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Standardization of field rapid generation advancement (FRGA) technology in Konkan region for rice (*Oryza sativa* L.)

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Abstract
Experiment was carried out at Regional Agricultural Research Station, Karjat, Raigad, Maharashtra, India during Kharif 2022 for standardization of Field Rapid Generation Advancement (FRGA) technology in Konkan region for rice. The experiment was laid out in Factorial Randomized Block Desing (FRBD) with three replications. The performances for different planting setups, viz., T_1-dense seed sowing in the protected field, T_2-seedling transplanted in close spacing (5 X 5 cm), T_3-seed sowing in protrays and putting in puddled field after 15 days, T_4-seed sowing in protrays and putting in unpuddled field after 15 days, T_5-seed sowing in protrays and putting in polycarbonate house (no control condition) and T_6-control: normal transplanting at 15 x 20 cm on three genotypes, namely V_1-early (115-120 days)-KJT3, V_2-mid late (125-130 days)-KJT5 and V_3-late (140-145 days)-KJT2 were evaluated for plant height (cm), days to first flowering, days to premature harvest and immature seed germination count (%) for standardization. It was noted that the significant maximum plant height was measured in T_1-Dense seed sowing in the protected field. The significant highest early days to first flowering and days to premature harvest were achieved in T_4-Seed sowing in protrays and putting in unpuddled field after 15 days planting setup in field RGA was successfully achieved. The significant highest immature seed germination count (%) was achieved in T_3-Seed sowing in protrays and putting in puddled field after 15 days in the field RGA was denoted. This noted outcome provide promising solution for addressing the plant breeding limitation of longer seed to seed generation times. The reduction in generation time provides fast variety release process ultimately increasing genetic gain and contribute to food security in rice.

Keywords: Rapid generation advancement (RGA), plant density, factorial randomized block desing (FRBD), flowering, germination, rice

Introduction

The growing population of world required significant increase in rice crop yields. The future demand can not meet by the current rate of genetic gain in rice crops. The time required for seed to seed is one among the major limitation in accelerating crop improvement activity. The traditional breeding practices unable to keep up with increasingly rising demand for cereal production. Traditional practices are generally time-space-resources consuming (Anjum *et al*., 2017) [2]. The rate of genetic gain is far inadequate to meet the required demand of food in major crops (Cooper *et al*., 2020) [5]. The reducing time of breeding cycle or accelerated breeding is one of the easy ways to increase the genetic gain (Atlin *et al*., 2017) [3].

Rice breeding activity around the world has prominent challenge of integrating technology, theory and logistics into a combined breeding system capable in generating sustainably high genetic gain. The breeding activity seeks to modernize their approach to genetic improvement have rather fortunate problem of selecting among myriads available tools they can use. DH technology was a quick way in creating fixed lines in a single step. In a self-pollinated crop like rice, particularly where high throughput DH technologies are generally not well established, utilizing RGA make good sense as it achieved many goals from DH technology (Collard *et al*., 2017) [4]. The present study taken to standardise Field Rapid Generation Advancement (FRGA) technology in Konkan region for rice.

Materials and Methods

The field experiment was conducted during *Kharif* 2022 at Regional Agricultural Research Station, Karjat, Raigad, Maharashtra, India having tropical monsoon climatic condition. The experiment was laid out in Factorial Randomized Block Desing (FRBD) with three replications. The details of treatments were provided in Table 1. In order to evaluate the effect of crop setup on rapid generation advancement for developing new rice variety fastly than traditional breeding technology following observations on plant height, days to first flowering, days to immature harvest, germination count (%) and the observational data were statistically analysed using "Analysis of Variances test" {(Panse and Sukhatme (1967) [11], Gomez and Gomez (1983) [8] and Rangaswamy (2010) [12]}. The observations were recorded as

1. Plant height

It was measured at pre mature harvests stage from the ground level to the tip of tallest panicle of rice plant, excluding the awns from 10 plant and average was consider as plant height in cm.

2. Days to first flowering

Period (number of days required) from date of sowing to date of first flower emergence of rice plant from plot or protray were recorded in days.

3. Days to premature harvest

The number of days was counted from the date of seed sowing to 14 days after 100% anthesis of tagged plant which was flowers most early. (The rice plant was tagged at 100% anthesis. For premature harvest, the panicle of the tagged rice plant was harvested 14 days after 100% anthesis and treated using 90ppm GA_3 obtained through standardisation procedure.)

4. Immature seed germination count:

The number of seeds that have sprouted and developed into seedlings after 10 days of sowing was counted after GA_3 treatment and express in percentage using following formula:

$$\text{Immature seed germination count (\%)} = \frac{\text{(Number of seeds germinated)}}{\text{(Number of seeds in the tray)}} \times 100$$

Results and Discussion

1) Plant height (cm)

Performance of planting setups

Upon assessment of data summarized in Table 2. denoted that various planting setups provide significant performance of rice plant height in field RGA. The Table 2. provides, as per CD, significant topmost plant height was denoted in T_1-Dense seed sowing in the protected field at 103.86 cm in the field RGA. On analysing this with T_6-Control: Normal transplanting at 15 X 20 cm in field condition, average plant height, it was found to be less by 7.58 cm in the RGA.

Plant height was significantly affected by different planting setups and different genotypes from various maturity groups. The significant maximum plant height was measured in T_1-Dense seed sowing in the protected field in field RGA was successfully achieved. The similar results also reported by Janwan *et al*. (2013) [9], Ahmed *et al*. (2022) [1] and Collard *et al*. (2017) [4].

Performance of genotypes

The data regarding genotypes height, denoted in Table 3. revealed that various genotypes from different maturity groups provide their significant influence on rice plant height in field RGA. The significant highest plant height was noted in Karjat 5 (V_2) genotype, having mid late maturity at 94.91 cm in field RGA. This followed by Karjat 2 (V_2) with late maturity genotype, which had significant plant height of 87.28 days in the RGA as per CD. Additionally, Karjat 3 (V_1) with early maturity has, as per CD, significant plant height as 82.97 days.

The significant maximum plant height was noted in Karjat 5 (V_2) genotype, having mid late maturity followed by Karjat 2 (V_3) with late maturity genotype, and Karjat 3 (V_1) with early maturity in RGA. The similar results also reported by Janwan *et al*. (2013) [9], Ahmed *et al*. (2022) [1] and Collard *et al*. (2017) [4].

Performance of interaction of planting setups and genotypes

Topmost appraisal of data notably obtained from summarized Table 4. provides that various planting setups and different genotypes from various maturity groups denoted significant interaction performance of rice plant height in field RGA.

The noteworthy, mid late genotype Karjat 5 (V_2), as per CD, significantly achieved highest plant height along with T_1-Dense seed sowing in the protected field planting setup at 111.93 cm in the RGA. Upon analysing this plant height with T_6-Control: Normal transplanting at 15 X 20 cm in field condition with Karjat 5 genotype, it was found to be less by 9.07 cm in the RGA.

The Karjat 3 (V_1) rice genotype, having early maturity, as per CD, significantly noted, highest plant height along with T_1-Dense seed sowing in the protected field planting setup as 97.00 cm in the RGA. Upon analysing plant height with T_6-Control: Normal transplanting at 15 X 20 cm in field condition with Karjat 3 genotype, it was found to be less by 6.00 cm in the RGA.

The keynote, late genotype Karjat 2 (V_3), as per CD, significantly achieved the highest plant height along with T_1-Dense seed sowing in the protected field planting setup as 102.63 cm. Upon analysing plant height with T_6-Control: Normal transplanting at 15 X 20 cm in field condition with Karjat 2 genotype, it was recorded as less by 7.70 cm in the RGA.

For the interaction performances, highest plant was noted in T_1-Dense seed sowing in the protected field planting setup with Karjat 5 (V_2) genotype, having mid late maturity followed by Karjat 2 (V_3) with late maturity genotype, and Karjat 3 (V_1) with early maturity in RGA. The similar outcomes also reported by Janwan *et al*. (2013) [9], Ahmed *et al*. (2022) [1] and Collard *et al*. (2017) [4].

2) Days to first flowering

Performance of planting setups

Upon keynote assessment of data summarized in Table 2. denoted that various planting setups provide significant performance of rice days to first flowering. The Table 2. provides, as per CD, significant keynote, topmost early days to first flowering were achieved in T_4-Seed sowing in protrays and putting in unpuddled field after 15 days planting setup at 69.67 days in the filed RGA denoted. On analysing this with T_6-Control: Normal transplanting at 15

X 20 cm in field condition average days to first flowering, it was obtained early by 24.33 days.

The days to first flowering was affect from different planting setups and different genotypes from various maturity groups significantly. The significant early days to first flowering were achieved in T_4-Seed sowing in protrays and putting in unpuddled field after 15 days planting setup in field RGA was successfully achieved. The treatment was significantly early as compared to control in field RGA. The above findings are in conformity with Fahim *et al*. (1998) [6], Janwan *et al*. (2013) [9], Ahmed *et al*. (2022) [1] and Collard *et al*. (2017) [4].

Performance of genotypes

The prominent data regarding the keynote average performance of days to first flowering of rice summarized in Table 3. recorded that different genotypes from different maturity groups provide significant impact on rice days to first flowering in filed RGA. The noteworthy, as per CD, significant highest early days to first flowering in Karjat 3 (V_1) genotype having early maturity as 64.17 days in the RGA was noted. This was followed by Karjat 5 (V_2) with the mid-late genotype, which had significant days to first flowering of 78.17 days in the RGA as per CD. Additionally, Karjat 2 (V_3) with late maturity having, as per CD, significant days to first flowering as 85.78 days.

The noteworthy significant highest early days to first flowering obtained in Karjat 3 (V_1) genotype having early maturity followed by Karjat 5 (V_2) with the mid-late genotype, and Karjat 2 (V_3) with late maturity in RGA. The above findings are in conformity with Fahim *et al*. (1998) [6], Janwan *et al*. (2013) [9], Ahmed *et al*. (2022) [1] and Collard *et al*. (2017) [4].

Performance of interaction of planting setups and genotypes

It was explicit from data of Table 5. denote that different planting setups and different genotypes from different maturity groups showed non significant interaction of rice days to first flowering in field RGA.

However keynote, the Karjat 3 (V_1) rice genotype having early maturity, as per CD, significantly noted, highest early rice days to first flowering along with T_4-Seed sowing in protrays and putting in unpuddled field after 15 days planting setup as 59.33 days in the RGA. Upon analysing rice days to first flowering from T_4-Seed sowing in protrays and putting in unpuddled field after 15 days planting setup with T_6-Control: Normal transplanting at 15 X 20 cm in field condition with Karjat 3 genotype, it was found to be early by 19.67 days in the RGA.

The noteworthy, mid late genotype Karjat 5 (V_2), as per CD, significantly achieved highest early rice days to first flowering along with T_4-Seed sowing in protrays and putting in unpuddled field after 15 days planting setup at **72.00** days in RGA. Upon analysing rice days to first flowering from T_4-Seed sowing in protrays and putting in unpuddled field after 15 days planting setup with T_6-Control: Normal transplanting at 15 X 20 cm in field condition with Karjat 5 genotype, it was found to be early by 24.00 days in the RGA.

The keynote, late genotype Karjat 2 (V_3), as per CD, significantly achieved the highest early rice days to first flowering along with T_4-Seed sowing in protrays and putting in unpuddled field after 15 days planting setup as 77.67 days. Upon analysing rice days to first flowering from T_4-Seed sowing in protrays and putting in unpuddled field after 15 days planting setup with T_6-Control: Normal transplanting at 15 X 20 cm in field condition with Karjat 2 genotype, it was found to be early by 29.33 days.

Keynote days to early flowering was increasing early from 115-120 days genotype to 140-145 days genotype. Maximum early days to flowering were gained in late maturity genotype KJT 2 in T_4-Seed sowing in protrays and putting in unpuddled field after 15 days planting setup as compared to control. The above findings are in conformity with Fahim *et al*. (1998) [6], Janwan *et al*. (2013) [9], Ahmed *et al*. (2022) [1] and Collard *et al*. (2017) [4].

3) Days to premature harvest

Performance of planting setups

Upon appraisal of data summarized in Table 2. denoted, that various planting setups provides significant performance of rice days to premature harvest in field RGA. From keynote, summarized Table 2. obtained that highest early days to premature harvest achieved in T_4-Seed sowing in protrays and putting in unpuddled field after 15 days planting setup as 88.11 days. On analysing this with T_6-Control: Normal transplanting at 15 X 20 cm in field condition, average days to harvest, it was notably obtained early by 40.11 days.

Days to premature harvest were significantly affected by different planting setups treatments and different genotypes from various maturity groups. The significant highest early days to premature harvest in T_4-Seed sowing in protrays and putting in unpuddled field after 15 days planting setup in RGA was successfully achieved. The above results are in conformity with Fahim *et al*. (1998) [6], Janwan *et al*. (2013) [9], Ahmed *et al*. (2022) [1] and Collard *et al*. (2017) [4].

Performance of genotypes

The premier data regarding notable average performance of days to premature harvest of rice represented in Table 3. revealed that different genotypes from various maturity groups provide significant influence on rice days to premature harvest in field RGA. The noteworthy, as per CD, significant topmost early days to premature harvest gain in Karjat 3 (V_1) genotype as 86.11 days in the field RGA noted. This was followed by Karjat 5 (V_2) with the mid-late genotype, which, as per CD, significant days to premature harvest of 100.06 days in the RGA. Additionally, Karjat 2 (V_3) with late maturity has, as per CD, significant days to premature harvest as 107.67 days.

The significant topmost early days to premature harvest gain in Karjat 3 (V_1) early maturity genotype followed by Karjat 5 (V_2) with the mid-late genotype, and Karjat 2 (V_3) with late maturity in RGA. The above results are in conformity with Fahim *et al*. (1998) [6], Janwan *et al*. (2013) [9], Ahmed *et al*. (2022) [1] and Collard *et al*. (2017) [4].

Performance of interaction of planting setups and genotypes

It was explicit from data of Table 6. denote that different planting setups and different genotypes from different maturity groups showed non significant interaction of rice days to premature harvest in field RGA.

However, the Karjat 3 (V_1) rice genotype having early maturity, as per CD, significantly noted, highest early rice days to premature harvest along with T_4-Seed sowing in protrays and putting in unpuddled field after 15 days planting setup as 77.67 days in the RGA. Upon analysing rice days to premature harvest from T_4-Seed sowing in protrays and putting in unpuddled field after 15 days with T_6-Control: Normal transplanting at 15 X 20 cm in field condition with Karjat 3 genotype, it was found to be early by 36.33 days in the RGA.

The noteworthy, mid late genotype Karjat 5 (V_2), as per CD, significantly achieved highest early rice days to premature harvest along with T_4-Seed sowing in protrays and putting in unpuddled field after 15 days planting setup as 90.67 days. Upon analysing rice days to premature harvest from T_4-Seed sowing in protrays and putting in unpuddled field after 15 days with T_6-Control: Normal transplanting at 15 X 20 cm in field condition with Karjat 5 genotype, it was found to be early by 40.00 days.

The keynote, late genotype Karjat 2 (V_3), as per CD, significantly achieved the highest early rice days to premature harvest along with T_4-Seed sowing in protrays and putting in unpuddled field after 15 days planting setup as 96.00 days. Upon analysing rice days to premature harvest from T_4-Seed sowing in protrays and putting in unpuddled field after 15 days with T_6-Control: Normal transplanting at 15 X 20 cm in field condition with Karjat 2 genotype, it was found to be early by 44.00 days.

The days to premature harvest was increasing early from Karjat 3 genotype to Karjat 2 genotype. Maximum early days to premature harvest were gained in late maturity genotype in T_4-Seed sowing in protrays and putting in unpuddled field after 15 days planting setup as compared to control. The above findings are in conformity with Janwan *et al*. (2013) [9], Ahmed *et al*. (2022) [1] and Collard *et al*. (2017) [4].

4) Immature seed germination count (%)

Performance of planting setups

Upon appraisal of data summarized in Table 2. denoted that various planting setups provide significant performance of rice immature seed germination count (%) from field RGA. The keynote Table 2. provides that significant topmost immature seed germination count (%) achieved in T_4-Seed sowing in protrays and putting in unpuddled field after 15 days at 78.33% in the RGA. On analysing T_3-Seed sowing in protrays and putting in puddled field after 15 days with T_6-Control: Normal transplanting at 15 X 20 cm, it was obtained less by 12.00% in the RGA.

The different planting setups treatments and different genotypes from various maturity groups significantly affect the immature seed germination count (%). The significant highest immature seed germination count (%) was achieved in T_3-Seed sowing in protrays and putting in puddled field after 15 days in the field RGA was denoted. Above findings are also supported from, Fahim *et al*. (1998) [6], Janwan *et al*. (2013) [9], Collard *et al*. (2017) [4], Ahmed *et al*. (2022) [1], Ghosh *et al*. (2018) [7], Watson *et al*. (2018) [14], Sandhu *et al*. (2024) [13], Kabade *et al*. (2024) [10].

Performance of genotypes

The data regarding the average performance of immature seed germination count (%) of rice represented in summarized Table 3. denoted that different genotypes from various maturity groups showed significant effect on rice immature seed germination count (%) in RGA. Karjat 5 (V_2) with the mid-late genotype, had highest immature seed germination count (%) as 79.39% in the RGA which was at par with Karjat 3 (V_3) with early maturity, having immature seed germination count (%) as 77.06%, which is also at par with Karjat 2 with late maturity having immature seed germination count (%) as 75.56% as per CD.

The Karjat 5 (V_2) with the mid-late genotype, had highest immature seed germination count (%) which was at par with Karjat 3 (V_1) with early maturity and later is also at par with Karjat 2 (V_3) with late maturity in RGA. Above findings are also supported from, Fahim *et al*. (1998) [6], Janwan *et al*. (2013) [9], Collard *et al*. (2017) [4], Ahmed *et al*. (2022) [1], Sandhu *et al*. (2024) [13], Kabade *et al*. (2024) [10].

Performance of interaction of planting setups and genotypes

It was explicit from data of Table 7. indicates that different planting setups and different genotypes from different maturity groups showed significant interaction of rice immature seed germination count (%) in field RGA.

The noteworthy, mid late genotype Karjat 5 (V_2), as per CD, significantly achieved highest rice immature seed germination count (%) along with T_4-Seed sowing in protrays and putting in unpuddled field after 15 days planting setup at 82.33% in RGA. Upon analysing rice immature seed germination count (%) from T_4-Soil (50%) + Vermicompost with T_6-Control: Normal transplanting at 15 X 20 cm in field condition with Karjat 5 genotype, it was found to be less by 9.67% was noted.

The Karjat 3 (V_1) rice genotype having early maturity, as per CD, significantly noted, highest rice immature seed germination count (%) along with T_3-Seed sowing in protrays and putting in puddled field after 15 days planting setup as 80.33% in RGA. Upon analysing rice immature seed germination count (%) from T_3-Seed sowing in protrays and putting in puddled field after 15 days planting setup with T_6-Control: Normal transplanting at 15 X 20 cm in field condition with Karjat 3 genotype, it was found to be less by 9.67% noted.

The keynote, late maturity genotype Karjat 2 (V_3), as per CD, achieved the highest rice immature seed germination count (%) along with T_3-Seed sowing in protrays and putting in puddled field after 15 days planting setup 78.33% in the RGA. Upon analysing rice immature seed germination count (%) from T_3-Seed sowing in protrays and putting in puddled field after 15 days with T_6-Control: Normal transplanting at 15 X 20 cm in field condition with Karjat 2 (V_3) genotype, it was found to be less by 14.67% in the RGA was obtained successfully.

For interaction performance, T_4-Seed sowing in protrays and putting in unpuddled field after 15 days planting setup with the mid late maturity genotype Karjat 5 (V_2), significantly achieved highest rice immature seed germination count (%). Above findings are also supported from, Fahim *et al*. (1998) [6], Janwan *et al*. (2013) [9], Collard *et al*. (2017) [4], Ahmed *et al*. (2022) [1], Ghosh *et al*. (2018) [7], Watson *et al*. (2018) [14], Sandhu *et al*. (2024) [13], Kabade *et al*. (2024) [10].

Table 1: Treatments details for standardization of field RGA

Tr. No.	Treatments
I	**Factor V: Genotype**
V_1	Karjat 3: Early (115-120 Days)
V_2	Karjat 5: Mid late (125-130 Days)
V_3	Karjat 2: Late (140-145 Days)
II	**Factor T: Planting methods**
T_1	Dense seed sowing in the protected field
T_2	Seedling transplanted in close spacing (5 X 5 cm)
T_3	Seed sowing in protrays and putting in puddled field after 15 days
T_4	Seed sowing in protrays and putting in unpuddled field after 15 days
T_5	Seed sowing in protrays and putting in polycarbonate house (No control condition)
T_6	Control: Normal transplanting at 15 X 20 cm

Table 2: Overall performance of planting setup treatments for the plant height, days to first flowering, days to premature harvest, immature seed germination count% in the experiment of field RGA standardisation.

Factor A				
Treatment	**Plant Height (cm)**	**Days to first flowering**	**Days to premature harvest**	**Immature seed germination count%**
T_1	103.856^{b}	74.222^{bc}	94.556^{b}	67.667^{e}
T_2	96.811^{c}	76.111^{b}	97.333^{b}	71.333^{d}
T_3	77.456^{d}	70.889^{d}	89.778^{c}	79.667^{b}
T_4	71.522^{e}	69.667^{d}	88.111^{c}	78.333^{b}
T_5	69.222^{e}	71.333^{cd}	89.667^{c}	75.333^{c}
T_6	111.444^{a}	94.000^{a}	128.222^{a}	91.667^{a}
SE(m)±	0.73	0.84	0.99	0.74
CD @ 0.05%	2.10	2.42	2.84	2.12
CV%	2.48	3.32	3.03	2.86
F Test	SIG	SIG	SIG	SIG

Tukey Range Test: Means with the same letter are not significantly different
Factor A-Protray media: T_1-Soil (100%), T_2-Vermicompost (100%), T_3-FYM (100%), T_4-Soil (50%) + Vermicompost (50%), T_5-Soil (50%) + FYM (50%), T_6-Soil (50%) + Vermicompost (25%) + FYM (25%). T_7-Control: Normal transplanting at 15 X 20 cm

Table 3: Overall performance of genotype treatments for the plant height, days to first flowering, days to premature harvest, immature seed germination count% in the experiment of field RGA standardisation.

Factor B				
Treatment	**Plant Height (cm)**	**Days to first flowering**	**Days to premature harvest**	**Immature seed germination count%**
V_1	82.967^{c}	64.167^{c}	86.111^{c}	77.056^{b}
V_2	94.906^{a}	78.167^{b}	100.056^{b}	79.389^{a}
V_3	87.283^{b}	85.778^{a}	107.667^{a}	75.556^{b}
SE(m)±	0.52	0.59	0.70	0.52
CD @ 0.05%	1.48	1.71	2.01	1.50
CV%	2.48	3.32	3.03	2.86
F Test	SIG	SIG	SIG	SIG

Tukey Range Test: Means with the same letter are not significantly different
Factor B-Genotype: V_1-Early (115-120 Days)-KJT3, V_2-Mid late (125-140 Days)-KJT$_5$, V_3-Late (140-145 Days)-KJT2

Table 4: Overall performance of interaction of planting setup treatments and genotype treatments for the plant height (cm) in the experiment of field RGA standardisation.

Plant Height (cm)			
Interaction A X B			
A/B	**V_1**	**V_2**	**V_3**
T_1	97.000^{b}	**111.933^{b}**	102.633^{b}
T_2	90.200^{c}	105.867^{c}	94.367^{c}
T_3	73.333^{d}	81.667^{d}	77.367^{d}
T_4	68.300^{e}	75.667^{e}	70.600^{e}
T_5	65.967^{e}	73.300^{e}	68.400^{e}
T_6	103.000^{a}	121.000^{a}	110.333^{a}
SE(m)±	1.26		
CD @ 0.05%	3.63		
CV%	2.48		
F Test	SIG		

Tukey Range Test: Means with the same letter are not significantly different
Factor A-Protray media: T_1-Soil (100%), T_2-Vermicompost (100%), T_3-FYM (100%), T_4-Soil (50%) + Vermicompost (50%), T_5-Soil (50%) + FYM (50%), T_6-Soil (50%) + Vermicompost (25%) + FYM (25%). T_7-Control: Normal transplanting at 15 X 20 cm
Factor B-Genotype: V_1-Early (115-120 Days)-KJT3, V_2-Mid late (125-140 Days)-KJT$_5$, V_3-Late (140-145 Days)-KJT2

Table 5: Overall performance of interaction of planting setup treatments and genotype treatments for the days to first flowering in the experiment of field RGA standardisation.

Days to first flowering			
Interaction A X B			
A/B	**V_1**	**V_2**	**V_3**
T_1	62.000^{b}	76.333^{bc}	84.333^{b}
T_2	64.667^{b}	78.333^{b}	85.333^{b}
T_3	60.333^{b}	72.667^{bc}	79.667^{bc}
T_4	59.333^{b}	72.000^{c}	77.667^{c}
T_5	59.667^{b}	73.667^{bc}	80.667^{bc}
T_6	79.000^{a}	96.000^{a}	107.000^{a}
SE(m)±	1.46		
CD @ 0.05%	4.18		
CV%	3.32		
F Test	NS		

Tukey Range Test: Means with the same letter are not significantly different

Factor A-Protray media: T_1-Soil (100%), T_2-Vermicompost (100%), T_3-FYM (100%), T_4-Soil (50%) + Vermicompost (50%), T_5-Soil (50%) + FYM (50%), T_6-Soil (50%) + Vermicompost (25%) + FYM (25%). T_7-Control: Normal transplanting at 15 X 20 cm

Factor B-Genotype: V_1-Early (115-120 Days)-KJT3, V_2-Mid late (125-140 Days)-KJT$_5$, V_3-Late (140-145 Days)-KJT2

Table 6: Overall performance of interaction of planting setup treatments and genotype treatments for the days to premature harvest in the experiment of field RGA standardisation.

Days to premature harvest			
Interaction A X B			
A/B	**V_1**	**V_2**	**V_3**
T_1	82.333^{bc}	96.667^{bc}	104.667^{bc}
T_2	86.000^{b}	99.333^{b}	106.667^{b}
T_3	78.667^{c}	91.000^{c}	99.667^{cd}
T_4	77.667^{c}	90.667^{c}	96.000^{d}
T_5	78.000^{c}	92.000^{c}	99.000^{cd}
T_6	114.000^{a}	130.667^{a}	140.000^{a}
SE(m)±	1.71		
CD @ 0.05%	4.92		
CV%	3.03		
F Test	NS		

Tukey Range Test: Means with the same letter are not significantly different

Factor A-Protray media: T_1-Soil (100%), T_2-Vermicompost (100%), T_3-FYM (100%), T_4-Soil (50%) + Vermicompost (50%), T_5-Soil (50%) + FYM (50%), T_6-Soil (50%) + Vermicompost (25%) + FYM (25%). T_7-Control: Normal transplanting at 15 X 20 cm

Factor B-Genotype: V_1-Early (115-120 Days)-KJT3, V_2-Mid late (125-140 Days)-KJT$_5$, V_3-Late (140-145 Days)-KJT2

Table 7: Overall performance of interaction of planting setup treatments and genotype treatments for the percentage of immature seed germination in the experiment of field RGA standardisation.

Immature seed germination count%			
Interaction A X B			
A/B	**V_1**	**V_2**	**V_3**
T_1	67.667^{e}	70.667^{e}	64.667^{d}
T_2	71.667^{de}	73.667^{de}	68.667^{d}
T_3	80.333^{b}	80.333^{bc}	78.333^{b}
T_4	77.333^{bc}	82.333^{b}	75.333^{bc}
T_5	75.333^{cd}	77.333^{cd}	73.333^{c}
T_6	90.000^{a}	92.000^{a}	93.000^{a}
SE(m)±	1.28		
CD @ 0.05%	3.67		
CV%	2.86		
F Test	NS		

Tukey Range Test: Means with the same letter are not significantly different

Factor A-Protray media: T_1-Soil (100%), T_2-Vermicompost (100%), T_3-FYM (100%), T_4-Soil (50%) + Vermicompost (50%), T_5-Soil (50%) + FYM (50%), T_6-Soil (50%) + Vermicompost (25%) + FYM (25%). T_7-Control: Normal transplanting at 15 X 20 cm

Factor B-Genotype: V_1-Early (115-120 Days)-KJT3, V_2-Mid late (125-140 Days)-KJT$_5$, V_3-Late (140-145 Days)-KJT2

Conclusion

The standardized field rapid generation advancement with prominent treatment provides promising solution to rice breeder community for addressing limitation of longer generation times. The highest early days to first flowering and days to premature harvest were noted in T_4-Seed sowing in protrays and putting in unpuddled field after 15 days planting setup in field RGA, boost the rate of genetic improvement. It reduced interval between seed-to-seed generation and accelerate selection cycles in breeding activity. This enables the development of new high-yielding varieties in shorter duration and enhances genetic gain in rice.

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