the flower diameter, GVT75+55 8.1.22 has one of the highest extreme values among all observations in the flower stamen diameter character (1.8 cm).

As a rule, the induced mutation causes a decrease in the quantitative characters of plants as a result of the direct effect on the plant's genetic material. Hajizadeh et al. (2022) reported a reduction in the number of leaves and stem length with increasing doses of gamma irradiation. Artificial mutation induction using EMS mutagen can reduce the percentage of chrysanthemum seed germination (Purente et al. 2020). However, in some unique cases, induced mutagenesis was observed to enhance quantitative characters. Yoosumran et al. noted an increase in the number of leaves of *Dendranthemum grandiflora* through the application of EMS in vitro. Induced mutation using chronic techniques, low doses of mutagen treatment for an extended period, increased the putative mutants' quantitative characters of *Celosia cristata* compared to the control treatment (Aisyah et al. 2022).

Table 2. Information on the floral qualitative characters of *P. grandiflora* in the MV8 population

Initial genotype (before irradiated)	Single irradiation dose (Gy)	Recurrent irradiation dose (Gy)	Mutant phenotype in the MV7 population	Population MV8 (%)			
				Backward mutation	Forward mutation	Characters stability	Non-flowering
Red petal present	50	35	Pink petal present	-	-	78.50	21.50
		45	Pink petal present	-	6.50	82.60	10.90
		55	Pink petal present	-	-	73.30	26.70
	100	55	Pink petal present	-	0.90	49.10	50.00
Variegata petal present	50	35	Pink purple petal present	-	3.30	91.20	5.50
		45	Pink purple petal absent	-	2.60	89.60	7.80
		-	Pink purple petal present	-	-	82.65	17.35
	75	55	Pink purple petal present	-	-	83.80	16.20
		35	Pink purple petal absent	-	16.00	34.00	60.00
		55	Pink petal present	-	9.90	44.60	45.50
	125	35	Pink purple petal present	-	-	64.30	35.70
		45	-	-	-	63.50	36.50
		55	-	-	81.10	18.90	

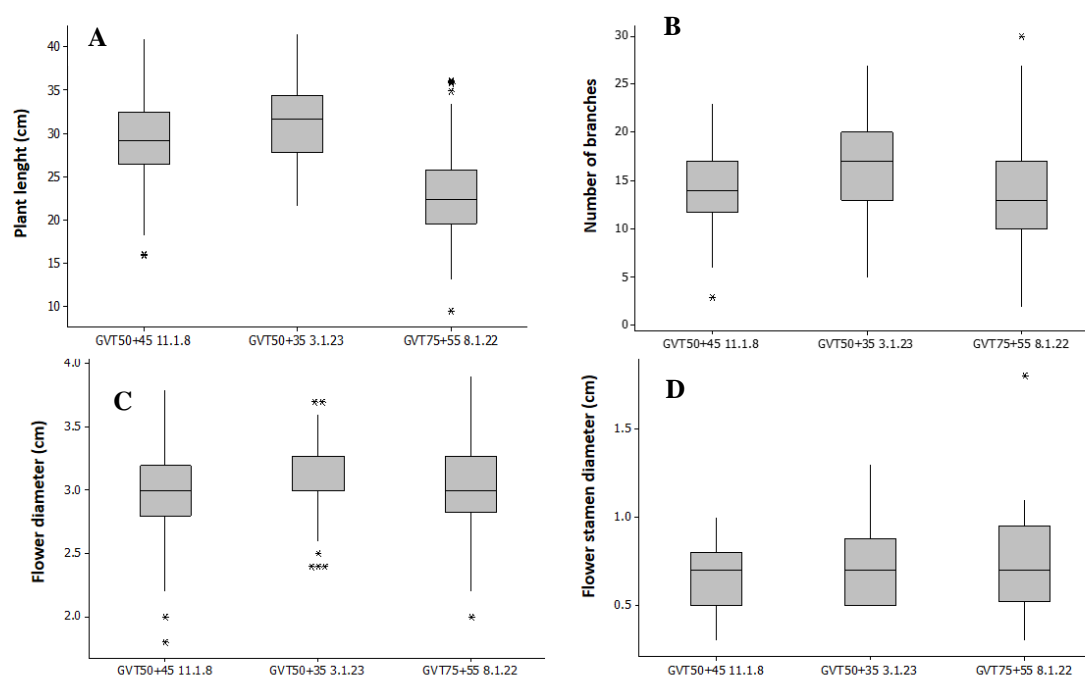


Figure 4. Distribution of *P. grandiflora* quantitative data in the MV8 population. A. Plant length, B. Number of branches, C. Flower diameter, D. Flower stamen diameter

The changes and stability of flower shape and color of *P. grandiflora* mutants in the MV8 population.

The selection character of *P. grandiflora* is the qualitative character of the flower, including the shape and color of the flower. We summarize the changes and stability of flower shape and color of *P. grandiflora* in the MV8 population in Table 2. None of the *P. grandiflora* mutants in the MV8 population showed a backward mutation. The former phenomenon, the backward mutation, indicates that The recurrent irradiation technique has produced new genotypes in the breeding program of *P. grandiflora*. The backward mutation changes the mutant phenotype to the original form. The percentage of character stability refers to the plants that did not undergo morphological transformations in the MV8 population. The highest percentage of flower character stability derives from recurrent irradiation treatment at a dose of 50+35 Gy with the appearance of pink purple petal present (91.20%).

The percentage of forwarding mutation demonstrates the emergence of new germplasm with unique flower shape and color characteristics. However, the highest nonflowering percentage was recorded at the same dose (60.00%). Another recurrent irradiation dose showing a high percentage of nonflowering is 100+55 Gy (50.00%). High irradiation doses, 100 Gy and 50 Gy, are strongly reckoned to cause genetic, biological, and physiological damage. The biological barrier caused by induced mutation is sterility and flowerless (Syukur and Sastrosumarjo 2015).

In a series of plant breeding programs, the potential genotypes, new cultivar candidates, can be confirmed in the advanced generation. This statement is in line with the research results by Andrew-Peter-Leon et al. (2021). They found a new candidate genotype of rice in the M6 population (sixth generation in the mutation breeding program)

produced by induced mutagenesis using Ethyl methane sulfonate (EMS). In addition, an increase in yield component in M6 generation sesame mutants was reported by Monshi and Tabassum (2021). Hussain et al. (2021) obtained new wheat genotypes in the M7 population. Many researchers have reported the success of mutation breeding in producing superior varieties. In this study, we found potential mutants of *P. grandiflora* with new and unique characters, specifically in the flower part. However, this research needs to be continued for further assessment related to the stability of the agromorphological characters of *P. grandiflora*, mainly on the inflorescence characters. Conclusively, *P. grandiflora* experienced morphological changes in several quantitative and qualitative characters due to the induction of gamma irradiation mutagenesis. This study proves that changes caused by artificial mutations can be inherited and also initiate opportunities for the emergence of new morphological variations in the subsequent generation.

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