Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.5032

ISSN: 2320 – 7051

Int. J. Pure App. Biosci. **5 (5):** 228-233 (2017)

Research Article

International Journal of Pure & Applied Bioscience

OPEN ACCESS

Development of Semidwarf and Mid-Late Maturing Jawaphool Mutant Through the Use of Gamma Radiation

Deepak Sharma[1*], B. K. Das[2], Vikas Kumar[2], Ashish Kumar Tiwari[1] and Parmeshwar K. Sahu[1]

[1]Department of Genetics and Plant Breeding, Indira Gandhi Krishi Vishwavidyalaya, Raipur- (Chhattisgarh), India

[2]Nuclear Agriculture and Biotechnology Division, Bhabha Atomic Research Centre, Trombay, Mumbai, India

*Corresponding Author E-mail: deepakhybridrice@gmail.com

Received: 22.06.2017 | Revised: 5.07.2017 | Accepted: 8.07.2017

ABSTRACT

Jawaphool is a very popular traditional short grain aromatic variety of Chhattisgarh. Inspite of its premium gain quality it is very tall and having very late maturity. Due to tall stature this variety is prone to lodging which causes heavy reduction in yield. Physical mutagen (Gamma rays) is successfully utilized to develop the some promising Jawaphool mutants of traditional Jawaphool with reduced plant height, number of effective tillers per plant, earliness and higher grain yield and clustered panicle with red kernel colour. Frequencies of viable mutants with economically important characters were observed particularly for the dose of 300Gy in M_2. This dose is also most desirable in inducing viable mutants in Jawaphool with semi tall stature and mid late to late maturity. Total 05 types of desirable mutants were selected and further advanced from M3 to M6 generations upto homozygosity. The frequency of different mutants over genotypes were observed as 04 are semi-tall (15 to 20% reduction in plant height) with mid late maturity and high grain yield and 01 are tall with late maturity, increased effective tiller, fertile spikelet's per panicle , clustered panicle with red kernels and about 15 to 20% higher grain yield as compared to traditional Jawaphool variety.

Key words: *Rice, Induced mutation, Gamma rays, Traditional aromatic short grain rice*

INTRODUCTION

Rice (*Oryza sativa* L.) is the staple food of more than half of the world's population. The importance of this crop lies in the fact that it has shaped the cultures, diets and economies of millions of people living particularly in Asia. Rice plays a pivotal role for food and nutritional security and eradicating poverty. Chhattisgarh, the rice bowl of central India, besides having high yielding cultivars, is also confined with hundreds of indigenous short and medium grain aromatic cultivars and landraces grown in pockets of the state, such as Vishnubhog (Pendra), Shyamajeera (Surajpur), Badshahbhog (Jagdalpur), Gangabaru (Sukma), Dubraj (Sihava-Nagari), Kalikamod (Durg), Elaychi (Gariyaband), Chinnor (Janjgir-Champa), Shrikamal (Korea) etc. These aromatic rice cultivars possess exemplary quality traits like aroma, fluffiness and taste.

Cite this article: Sharma, D., Das, B.K., Kumar, V., Tiwari, A.K. and Sahu, P.K., Development of Semidwarf and Mid-Late Maturing Jawaphool Mutant Through the Use of Gamma Radiation, *Int. J. Pure App. Biosci.* **5(5):** 228-233 (2017). doi: http://dx.doi.org/10.18782/2320-7051.5032

These varieties were traditionally grown by the farmers since many years. However, during last decades, these rice varieties were found to be very much neglected by those farmers and vanished from farmer's field and market. The gradual loss in the qualities of these aromatic rice and low yield potential were supposed to be the major causes for their extinction. Some minor defects viz. very tall plant height (Prone to lodge) and very late maturity are the main causes to lowering the yield potential of these varieties. More than 300 of traditional land races of aromatic rice with pleasant aroma are grown in different part of the state. Among these Jawaphool is very popular variety in the local markets of Chhattisgarh due to its excellent cooking quality and taste. Estimates indicate that Jawaphool occupied very less area of the total rice area of Chhattisgarh. Only some millers are support to cultivate this variety by contract farming. The cultivar-Jawaphool is characterized by photo insensitivity, late maturity (150 days), tall plant stature (155cm) that is prone to lodging and poor responsive to fertilizer application. As the market value of rices like Jawaphool is quite substantial, there is need to improve the yield potential of such premium cultivars by reducing the plant height and enhancing fertilizer responsiveness without losing the important quality traits including aroma[2]. Induced mutagenesis is an important tool to improve one or two characters particularly plant height as well as duration with incorporation of yield component traits due to pleiotropism. Therefore, present investigation has been carried out using 300Gy doses of gamma-rays in Jawaphool for reduced height and earliness.

MATERIALS AND METHODS

A traditional aromatic rice variety OF Chhattisgarh state namely, Jawaphool (short slender grain) was selected for this study. Total 1000 seeds of Jawaphool were treated with previously standardized dose (300Gy) of gamma rays at Bhabha Atomic Research Center, Trombay, Mumbai- 400085 during 2013. M_1 population was raised during *Kharif* 2013. M_2 populations were grown during *Kharif* 2014. Desirable mutant plants were selected from M_2 population and were grown as progeny rows in M_3 and subsequent generations.

Total 398 Jawaphool lines of M_2 population were grown during *kharif* 2014. Out of 398 populations of M_2, 27 desirables (semi-tall and mid late maturity) plants of Jawaphool were selected and those materials were further advanced during *Rabi* 2015-16. Finally, 5 plants were selected for seed multiplication. After observing homozyosity of mutants, seed materials of selected mutants were grown in M_4 and subsequent generations.

RESULTS AND DISCUSSION

Various morphological characters of different mutants and frequency of wide range of viable mutations are presented in Table 1. Five mutants in Jawaphool with semi-tall stature, mid late maturing, increased tillering, and clustered panicle with red kernel colour (Figure 1) and higher grain yield (Figure 2). The differences observed in the spectra of morphological mutations were more of quantitative nature rather than qualitative. Mostly macro mutations *i.e.* high frequency of semi-tall and mid-late maturity mutants were observed in the present study.

Jawaphool have very good cooking quality and aroma, but it possesses two detrimental aspects, which are tall stature (155cm) habit with weak straw and late maturing (145-150 days). Both these attributes make the cultivar incapable of responding to good fertility or withstanding lodging. In such situation, isolation of mid-late maturing, semi-tall, clustered grains with red pericarp desirable mutants have assumed great significance. Total 04 mid-late maturing mutants (120-125 days) as compared to traditional Jawaphool (150-155 days) were isolated with 15 to 20% reduction of days to maturity (Figure 3). Several workers also reported early maturing mutants in rice after mutagen treatments[1,3,4]. Out of five mutants 04 semi-tall mutants was selected (115-120cm) and exhibited 15 to 20% reduction of plant

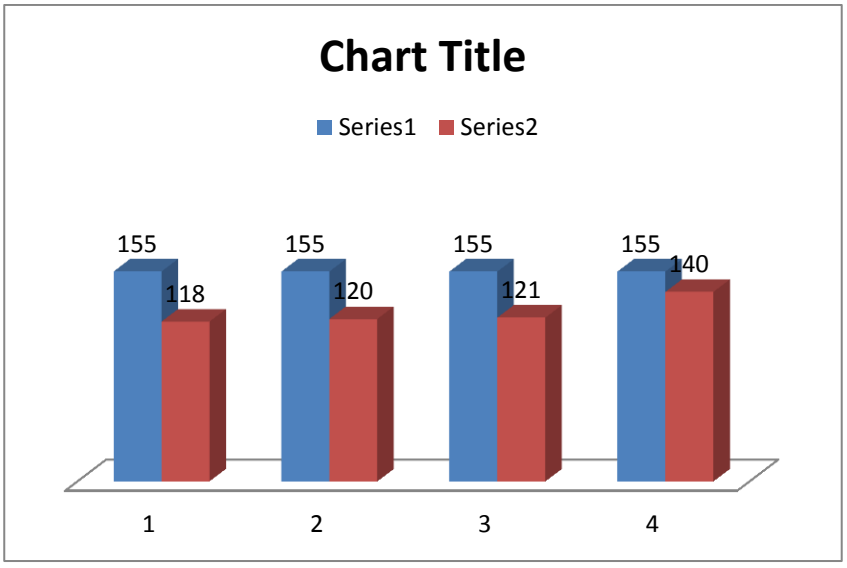
height presented in (figure 3) and one mutant of Jawaphool Mutant-56 was tall stature but having very thick and sturdy stem, more numbers of tillers per plant, long panicles, high numbers of fertile spikelets per panicle with red kernel colour and good grain quality (fig-3). Its plant height is 160 cm as compared to traditional Jawaphool (155 cm). It was found that 300Gy dose of gamma rays was desirable because most of viable mutants were observed with this dose. Several workers also reported dwarf and semi-dwarf mutants in rice after mutagenic treatments[1,3]. In many countries, particularly in India the native land races that are much appreciated for their premium grain quality are not being fully exploited commercially due to their low productivity. In this context, the present study is significant as it deals with the genetic enhancement of Jawaphool for traits like semi dwarf plant stature. It was also found that these semi-dwarf bred true in M_4 generation based on synchronized morphological characters.

Table 1: Different Morphological Observations of Jawaphool

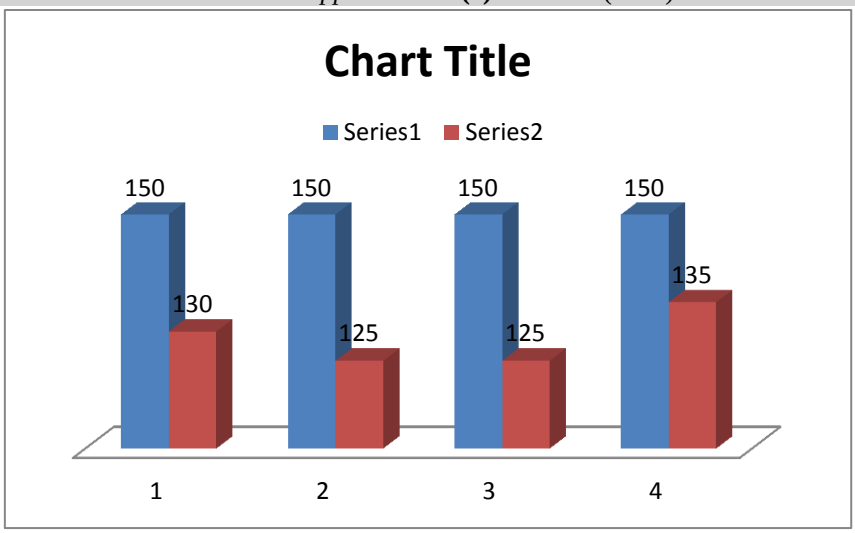
S. No.	Mutants	Leaf Color	Stem Thickness	Plant Height cm.	Days To Maturity	Total Tillers Per Plant	Effective Tillers Per Plant	Panicle Length	Per Panicle Seed (Filled/Unfilled)
NORMAL JAWAPHOOL									
	Normal plant	**LG**	**M**	**155**	**150**	**12**	**10**	**30**	**302**
SEMI - TALL MUTANT JAWAPHOOL									
1	Mutant-17	LG	M	118	130	13	12	29	298
2	Mutant-18	LG	M	120	125	16	14	32	328
3	Mutant-31	LG	M	121	125	14	12	31	312
4	Mutant-52	LG	M	140	135	12	10	28	279
RED PERICARP and CLUSTERED GRAIN JAWAPHOOL MUTANT									
5	Mutant-56	G	THICK	160	150	18	15	36	356

LG- Light Green **M**- Medium **G**- Green

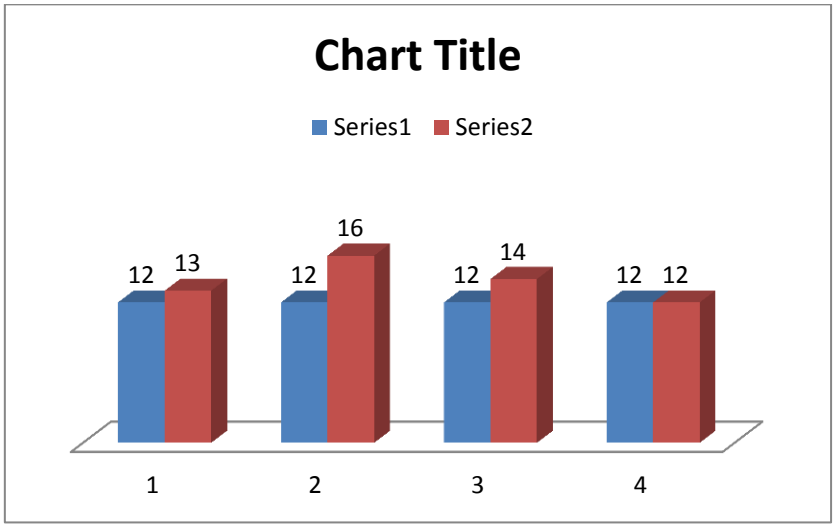
Graph 1: Jawaphool Semi-tall mutant (Series 2) compression with local Jawaphool (Series 1)



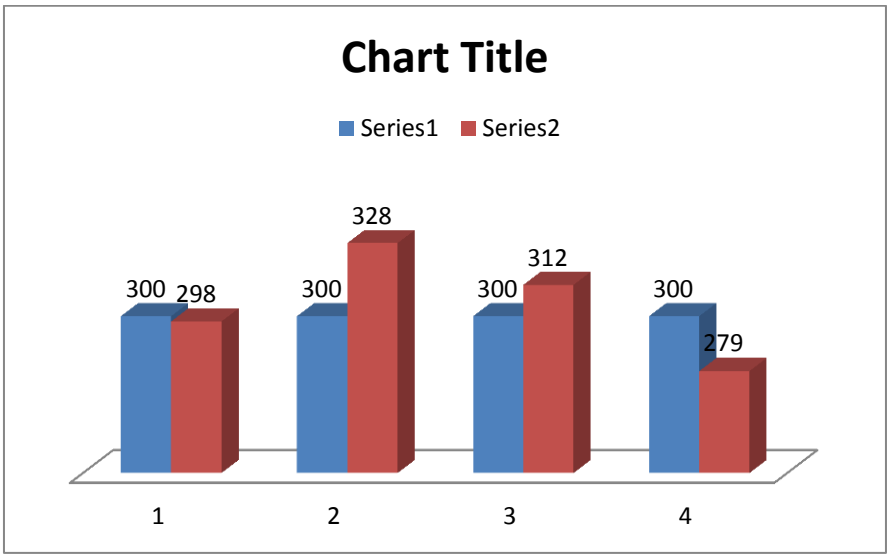
Plant height 15-20% reduced



Days to maturity 10-14% reduced



No of tillers 10-15% increases



No of seeds per panicles increase 1-2%

Fig. 1: Jawaphool mutant with red kernel

Fig. 2: Different types of Jawaphool mutants

CONCLUSION

In the present study it is concluded that mutation breeding is an effective tool to improve some minor defects of traditionally very popular local variety Jawaphool with incorporate semi-tall stature, desirable yield component traits, fertilizer responsiveness and better grain yield without losing its original gain quality.

Acknowledgement

Authors are highly thankful to Programme officer and Secretary, BRNS, BARC, Mumbai, Head, NA&BTD, BARC Mumbai and Director, Biosciences Group, BARC, Mumbai for providing necessary funds as well as irradiation facilities.

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